

SECOND NORDIC  
INTERNATIONAL CONFERENCE ON  
CLIMATE CHANGE ADAPTATION

**ADAPTATION RESEARCH MEETS  
ADAPTATION DECISION-MAKING**



**Programme and Abstracts**

**Helsinki, Finland 29-31 August 2012**

# Welcome to Helsinki

## for the Second Nordic International Conference on Climate Change Adaptation

Nearly two years have passed since a small team of researchers began a new chapter in Nordic co-operation on climate change by organising a conference in Stockholm, Sweden. The conference, entitled Climate Adaptation in the Nordic Countries – Science, Practice, Policy, co-ordinated by the Stockholm Environment Institute and hosted by Stockholm University in November 2010, was the first of its kind in the Nordic region. Expertly choreographed by Richard Klein, Annika Nilsson and Johanna Ulmanen, it attracted 180 participants and provided an ideal setting for an exchange of experiences and information between members of the scientific community and representatives of agencies and organisations responsible for managing issues related to the potential effects of future climate change.

Some of the lessons drawn from the Stockholm conference included: (i) identification of a continuing knowledge gap in the Nordic region concerning climate change, both among the general public and policy makers, (ii) recognition that local adaptation needs political leadership and support at national level, and (iii) realisation that issues relating to future climate change need to be integrated into existing institutions and decision-making. In addition, some priority issues were identified to be addressed in research, practice and policy, including examining the use of financial incentives for adaptation, continued investigations of causal links between climate change and specific outcomes such as human health, and the need to link policies and measures for climate change adaptation with other policies to ensure the best use of resources.

Two years on, and practitioners have enhanced their expertise whilst researchers have honed their methods and tools to address some of the gaps identified in Stockholm. There has also been tangible progress in the policy arena, and there are now a dozen national adaptation strategies already in place in Europe (four in Nordic countries), with others under construction. Since the European Commission adopted its White Paper on adaptation to climate change in 2009, many of that document's 33 actions have been implemented, a climate change adaptation platform, Climate-ADAPT, was launched at the European Environment Agency in March this year, and just a week before this conference the Commission concluded a public consultation of stakeholders and experts in member states designed to feed into the preparation of a European Union adaptation strategy.

Our Conference therefore presents an ideal opportunity to take stock of ongoing efforts and to consider how adaptation research efforts are keeping pace with policy demands as well as the needs of public and private decision-makers operating at a range of scales. It brings together researchers, public and private decision-makers, as well as those who plan and realize adaptation plans. Session themes include, among others: national and local adaptation plans, climate portals and climate services, adaptation in developing countries, legal aspects of adaptation, economic appraisal of adaptation, analysing and handling risk and uncertainty, urban planning and scenarios. The contributors have very diverse backgrounds, ranging from biosciences to social sciences, economics to geo-sciences, and engineering to architecture. Interest in climate change adaptation in the Nordic region is clearly high, with over 70% of our participants drawn from the five Nordic countries, but we have also managed to attract participation from further afield, with registrations received from 30 countries in all, 17 of these in Europe. A number of early-stage Nordic researchers will also be attending a pre-Conference PhD Workshop at the same venue, and their perspectives will be well reflected in the Conference, via the plenary, poster and parallel sessions.

In this Olympic year, let's hope that our Conference offers everyone a chance to strike gold!

**Timothy Carter, Adriaan Perrels and Mikael Hildén** (Local organisers)



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## Sponsors

This Conference is a joint initiative between two Nordic research networks: NORDCLAD-Net (NORDic CLimate change ADaptation research Network) and NONAM (Nordic Network on Adaptive Management in relation to climate change), which are both funded by NordForsk in its TFI Network initiative on Effect Studies and Adaptation to Climate Change, with major co-funding and scientific support from the Swedish research programme Mistra-SWECIA and supplementary funding from the Finnish Research Programme on Climate Change (FICCA) of the Academy of Finland and from the City of Helsinki. The organisers are extremely grateful to the sponsors for their generosity, which has helped to reduce the registration fees and assisted greatly in Conference organisation.

**NordForsk** was established on 1 January 2005 as a joint Nordic body under the Nordic Council of Ministers for Education and Research. The objective of NordForsk is to facilitate effective cooperation between the Nordic countries within the sphere of research and research driven innovation, promote excellence in research and contribute to the implementation of the Nordic Research and Innovation Area (NORIA). NordForsk provides funding for Nordic research cooperation as well as advice and input on Nordic research policy. This Conference is a direct outcome of the joint NordForsk, Nordic Innovation Centre and Nordic Energy Research administered Top-level Research Initiative (TRI), which is the largest joint Nordic research and innovation initiative to date. It comprises six sub-programmes that seek to involve the very best agencies and institutions in the Nordic region, and promote research and innovation of the highest level, in order to make a Nordic contribution towards solving the global climate crisis. The sub-programme "Effect Studies and Adaptation to Climate Change", for which NordForsk provides administrative and secretariat functions, aims to improve knowledge about the effects of climate change, about the adaptation capacities of society, and about the risks and opportunities that the effects of climate change may bring to the Nordic region. A call for Nordic Networks was launched in August 2009, with an objective to improve our knowledge about the effects of climate change, focusing on how we can adapt to these in the future. The joint organisers, NORDCLAD-Net and NONAM, are two of the ten networks that were funded within this sub-programme. Three 5-year Nordic Centres of Excellence are also beneficiaries of the sub-programme, which disburses in total some 100 million NOK.

**Mistra-SWECIA**, the Swedish Research Programme on Climate, Impacts and Adaptation, is a major research initiative of the The Swedish Foundation for Strategic Environmental Research (Mistra). Mistra supports research of strategic importance for a good living environment and sustainable development by investing in various initiatives in which researchers and users make joint contributions to solving key environmental problems. Every year, Mistra invests a sum of around 200 million SEK in various research initiatives to build bridges among academic disciplines, as well as between research, on the one hand, and companies, public agencies and other stakeholders on the other. This includes a total investment of 87 million SEK over the eight

years of Mistra-SWECIA, which is developing research-based documentation for decisions on climate change, its impacts and the process of climate adaptation. The initial programme phase, between 2008 and 2011, focused on modelling of climate, the economy and impacts on ecosystems and ecosystem services. There was also an emphasis on studying processes that promote or prevent adaptation. In the second phase, 2012–15, the modelling tools developed are to be supplemented and used in scenario studies. Users will be engaged in planning and designing scenarios and analysing results. Special attention is being paid to land use issues in forestry, agriculture and nature conservation. Mistra-SWECIA was a prominent sponsor and contributor to the 2010 Stockholm Conference, and is again stepping forward to offer generous support at this Conference, with many of its researchers presenting their latest results.

**The City of Helsinki**, through the office of its Deputy Mayor for Public Works and Environmental Affairs, has kindly agreed to host a Reception for the Conference on the evening of Wednesday 29 August. This will be held at the City Hall, which presently houses the City Board's meeting room, the City Office and entertaining facilities. A new building in the centre of the block was designed by Professor Aarno Ruusuvuori and was built in 1985-88. On alternate Wednesdays the City Council meets on the second floor of this building, which received the Europa Nostra award in 1989. In addition to hosting the Reception, the Deputy Mayor, Dr Pekka Sauri, will also provide a welcoming keynote presentation at the Conference. His office has responsibilities for the sustainability, functionality, maintenance and safety of the urban environment as well as public transport, public utilities and committees for rescue, public works and environment.

**The Academy of Finland** funds research in Finland annually to the tune of 327 million EUR (year 2012), operating across the full spectrum of scientific disciplines, and accounting for some 3,000 researcher full time equivalent posts at universities and research institutes. Funding is provided for research projects, research programmes, Centres of Excellence in research, research posts, foreign visiting professors' work in Finland, researcher training, international networking and research collaboration between universities, research institutes and business companies. The Academy is currently funding the Finnish Research Programme on Climate Change (FICCA, 2011–2014), which was launched to respond on a broad front to the scientific challenges posed by climate change. One of the principles underlying the FICCA programme is to support the type of multidisciplinary research that addresses the social and environmental spheres side by side – the objective being a systemic approach to research problems. There are currently 11 national projects and six international joint projects underway in FICCA. Many of these have a strong emphasis on climate change adaptation and are well represented at the Conference, which is also the beneficiary of support funding from FICCA.

**The Finnish Environment Institute (SYKE)** was established in 1995 as a centre for research and development in the environmental field (SYKE is the institute's Finnish acronym). SYKE forms part of Finland's national environmental administration, and mainly operates under the auspices of the Ministry of the Environment, although the Institute's

work related to water resources is supervised by the Ministry of Agriculture and Forestry. The activities of SYKE take place in seven centres: the Freshwater, Marine Research, Natural Environment, Consumption and Production, Environmental Policy, Laboratory, and Data and Information centres. The main tasks of these centres are research, development and production of various services. SYKE's Climate Change Programme, as a full partner in the NORDCLAD-Net network, has been jointly responsible for the local organisation of the Conference with the Finnish Meteorological Institute. In its umbrella role for climate change research at SYKE, the Programme has been able to draw on technical, scientific and logistical support from several of the SYKE centres and departments.

**The Finnish Meteorological Institute** is a research and service agency under the Ministry of Transport and Communications. FMI's main objective is to provide the Finnish nation with the best possible information about the atmosphere above and around Finland, for ensuring public safety relating to atmospheric and airborne hazards and for satisfying requirements for specialized meteorological products. The institute also carries out research to improve our knowledge about present, past and future climates as well as climate change and its mitigation. Its main climate change research areas include: natural climate variability and extremes in Finland and surrounding areas, past and projected future anthropogenic climate change, and climate change impacts and adaptation, and measurement and modelling of greenhouse gas concentrations in the atmosphere. FMI co-ordinates the NONAM network out of its Research Group on Socio-economic Impacts of Climate and Weather, and is jointly organising and providing logistical support for the Conference with the Finnish Environment Institute.

## Scientific Committee

**Timothy Carter** (Co-chair), Finnish Environment Institute (SYKE), Finland‡\*

**Adriaan Perrels** (Co-chair), Finnish Meteorological Institute, Finland‡\*

**Carlo Aall**, Western Norway Research Institute, Norway‡

**Paavo-Petri Ahonen**, Academy of Finland, Finland

**Jens Hesselbjerg Christensen**, Danish Meteorological Institute, Denmark

**Michael Goodsite**, Aarhus University, Denmark‡

**Kirsten Halsnæs**, Technical University of Denmark, Denmark

**Mikael Hildén**, Finnish Environment Institute (SYKE), Finland‡\*

**Grete Hovelsrud**, Nordlund Research Institute, Norway

**Karl Georg Høyer**, Oslo University College, Norway

**Henning Høgh Jensen**, Aarhus University, Denmark

**Sirkku Juhola**, Aalto University, Finland

**Annika Carlsson Kanyama**, Swedish Defence Research Agency, Sweden

**Sigrún Karlsdóttir**, Icelandic Meteorological Office, Iceland‡

**Carina Keskitalo**, Umeå University, Sweden

**Richard Klein**, Stockholm Environment Institute, Sweden‡

**Jari Niemelä**, Helsinki University, Finland

**Annika Nilsson**, Stockholm Environment Institute, Sweden

**Karen O'Brien**, University of Oslo, Norway‡

**Jens C. Refsgaard**, Geological Survey of Denmark & Greenland, Denmark‡

**Dominic Stead**, Delft University of Technology, Netherlands

**Monica Tennberg**, University of Lapland, Finland

**Oskar Wallgren**, Stockholm Environment Institute, Sweden‡

**Paul Watkiss**, Paul Watkiss Associates, Oxford, UK

The Scientific Committee comprises members from the NORDCLAD-Net and NONAM networks (core group, denoted by ‡) as well as an extended group of invited experts from other Nordic organisations and institutions outside the Nordic region. The core Committee has had primary responsibility for the planning and content of the Conference. The extended Committee assisted in selecting abstracts, providing advice on the programme, keynote speakers and session chairs, and promoting the Conference through their extensive international networks. Local organisers are denoted by \*.

## Local Organisation

The local organisation has been co-ordinated by Timothy Carter and Mikael Hildén at the Finnish Environment Institute (SYKE) and Adriaan Perrels at the Finnish Meteorological Institute (FMI), with management assistance by Miia Malkamäki at Conference Hotel Rantapuisto and Susa Kukkonen and Eeva Herranen at Area Travel Agency. The local organisers are indebted to colleagues on the Scientific Committee for their sterling efforts as reviewers, session chairs, idea generators and advisers. Paavo-Petri Ahonen chaired the committee judging the poster competition. A group of enthusiastic assistants from SYKE and FMI kindly volunteered to look after logistical matters for participants. Seija Aspola at SYKE is the talent responsible for the superb graphic design of this Conference (website, poster, covers, banners, T-shirts, pens, bags, and so on). Communications were handled by Nina Kukkurainen (FMI) and Anna Toppari (SYKE). Finally, our special thanks are due to Nina Pirttioja (SYKE) and Väinö Nurmi (FMI) who, in addition to their own research contributions, sacrificed a lot of their spare time in formatting the abstract volume, overseeing the registration process, arranging for the equipment and logistical support to be in the right place at the right time and altogether ensuring the smooth progress of proceedings.

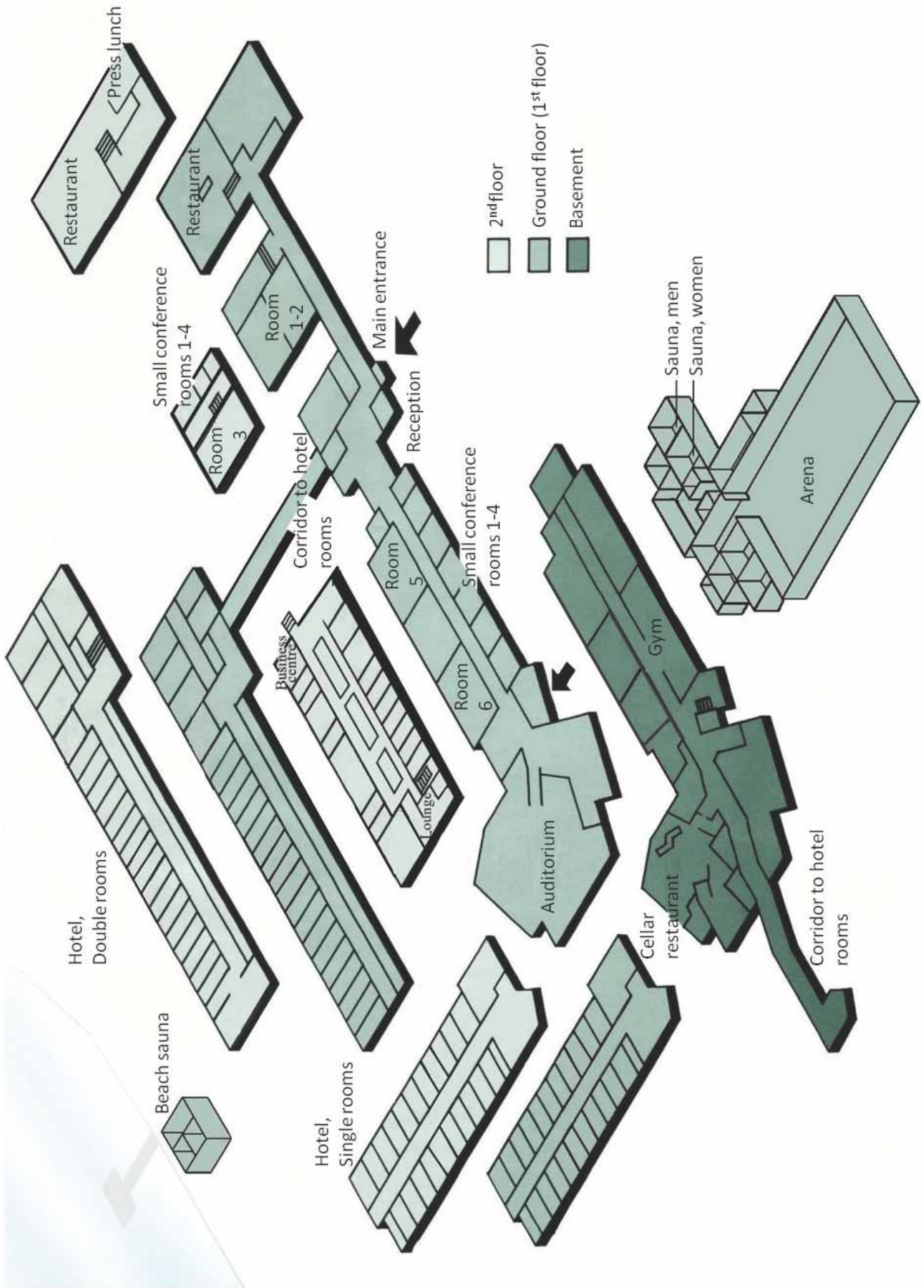
## Venue and Directions

The Conference will be held at **Conference Hotel Rantapuisto** in a superb location adjacent to the Gulf of Finland. Conference Hotel Rantapuisto is equipped with a large auditorium for plenary sessions, numerous meeting rooms capable of accommodating parallel sessions and a purpose built exhibition hall for displaying posters. A floor plan of Rantapuisto can be found on the next page. Rantapuisto is in the Vuosaari district of Helsinki, about 20 minutes drive from the centre of Helsinki and from the airport, address:

Conference Hotel Rantapuisto  
Ramsinniementie 14, FIN-00980 HELSINKI  
Tel. +358 (0)9 31911; Fax +358 (0)9 319 1400  
[rantapuisto@rantapuisto.fi](mailto:rantapuisto@rantapuisto.fi)

**Arrivals from Helsinki Vantaa airport:** Finnair airport bus to city centre (single fare 6.20 EUR) and then public transport (described below) or taxi direct to Conference Hotel Rantapuisto or city hotels (35-45 EUR)

**Arrivals from Helsinki Central Railway Station:** Use public transport (below) or taxi (ca. 35 EUR) to reach Conference Hotel Rantapuisto. It is possible to walk to Hotel Arthur (500 m) or Hotel Helka (700 m) or take a taxi.



**Public transport from Helsinki city centre:** Public transport from Helsinki city centre: There is an underground (Metro) connection direct to Rastila (in the direction of Vuosaari) from the Railway Station and other city centre Metro stations. The journey takes about 20 minutes and a single fare is 2.20 EUR. Tickets must be bought before travel from the Metro station. From 29 to 31 August, a regular shuttle service will be operated between Rastila Metro station and Conference Hotel Rantapuisto. The journey takes about 5 minutes. It is also possible to walk the 2 km from Rastila (the journey takes about 20-30 minutes).

**Bicycle:** For the more adventurous, it is always possible to rent a bike and navigate your way to the Conference. Much of the journey from the city centre is along the coast (about 15 km), and there is a journey planner map with detailed cycle routes, available for consultation. Ask your hotel for more information on bicycle rental companies in Helsinki.

**Arrivals by car:** Conference Hotel Rantapuisto is about 20 minutes by car from Helsinki city centre and is easily accessible from the inner ring road.

## Conference Themes, Evaluation of Abstracts and Programme Structure

The Conference seeks to identify common ground between adaptation research and adaptation decision-making by comparing experiences, reporting new insights and revealing key gaps in knowledge. The original Call for Abstracts was organised around five broad research themes. Themes 1-4 were taken directly from a review article by Eakin and Patt (2011) entitled: "Are adaptation studies effective, and what can enhance their practical impact?" (*WIREs Climate Change* 2: 141-153). One of the authors, Anthony Patt, will deliver a Keynote Presentation in the opening session of the Conference where he will expand on these ideas. In their article, the authors present a matrix where they attempt to classify lessons and themes emerging from adaptation research. The four columns of the matrix reflect the types of adaptation research, and these were adopted as themes 1-4 in the Call: Risk assessment and impact response, Vulnerability and adaptive capacity, Building resilience, and Implementing practical policies. To account for contributions that might span different types or that may slip between the four classes, a fifth category was added on "Cross-cutting issues".

Using these themes as a loose framework, abstract submissions were then invited for poster or oral presentations up to a cut-off date of 30 March 2012. Approximately 200 abstracts were received and 20 members of the Scientific Committee (SC) then contributed to an evaluation procedure during April comprising the following steps:

1. SC members evaluated about 30 abstracts each, while the three local organisers on the SC reviewed all 200. This resulted in a comprehensive coverage of the abstracts, with more than half receiving six independent reviews, most others four or five reviews and a handful evaluated by just three reviewers.

2. Due to the strong response, and in order to offer a fair opportunity for all applicants, the SC imposed a restriction on individuals who had submitted multiple abstracts to present at most a single oral and single poster contribution. Note that this constraint has had to be relaxed subsequently in a few cases, due to withdrawals or other mitigating circumstances.
3. SC evaluators were asked to provide suggestions of relevant sectors or topics that abstracts might be classified under. They were also asked to provide a rating of each abstract and an indication of whether they endorsed author requests for oral or poster presentations or suggested a re-designation or rejection. Freeform comments on the abstracts were also provided.
4. The local organisers pooled the evaluation ratings and comments, analysed and summarised these and mailed the results to the SC members. After obtaining feedback, a series of local meetings were held to draw up an abstract shortlist and to select specific session themes for the Conference, which were then iterated with SC members.
5. All applicants were informed of the SC decisions, and following responses from the presenters, refinements were made to the final lists. A number of additions were also made to the poster session, comprising contributions from students attending a related NORDCLAD-Net/NONAM PhD workshop on Climate Change Adaptation - Analysis, Planning and Implementation at the same venue ahead of the main Conference.
6. The process resulted in the selection of the 100 oral and 49 poster presentations listed in the final programme (see next page), abstracts of which are included in this volume (page 19 onwards). A few of these were re-designations (i.e. from oral to poster or *vice versa*). A number of abstracts were rejected, usually because their content was far from the adaptation theme, too technical, very weak, undeveloped or poorly explained. The SC was careful to review each of the latter cases and reach a collective decision on rejection.

Overall, the final programme includes five Plenary Sessions, featuring Keynote presentations that offer an introduction to some of the Conference themes as well as opening and closing statements. The main body of the Conference comprises five sets of five Parallel Sessions on 18 distinct themes with four presentations in each (some themes occupying two consecutive sessions), a Poster Session on topics covering the full gamut of themes, and two Plenary Panel discussions, one on Adaptation Research and the second on Adaptation Policy. On Thursday 30 August there will be a Press Lunch at which a number of Keynote and Panel presenters will join the local organisers in inviting questions from the media on some of the main messages of the Conference.



## DETAILED PROGRAMME

### Wednesday 29 August 2012

08:00-10:00	REGISTRATION	Rantapuisto lobby
10:00-10:30	REFRESHMENTS	Kahvila <sup>1</sup>
10:30-12:00	Plenary Session 1 – Opening Chair: Timothy Carter	Auditorium
	Words of Welcome and Introductions	Timothy Carter
	Official Welcome and Keynote Presentation 1 Welcome: Adapting to climate change in Helsinki	Pekka Sauri
	Messages from our sponsors NordForsk	Harry Zilliacus
	Mistra-SWECIA	Markku Rummukainen
	Academy of Finland (FICCA)	Harri Hautala
	Young researcher perspective 1	PhD student
	Young researcher perspective 2	PhD student
	Keynote Presentation 2 Framing adaptation research for supporting decision-making	Anthony Patt
12:00-13:15	LUNCH	Ravintola <sup>2</sup> (both floors)
13:15-14:45	Parallel Session 1.1: Adaptation information and portals I Chair: Sanna Luhtala	Auditorium
	1.1.1 Climate-ADAPT: The European Climate Adaptation Platform	Stéphane Isoard
	1.1.2 Climateguide.fi – a boundary service between the public and the research community	Juha A. Karhu
	1.1.3 The Danish portal for adaptation to climate change	Louise Grøndahl
	1.1.4 The establishment of a Swedish National Knowledge Centre for Climate Change Adaptation	Lena Lindström
13:15-14:45	Parallel Session 1.2: Scenarios for adaptation Chair: Jens Hesselbjerg Christensen	Room 1-2
	1.2.1 Progress in the development of new scenarios to support IAV research	Timothy Carter
	1.2.2 Connecting local scenarios for climate adaptation to a global scenario framework	Henrik Carlsen
	1.2.3 Scenarios of adaptive capacity, exposure and sensitivity for an indicator-based climate change vulnerability assessment	Stefan Fronzek
	1.2.4 Downscaling climate projections for adaptation: Advantages and challenges of interdisciplinary collaboration	Grete K. Hovelsrud
13:15-14:45	Parallel Session 1.3: Legal aspects of adaptation Chair: Mikael Hildén	Room 3
	1.3.1 Do we need European burden sharing for adaptation?	Susanne Hanger
	1.3.2 The High North and its Security Conundrum – EU Climate Change and Energy Policy Adaptation in Response to Global Warming in the Arctic	Michael Laiho
	1.3.3 Spatial planning of a moving target? Searching for synergies between marine spatial planning and adaptation to climate change	Riku Varjopuro
	1.3.4 Adapting to the unknown: Legal norms for handling uncertainty in land use planning	Eivind Junker
13:15-14:45	Parallel Session 1.4: Regional strategy development I Chair: Michael Goodsite	Room 5
	1.4.1 The Role of Collaboration in Effective Adaptation Decision-Making	Carrie Spencer
	1.4.2 Climate change adaptation from a County perspective - From theory and expertise to practical implementation	Susanne Aristegui Adolphi
	1.4.3 Development of the adaptation process in the Swedish Counties of Skåne and Östergötland - Advances and challenges	Anna Bratt
	1.4.4 Analysis of regional climate strategies	Jouko Inkeröinen
13:15-14:45	Parallel Session 1.5: Adaptation in developing countries Chair: Richard Klein	Room 6
	1.5.1 Building Adaptive Capacity of Coastal Communities in Bangladesh through Sustainable Decision Making Process: Focusing on Adaptation to Climate Change	Nahid Sultana
	1.5.2 Climate change adaptation in rural Ghana and Botswana: perceptions and complex environments	Pieter Pauw
	1.5.3 Climate Change Impacts and Adaptation by Communities Adjacent Forest Resources in Kilolo District, Tanzania	Suzana Augustino
	1.5.4 Increasing adaptive capacity in rural Africa: filling the gaps – lessons from 5 African countries	Annita Annies & Senja Väätäinen
14:45-15:15	REFRESHMENTS	Kahvila <sup>1</sup>

Finnish terms: 1 Café; 2 Restaurant



## DETAILED PROGRAMME

### Wednesday 29 August 2012 (continued)

15:15-16:15	<b>Plenary Session 2 Chair: Jens Christian Refsgaard</b>	<b>Auditorium</b>
	<b>Keynote Presentation 3</b> Climate change in the Arctic: who is vulnerable? Carina Keskitalo	
	<b>Keynote Presentation 4</b> Informing and advising on climate change adaptation in Canada: a decade of experience Alain Bourque	
16:15-16:30	<b>REFRESHMENTS</b>	<b>Kahvila<sup>1</sup></b>
16:30-18:00	<b>Parallel Session 2.1: Adaptation information and portals II Chair: Grete Hovelsrud</b>	<b>Auditorium</b>
2.1.1	Experiences from developing adaptation tools in a trans disciplinary manner	Annika Carlsson-Kanyama
2.1.2	Adaptation support: linking science, stakeholder knowledge and results from practical testing	Andrea Prutsch
2.1.3	Communicating adaptation knowledge to support strategy development and implementation on local level	Petra Mahrenholz
2.1.4	Centre for Regional change in the Earth System (CRES)	Jens H. Christensen
16:30-18:00	<b>Parallel Session 2.2: Uncertainty Chair: Timothy Carter</b>	<b>Room 1-2</b>
2.2.1	Uncertainties in Climate Adaptation: Are They Undermining Decision-making Processes?	Ana Rovisco
2.2.2	Consideration of uncertainty in European National Adaptation Strategies	Susanne Lorenz
2.2.3	The role of uncertainty in climate change adaptation - examples from the water sector in Denmark	Jens Christian Refsgaard
2.2.4	Moving from a one-dimension to a multi-dimension perspective on uncertainty: Paralyzing or stimulating local climate change adaptation?	Carlo Aall
16:30-18:00	<b>Parallel Session 2.3: Flood risk Chair: Adriaan Perrels</b>	<b>Room 3</b>
2.3.1	Adapting Quebec coastal communities to climate change : progress assessment after 10 years of research and participative approaches	Jean-Pierre Savard
2.3.2	Vulnerability And Adaptation Assessment Of Flood Prone Areas	Tony Rosqvist
2.3.3	Vulnerability of flood peaks to climate change in Great Britain	Christel Prudhomme
2.3.4	Climate Change: Risk Perceptions in Norway	Päivi Lujala
16:30-18:00	<b>Parallel Session 2.4: Regional strategy development II Chair: Oskar Wallgren</b>	<b>Room 5</b>
2.4.1	ClimateXChange: Linking Adaptation Research with Adaptation Decision-Making in Scotland	Iain Brown
2.4.2	The BaltAdapt Project – A Multi-Stakeholder, Transnational Approach toward a Regional Adaptation Strategy for the Baltic Sea Region	Maxi Nachtigall
2.4.3	Climate change impacts and the adaptation measures in the Finnish water industry	Mirjam Orvomaa
2.4.4	Has climate change affected whitefish reproduction and catches in the Gulf of Bothnia?	Lauri Urho
16:30-18:00	<b>Parallel Session 2.5: Rural livelihoods Chair: Karen O'Brien</b>	<b>Room 6</b>
2.5.1	Adaptive capacity and community resilience in Northern Norwegian communities	Helene Amundsen
2.5.2	Impacts of climate changes on Arctic herding communities. The case of Finnish Fell Lapland	Élise Lépy
2.5.3	Land Use conflict in a Climate Change Perspective: Reindeer herding in Nordland, Northern Norway	Camilla Risvoll Godø
2.5.4	Migrating to Tackle Climate Variability and Change? Insights from Coastal Fishing Communities of Bangladesh	Md. Monirul Islam
18:00	<b>BUSES LEAVE FOR RECEPTION IN HELSINKI CITY HALL AT 18:30</b>	<b>Rantapuisto main entrance</b>

Finnish terms: 1 Café



## DETAILED PROGRAMME

Thursday 30 August 2012

08:00-09:00	<b>REGISTRATION</b>	<b>Rantapuisto lobby</b>
09:00-10:00	<b>Plenary Session 3 Chair: Sigrún Karlsdóttir</b> <b>Keynote Presentation 5</b> Climate change, biodiversity and conservation planning <b>Keynote Presentation 6</b> Estimating the costs and benefits of climate change adaptation in Europe	<b>Auditorium</b> Mar Cabeza Paul Watkiss
10:00-10:30	<b>REFRESHMENTS</b>	<b>Kahvila<sup>1</sup></b>
10:30-12:00	<b>Parallel Session 3.1: National adaptation strategies I – Policy Chair: Sabine McCallum</b>	<b>Auditorium</b>
3.1.1	Evaluating climate change adaptation policies in European countries: Policy labeling or Policymaking?	Johann Dupuis
3.1.2	Evaluation and revision of Finland's National Adaptation Strategy	Sanna Luhtala
3.1.3	Adaptation to climate change – agenda setting and policy integration in Germany	Rebecca Stecker
3.1.4	Monitoring and evaluating adaptation measures - a critical review	Mikael Hildén
10:30-12:00	<b>Parallel Session 3.2: Urban planning I Chair: Hans Jørgen Henriksen</b>	<b>Room 1-2</b>
3.2.1	City 2 - Ecologies of Climate Change Adaptation	Nora Kinnunen
3.2.2	Climate Change Adaptation in Urban Design: the Expectant Design Approach	Laura A. Delaney Ruskeepää
3.2.3	Towards legitimate governance arrangements for adaptive flood risk management in urban areas	Heleen Mees
3.2.4	Climate change considerations in urban planning	Irmeli Wahlgren
10:30-12:00	<b>Parallel Session 3.3: Natural resource management I Chair: Carlo Aall</b>	<b>Room 3</b>
3.3.1	Adaptation of management of Norway spruce stands to changing climate	Raisa Mäkipää
3.3.2	Spruce forests on their southern boundaries: to adapt or not to adapt	Viktar Kireyeu
3.3.3	Mitigating the effects of climate change - Assisted Dispersal and regulation	Elna Vaara
3.3.4	Boreal protected area network as an adaptation means to preserve avian biodiversity in a changing climate	Raimo Virkkala
10:30-12:00	<b>Parallel Session 3.4: Economic appraisal I Chair: Kirsten Halsnæs</b>	<b>Room 5</b>
3.4.1	Impact Assessment, Costs, and Decision Making for Climate Change and Adaptation	Jay Gregg
3.4.2	SALDO: the Social costs of Adaptation: approaches to an evaluation of aDaptation Options	Martin König
3.4.3	Insure or Invest in Green Technologies to Protect Against Adverse Weather Shocks ?	Sami Myyrä
3.4.4	Interpreting welfare effects in induced economic impact evaluation of extreme events	Hanna Virta
10:30-12:00	<b>Parallel Session 3.5: Policy learning I Chair: Sirkku Juhola</b>	<b>Room 6</b>
3.5.1	Integrating Stakeholders in Policy Development for Adaptation to Climate Change: Lessons and Experience from German Dialogue Processes	Esther Hoffmann
3.5.2	Engaging stakeholders in identification of capacity development needs within disaster risk reduction by means of a think tank process	Peter van der Keur
3.5.3	Participation and learning for climate change adaptation: Experiences from local urban planning and forestry in Sweden	Oskar Wallgren
3.5.4	Exploring the interactions between science, stakeholders and their implications for learning about climate change adaptation: Experiences from the Swedish Forestry Sector	Gregor Vulturius
12:00-13:15	<b>LUNCH</b> <b>PRESS LUNCH</b>	<b>Ravintola<sup>2</sup> (both floors)</b> <b>Ravintola<sup>2</sup> (Kabinetti)</b>
13:15-14:45	<b>Plenary Panel – Research Chair: Richard Klein</b> <b>Ian Burton</b> , University of Toronto <b>Kris Ebi</b> , IPCC <b>Janne Hukkinen</b> , Helsinki University/FP7 Advisory Group <b>Markku Rummukainen</b> , Mistra-SWECIA <b>Harry Zilliacus</b> , NordForsk	<b>Auditorium</b>
14:45-16:00	<b>POSTER SESSION AND REFRESHMENTS (Posters P1-P5)</b>	<b>Arena<sup>3</sup></b>
P1	Climate Information: Using the Spotfire platform to improve data visualisation and accessibility of UK climate projections	Joseph Hägg
P2	Property managers compliance in property insurance policies, focus on flash flooding	Petri Saarinen
P3	Adaptation to coastal flooding on household level: To what extent is it determined by nationality?	Jana Koerth
P4	MAVERIC: interactive mapping of vulnerability to climate change at a municipality-scale in Finland – online demonstration of an internet mapping tool	Stefan Fronzek
P5	Co-operating efforts within the Nordic Framework for Climate Services	Elin Löwendahl

Finnish terms: 1 Café; 2 Restaurant; 3 Arena



## DETAILED PROGRAMME

### Thursday 30 August 2012 (continued #1)

14:45-16:00	POSTER SESSION AND REFRESHMENTS (Posters P6-P49)	Arena <sup>3</sup>
P6	Visualization supported dialogue for climate adaptation in the Baltic Sea Region	Tina-Simone Neset
P7	LandCaRe-DSS, an interactive, model-based decision support system for scenario-driven climate change adaption in agriculture	Michael Berg
P8	Bridging the gap between Science and Society	Marianne Hall
P9	Skiing on thin snow? – Assessing the usability of a planning support tool on climate change-related vulnerability of winter outdoor recreation in Finland	Simo Haanpää
P10	Smart Phone Application for Promoting Climate Change and Food Safety Awareness	Gun-Hee Kim
P11	Building adaptive capacity through inter- and transdisciplinary scenario planning: Findings from a case study in Rostock, Germany	Bart Jan Davidse
P12	Minding the uncertainties	Jussi Ylhäisi
P13	Methods for assessing vulnerability	Jan Ketil Rød
P14	Institutional challenges of water governance to adapt to a changing climate – a case study of the Rhine	Rebecca Stecker
P15	How do municipalities in Sweden deal with uncertain sea level rise in their planning?	Jacob von Oelreich
P16	Land use planning and emergency provision for a changing climate	Halvor Dannevig
P17	How to design a successful stakeholder dialogue on adaptation to climate change?	Esther Hoffmann
P18	Corporate Adaptation to Climate Change: A Learning Challenge	Esther Hoffmann
P19	NGOs and Climate change adaptation: Whose interest matters???	Faith Mavengere
P20	Networking global climate adaptation actors: A concept from climate-sensitive Taiwan	Yi-Chang Chiang
P21	Decision Support for Climate Change Adaptation	Heikki Tuomenvirta
P22	Farmers' perceptions on climate change: Information needs and barriers for implying mitigation and proactive adaptation	Hanna Mäkinen
P23	Structuring tools for municipal climate adaptation planning - process and impact analysis	Christina Frost
P24	Synergies, Conflicts and Trade-offs: Findings from a comparative case study of Copenhagen and Portland	Patrick Driscoll
P25	Mitigating the impacts of extreme weather originated disasters by simulating the effects of different preparation and action decisions of crisis management	Anna-Mari Heikkilä
P26	Stakeholder analysis of flood risk management reduction strategies in Paz River catchment, Guatemala-El Salvador	Héctor Estuardo Guinea Barrientos
P27	Rural Transformations: Livelihood adaptation to climate change in Uganda.	Sarah Cooper
P28	Adapting to climate change: households' response strategies to hailstorm and drought in Lijiang, China	Yuan Zheng
P29	Impacts of climate change on multiple ecosystem services: processes and adaptation options at landscape scales (CLIMES)	Maria Holmberg
P30	Livelihoods, Vulnerability and Adaptive Capacity: A Case Study from Rural Lao	Xi Jiao
P31	Investigating the relationship between mortality and temperature and a possible acclimatization effect in Finland	Reija Ruuhela
P32	Stratified climate vulnerability analysis for heat waves in a Swedish city: who is vulnerable and why?	Lina Lundgren
P33	Exposure to heat and occupational health in a warming world	Karin Lundgren
P34	Planning a sustainable and climate-proof built environment: the special case of real estate value formation and residential qualities	Athanasios Votsis
P35	Dynamics of mixed-species forests in changing climate – how different species combinations adapt to climate change?	Vladimir Shanin
P36	Carbon balance of forest land in Finland under the effect of different levels of wood use and climate change	Risto Sievänen
P37	How does climate change affect forest carbon balances and damages – Climforisk, EU Life+ project	Mikko Peltoniemi
P38	The impact of climate-change-induced storm risk on the optimal rotation period in Finnish forests	Karoliina Pilli-Sihvola
P39	Modelling Growth from Stem Diameter Changes during Drought of Scots Pine	Tommy Chan
P40	Autumn frost hardening development of Scots pine and Norway spruce seedlings in future climate	Saila Varis
P41	Estimating carbon fluxes by combining climate-sensitive process models, NFI data and Landsat satellite images	Sanna Härkönen
P42	Ecosystem modeling of vegetation growth and risk for damage– linking user needs to model development	Bakhtiyor Pulatov
P43	A survey study on nature conservation in semi-natural grasslands and forests in a changing climate	Anna Tainio
P44	Perceptions on Resilience in Finnish Food Supply Chains	Antti Puupponen
P45	Pre-anthesis high-temperature acclimation alleviates damage to the flag leaf caused by post-anthesis heat stress in wheat	Xiao Wang
P46	Enhancing adaptive capacity of Finnish agrifood systems: a Delphi based survey on stakeholder views	Sari Himanen
P47	Green roofs as an urban adaptation tool – Cost-benefit analysis	Väinö Nurmi
P48	Climate change impacts on energy demand for heating and cooling of buildings in Finland	Kirsti Jylhä
P49	Climatic challenges in road maintenance: will they increase or not?	Ari Venäläinen



## DETAILED PROGRAMME

### Thursday 30 August 2012 (continued #2)

<b>16:00-17:30</b>	<b>Parallel Session 4.1: National adaptation strategies II – Research</b> Chair: Andrea Prutsch	<b>Auditorium</b>
4.1.1	Selecting appropriate methods for adaptation decisions	Alexander Bisaro
4.1.2	Matching available climate change knowledge with adaptation strategies at the national level: an example from Portugal	Ana Gomes
4.1.3	Synthesis of adaptation research in different sectors in Finland	Reija Ruuhela
4.1.4	Reframing adaptation? - responding to indirect impacts of climate change	Oskar Wallgren
<b>16:00-17:30</b>	<b>Parallel Session 4.2: Urban planning II</b> Chair: Carlo Aall	<b>Room 1-2</b>
4.2.1	The role of social strategy games in understanding the trade-offs between mitigation and adaptation in climate change decision-making in cities	Sirkku Juhola
4.2.2	Governing adaptation to natural hazards in land-use planning	Trude Rauken
4.2.3	Managing conflicting claims in planning: the example of climate change adaptation in local housing policy	Mattias Hjerpe
4.2.4	Afraid of (Climate) Change? Institutional Implications in Local Climate Change Governance	Anja Wejs
<b>16:00-17:30</b>	<b>Parallel Session 4.3: Natural resource management II</b> Chair: Sigrún Karlsdóttir	<b>Room 3</b>
4.3.1	Significance of adaptation to forest management and economic returns in forests under transition due to climate change	Annikki Mäkelä
4.3.2	Modelling interactions of climate, crop management and phenology and their effect on barley yields in Finland (1971-2010).	Reimund Rötter
4.3.3	Identifying synergies between adaptation and mitigation strategies in agriculture	Anita Wreford
4.3.4	Diversification as a means to enhance resilience of agrifood systems	Helena Kahiluoto
<b>16:00-17:30</b>	<b>Parallel Session 4.4: Economic appraisal II</b> Chair: Paul Watkiss	<b>Room 5</b>
4.4.1	Response to weather conditions and weather forecasts as a basis for assessing climate change adaptation	Adriaan Perrels
4.4.2	Effects of Climate Change on Inland Waterway Transport Networks	Tim Breemersch
4.4.3	A way of assessing flood risks changes from hazard maps	Jari Silander
4.4.4	Environmental and economic impact assessment due to sea-level rise in the Basque coast based on different scenarios obtained from the geological record	Elisa Sainz de Murieta
<b>16:00-17:30</b>	<b>Parallel Session 4.5: Policy learning II</b> Chair: Carina Keskitalo	<b>Room 6</b>
4.5.1	Dealing with ambiguity in climate change adaptation - conceptual framework	Hans Jørgen Henriksen
4.5.2	Conservation and/or Adaptation? Clashing Cognitive Frames in Adaptation Policy at the EU	György Pataki
4.5.3	Gendering the Local Climate Adaptation Process	Karin Edvardsson Björnberg
4.5.4	Cultural Differences in Handling Climate Change Adaptation	Nicole Mahlkow & Karsten Balgar
<b>17:30-18:00</b>	<b>ALL POSTERS TO BE DISMOUNTED</b>	<b>Storage room available</b>
<b>18:00</b>	<b>BUSES LEAVE FOR CONFERENCE DINNER AT HAIKKO MANOR</b>	<b>Rantapuisto main entrance</b>



## DETAILED PROGRAMME

### Friday 31 August 2012

08:00-09:00		REGISTRATION	Rantapuisto lobby
09:00-10:00	Plenary Session 4 Chair: Adriaan Perrels		Auditorium
	<b>Keynote Presentation 7</b> Framing policy and development co-operation for climate change adaptation	Michael Mullan	
	<b>Keynote Presentation 8</b> The adaptive challenge of climate change	Karen O'Brien	
10:00-10:30	REFRESHMENTS		Kahvila <sup>1</sup>
10:30-12:00	Parallel Session 5.1: Enhancing climate services Chair: Reija Ruuhela		Auditorium
	5.1.1 Understanding the landscape of climate services to inform adaptation decision-making	Roger B. Street	
	5.1.2 The German Climate Service Center: a national answer to a global challenge	Michaela Schaller	
	5.1.3 Strong wind exposure and wind-loss mapping in Norway	Tomasz Opach	
	5.1.4 Headline Messages: decision-relevant messages on climate change adaptation for Scotland	Joseph Hägg	
10:30-12:00	Parallel Session 5.2: Local adaptation plans Chair: Sirkku Juhola		Room 1-2
	5.2.1 Implementing adaptation to climate change at the local level in Norway	Grete K. Hovelsrud	
	5.2.2 Climate change adaptation and local private actors: a study case of the forestry sector in Wallonia (Belgium)	Valentine van Gameren	
	5.2.3 Risk and vulnerability analysis – a feasible process for local climate adaptation in Sweden?	Karin Mossberg Sonnek	
	5.2.4 Generic constraints for adaptation in multi-level governance contexts: Lessons from Australia and Finland	Susanna Kankaanpää	
10:30-12:00	Parallel Session 5.3: Projecting impacts and adaptation responses Chair: Jens Hesselbjerg Christensen		Room 3
	5.3.1 Impacts and adaptation options of climate change on ecosystem services in Finland: a model based assessment	Martin Forsius	
	5.3.2 Adaptation to climate change in agricultural water protection – Catchment scale model analysis	Katri Rankinen	
	5.3.3 New 30-year time series of agroclimatic indicators for present and future climate as a basis for assessing different adaptation strategies for crop production in Finland	Jukka Höhn	
	5.3.4 Probabilistic assessment of crop adaptation options under a changing climate	Nina Pirttioja	
10:30-12:00	Parallel Session 5.4: Energy and infrastructure Chair: Oskar Wallgren		Room 5
	5.4.1 Adapting utilities to climate change – challenges, conflicts, and barriers in Germany	Esther Hoffmann	
	5.4.2 Adaptation to climate change of engineering structures	Mark Trexler	
	5.4.3 A Bayesian Classifier for Climate Model Ensemble Selection	Luca Garrè	
	5.4.4 Governing quasi-public network services for adaptation to climate change	Tor Håkon Inderberg	
10:30-12:00	Parallel Session 5.5: Health and well being Chair: Annika Carlsson Kanyama		Room 6
	5.5.1 Climate change and infectious disease in Europe: Mapping future vulnerabilities	Jonathan E. Suk	
	5.5.2 Climate change and health - building resilience through eHealth	Åsa Holmner Rocklöv	
	5.5.3 Climate change adaptation in practical level tourism development	Kaarina Tervo-Kankare	
	5.5.4 Climate change vulnerability indicators for cross-country skiing	Mia Landauer	
12:00-13:15	LUNCH*		Ravintola <sup>2</sup> (both levels)
13:15-14:45	Plenary Panel – Policy Chair: Mikael Hildén		Auditorium
	Anne Brunila, Fortum Oyj		
	Kåre Svarre Jakobsen, Danish Nature Agency		
	Sabine McCallum, Austrian Environment Agency		
	Ville Niinistö, Finnish Minister of the Environment		
	Haavard Stensvand, Head of Civil Protection and Emergency Planning, Sogn og Fjordane		
14:45-15:30	Plenary Session 5 – Closing Chair: Timothy Carter		Auditorium
	Young researcher synopsis 1	PhD student	
	Young researcher synopsis 2	PhD student	
	Poster award	Paavo-Petri Ahonen	
	Reflections: NONAM & NORDCLAD-Net	Adriaan Perrels & Oskar Wallgren	
	Final remarks, Acknowledgements and Close	Timothy Carter	
15:30	CLOSE		

Finnish terms: 1 Café; 2 Restaurant

\* Lunch on Friday will be in two sittings, the second at 12:30 (details to be announced)



Second Nordic International Conference on Climate Change Adaptation, 29-31 August 2012, Helsinki, Finland  
*Adaptation Research meets Adaptation Decision-Making*

**PROGRAMME AT A GLANCE**

Time	29 AUG	30 AUG	31 AUG
8:00-9:00	Registration	Registration	Registration
9:00-10:00	Plenary Keynote 5: Mar Cabeza Keynote 6: Paul Watkiss	Plenary Keynote 7: Michael Mullan Keynote 8: Karen O'Brien	Plenary Keynote 9: ...
10:00-10:30	Refreshments	Refreshments	Refreshments
10:30-12:00	Opening Plenary Official Welcome and Keynote 1: Pekka Saari Messages from our sponsors Young researcher perspective 1 Young researcher perspective 2 Keynote 2: Anthony Patt	Parallel sessions 3.1: NAS I - Policy (A) 3.2: Urban planning I (L-2) 3.3: Natural resource management I (3) 3.4: Economic appraisal I (5) 3.5: Policy learning I (6)	Parallel sessions 4.1: NAS II - Research (A) 4.2: Urban planning II (L-2) 4.3: Natural resource management II (3) 4.4: Economic appraisal II (5) 4.5: Policy learning II (6)
12:00-13:15	Lunch	Lunch	Lunch
13:15-14:45	Parallel sessions 1.1: Adaptation information/portals (A) 1.2: Scenarios for adaptation (1-2) 1.3: Legal aspects of adaptation (3) 1.4: Regional strategy development I (5) 1.5: Adaptation in developing countries (6)	Plenary Panel: Research Chair: Richard Klein, SEI Ian Burton, University of Toronto Kris Ebi, IPCC Janne Hukkinen, Helsinki University Markku Rummukainen, MISTRA-SWEDCA Harry Zilliacus, NordForsk	Plenary Panel: Policy Chair: Mikael Hildén, SYKE Anne Brunila, Finland Kåre Svarre Jakobsen, Denmark Sabine McCallum, Austria Ville Niinistö, Finland Haavard Stensvand, Norway
14:45-15:15	Refreshments	Session & Refreshments	Closing Plenary Young researcher Young researcher Poster award Reflections Final remarks
15:15-16:15	Plenary Keynote 3: Carina Kesikitalo Keynote 4: Alain Bourque	Poster Session & Refreshments	Plenary Young researcher Young researcher Poster award Reflections Final remarks
16:30-18:00	Refreshments	Parallel sessions	Parallel sessions
18:30-20:00	Reception (Helsinki City Hall)	Dinner (Haikio Manor)	

## Keynote Speakers

There are eight Keynote presentations at the Conference, and speakers are listed below in chronological order of their presentations.

### Wednesday 29 August, 10:30-12:00

#### **Keynote presentation 1: *Welcome: Adapting to climate change in Helsinki.* Pekka Sauri**

**Pekka Sauri** has served as Deputy Mayor of the City of Helsinki since 2003, in charge of Public Works and Environmental Affairs. He was elected to the office as a Finnish Green League party member by Helsinki City Council, first for a seven-year term, and re-elected for another seven years in 2010. Prior to his current office, Dr Sauri served in various positions in mental health counselling in Finland in 1975–2003. He was Chairman of the Green League of Finland in 1991–93. He also worked as a radio journalist in 1986–2002. Dr Sauri's long list of positions of trust over the past 21 years, both in Finland and internationally include chairmanship of the European Federation of Green Parties in 1994–97. Dr Sauri holds a Doctor of Philosophy degree from the Brunel University, London, U.K.

#### **Keynote presentation 2: *Framing adaptation research for supporting decision-making.* Anthony Patt**

**Anthony Patt** is a Senior Research Scholar at the International Institute for Applied Systems Analysis, where he leads the Decisions and Governance Research Group in the program on Risk, Policy and Vulnerability. Dr. Patt is trained in law and public policy, having received a PhD from Harvard University in 2001. His research has covered several aspects adaptation, and climate policy more generally. Focusing on Africa and Europe, much of this has looked at how people make decisions under conditions of uncertainty, and how expert advisors can best communicate uncertainty in order to assist people in making thoughtful and motivated adaptation choices. It has also included research on the drivers of adaptive capacity, and issues of renewable energy expansion in developing countries. Dr. Patt is currently a Review Editor for the IPCC Working Group II, a lead author for Working Group III, an editorial board member of Global Environmental Change, and a senior editor of Climate & Development and Regional Environmental Change. He lives near Vienna with his wife, Dagmar Schröter, and their two children.

### Wednesday 29 August, 15:15-16:15

#### **Keynote presentation 3: *Climate change in the Arctic: who is vulnerable?* Carina Keskitalo**

**E. Carina H. Keskitalo** is Professor of Political Science at the Department of Geography and Economic History, Umeå University, Sweden. She has published widely on adaptation to climate change in renewable land use (forestry, reindeer husbandry, fishing and tourism) in northernmost Europe and on the development of adaptation policy in multi-level governance (local to national levels) in European countries.

#### **Keynote presentation 4: *Informing and advising on climate change adaptation in Canada: a decade of experience.* Alain Bourque**

**Alain Bourque** holds a BSc in Meteorology from McGill (1989) and a MSc in Atmospheric Science from UQAM (1996). He acted as a meteorologist/climatologist with Environment Canada from 1989 to 2001. He was involved in the analyses of the 1996 Saguenay flooding, the 1998 ice storm and many other activities linked to the impacts and adaptation of extreme weather and climate change. He established and now co-ordinates the Impacts and Adaptation program of the Ouranos Consortium. Ouranos has been created in 2001 to study the regional climatology and the adaptation to climate change. He is the lead author of the Quebec chapter in the Canadian government's assessment entitled "From Impacts to Adaptation: Living with Climate Change in Canada 2007", and was involved in the Quebec chapter of the cross-Canada assessment in 1997. He also contributed to the recent Ouranos publication (2010) "Adapting to Climate Change". He has been a reviewer for the North America chapter of the last IPCC report, Working Group II, he is co-author of several scientific articles about climate change and he is often approached by the media to make presentations about the impacts of climate change and how to deal with them.

### Thursday 30 August, 9:00-10:00

#### **Keynote Presentation 5: *Climate change, biodiversity and conservation planning.* Mar Cabeza**

**Mar Cabeza-Jaimejuan** is a researcher at the Metapopulation Research Group, at the Dept of Biosciences, University of Helsinki. Cabeza obtained her first degree in Spain (University of Barcelona) and her PhD in Finland, at the University of Helsinki. After a three-year postdoc at the Biodiversity and Global Change Lab with Dr. Miguel B. Araújo (CSIC, Spain), Cabeza is now an established PI at the University of Helsinki, leading the "Global Change and Conservation" team. Most of Cabeza's research is strongly linked to conservation, including theoretical and applied projects both in the developed and developing worlds. Cabeza has participated in a number of international climate change projects, (e.g. "Impacts of climate change on biodiversity and ecosystem goods and services in the Barents Region", a Nordic Council project or MACIS, an EU-FP6 project) and she is currently the leader of the Biodiversity Work Package of the EU-FP7 project RESPONSES. Climate change is affecting conservation areas and is increasing the conservation needs for many species. Also adaptation and mitigation strategies in numerous sectors may affect biodiversity negatively. Understanding and projecting such threats, dealing with uncertainties, and developing approaches to improve conservation planning is currently occupying Cabeza's research agenda.

#### **Keynote Presentation 6: *Estimating the costs and benefits of climate change adaptation in Europe.* Paul Watkiss**

**Paul Watkiss** is an independent researcher, a senior associate of the Stockholm Environment Institute, and a Visiting Senior Researcher at the Environmental Change Institute at the Oxford University in the UK. He is an internationally recognised expert specialising in the economics of climate

change and adaptation. He was the technical director of the EC FP7 ClimateCost research project on the economic costs of climate change in Europe, which included analysis of the costs and benefits of adaptation. Paul has worked as an advisor to the EEA, the EC, the OECD, the UK Government and the UNFCCC. He led the 2007 EEA costs of adaptation report and the 2009 UNFCCC SUBSTA technical report on the costs and benefits of adaptation. He recently developed the method for the UK's National Economics of Climate Resilience Study, a major input to the National Adaptation Programme. His current research interests (on the FP7 Mediation Project) include the use of new decision support tools for assessing the economics of adaptation under uncertainty.

## Friday 31 August, 9:00-10:00

**Keynote Presentation 7: *Framing policy and development co-operation for climate change adaptation.* Michael Mullan**

**Michael Mullan** leads the Organisation for Economic Cooperation and Development's (OECD) work on climate change adaptation. This encompasses analysis of adaptation policies in OECD countries, integrating adaptation into development assistance and cross-cutting economic issues. Prior to this he was an Economic Advisor for the UK Government, responsible for domestic adaptation policy. He has also worked on a variety of areas related to climate change including: an independent review of finance for reducing emissions from deforestation, mitigation cost curves and agri-environment policy. Michael studied at the University of Oxford and the School of African and Oriental Studies (SOAS), University of London.

**Keynote Presentation 8: *The adaptive challenge of climate change.* Karen O'Brien**

**Karen O'Brien** is a Professor in the Department of Sociology and Human Geography at the University of Oslo, Norway. Her research focuses on climate change impacts, vulnerability and adaptation and the implications for human security, as well as on the relationships between globalization and environmental change. She is particularly interested in the relationship between personal, cultural, organizational and systems transformation, including how trans-disciplinary and integral approaches to global change research can contribute to a better understanding of how societies both create and respond to change. She has participated in the IPCC Fourth and Fifth Assessment Reports, as well as the Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX). She has written and edited a number of books, including *Environmental Change and Globalization: Double Exposures* (Oxford, 2008), *Adapting to Climate Change: Thresholds, Values, Governance* (Cambridge, 2009) and *Climate Change, Ethics, and Human Security* (Cambridge, 2010).

## Plenary Panelists

There are two Plenary Panel discussions scheduled: one on Adaptation Research and the other on Adaptation Policy. The Panelists are all prominent individuals drawn from a wide range of countries, backgrounds and experiences.

## Thursday 30 August, 13:15-14:45

### Plenary Panel on Climate Change Adaptation Research

**Richard Klein (Chair)** is a senior research fellow at the Stockholm Environment Institute (SEI) and an adjunct professor at the Centre for Climate Science and Policy Research of Linköping University. He is an expert on the science and policy of adaptation to the impacts of climate change, with twenty years of experience in original research, science assessment and policy advice. Much of Richard's current work addresses the role of adaptation in the design and implementation of a global climate policy agreement, but his work also concerns social and institutional adaptation in Sweden and other European countries. Richard is the founder and editor-in-chief of the academic journal *Climate and Development*, which first appeared in 2009. He has been an IPCC author since 1994, and co-director and chief scientist of the Nordic Centre of Excellence NORD-STAR since 2011. Before joining SEI in 2006, Richard spent almost eight years at the Potsdam Institute for Climate Impact Research. He began his career at the Institute for Environmental Studies of the VU University in Amsterdam in 1992. To date he has produced over 100 journal articles, book chapters and reports, edited two books and two journal special issues, and contributed to numerous international workshops and conferences.

**Ian Burton** is an Emeritus Professor at the University of Toronto and a Scientist Emeritus with the Climate Research Division in Environment Canada. He was an early contributor to the development of adaptation research and policy, and served as a Lead Author for the IPCC 3rd and 4th Assessments and is now working on the 5th Assessment. He recently served as co-chair of the Advisory Panel on Climate Change Adaptation for the Government of Ontario, and as a consultant to the City of Toronto on climate risk assessment. Ian served as a Convening Lead Author in the recently published IPCC Special Report on Extremes (SREX), and is now co-chair of the Working Group on Forensic Disaster Investigations in the new ICSU International Programme on Integrated Research on Disaster Risk (IRDR). His most recent book is *The Earthscan Reader on Adaptation to Climate Change* edited with E. Lisa F. Schipper.

**Kristie L. Ebi** is a Consulting Professor in the Department of Medicine, Stanford University and the Executive Director of the IPCC WGII Technical Support Unit. Prior to these positions, she was an independent consultant conducting research on the impacts of and adaptation to climate change, including on extreme events, thermal stress, food borne safety and security, and vector borne diseases. She has worked with WHO, UNDP, USAID, and others on assessing vulnerability and implementing adaptation measures in Central America, Europe, Africa, Asia, and the Pacific. She facilitated adaptation assessments for the health sector for the states of Maryland and Alaska. She was a coordinating lead author or lead author in the IPCC Fourth Assessment Report, the Millennium Ecosystem Assessment, the International Assessment of Agricultural Science and Technology for Development, and two US national assessments. Dr. Ebi's scientific training includes an M.S. in toxicology and a Ph.D. and a Masters of Public Health in epidemiology, and two years of postgraduate research at the

London School of Hygiene and Tropical Medicine. She has edited four books on aspects of climate change and has more than 100 publications.

**Janne I. Hukkinen** (born 1957; PhD, University of California, Berkeley, 1990; MSc, Helsinki University of Technology, Finland, 1984) is professor of environmental policy at the University of Helsinki. He studies the cognitive aspects of sustainability assessment and strategy, with empirical applications in participation and expertise in environmental and technology policy. He is a board member of the European Society for Ecological Economics (ESEE) and chair of the Finnish Society for Environmental Social Science (YHYS). Hukkinen is an Expert Counsellor on the Environment for the Supreme Administrative Court of Finland and a member of the European Commission's 7th FP Environment and Climate Scientific Advisory Group. He was an Academy of Finland senior fellow and visiting scholar at the University of California, Santa Barbara in 2006 and an American Association for the Advancement of Science (AAAS) Environmental Science and Engineering fellow at the US EPA in Washington DC in 1990. He is the winner of the Harold D. Lasswell award for the best article in Policy Sciences in 1990. In addition to over 70 peer-reviewed scientific articles or book chapters, he is the author of *Sustainability Networks* (2008) and *Institutions in Environmental Management* (1999), both published by Routledge.

**Markku Rummukainen** has long experience in climate change research, not least in the development, evaluation and application of regional climate models to climate scenarios. In conjunction to these activities, he has collaborated with climate impact researchers and engaged in research communication. Since 2008, he is the Programme Director of the Swedish strategic environmental research programme *Mistra-SWECIA* ([www.mistra-swecia.se](http://www.mistra-swecia.se)) on interdisciplinary research on climate change adaptation. Markku is Professor in climatology and Deputy Head of the Centre for Environmental and Climate Research at Lund University. At Lund University, he also coordinates the Strategic Research Area MERGE that collects five universities and the Swedish Meteorological and Hydrological Institute (SMHI) to develop global and regional climate models into Earth system models that include interactive vegetation and related processes and feedback. He works also as a Climate Advisor at SMHI and provides expert support to the Swedish Government in the UN climate negotiations and contributes to the work of the IPCC. He was earlier the Head of the Rossby Centre, the climate modelling research unit of the SMHI in 1997-2005 and before 1997 did research on stratospheric ozone in Finland and Norway.

**Harry Zilliacus** is a Senior Adviser at NordForsk, Oslo. Harry is also docent in Physical Geography at the University of Helsinki (PhD 1987). In 1993-2003, he was the secretary of the Nordic Working Group on environmental monitoring and data (NMD) based at the Finnish Environment Institute (SYKE). In addition to teaching in Helsinki he was affiliated with Boston University, USA, and Fudan University in Shanghai, PR China, as visiting professor in 1987 and 2002, respectively. His own research he carried out in the Nordic region and in Central Asia. Harry's current responsibilities at NordForsk working for the Nordic Council of Ministers, are

mainly as programme secretary for several Nordic Centre of Excellence programmes (Food, nutrition and health; Nordic welfare; Effect studies and adaptation to climate change). He is presently involved in the ongoing Top-level Research Initiative and its NCoE programmes and Nordic network activities (ADAPT, sub-programme 1). Harry has also contributed to cooperation of Nordic research and researcher education in fields such as the Arctic, Russia and the Baltics, and bibliometrics.

## Friday 31 August, 13:15-14:45

### Plenary Panel on Climate Change Adaptation Policy

**Mikael Hildén (Chair)** is the Director of the Climate Change Programme at the Finnish Environment Institute (SYKE). He has a Ph.D. in Ecology/Resource Management and more than 20 years of experience in environmental management, research, training and consulting both in Finland and abroad. Dr Hildén has managed many projects on environmental policy in Finland and internationally combining legal, economic, social, technical and scientific research on environmental policy, including the use of decision analysis as a framework for dealing with environmental issues. He has lead several multidisciplinary research projects in particular on the evaluation of environmental policy and on environmental assessment of policies, plans and programmes, including the national climate strategies. In recent years his work has been related to innovation studies and the effects of policies on environmentally significant innovations, including those in the realm of climate policy.

**Anne Brunila** is Executive Vice President, Corporate Relations and Strategy for Fortum Corporation. She holds a DSc in Economics and Business Administration from the Helsinki School of Economics and previously served as President of the Finnish Forest Industries Federation, as General Director of the Finnish Ministry of Finance as well as in several advisory and executive positions in the Bank of Finland and the European Commission. Her current key positions of trust include membership of the Board of Sampo plc and Kone Corporation as well as advisory roles for the Research Institute of the Finnish Economy, the Finnish Business and Policy Forum and Aalto University Foundation.

**Kåre Svarre Jakobsen** is Head of Division at the Danish Ministry of the Environment, Nature Agency - Division of water, urban environment and climate change adaptation. In his past he worked at the National Association of Local Authorities in Denmark and the municipalities of Greve and Ringsted. Serving political decision makers at national and local level on climate change adaptation is one of his main work areas. This includes e.g. policy development, preparing new legislation as well as a new national action plan on climate change adaptation, autumn 2012. Mr. Kåre Svarre Jakobsen received his Master of Social Science from Roskilde University in 1999 and his Graduate Diploma in Business Administration (Organization and Management) from Copenhagen Business School in 2005.

**Sabine McCallum** leads the Environmental Impact Assessment & Climate Change Unit at the Environment Agency Austria. She acts as national representative in the EU

Adaptation Steering Group as well as the working group on 'Knowledge Base on Climate Change Impacts, Vulnerability and Adaptation' and is a board member of the Climate Change Centre Austria. Further, she is leading research projects on national, transnational and EU level with the focus on practical adaptation responses in various fields. Her current consultancy work for the European Parliament and the European Commission has the focus on climate-proofing key EU policies and providing support to the development of the EU adaptation strategy. Within her duties she is also responsible for establishing the Austrian adaptation strategy in support of the Ministry of Agriculture, Forestry, Environment and Water Management as well as capacity building and awareness raising activities with relevant stakeholders. Sabine McCallum holds an MSc in Landscape Ecology and Landscape Planning from the University of Natural Resources and Applied Life Sciences Vienna, Austria. Her expertise ranges from integrated assessment covering methodological, socio-economic and biophysical dimensions, policy relevant aspects of climate change adaptation, to policy implementation and stakeholder involvement. Her current research interests also include risk and uncertainty, vulnerability assessments, specific support for regional and sectoral adaptation and tailored adaptation options in various fields.

**Ville Niinistö** is the Finnish Minister of the Environment. A native of Turku, he gained a masters degree in Political History from the University of Turku in 2003. Between 2003 and 2005 he was a member of the Green League's Board of Directors and from 2005 to 2007 he served as the party's deputy leader. In October 2004 he was elected to the Turku City Council and appointed as the Green League's representative on the town board. He also chaired the party's group in the regional council. In spring 2007 he was elected to Parliament and in 2009 was elected to chair the Green League's parliamentary group. He was elected for his second term in Parliament in 2011. In the summer of the same year he was also elected as the party leader, and when the Greens entered the Katainen Government he was appointed Minister of the Environment.

**Haavard Stensvand** is the Head of Emergency Planning for the County Governor of Sogn og Fjordane, Norway. He has been concerned with issues related to climate change adaptation since he started at the office of the County Governor in 2005. The main part of their practical work on adaptation is related to their role in the spatial planning system. The County Governor has a guiding and supervising role, which means that, among other topics, they look after how risk and vulnerability assessments have been incorporated in the planning. Guidelines from the Directorate for Civil Protection and Emergency Planning (DSB) emphasize that they must reject spatial plans when risk and vulnerability assessments have not been done, or when found to be insufficient. Assessments are regarded as insufficient if they do not include an analysis of the consequences of climate change. He has also worked on the secretariat of the national committee responsible for preparing the report "Adapting to a changing climate", and has held lectures on local climate adaptation at the The National Emergency Planning College (NUSB). In the period 2007-2010 he was responsible for the County Governors part of the international adaptation project "Clim-ATIC".

## PhD Workshop

Immediately prior to the Conference, a two day PhD Workshop was organised in which 13 PhD students and 7 moderators and lecturers participated. The purpose of the Workshop was to offer PhD students an opportunity to review in depth selected themes and aspects of their dissertation research. In addition to three lectures, students will have discussed and reviewed their PhD research among themselves and with international experts in parallel small group sessions. On the basis of these review sessions, students have prepared two presentations for the opening plenary of the Conference. The PhD students also function as session rapporteurs during the Conference, and will present a summary of their observations during the closing plenary.

## Social Programme

### Reception at Helsinki City Hall Wednesday 29 August, 18:30-20:00

Helsinki City Hall is located in the heart of Helsinki's Neoclassical town centre, facing the Market Square. In 1812 Helsinki became the capital of Finland, then an Autonomous Grand Duchy and part of the Russian Empire. This altered status necessitated a search for suitable buildings to house government officials and the new administration. A perfect location was found adjacent to the Market Square and the favourite architect of Tsar Nicholas I, Carl Ludwig Engel, was commissioned to design a set of assembly rooms. One of these was completed in 1833 and opened as the Seurahuone Hotel, complete with banqueting rooms and a main hall that could accommodate up to 1,600 people. The Seurahuone Hotel became a centre of high society in 19th century Helsinki, the scene of fine balls and concerts attended by Finnish and Russian officers, gentry and other officials. The Hotel installed gas lamps and running water in the 1860s and at the end of the nineteenth century was one of the earliest Finnish adopters of an innovative new technology, electricity.

The building operated as a hotel until 1913, though the City had purchased the site in 1901 with a view on constructing a new town hall. After serving as a Russian naval hospital during the First World War, the building was rescued from demolition and fully refurbished in the 1920s to fulfil its new role as City Hall. It housed sessions of the Helsinki City Council in 1932-1965 after which it underwent major renovation and rebuilding in 1965-1970 under the direction of professor Aarno Ruusuvuori. Of the original hotel, only the main hall, facade and entrance colonnade remain, with the main hall nowadays used primarily for receptions and official entertaining.

Source: Helsinki City Information Office  
(<http://www.hel2.fi/kkansl/english/cityhall.htm>)



## Abstracts of Oral Presentations

### Parallel Session 1.1: Adaptation information and portals I

#### 1.1.1 Climate-ADAPT: The European Climate Adaptation Platform\*

S. Isoard<sup>1</sup>, M. Rini<sup>2</sup>, A. Jol<sup>1</sup> and H.-M. Füssel<sup>1</sup>

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Sharing information about climate change impacts, vulnerability and adaptation is instrumental in supporting stakeholders develop and implement timely, adequate and proportionate adaptation actions. The European Union (EU) has therefore developed a web platform which constitutes the gateway to information relevant for climate change adaptation in Europe. Climate-ADAPT ([www.climate-adapt.eea.europa.eu](http://www.climate-adapt.eea.europa.eu)), launched in March 2012, collects information about adaptation across Europe, provides an overview of climate change observations, impacts, scenarios and vulnerabilities as well as initiatives undertaken by European countries. Climate-ADAPT, which is a central initiative from the European Commission, constitutes a key contribution towards EU's 2013 Adaptation Strategy which will further support Europe adapting to climate change and assessing its vulnerability. The added value of Climate-ADAPT is to support EU's efforts in strengthening the climate change adaptation knowledge base by providing for the first time a gateway to a European overview of climate change adaptation information. The platform, which is hosted by the European Environment Agency, will be regularly updated and further developed so that public authorities at the European, national, regional and local levels can find up-to-date information in a structured, coherent and concise manner that can support their initiatives. Climate-ADAPT delivers vital information to support EU's progress in tackling the adaptation challenge and mainstreaming adaptation in its sectoral policies. The knowledge base for adaptation is developing rapidly and Climate-ADAPT therefore contains an overview of key completed and ongoing European research projects (e.g. up-to-date climate change observations, mapping regional climate change impacts, methodologies for vulnerability assessments, implemented measures, damage and adaptation costs assessments). Climate-ADAPT also includes a data base of adaptation case studies across Europe that provides examples of practices and offers information from which lessons learned can be drawn, together with a tool that supports the governance of adaptation.

\*A computer demonstration on this topic will be offered in the poster session.

#### 1.1.2 Climateguide.fi – a boundary service between the public and the research community\*

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Finland's Climateguide.fi portal collects and organises fragmented and reliable scientific information on climate change into a more understandable form under one, easy-to-use web-portal thus acting as a boundary service between the users and the research community. The portal presents background articles on climate science in general and Finland's changing climate as well as impacts of climate change, mitigation, and adaptation. Some of the subjects are also visualised by interactive learning tools. In addition to

information concerning the whole of Finland, Climateguide.fi includes more specific data by providing means of examining future scenarios on impacts of climate change at regional scale and information about the historical and future climate at local scale. The portal offers also practical mitigation and adaptation solutions and tools for planning and decision-making in municipalities in its Community response wizard. In order to ensure the portal's usability, stakeholders were actively involved in designing the Climateguide.fi. The steering group of the portal project consisted of representatives of the partners, municipalities, other information producers, and communicators. A pilot group of end-users tested the early versions of the portal. As the website is especially targeted to municipalities, end-user training sessions and workshops have been organised in different parts of Finland. The site has been actively promoted in different seminars, trade fairs, magazine articles, and in Facebook. Thus far, it has gathered 130 000 page views and 1 200 weekly users. Climateguide.fi portal was produced in a EU LIFE+ project by a consortium of three partners: the Finnish Meteorological Institute (FMI), the Finnish Environment Institute (SYKE) and Aalto University Centre for Urban and Regional Studies (YTK) and coordinated by the FMI. The Finnish version of the portal, Ilmasto-opas.fi, was launched in October 2011. The site will be maintained and developed in three languages, Finnish, Swedish and English, by the partners of the consortium but the objective is to obtain more partners and information producers. Current co-funders are the Ministry of the Environment, the Ministry of Transport and Communications, and the Finnish Innovation Fund Sitra.

\*A computer demonstration on this topic will be offered in the poster session.

#### 1.1.3 The Danish portal for adaptation to climate change\*

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Adaptation to climate change in Denmark has been going on for nearly a decade. A Danish strategy was formulated and adopted in 2008, which laid the base for developing and launching the web portal ([www.klimatilpasning.dk](http://www.klimatilpasning.dk)). The portal is a one-stop-shop for information on climate change adaptation, aiming at supporting and facilitating local, regional and sectoral planning for climate change adaptation. This is done by addressing the requirement for an authoritative source of climatic information in Denmark. So far the main focus has been on the municipalities, to facilitate their process of developing local adaptation plans by the end of 2013. The work on the platform commenced in 2008 after the strategy was adopted and has been in a development process since. The web portal is build as a tool to guide the user – local, regional and sectoral planners – through the process of adaptation planning, from fundamental understanding of change in climate to being able to integrate its consequences into decision making. Hence the portal provides access via a webGIS, to climatic data, information such as reports and texts as well as interactive tools. In addition cases on best practice are provided. The organisational setup behind the web portal is comprised of ministries and agencies provide the information at the portal. In addition the Coordination unit for Research in Climate Change Adaptation supports the provision of research based results as well as research institutions provide the scientific basis and research results. The presentation will have focus on the web portal.

\*A computer demonstration on this topic will be offered in the poster session.

### 1.1.4 The establishment of a Swedish National Knowledge Centre for Climate Change Adaptation

E. Löwendahl<sup>1</sup> and L. Lindström<sup>1</sup>

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The Swedish government has requested the Swedish Meteorological and Hydrological Institute (SMHI) to establish a national centre of knowledge for climate change adaptation. Inaugurated in 2012, the Swedish National Knowledge Centre for Climate Change Adaptation (the Centre) will serve as a node where knowledge is collected, developed and conveyed to different parts of the society. In particular, the Centre will be a node for regional, national and international knowledge on climate change adaptation. Within the frame of the Centre, the dialogue with different stakeholders will be increased to enhance the understanding of current and future needs for knowledge within the broad field of climate change adaptation. The Centre will also serve as meeting place for discussions of problems and solutions related to climate change adaptation. The efforts within the Centre must build on cooperation and dialogue with other actors in the society. Importantly, this includes a dialogue with the County Administrative Boards and other national authorities, but also knowledge producers and stakeholders such as universities, industry and trade associations. In this connection, the Centre will intensify the cooperation with two neighbouring research centres: Rosby Centre (the climate modelling unit at SMHI's research department) and the Centre for Climate Science and Policy Research (CSPR) at SMHI and Linköping University. The Centre also aims to align its operations to, and thus also enhances its potential contribution to, the development of a strategy for climate change adaptation of the Baltic Sea Region. Since 2009, the Swedish government has appointed SMHI the task to support the County Administrative Boards with climate change information to facilitate their role as coordinators of regional adaptation to climate change. SMHI has mainly provided regional climate information. Examples of this are climate indicators and county analyses where the historical and future climate is presented at county level. Moreover, on request by the provincial governments, similar information is downscaled to catchment areas. SMHI has also given lectures, provided interpretation and reviewed material produced by the County Administrative Boards themselves. The Swedish climate change adaptation portal will serve as the main information channel for the Centre. Following dialogues with the main users of the portal, it has got a new structure and new content have recently been added.

## Parallel Session 1.2: Scenarios for adaptation

### 1.2.1 Progress in the development of new scenarios to support IAV research

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In 2000, the Intergovernmental Panel on Climate Change (IPCC) published the Special Report on Emissions Scenarios (SRES), a set of global scenarios designed for application in climate change research. These have been widely used in projecting future changes in atmospheric composition, climate and sea level and their potential impacts on natural and human systems, and for analysing adaptation and mitigation responses. In 2006, departing from its previous coordinating role, the IPCC requested that the international research community develop a new set of scenarios for climate change assessment, while offering to assist in catalysing the process. This presentation reports recent progress in new scenario development,

with special attention paid to their applicability for impact, adaptation and vulnerability (IAV) assessment. A first step was to specify a set of four alternative trajectories of future atmospheric greenhouse gas and aerosol concentrations, known as Representative Concentration Pathways (RCPs). These have subsequently been applied in a parallel process involving experiments with: (i) Earth System Models to investigate implications of RCPs for different aspects of the climate system, and (ii) Integrated Assessment Models (IAMs) to explore alternative socioeconomic conditions that could result in RCPs, or that might depart from them. Modelling of the climate system is being co-ordinated in the Coupled Model Intercomparison Project Phase 5 (CMIP5), results of which are already appearing and are being evaluated for the IPCC Fifth Assessment Report (AR5). A status report will be given on climate model outputs, their availability for the IAV community and plans for providing derivative data and guidance to assist prospective users. Socioeconomic scenarios are being constructed within a framework designed by IAM and IAV researchers to represent a range of plausible economic, technological, demographic, policy and institutional developments that can influence the capacity of societies to mitigate or to adapt to climate change. The framework allows for multiple IAM quantifications, which are grouped according to shared assumptions about future developments known as Shared Socioeconomic Pathways (SSPs). Five SSPs have been defined, each with draft "storylines" describing their shared assumptions. Progress will be reported on the ongoing work to quantify SSPs and make them available for IAV researchers to apply alongside RCP-based climate scenarios.

### 1.2.2 Connecting local scenarios for climate adaptation to a global scenario framework

H. Carlsen<sup>1</sup>, K. Mossberg Sonnek<sup>1</sup> and P. Wikman-Svahn<sup>1</sup>

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A new framework for using scenarios in climate change research has recently been developed in connection to IPCC's fifth assessment report. This new "IPCC scenario framework" is designed for a wide range of uses in mitigation, adaptation and impact assessments and aims to facilitate cooperation, comparisons and re-use in different contexts. In the context of local climate change adaptation (e.g., for local policy decisions), global socioeconomic changes are often perceived as less important by the end-users, while other, often local, factors are deemed more important. This paper presents a scenario planning tool developed within the Swedish research programme Climatoools. A key characteristic of the scenario tool presented in this paper is the strong involvement of stakeholders not only in the use of scenarios, but also in the scenario development process. The scenario planning tool has been tested in a number of case studies, including the health sector, tourism companies, and in climate change adaptation of freshwater resources. The aim in this paper is to contribute to the new IPCC scenario framework by focusing on the demands of local climate change adaptation. In particular, we devise an approach for tailored local scenarios set in a context of global scenarios. This approach builds on a case study where we used the local scenario tool with elements from the new IPCC scenario framework. Based on this we propose a practical scenario methodology for developing and using socioeconomic scenarios for local climate change adaptation that is in line with local needs and is harmonized with the new framework for socioeconomic scenarios. Finally we argue for the importance of connecting local scenario work to a generic framework. Specifically, a standardised scenario methodology makes it possible to compare different studies and results. Standardisation also reduces the risk of a local bias of the scenarios. Over longer time frames global developments are very important for national development, and global scenarios may therefore be more relevant for policy-making that covers a large spatial scale (e.g. a whole nation state).

### 1.2.3 Scenarios of adaptive capacity, exposure and sensitivity for an indicator-based climate change vulnerability assessment

S. Fronzek<sup>1</sup>, E. Terämä<sup>2,3</sup>, A. Inkinen<sup>3</sup>, H. Mela<sup>1</sup>, N. Veijalainen<sup>4</sup> and T.R. Carter<sup>1</sup>

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Vulnerability to climate change is often defined as a function of exposure to climate change, sensitivity to the exposure, and adaptive capacity. In this paper, we employ this definition in an indicator-based, municipality-scale vulnerability assessment for Finland in two thematic areas: the elderly, and winter outdoor recreation. Conventionally, scenarios are developed to describe future changes in indicators of exposure and sensitivity, but adaptive capacity is assumed unchanged at the present situation. Here, we present scenarios for adaptive capacity indicators alongside those of exposure and sensitivity. We have developed scenarios of these indicators at the relevant scale for the mid-21st-century, including detailed demographic variables as well as extrapolation and development of other indicators based on available historical trends. Population projections with details on future age and gender structures were estimated with a population model that simulates migration, fertility and life expectancy. For other indicators of adaptive capacity, alternative scenarios were developed that make different assumptions about future trends. Combining exposure and sensitivity we were able to address potential impacts of future changes in the physical environment. A temperature-mortality model was applied with daily gridded climate data for the elderly theme. Snow conditions for winter recreation were estimated with a snow depth model. Both models were applied for climates assuming current (observed) and future (climate model-based) conditions. Uncertainties in some of the determinants of future vulnerability were quantified. For some indicators (e.g. population and extreme weather events), we also explored the possibility of expressing uncertainties probabilistically. The indicators are captured in a geographically detailed web-based tool that allows interactive mapping of combinations of indicators into indices of vulnerability. The tool is designed to allow users to explore these aspects (e.g. by selecting indicators of interest, mapping them alone, weighting them, combining them, and/or looking at them in conjunction with exposure indicators under different climate scenarios), rather than predefining the factors that influence vulnerability. The vulnerability mapping tool is available at: [www.iav-mapping.net](http://www.iav-mapping.net).

### 1.2.4 Downscaling climate projections for adaptation: Advantages and challenges of interdisciplinary collaboration

G.K. Hovelsrud<sup>1</sup>, I. Hanssen-Bauer<sup>2</sup>, H. Dannevig<sup>3</sup> and B. van Oort<sup>4</sup>

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We discuss how close cooperation between climatologists (Norwegian Meteorological Institute), social scientists (CICERO and Nordland Research Institute) and local partners, has produced tailored climate scenarios of high relevance for climate change adaptation at local levels. Following the CAVIAR (Smit et al 2008) "bottom-up" approach of establishing local vulnerability and adaptive capacity to the combined effects of climatic and societal change, local actors have been involved in defining the research focus. Through an

iterative process between local partners, met.no and CICERO the most relevant climate elements for natural resource use and municipal planning were determined. Through empirical downscaling and statistical adjustment of results from regional climate models, local scenarios were developed, and discussed in an iterative process with local partners with respect to future adaptation needs and applicability. Advantages of this iterative and inclusive approach include: through close communication identifying site-specific climate adaptation challenges, finding climate elements relevant for local conditions; increasing local expertise through involvement; obtaining tailored downscaled projections of high local relevance; and closely following-up specific cases and needs. This approach has highlighted some challenges: interpreting and communicating the wishes (from users) and possibilities (from met.no) in a mutually understandable way; informing the users about the uncertainties, limitations and implications of the products at the start to avoid unrealistic expectations and misuse of the products; progress depending on multiple agendas of 1) local politicians with many tasks and priorities, 2) product developers and 3) timing of delivery and requests to maintain high motivation locally. Preliminary experiences with the use of the downscaled projections suggest that the users have a good understanding of meaning and potential use; that working with the projections have contributed to increased local awareness about climate change; and that they currently are being used for planning purposes. These experiences indicate that the method of local involvement and interdisciplinary collaboration has been successful.

## Parallel Session 1.3: Legal aspects of adaptation

### 1.3.1 Do we need European burden sharing for adaptation?

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The future impacts of climate change have been forecasted to be unevenly distributed not only globally but also regionally. Across Europe some regions will suffer from the adverse impacts while others will profit, and inequalities will likely increase in the face of disproportional capacities to adapt. So far adaptation has mostly been framed as a regional or even local problem and the European Commission has limited its adaptation efforts to its own institutions and policies. However, if the EU's core objectives of social and economic cohesion are endangered by climate change, European instruments for burden sharing will be in order to secure a harmonious development. In the light of the known reluctance of EU member states to engage in burden sharing efforts, I investigate the following questions: On what normative grounds can we justify EU action for burden sharing and to what extent do existing policy measures provide adequate and fair distributions in support of adaptation efforts? In order answer these questions I develop a normative framework of principles of distributive justice. Based on this framework I do two things. First, I analyze adaptation discourses as to their normative implications for burden sharing. Secondly, I appraise the distributive effects of EU policy measures that are relevant in the context of adaptation. In my presentation I will discuss the results of these two analyses and their implications for future burden sharing arrangements in the EU.

### 1.3.2 The High North and its Security Conundrum – EU Climate Change and Energy Policy Adaptation in Response to Global Warming in the Arctic

K. Hossain<sup>1</sup> and M. Laiho<sup>2</sup>

<sup>1</sup>University of Lapland, Department of Law, Rovaniemi, Finland;

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The EU is known as a leading actor in the promotion of an international climate change agenda. Its internal and external policies on progressive climate regulation often confront issues related to energy security. Growing internal energy security concerns have led EU policy makers to develop a strategy aiming to secure resources in various locations. The European High North (the Arctic) is increasingly becoming the main and stable supplier of the non-renewable energy resources in the EU market. While as a region, the Arctic environment suffers from drastic climate change, the reserves of potential non-renewable energy resources frame the inter-relationship between climate change and energy potential. On one hand the EU policy makers see the Arctic as a chief platform for ensuring the stable energy security network in the years to come. On the other hand, however, EU policy aims at promoting and strengthening the Arctic environment. Consequently the gradual emphasis for adaptation to renewable resources is high on the EU's agenda. This paper looks closely at the dynamics involved in EU policy making, in regard to efforts to adapt energy policy to a developing climate change regime. Current policy making dynamics are explored in regard to the complimentary aspects of 'mitigation' and 'adaptation' – global warming control is implemented by using methods of mitigation to reduce carbon emissions, while at the same time adaptation to new regimes of energy development plays its role in maintaining a cleaner use of technology and maximising energy output. Furthermore, the use of scientific innovation is seen as an important means to realising the potential for incorporating renewable resources into the expanding energy market. The authors of this paper focus on policy making from the viewpoint of EU law and politics as a means to understanding how adaptation to climate change affects energy security.

### 1.3.3 Spatial planning of a moving target? Searching for synergies between marine spatial planning and adaptation to climate change.

R. Varjopuro<sup>1</sup> and M. Hildén<sup>2</sup>

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Marine spatial planning is a new integrative approach for managing marine resources and protecting marine environments. Its main objective is to achieve balanced and sustainable use of marine space and resources, but it is also promoted as a tool for climate change adaptation. This paper compares the main principles of marine spatial planning and climate change adaptation. There are some obvious synergies between the two. For instance, both marine spatial planning and planning for climate change adaptation are, by definition, future oriented, which offers possibilities for combining climate change adaptation consideration into the planning of marine activities. Marine spatial planning operates on and even enacts future trajectories of economic activities. This, in turn, can support planning for climate change adaptation to better consider both future climate conditions and socio-economic development. Both rely heavily on scenarios and both have to recognize uncertainties. In addition to the obvious synergies, there are possible discrepancies between the two planning approaches. One critical question is how to plan the use of an environment undergoing change? Marine

spatial planning is often considered as a zoning exercise that will solve multiple-use conflicts by allocating areas for different purposes, whereas adaptation to climate change in marine systems is about adjusting to changing conditions, often by shifting location. A rigid zoning-based planning may cause problems for adaptation. Another discrepancy pertains to time scales. Marine spatial planning aims at striking a balance between competing uses of the marine space or to promote new sustainable ways of using the marine environments. Its time-horizon covers one or two decades ahead, while climate change considerations necessarily operate on longer horizons. A planner's dilemma is to combine different time horizons in one plan: a short term conflict resolution may require allocating marine areas for activities that will operate or have impacts in the area for several decades or even centuries. With such time-horizons impacts of the climate change will kick in. This conceptual paper scrutinizes synergies and discrepancies between the two planning approaches and suggests ways of combining them.

### 1.3.4 Adapting to the unknown: Legal norms for handling uncertainty in land use planning

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According to Norwegian land use planning law, authorities are obliged to consider climate change adaptation in the planning process. The Planning and Building Act (2008) furthermore demands that development plans are based on Risk and Vulnerability Assessments (RVAs) -- of which climate change is a self-evident element. The RVAs are supposed to provide scientific background for decision-makers. However, all science entails some uncertainty. This is especially true for assertions including some element of prediction of the future, such as assessments of hazards related to climate change. Thus, the RVAs will inevitably contain more or less uncertain or unknown elements. The Planning and Building Act lacks explicit directions on how to deal with incomplete scientific knowledge. In this paper, I will first discuss why the notion of uncertainty is important and deserves specific attention. Then, I'll explain why it is necessary to handle uncertainty through legal norms. Finally, I will outline some options on how to deal with uncertainty in practice. My methodological approach is primarily theoretical, building on statutes, regulations and other formal sources of law. Where appropriate, existing theory and examples from practice are analyzed and discussed. While my specific examples are from the Norwegian land use planning regime, I believe that the problem as such and the suggestions I make have wide applicability.

## Parallel Session 1.4: Regional strategy development I

### 1.4.1 The Role of Collaboration in Effective Adaptation Decision-Making

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Climate change impacts often cut across geographic and sectoral boundaries. Effective management of the risks often requires cooperation across sectoral, geographic, professional and organizational boundaries. While collaboration can be a logistical

challenge, when successful it can improve the exchange of knowledge, make more efficient use of resources by enhancing economies of scale, inspire action amongst peers, and help avoid divergent goals and conflict. It can also increase the likelihood that recommendations proposed are ultimately implemented. In 2008, the Regional Adaptation Collaborative (RAC) program was established in Canada to support collaborative approaches to adaptation decision-making. Six collaboratives were established across Canada, together encompassing all 13 Canadian provinces and territories. Each RAC drew in decision-makers spanning multiple levels of government, civil society, academia and industry to address regionally identified priorities such as coastal management, drought and flood planning, land use planning, and natural resource management. The presentation will use examples from the RAC program to illustrate: i) early challenges faced, such as a lack of common vocabulary and working with decision-makers in different states of adaptation readiness; ii) the benefits of examining issues across jurisdictional boundaries; iii) lessons learned such as dealing with uncertainty and how decision-focused collaboration can strengthen and expand pre-existing collaborative relationships; and iv) successes achieved through collaboration, such as guidance and tools that are readily mainstreamed into existing decision processes and peer-inspired action.

#### 1.4.2 Climate change adaptation from a County perspective - From theory and expertise to practical implementation

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The Swedish climate change adaptation strategy relies mainly on the Swedish Commission on Climate and Vulnerability from 2007, which suggested that much of the mandate be allocated to the County Administrative Boards. The mandate concerns responsibility to coordinate climate change adaptation at regional level, especially with respect to the municipalities. While it is expanding and growing very rapidly, the Stockholm metropolitan area is facing great challenges. The vulnerability of society to the effects of climate change is increasing as the population grows. The County Administrative Boards' broad mandate is diverse and complex in many respects. The main objective is to pass on appropriate information and relevant knowledge to local decision makers, create functional tools and platforms, and facilitate the implementation of climate change adaptation measures. The aim is to support the municipalities in producing their own climate change adaptation plans. A climate and vulnerability analysis and action plan form essential components of such a plan. The challenge is thus to ensure that these are performed and drawn up despite a lack of binding legislation in this area. This has forced the County Administrative Board in Stockholm to develop communication strategies and make greater efforts to educate. In order to structure the municipalities' work on climate change adaptation, a process model has been developed that functions as a strategic cross-sector platform. The process is easy for practitioners and decision makers to understand and implement. With support from the regional analysis that has been developed – the process model – combined with a structural tool, the local municipalities should be able to identify vulnerabilities and opportunities at local level and incorporate these in their local adaptation plan. Many municipalities have recently initiated processes at strategic level to implement adaptation plans. The enormous amount of material and knowledge within this area is slowly being transformed into action, and stakeholders are finding their roles. The opportunities to adapt to climate change in the county are good. Tangible processes and specific methods will make it easier to reach out to decision makers. Our hope is that awareness and foresight today will lead to a sustainable means of planning for and confronting future challenges in a way that gives positive effects for the region and enables it to evolve.

#### 1.4.3 Development of the adaptation process in the Swedish Counties of Skåne and Östergötland - Advances and challenges

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Within the European Union a strategy for adaptation is in preparation, to be presented by the DG CLIMA to the European Commission in spring 2013. Several countries in Europe have during the last years initiated, developed or even implemented national strategies for adaptation. In Sweden, an extensive national assessment on vulnerability to a changing climate was presented in 2007. Further, adaptation is mentioned in two bills on Climate and Energy. The Swedish governments' strategy in 2009 was a commission to the 21 county administrative boards to coordinate the adaptation work regionally, with support from national authorities. The only guideline for Swedish climate change adaptation is: Climate adaptation implies measures to adapt society to those changes in climate we already notice today as well as those we cannot stop in the future, to reduce damages, make use of possibilities and manage consequences. The county based work has developed according to different regional conditions in Sweden. Here we will discuss the outcome of these years of adaptation work, with a closer look at two counties. Municipalities within the County Administrative Boards of Skåne (33) and Östergötland (13) in southern Sweden were visited to start a dialogue on adaptation. Complemented by a survey, the needs and prioritizing of work within municipalities were studied. We will present the constraints and support found and the reasons for these. Additionally, we will explore what is needed for counties and municipalities in order to proceed further with the implementation of adaptation actions and plans. Findings will be related to the adaptation process in neighboring countries. Can constraints encountered locally to some extent be mitigated by guidelines from national or EU level? It was found that municipalities that had already encountered a weather related catastrophe had worked more with adaptation issues. Commonly, adaptation perspectives were considered within the spatial planning process, partly explained by the legislative support. Issues regarding different water aspects were most municipality's main concern (such as sea level rise, protection needs), whilst issues related to public health was not yet identified. The survey also reveals challenges and future needs within municipalities in order to proceed and progress work, for example related to who is regarded as the responsible party, and financial aspects.

#### 1.4.4 Analysis of regional climate strategies

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In the adaptation to and the mitigation of the climate change it is often necessary to look at larger units than one municipality, and regional strategies can be important factors in achieving the national and international goals. In Finland the short history of regional climate strategies dates back to the latest National Climate and Energy Strategy (2008) which states that regions and sub-regions are required to initiate regional strategies and action plans. Regional climate work has found its stead in Finland well and most of the regions are active. In the northern Finland all three regions (the North Ostrobothnia, Lapland and Kainuu) have established regional strategies. The purpose of this work was to evaluate how the national

climate goals are implemented in the regional and local strategies and the programs in the Northern Finland. The specific goal was to describe the process by which the regional strategies have been prepared and implemented and how the procedure has expanded to include whole northern Finland. Recent studies have brought up the need to view the strategic planning as a practice or a set of interrelated practices and find out how learning from one region may be used in the next, even though exact replication is not possible. Based on the analysis made, good practices are presented to outline how similar strategy work can be carried out elsewhere. The analysis also supports the implementation of individual strategies as well as the synchronization of different strategies and the role of co-operation. An overview of the strategy processes was developed on the basis of the strategy documents. In addition, 2-4 key persons from every strategy and program process was interviewed in order to obtain a relevant insight into the process, its success factors and challenges. A core region in the analysis was Northern Ostrobothnia with respect to strategy development and implementation. The review includes both the regional (Northern Ostrobothnia, Lapland and Kainuu) and sub-regional and/or local level (Oulu, Rovaniemi, Kajaani).

## Parallel Session 1.5: Adaptation in developing countries

### 1.5.1 Building Adaptive Capacity of Coastal Communities in Bangladesh through Sustainable Decision Making Process: Focusing on Adaptation to Climate Change

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The improvement of people's livelihoods in the coastal zone of Bangladesh largely depends on the climate adaptation approaches adopted in relation to water management and agricultural practice. This is because of the exposure and sensitivity of the coastal region to climate change impacts. Although the cross-sectoral dimension of Integrated Coastal Zone Management (ICZM) encourages stakeholder engagement during the preparation of the plans, subsequent steps tend to be top-down in nature, which creates critical gaps between national and local level governance. For this reason the outputs of ICZM (i.e., policy, strategies, and programmes), and recent climate adaptation action plans, are largely ineffective at implementing, monitoring and evaluating the processes of building the adaptive capacity of coastal individuals and communities to climate change. Therefore the aim of this paper is to understand how different stakeholders make decisions about coastal adaptation. It also examines what set of adaptation indicators might be best suited to supporting decision making in coastal regions. A qualitative study was conducted in a south western estuarine district (Shatkira) of Bangladesh in early 2012 with the purpose of analysing the adaptive capacity of communities (farmers, fishermen, women householders, local businessmen, professionals etc.) as measured through the different forms of capitals (human, social, natural, physical and financial). Moreover, investigating the decisions and decision-making processes at different scales (national, district, local) by semi-structured interview of government officials, employees of NGOs, local leaders and local stakeholders, it was possible to identify the missing components of the ICZM plan. We recommend a 'sustainable decision making process' that builds on the strengths of the current ICZM but addresses the missing components (e.g., equity, knowledge, enable institutions etc.) identified from our analysis of the decisions and decision-making processes in a coastal area of Bangladesh. Considering the barriers to adoption and effective

implementation of the decisions, this case study identified the successes and failings of the process, and its relevance for similar regions in other developing countries of the world.

### 1.5.2 Climate change adaptation in rural Ghana and Botswana: perceptions and complex environments

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The Parties to the UNFCCC consider Africa to be 'particularly vulnerable' to climate change and the continent is a focus area for international adaptation finance. Its agricultural sector contributes 29% of the GDP of African countries and employs 520 million people, but is mostly subsistence-based and rain-fed. The sector is therefore vulnerable to climate change and subsistence farmers have a crucial role for Africa to adapt successfully. These people qualify for receiving adaptation finance, but at the same time it is unclear how they actually perceive climate change and what ability they have to adapt. Based on a survey among subsistence farmers in rural Ghana (N=107) and Botswana (N=120) we studied how perceptions of climate related hazards relate to people's adaptation practices. We found strong similarities between the respondents' 1) perception climate related hazards and existing environmental degradation, and 2) their considered adaptive measures and existing development plans and policies in the case study countries. Furthermore, we found that a perceived high vulnerability and climate-dependency do not necessarily result in autonomous adaptation. And finally, that the perceived successfulness of individual adaptive measures does not respond to the respondents' perception of adaptation. In other words, in the complex environment in which farmers operate, adaptation depends on much more than individual adaptive measures alone. This research leads to some practical recommendations for policymakers in the field of international adaptation finance: 1) build on existing development plans and policies on climate-related environmental problems, as current development constraints and climate change adaptation are strongly related; 2) farmers relate adaptation to e.g. their experience, climate-dependency and means, and not to implementing a set of individual adaptive measures. Financing successful adaptation thus requires more than financing the implementation of adaptive measures; 3) extremely vulnerable people do not necessarily adapt autonomously, which shows that ex post adaptation will remain important.

### 1.5.3 Climate Change Impacts and Adaptation by Communities Adjacent Forest Resources in Kilolo District, Tanzania

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Despite over 20 million Tanzanians depend on Non Timber Forest Products (NTFPs) for livelihood. Research studies on climate change and its impact on forest products especially the NTFPs - including vulnerability and adaptation strategies are inadequate in



## Parallel Session 2.1: Adaptation information and portals II

### 2.1.1 Experiences from developing adaptation tools in a trans disciplinary manner

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In the five year research program Climatools eight adaptation tools were developed in a transdisciplinary manner together with civil servants in nine municipalities in Sweden, a consultancy firm and in close collaboration with the commissioning body. The academic disciplines represented in the program were economics, philosophy, health, natural resource management, physics and engineering and the tools spanned from those related to planning and risk management to those related to impacts from heat waves. Challenges and eventual solutions that occurred during the research program are discussed with focus on challenges that occurred when persons with different backgrounds and ambitions meet and are supposed to collaborate successfully. For the researchers, a challenge was to develop user friendly tools while still being able to publish scientific work within their own discipline. Also, the understanding of the complexity of routines and procedures in municipalities was poor at the beginning of the program. For the consultancy firm, the slow pace by which researchers developed tools was a challenge as well as the complexity of the tools. For the civil servants, finding time to take part in tool development was a challenge as well as to integrate tools testing into standard procedures such as risk and vulnerability assessment and planning. For the commissioning body, researchers' ambitions to carry out non-applied research were seen as problematic. A solution to these problems is to allocate ample time for each type of participant to understand the perspective of others as well to plan for tools testing well ahead in time. Further, it is important to be clear and honest about possible expectations including which results are considered crucial. Ways to handle eventual conflicts between the need for mono disciplinary academic publications and applied and transdisciplinary research should be developed.

### 2.1.2 Adaptation support: linking science, stakeholder knowledge and results from practical testing

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Since most adaptation actions are to be implemented at a provincial, regional and local level, the project called FAMOUS (Factory for Adaptation Measures Operated by Users at different Scales) aims to support the adaptation process in Austria at these decision levels. Thus, a toolbox for adaptation to climate change has been developed in transdisciplinary cooperation with foreseen users, comprising tailor-made methods and tools for policy and decision makers. In more details, the toolkits aim to address barriers which might hinder the adaptation policy process proactively as well as Austrian particularities regarding the political system and respective multi-level governance considerations. Therefore, the literature on barriers in adaptation policy has been investigated and classified in order to be able to address these barriers systematically in the toolkits. Additionally, an analysis of the political, social and legal framework as well as interviews with responsible policy makers give insights into the multi-level governance framework of selected adaptation policies in two Austrian case study areas. Based on stock taking results,

results from the multi-level-analysis and stakeholder needs and experiences, the following three toolkits have been developed. They address the main steps of the policy cycle: 1 The "Create the ground for adaptation" toolkit aims to support the agenda setting stage of policy making (e.g. by providing information material and references, helping to identify relevant stakeholders, ...). 2 The "Identify problems and prioritize" toolkit is concerned with facilitating decision-making (e.g. prioritisation of main impacts, providing a multi-stress analysis, ...) 3 The "Find solutions, set actions and evaluate" toolkit aims to foster the implementation and evaluation of policies (e.g. by providing checklists for mainstreaming adaptation, suggesting an evaluation scheme, ...) In autumn 2012, the toolkits will be practically tested in two case study areas (in an Austrian province and in an Austrian region) and adjusted accordingly to the outputs from evaluating the performance of the implementation process. The paper presents the toolkits as one possible approach in adaptation support and advice and highlights the experiences gained from the development process in terms of what worked and what didn't as well as what next steps are necessary for practical delivery of adaptation action.

### 2.1.3 Communicating adaptation knowledge to support strategy development and implementation on local level

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The German adaptation strategy is explicit for the improvement of awareness building and knowledge transfer. An adequate data and knowledge base about adaptation issues is required to stimulate the further implementation of adaptation activities. The German Federal Government has therefore committed itself to facilitate access to information and raising the level of knowledge in society about the requirements and possibilities of adaptation by taking communication measures. The Web portal [www.anpassung.net](http://www.anpassung.net) is a key platform within this process. By the end of 2013 it will be transformed into a national information, communication and cooperation system for adaptation to climate change in Germany. The portal is intended to serve the networking of information provision on adaptation activities and policy, and is being further expanded for this purpose in cooperation with other governmental agencies. Basic information products are already available such as practically relevant fundamental knowledge, access to climate data, databases of measures and projects, guidance tools on adaptation for various users (e.g. "Klimalotse"), a regular newsletter and up-to-date network information. With two examples (Actionbase Adaptation, project catalogue) the presentation will describe how the Web portal forms the interface to the European Climate Adaptation Platform and how it will be developed further. In order to bundle activities of independent adaptation initiatives taken by non-state actors on a single information platform and raise their profile, KomPass is administering an ever-expanding database of measures for adaptation to climate change entitled "Tatenbank Anpassung" (Actionbase Adaptation). Actors can enter measures in this database that have already been implemented, and have therefore been tried and tested in practice. These examples are intended to provide local authorities, businesses, associations, etc. with promising measures and therefore assist them in the realization of their own measures, and to encourage exchanges of experience and knowledge as well as networking among actors and promote the dissemination of measures. As a second tool the project data catalogue documents a large number of research projects that have been initiated at very different levels. It is linked with the Circle Infobase. The entries will be updated regularly.

## 2.1.4 Centre for Regional change in the Earth System (CRES)

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CRES is a multidisciplinary climate research platform, which brings together leading scientists with excellent and long track records of quality research in climate change and key Danish stakeholders and practitioners with a need for improved climate information. CRES is the result of a grant of 4 MEuro from the Danish Council of Strategic Research in October 2009 over a period of 5 years and co-funded by the participating institutions. The mission of CRES is to establish a coordinated research effort of high relevance to societal preparedness for climate change and to enhance Denmark's contribution to international climate change research. In taking an interdisciplinary approach, the overall objective of CRES is to extend knowledge of and reduce the uncertainties surrounding regional climate change and its impacts and thereby support future climate change adaptation and mitigation policies. Specific objectives are to: a) reduce uncertainty surrounding regional climate change and its impacts for the period 2020-2050 by improving model formulation and process understanding; b) identify key changes and tipping points in the regional hydrological system, agriculture, freshwater and estuarine ecosystems caused by changes in seasonality, dynamics and extreme events of precipitation, droughts, heat waves and sea level rise; c) quantify confidence and uncertainties in predictions of future regional climate and its impacts, by improving the statistical methodology and substance and by integrating interdisciplinary risk analyses; d) interpret these results in relation to Danish, European, and global risk management approaches for climate change adaptation and mitigation; The expected outcome of CRES will be innovative in providing operational solutions for quantifying climate change and more accurate depictions of its impacts on hydrological, biological and social systems at regional and local scales, based on coupled climate-hydrological-ecosystem-risk analyses models. The centre aims provide new information on the effects of extreme events and on tipping points (climate, hydrology, nutrient dynamics, ecosystem responses and risks) and their interactions. In collaboration with key stakeholders, this will impact climate change adaptation strategies in Denmark and possibly beyond.

## Parallel Session 2.2: Uncertainty

### 2.2.1 Uncertainties in Climate Adaptation: Are They Undermining Decision-making Processes?

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The now convincing evidence that climate is changing brings about additional sources of uncertainty for decision-makers. Adaptation decisions are being and will need to be made even though climate, environmental and socio-economic uncertainties exist. Uncertainty is usually associated with limitations in the scientific knowledge side and has been described as any deviation from the unachievable ideal of completely deterministic knowledge of a relevant system. This can refer to natural-driven systems like the climate, mostly human-driven

as those that determine future GHG emissions, or integrated systems with multiple feedbacks (e.g. Earth system). Climate adaptation decision-making is a continuous learning process within which uncertainties are inherent. Like most high stake, potentially transformative and financially sensitive decisions, adaptation is deeply dependent on available (scientific and empirical) knowledge about its prospective outcomes. A growing body of information about climate change and its potential impacts on socio-economic and environmental systems is becoming available for most regions and is starting to be applied to adaptation decisions across countries and scales. Nevertheless, concerns have risen about the way science can respond to the decision-makers' call for more (or more detailed) information and about whether practical adaptation decisions do in fact require more accurate and precise predictions. It has been suggested that rather than being unable to make decisions under uncertainty, what has been missing are decision-relevant information and the deployment of more appropriate decision-making frameworks. We will present our current work on uncertainties in support of climate adaptation decision-making which is based on a series of practical case-studies in which dealing with uncertainties was successfully accounted for (or identified but failed). We will focus on analysing the following issues: 1) how were uncertainties in climate change adaptation dealt with; 2) how were they communicated to stakeholders; and 3) what were the impacts of addressing them in the decision-making process. The selected case-studies were collected as part of the work of the CIRCLE-2 Joint Initiative on Climate Uncertainties. The case-studies examined present diversity among various scales (e.g., geographical, sectorial, level of decision-making) in order to allow for a broader analysis.

### 2.2.2 Consideration of uncertainty in European National Adaptation Strategies

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Over the past few years it has increasingly been acknowledged that the consideration of physical climate uncertainty in climate change decision and policy making is vital if effective strategies for adaptation are to be designed. At the same time several European countries have developed their National Adaptation Strategies (NAS) which are intended to inform adaptation planning and delivery across sectors and scales. To date there has been little research on how physical climate uncertainties have been and should be handled in NAS. This study for the first time explicitly addresses this issue, identifying shortcomings and indicating how communication could be improved. Our paper analyses the NAS of Belgium, Denmark, Finland, France, Germany, the Netherlands and the UK. We adopted a content-analytic approach to facilitate an in-depth comparison between the different strategies. Several cycles of coding and analysis were conducted to determine not only the proportion of each individual NAS dedicated to the treatment of uncertainty, but also to examine how much detail the NAS provide on 1) the sources of the uncertainties, 2) the numeric values and ranges associated with them and 3) the recommendations they give on how these uncertainties should be included in the adaptation planning process. Our findings suggest that the majority of the NAS only touch upon the issue of uncertainty, and fail to adopt a consistent and detailed approach to it. The French, Dutch and Finnish NAS are the only ones that provide some detail on the sources of the uncertainties, but none of the NAS provide detail on the numeric values attached to the uncertainties mentioned. What is more, no clear recommendations are given in any of the strategies as to the role of uncertainty in the design and delivery process of adaptation measures. This analysis shows that the existing NAS currently do not sufficiently include and communicate physical climate uncertainties and concludes with a discussion on which steps could be taken to increase uncertainty incorporation.

### 2.2.3 The role of uncertainty in climate change adaptation - examples from the water sector in Denmark

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A fundamental difference between climate change adaptation and previous physical planning approaches, such as water resources management, is that it has to cope with uncertainties that are much larger, of a different nature and in many cases cannot be quantified. This implies that a shift in planning paradigm is required and that many of our assessment methods and tools are no longer adequate. We present a new uncertainty framework (Refsgaard et al., 2012) that characterises uncertainty by three dimensions, namely (i) nature: epistemic, aleatory, ambiguity; (ii) level: statistical, scenario, qualitative, ignorance; and (iii) source of uncertainty: emission scenarios, climate models, downscaling methods, hydrological models, implementation uncertainty. Furthermore we present key principles in a new strategy for climate change adaptation of Denmark (IDA, 2012), namely (a) climate change risk assessments should be performed; (b) adaptation should be integrated in physical planning processes; (c) uncertainty should be dealt with; (d) stakeholders should be involved; (e) planning should be cross-sectorial; and (f) contingency plans for handling of extreme events should be prepared. Finally, we discuss alternative strategies for handling uncertainty such as establishment of system control and building of system resilience. The strategies are illustrated by examples from the Danish water sector. References Refsgaard JC, Arnbjerg-Nielsen K, Drews M, Halsnæs K, Jeppesen E, Madsen H, Markandya A, Olesen JE, Porter JR, Christensen JH (2012) The role of uncertainty in climate change adaptation strategies – A Danish water management example. *Mitigation and Adaptation Strategies for Global Change*. Accepted for publication. IDA (2012) *Klimatilpasning af Danmark – IDAs Klimatilpasningsstrategi*. The Danish Society of Engineers, IDA <http://ipaper.ipapercms.dk/IDA/Politik/Klimatilpasning/> (Climate adaptation of Denmark – IDAs climate adaptation strategy; in Danish)

### 2.2.4 Moving from a one-dimension to a multi-dimension perspective on uncertainty: Paralyzing or stimulating local climate change adaptation?

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The perspectives on uncertainty in the climate change debate is often reduced to the issue of “how certain” the knowledge is, best illustrated by the headline messages from the IPCC using terms like ‘likely’ and ‘very likely’ which are given a precise numerical definition (e.g. more than 90 % probability). This way of communicating uncertainty is probably best treated as an indication rather than presentation of uncertainty. Thus the question arises if this one-dimensional way of presenting uncertainty is a good indicator. In the work on sustainable development much attention in both research and policy making has been on the possible role of indicators. An important distinction is made between the scientific validity and the communication efficiency of indicators, and the importance of attaining a good balance between these two considerations. Too much weight on scientific validity have the tendency of creating indicators that communicate poorly, and indicators that communicate well have a tendency to become less scientifically valid. We will use this approach when discussing the challenge of describing and addressing uncertainty in local climate change adaptation policy making. The article is based on studying a large number of ongoing processes taking part in front runner municipalities in Norway when it comes to develop local climate change adaptation strategies. On this basis a method is presented on

how to relate to uncertainties in local decision making. The method includes a suggested multi-dimensional typology of uncertainty. The first axis pertains to where uncertainty is located; i.e. where in the systems ‘climate’, ‘nature’, or ‘society’ the uncertainty in question exists. The other axis pertains to the type of uncertainty at hand, where we distinguish between four qualitatively distinct forms of uncertainty: Basic uncertainty, model uncertainty, scale uncertainty and data uncertainty: We have basic insight into cause and effect, and have managed to model these relationships, but the input data does not allow our models to produce reliable results. Our main point is that different types of uncertainty may warrant different strategies for reducing the uncertainty experienced by decision-makers. This approach has currently been adopted by the Norwegian Association of Local and Regional Authorities in their work on guiding their members on climate change adaptation.

## Parallel Session 2.3: Flood risk

### 2.3.1 Adapting Quebec coastal communities to climate change: progress assessment after 10 years of research and participative approaches

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Climate change raises important issues for coastal communities of northern regions such as Quebec, a province of eastern Canada. Sea level rise (SLR), changes in ice cover and change in storminess increase the rate of coastal erosion and the risk of submersion. Ouranos, a user-driven consortium dedicated to applied research in impacts and adaptation to climate change, led several studies aiming to assess the vulnerability of coastal communities to CC and the impacts of climate change on critical coastal infrastructures. A particular attention was dedicated to elaborate and to test a model of participatory approach in order to optimize exchange of information between actors in adaptation at various governance and societal levels. This included local to central government decision makers and stakeholders, engineers, biophysical and human sciences research people including coastal dynamics experts, economists, social sciences and climate scientists. Case studies were used to assess these methods and to initiate and monitor adaptation resulting from this process. Significant changes in awareness, regulations and codes have been noticed as a result of these studies, including improvements in decision-making tools such as predictors of storm surges and wave climate and other coastal process (storminess, ice action, thaw and freeze processes, etc). Observing the implementation of adaptation also reveals some weaknesses of the adaptation process. The time interval between research and implementation of adaptation is critical; the replacement of actors of adaptation due to promotions, elections or other factors is faster than the typical 5 to 10 years process of adaptation research cycle. A more direct access to scientific information to local users can also result in political backlash from central government clerks that perceive this as a loss of power. The political decision makers are naturally reluctant to invest in prevention mostly because of lack of information on costs vs. benefits and this should be address at the early stage of the adaptation research process. Communication gaps between experts are as important as the gap in knowledge between users and science experts to slow down the adaptation process. Planning at the very beginning of the entire process from research to adaptation is essential to achieve adaptation in a complex biophysical and human environment.

### 2.3.2 Vulnerability And Adaptation Assessment Of Flood Prone Areas

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Pori is the only larger urban area in Finland with significant river flooding risks. The catchment area of Kokemäki river includes several lake areas, but these are located mostly in the upstream part of the catchment area. Even floods with a return time of 50 years (in recent climate) pose already a significant risk to the city's real estate and infrastructure. The project IRTORISKI studied the use of Event Tree Analysis (ETA) to assess the vulnerability and adaptation of flood prone areas. The Pori area was used as an example with data obtained from other related studies, such as TOLERATE. As a starting point for the ETA three flood scenarios were defined: Scenario 1: R=50 in current climate with current flood protection Scenario 2: R=30 in future climate of 2020-2050 with current protection Scenario 3: R=30 in future climate with new flood protection In order to assess the direct cost consequences the annual probabilities for the current climate are first assessed based on the annual cumulative distribution function as  $P(Q > qR) = 1 - F(Q < qR) = 1/R$ . How this probability function will change in response to climate change is uncertain. For Pori the flood volume of an R50 flood was estimated to have increased annual probabilities for the period 2020-2050 amounting to a return time of 30 years (R30). Typical barrier functions are that will mitigate the adverse consequences, given a flood event, are: 1) Flood containment 2) Location of infrastructure 3) Structural engineering 4) Emergency response 5) Core process/service redundancies In practice, the extent to which the above barriers are successful for a given flood event must be assessed based on subjective judgements of experts in e.g. hydrology, regional planning, emergency response rescue and infrastructure services. The consequences of a significant flood, such as R50 of today, are economic (direct/indirect), health, environment, and social consequences. Currently, in the Pori area, the consequences are mainly direct cost due to material damage and repair. The future consequences for floods may, however, show substantial indirect effects as market will react to recurring floods (business moves out, repair costs increase,...). In the paper, a full ETA is described quantifying the annual risks related to the above scenarios where the new flood protecting measure considered is the construction of an absorption area.

### 2.3.3 Vulnerability of flood peaks to climate change in Great Britain

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Effective national and regional policy guidance on climate change adaptation relies on robust scientific evidence. However, climate change risk assessments are generally made at a catchment level introducing a need for extrapolation for a national view. A 'sensitivity-exposure-adaptive capacity' framework was developed and applied in Great Britain to establish the vulnerability of catchment flood flows to climatic change projections, compared to the then adaptive policy based on a 20% increase in flood peaks. First the sensitivity of flood peaks to change in the climate is quantified for a range of catchments, and a set of typical response surfaces established. These response surfaces are then associated with catchment characteristics, demonstrating the role played by the catchments in the climate-flood processes. Second, the exposure from climate change is identified, using the probabilistic climate change scenarios of UKCP09. Third, the vulnerability to climate change is defined as the proportion of exposure scenarios suggesting impacts greater than the adaptive threshold of 20%. The method was applied to over 1,000 catchments and resulted in a probabilistic assessment of the potential impact range and associated vulnerability of

20-year return period flood peaks for 12 river-basins regions over England and Wales. The study showed that the then adaptation management guidance of a 20% allowance for flood flows could no longer be considered precautionary. This provided the scientific advice to UK water regulators and policy makers regarding flood risk and climate change, and enabled them to issue new, regional guidance.

### 2.3.4 Climate Change: Risk Perceptions in Norway

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Although the most massive and devastating natural disasters happen outside Norway, there are frequent, less dramatic events in the country. With climate change it is expected that there will be more and more natural disasters events, possibly considerably more severe than the present ones. Consequently, many Norwegians are concerned about the impacts of climate change, but there are also many who are not. In fact, 30 percent of respondents in the survey used in this paper do not think that there are human-induced changes in climate. In this paper we study why people consider the existence of human-induced climate change and the possibly consequences of it so differently. Can such differences be explained by demographic factors such as gender and age? Or is it dependent on educational and income levels? Maybe the inclination towards climate change and its consequences can be explained by people's values, such as general attitudes to environmental problems or political preferences? Or is it so that those who have experienced a climate related event in their home region or who live in places that are actually more prone to flooding, landslides and storms are more concerned about climate change's potential impacts than those living in places where it is unlikely that such events will occur? In this paper, we run quantitative analysis based on data from the 'Climate Barometer' survey conducted in 2010 by TNS Gallup to uncover how such mechanisms affect people's attitudes towards climate change in Norway. The survey includes a sample of 1334 persons with answers to over 40 climate related questions and data on their socioeconomic background. To include a measure on how exposed the respondent's home region is for natural hazards, we use expert assessments on actual landslides and flood prone terrain.

## Parallel Session 2.4: Regional strategy development II

### 2.4.1 ClimateXChange: Linking Adaptation Research with Adaptation Decision-Making in Scotland

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ClimateXChange was initiated in 2011 as a 'centre of expertise' with a specific remit to link scientific research with the requirements of decision makers in Scotland. For Adaptation, this interface is based around an integrated structure that includes: (i) developing baselines and system characterisation (ii) scenario analysis (iii) economic valuation and understanding trade-offs (iv) decision support. Key

cross-cutting themes that also link with the climate mitigation agenda include indicators, behaviour change, valuation, risk assessment, and demonstration projects. We will highlight how science-policy interaction is developing with particular focus on the new Adaptation Programme (AP) for Scotland. The AP is framed around a series of risks (and opportunities) that were identified by the UK Climate Change Risk Assessment. Policy responsibility is devolved to the Scottish Government, therefore the prioritisation of risks required translation across scales and administrative boundaries. This had important implications in terms of the evidence base and in the identification of priority adaptation actions between different sectors, related to categorisation of consequences, urgency and uncertainty. Particular challenges have emerged in terms of the identification of cross-sectoral risks – for example related to water, the coastal zone, land use change and critical infrastructure. The development of a systems-based approach with participatory tools such as scenarios and Bayesian networks has therefore become useful to further characterise and quantify these risks. This framework has been developed in association with application of an ecosystem-based approach to maximise synergies between scientific research and adaptation ‘in practice’. Increased emphasis has also been directed at understanding societal attitudes to adaptation, either in a reactive or proactive mode, as for example following extreme events. Together this information is being used to jointly construct a co-ordinated science-policy agenda around the key actions required to build climatic resilience. This agenda recognises different levels of knowledge associated with climatic impacts, and the need to develop improved mechanisms to prioritise and integrate strategies that are sustainable across social, economic and ecological systems.

#### 2.4.2 The BaltAdapt Project – A Multi-Stakeholder, Transnational Approach toward a Regional Adaptation Strategy for the Baltic Sea Region

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Climate change is already happening. No matter how much we reduce greenhouse gas emissions, we can no longer prevent adverse effects of climate change; we might only prevent worse. While adaptation to climate change is undoubtedly of much higher urgency in regions, as for example South-East-Asia, it is also an issue for other, comparatively less vulnerable regions. Sea level rise, increased river run-off, warming of the sea, decrease of its salinity level as well as more frequent storm surges are, for instance, meaningful climate risks in the Baltic Sea region. Bearing this in mind, it comes to no surprise that one of the priority areas in the EU Strategy for the Baltic Sea Region (EU-BSRS), adopted by the European Commission in 2009, is effective mitigation and adaptation to climate change. Moreover, the Action Plan accompanying the EU-BSRS calls for a regional climate change adaptation strategy for the Baltic Sea Region. In January 2011, nearly two years after this call, the so-called “BaltAdapt” project has taken up its work. The project brings together 12 partner institutions from around the Baltic Sea, researchers as well as policymakers, and intends to lay the grounds for a regional adaptation strategy by developing policy recommendations on the basis of a vulnerability assessment. This paper will introduce and discuss the BaltAdapt project as an attempt to develop a macro-regional adaptation strategy. Thereby, it seeks to provide empirical input to two research gaps: Firstly, the project stands for a new governance arrangement, since the adaptation strategy is being developed by different stakeholders, including researchers from social and natural sciences and policymakers from governmental and intergovernmental organizations. Secondly, the project targets the macro-regional level that has so far been rather neglected by adaptation research. Instead, adaptation has often been

viewed as something that needs to take place primarily at the local and national level. By participating in BaltAdapt project partner meetings, conducting expert interviews, and analyzing project documents, a good empirical basis for the paper is ensured. However, since BaltAdapt is running till the end of 2013, the author will not be able to discuss results, yet, but will rather do a process tracing.

#### 2.4.3 Climate change impacts and the adaptation measures in the Finnish water industry

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The current status and quantity of surface and groundwater resources are mainly good in Finland. Groundwater reservoirs or artificial groundwater provide 66 percent of the national water supply as only the largest cities use surface water. Five million Finns have access to the water distribution network and the daily use is in average 130 litres/person. Climate change will impact all areas of the water industry. Key impact factors are more frequent and severe weather conditions: storms, heavy rainfall, flooding, and droughts. These extreme weather events can jeopardize the quality and availability of water sources, and lead to the need of increased water treatment or even interrupt water distribution. Climate change impacts will affect the water supply acutely and thus water works should be in the forefront in adapting to a changing climate. There have been several significant distractions in local water distribution during the past ten years, which have demonstrated the vulnerability of the existing means, and thus emphasized the need to improve water suppliers' adaptation measures in hazardous situations. Adaptation measures for water works were outlined in our recent study. Precautionary measures include risk assessment, preparedness plans for water works, the planning of flood control and conservation of groundwater basins. Essential adaptation measures include positioning the intake wells so that no rainfall-discharge or surface water can directly flow into the wells even during flooding or heavy rainfall. The time of seepage must be adequate for all wells, especially bank filtration wells, to ensure water quality. Water quality must moreover be ensured by adequate control and treatment facilities including disinfection systems as well as standby batteries at the water intake plants. Furthermore, the risk of wastewater overflow discharge needs to be minimized by positioning wastewater facilities, especially pumps, outside of groundwater areas and flood risk areas. The water yield of smaller groundwater bodies should be evaluated in the perspective of prolonged droughts. The above mentioned means play an important role in adapting to climate change, however, the adaptation measures should be further developed, and more information on groundwater resources is needed. Cooperation between water works should be emphasized as it is particularly beneficial during hazardous situations for e.g. by enabling the access to alternative water supply sources.

#### 2.4.4 Has climate change affected whitefish reproduction and catches in the Gulf of Bothnia?

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Whitefish (*Coregonus lavaretus* s.l.) distribution ranges from small polar lakes in the North-Europe to the bigger and deep lakes in the Central-Europe. The whitefish also inhabits the Baltic Sea brackish water, with present major distribution area in the Gulf of Bothnia.

The brackish water whitefish has two ecotypes, one of which reproduces in the coastal sea areas and the other in rivers. Although the whitefish is considered as a cold water species, especially the sea-spawning type is cold water stenothermic; their newly hatched larvae seek into warmer shore habitats early in spring. Both types are indigenous and have a high economic and biodiversity value. In spite of the diversity and ability to adapt to different habitats, both ecotypes have become threatened in the Baltic Sea during past decades. Especially the anadromous whitefish is supported by annual stockings. Stockings with one summer old fingerlings became intensive during the late 1970's. Regardless of introductions with millions of whitefish larvae and juveniles commercial catches have had a decreasing trend since the beginning of 1990s. We examined the possible effect of climate change on whitefish catches in the Baltic Sea by comparing the (long time) catch statistics and climate data. We also compared the extent and quantity of the sea-spawning whitefish reproduction areas to catches. The amount of potential reproduction areas and catches both increased from south to north. We noticed several large scale variables that changed from south to north and concurrent to climate change.

## Parallel Session 2.5: Rural livelihoods

### 2.5.1 Adaptive capacity and community resilience in Northern Norwegian communities

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The background for this paper is the recent awareness and observed consequences of climate change for Arctic communities as reported in a number of research articles and reports. Consequences of climate change will require adaptation across different scales. This paper analyses community resilience and adaptive capacity in two municipalities in Northern Norway. These two coastal and peripheral municipalities are located in a region which arguably is more closely connected to changes in natural resources and conditions than in other parts of Norway, due to several communities' dependence on fisheries as the main employer. The municipalities are located on the island of Senja and in the archipelago of Vesterålen. The main common characteristic is the importance of natural resources for livelihoods and cultural identity. Each municipality hosts important fisheries ports, with active coastal fishers, landing facilities, processing industry, aquaculture, as well as new technologies that either make use of discards from the fisheries or cater for new needs within fisheries and aquaculture. These municipalities are rich in resources and some of the best fisheries in Norway are found in the waters along their coasts. Community resilience is the ability of a community to cope and adjust to stresses caused by social, political and environmental change and to engage community resources to overcome adversity and take advantage of opportunities in response to change. How are the local communities currently developing processes to deal with changing conditions in social, political, economic, environmental, and climatic conditions? The paper presents empirical work on current processes in communities to highlight processes, agencies, and institutions which are instrumental in driving adaptation today. Adaptation is understood as a continuous process of change in response to changes in combined multiple factors. The paper also highlights the dimensions of community resilience which are activated in the municipalities to enhance their resilience. It is found that the community resilience in the municipalities today could be challenged by future changes.

### 2.5.2 Impacts of climate changes on Arctic herding communities. The case of Finnish Fell Lapland

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Reindeer husbandry is an essential activity for the European Arctic regions from an economical and image point of view, as well as for indigenous communities. Finnish Lapland counts nowadays around 200000 of reindeers owned by some 5000 reindeer owners. During the past decades, Fell Lapland has been exposed to significant environmental changes which have affected the relationships between reindeer herders and their natural environment. Our objective is to assess the overall local social-cultural vulnerability of Finnish and Sámi reindeer communities of Muonio river valley and Sámi herding of Könkämäeno river valley with particular focus on coping with climate change. Past years, reindeer herding communities have faced many changes in their ways-of-life, but also suffered from the loss of pastures, the erosion of winter grazing grounds and the modification of migration routes partly due to environmental changes. The study analyses first the role of climate and seasonality changes such as the spatial and temporal variability of air temperatures, the alternation of colder and warmer waves in winter, the frequency and intensity of fall precipitations and its effects on the formation of ice layer between the lichen and the snow cover. The migration of reindeers is also affected by the river and lake ice conditions that herders use for crossing. Our presentation will then focus on the current way of life and the adaptive capacity of reindeer herders to cope with seasonal changes. We will stress the accent on their adaptation means, the weight of traditions, the traditional ecological knowledge and their perception of climate change. Finally we will emphasize the role played by mining, forestry and tourism industries in the conflicts of interest with reindeer herding communities, taking into account that Lapland could face general intensification of land uses in the case of global warming. Our scientific approach is mainly based on statistical treatments and interviews conducted with reindeer herders of the communities of Kilpisjärvi, Karesuando and Muonio. This research is part of the CLICHE project which aims to improve the understanding of the impacts of climate change on Arctic ecosystems and societies.

### 2.5.3 Land Use conflict in a Climate Change Perspective: Reindeer herding in Nordland, Northern Norway

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In this paper I will analyze how fragmentation of reindeer pastures affects reindeer herder's adaptive capacity in dealing with multiple changes and disturbances in addition to the overarching threat of climate change. Reindeer herding require large tracts of land and access to coastal pastures as well as other reserve pastures are particularly important for reindeer herders under unpredictable weather conditions. Reindeer pastures are under threat from several activities such as roads and railways which may lead to increased risk of injured or killed reindeers. Pastures are also accessed by others, such as farmers, tourists and hikers. With increased development and pressure on these land areas, the risk of land use conflict increases. Thus, retaining these pastures become increasingly important as external pressures of both social and ecological character expands, and thus is crucial in regards to reindeer herders' capacity to handle change and uncertainty when managing their pastoral lands. Reindeer herders may not utilise all available pastures every year, depending on climatic conditions at different times throughout the seasons. For instance, more prolonged autumns increasingly result in longer periods without snow cover, thus locking the pastures to reindeer grazing. This phenomenon has traditionally only been



## Parallel Session 3.1: National adaptation strategies I – Policy

### 3.1.1 Evaluating climate change adaptation policies in European countries: Policy labeling or Policymaking?

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European countries have increased their efforts to adapt to climate change. Various studies to assess progress towards the development of adaptation policies have been conducted. However, what is measured as progress strongly varies among policy analysts. Four studies that were reviewed in the context of this paper designate the United Kingdom as a form of “best case”. Building institutions on adaptation is generally considered the benchmark, however countries with strong existing policy frameworks that are resilient in the context of climate change are often not included in the analysis. We argue that the broadly shared definition of climate change adaptation provided by the IPCC-AR3 proves a methodological challenge to operationalize. Pressured by the increased political and social attention to climate change impacts, and in response to the European Commission and UNFCCC directives, Member States feel obliged to show progress on adaptation. Resultantly, Member States revert to symbol politics by relabeling existing policy efforts as “adaptation” policy. Arguably, many policy efforts do not contribute substantially to enhance resilience and formal policies aiming to mitigate climate change induced risk such as droughts or floods have always existed. Consequently, boundaries between climate change adaptation and business as usual policies have become blurry. We argue that these boundaries need to be clarified in order to assess real progress on adaptation made by European countries. This paper therefore aims to operationalize “climate change adaptation policy” by providing definitions and criteria that distinguish climate change adaptation policies from symbolic actions and business as usual policies. We propose a theoretical framework and apply it to the national communications to the UNFCCC of UK and Switzerland, which scored the highest on the “adaptation measures indicator” provided by Massey and Bergsma (2008). Our results show that even “best pupils” tend to use the label “adaptation” exaggeratedly. The analysis shows that distinguishing between business as usual and adaptation policies makes a more legitimate assessment of the progress on adaptation to climate change possible. Such distinctions are valuable to evaluate modes of governance, governmental investments, political performance and strategic policy initiatives.

### 3.1.2 Evaluation and revision of Finland’s National Adaptation Strategy

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The midterm evaluation of the implementation of Finland’s National Strategy for Adaptation to Climate Change was conducted in 2009 by a survey of whether and how the adaptation measures presented in the strategy had been launched in different sectors. To facilitate the formulation of a comprehensive view of the state of implementation of the strategy a preliminary indicator of the levels of adaptation was developed. Besides the adaptation measures launched the indicator takes account of recognition of the need for adaptation, cooperation between sectors, as well as adaptation research. With the help of this indicator it was possible to evaluate the approximate level of

adaptation in different sectors and the country as whole. The adaptation indicator can also be applied regionally or locally. On average, Finland was estimated to be on level two (on a scale from one to five) in adaptation which means that among the decision makers there is at least some understanding of the impacts of climate change and the need for adaptation measures has been recognized, at least to a certain extent. Some practical adaptation measures have also been identified and plans have been made or even launched for their implementation. The most advanced sector was found to be the water resources management where adaptation is already well integrated into the decision-making. It was noted, however, that there is a great deal of variability between and within the sectors and in many cases it is impossible to define the level of adaptation in each sector in an unambiguous way. The midterm evaluation of the Finnish Adaptation Strategy also took an inventory of the needs for updating the strategy. These needs and other recommendations will be taken into account in the revision of the strategy which will be conducted in 2012-2013. Finland was one of the first countries in the world to publish a National Adaptation Strategy and to evaluate it. The Adaptation Strategy was adopted in 2005 as an independent element of the wider National Energy and Climate Strategy. In these strategies it was stated that the evaluation of the implementation of the Adaptation Strategy and the determination of additional adaptation measures should be completed within six to eight years after the adoption of the strategy, once research and sector-specific work has provided new and more detailed information and experiences on climate change, its impacts and adaptation.

### 3.1.3 Adaptation to climate change – agenda setting and policy integration in Germany

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The present article analyzes the progress of policy for adjusting to the impacts of climate change in Germany. We consider a period from the early beginnings in the 1990s until the development of the so-called ‘Aktionsplan Anpassung’ (Adaptation Action Plan) of the German Adaptation Strategy of the Federal Government in 2011. Our specific concern is on the integration of this new topic into the political-administrative system and on the mainstreaming of adaptation to climate change in general. There are several studies on adaptation policy in Europe, mostly comparing different adaptation strategies, or discussing governmental tasks. In comparison to these, the present article goes a step back and provides a detailed representation of the development of German adaptation policy for the first time. The result offers a coherent picture regarding the lines of development and the present pattern of German adaptation policy – the frequently promoted integrated approach can in fact be identified. The empirical foundation of the article is based on a survey of literature and a set of 22 interviews. The set of interviews was supplemented with the evaluation of 18 unpublished primary sources from the time period of 2002-2009, which are directly connected with the development process of German adaptation strategy. The development of adaptation policy in Germany is investigated on the basis of five categories: horizontal integration, vertical integration, exchange between horizontal and vertical level, integration of expert community and modification of policy instruments. These five categories are based on the discussions on climate policy integration but with a certain extension. The first three categories refer to the integration within the political system. It is argued in this paper that we also need to include the aspects of expert integration and the aspect of adaptation policy instruments to fully understand and analyze adaptation policy. We identified four milestones of agenda setting and adaptation policy integration as being most important on the path to the Action Plan. An integrated approach was used for adaptation policy, mostly originating from

higher institutional levels. Crucial impulses emanated from the environmental departments. We argue that until now, the policy integration of adaptation to climate change can be interpreted predominantly as a strategy of mobilization.

### 3.1.4 Monitoring and evaluating adaptation measures - a critical review

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National adaptation plans proliferate throughout Europe as shown by country submissions to EEA's ClimAdapt-portal and adaptation action programmes begin to emerge. This increases the need for ways to monitor and evaluate progress in adaptation. Do the plans and programmes deliver? The European Commission has also become increasingly interested in these policies and measures and in its recent proposal for a regulation "on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change" mandatory reporting national adaptation actions is included. This raises the question how such monitoring and reporting could be carried out. In an ideal bureaucratic world it would be possible to specify a detailed and systematic framework so that all countries would report the same comparable information in a standardized format. Such information could be distilled into indicators of adaptation. This paper examines critically the basis for such an approach, reflecting on ongoing attempts in European countries to develop monitoring of adaptation and discussing them in a wider framework of policy evaluation and policy learning. The paper focuses on two different very sectors: water management and biodiversity conservation and suggest ways of progressing in the monitoring of adaptation action. The paper demonstrates that sectors have very different issues and information needs in monitoring and evaluation. The findings suggest that the primary focus in developing monitoring and evaluation of adaptation for policy development should be on policy learning, supported by identification of feed back loops, synergies and conflicts between measures rather than on detailed tracking of individual measures.

## Parallel Session 3.2: Urban planning I

### 3.2.1 City 2 - Ecologies of Climate Change Adaptation

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Adaptation to climate change in cities is typically addressed at the physical and technological level. This presentation questions the assumption that our core values and systems - products of the Enlightenment and the industrial revolution - as manifestations in cities, will remain suited to a new climate. It looks at how social, economic, political and cultural relationships might themselves be redesigned for the viable future of our cities. This leads to some proposed revised underlying principles for the design of cities and for the design process itself. It is argued that these principles and the process by which they are applied to the design, building and maintenance of cities must be ecological (non-linear, requiring relational thinking processes) rather than linear, definitive and prescriptive. The strategy of Metrofitting is presented: a conceptual and organisational approach which puts the city in a position to adapt to climate change. As an extension of retrofitting, metrofitting has a transformative agenda to identify major areas of threat and

develop a framework of strategies to prefigure a viable city future. It engages with the city's cultural and social fabric, opening the doors for changes in ideas related to food production, qualitative economies, cross-cultural learning, shelter and transport. Two speculative case studies are presented, based on successful submissions for design competitions. The first examines a new city for 50,000 people situated 100km from a major city in Australia. It is based on a retreat from the city due to climate change and the arrival of large numbers of environmental refugees. The second examines the economic, social, and physical options for a major coastal city in the face of significant sea level rise and increased strength of extreme weather events. Both case studies, while they present particular cities in sub-tropical Australia, propose a strategy of re-designing cities which in itself is adaptable to the specific issues of climate change adaptation in other countries. They present concepts for the re-imagining of cities, where a pre-emptive engagement with community assist in the re-direction of the psychological, building resilience, forming of new economies, and re-defining cultural and social transactions. They present concepts of designing-in-time from the future to the present: imagining viable scenarios for the future and designing the core strategies and actions to reach them.

### 3.2.2 Climate Change Adaptation in Urban Design: the Expectant Design Approach

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An already committed climate change coupled with variable effects of global development scenarios lends an uncertain future, and vulnerabilities in the built environment. The necessity of climate change adaptation's integration into building planning and processes is clear. Built space in cities, where population majority is now housed, has not been designed with climate change in mind, and this brings impetus to the development of adaptation strategies by urban designers and planners. "Design for sustainability" must transition to foster resiliency to environmental change. Climate change adaptation in urban design confronts issues of financial and environmental uncertainty, slow processes of environmental and urban change, and policy and government initiatives that are sometimes short-lived. Climate change adaptation policy is abundant, but problems are encountered in the implementation phase. Key issues of implementation are in the need for flexibility, engagement, and publicness. Stakeholder awareness and involvement in adaptation is critical; city residents must support adaptation measures as well as be engaged in needed behavior change. The building of long-term relationships for understanding and support between community and city is an important aspect of climate change adaptation. Urban design's role is, in part, to provide spatialization of flexible adaptation measures and platform space for public engagement. A design and research thesis in the Massachusetts Institute of Technology explores climate change adaptation and urban design in the context of Helsinki's Kalasatama coastal development. Using the Expectant Design [1] approach, the case study and design employs flexible architectural and urbanistic strategies in design for adaptability. The project's adaptation strategy illustrates a scheme that is incremental, flexible, expectant and public. Design proposes an approach that is implemented in a phased and open process, and that addresses the necessary adaptability of climate change adaptation. [1] Ruskeepää, Laura A. Delaney. (2011). *Adaptation and adaptability: expectant design for resilience in coastal urbanity*. Thesis, Massachusetts Institute of Technology, Dept. of Architecture. Cambridge, MA: Massachusetts Institute of Technology.

### 3.2.3 Towards legitimate governance arrangements for adaptive flood risk management in urban areas

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In recent times a shift has occurred from traditional flood management focused on the prevention of flooding (reduction of the probability) only, to more adaptive strategies focused on the reduction of the impacts of floods as a means to improve the resilience of occupied flood plains to increased river discharge levels and sea level rise. This shift has had implications for the public-private divide in flood risk management. In many countries flood prevention strategies reside under the exclusive responsibility of the government, since measures such as dikes and other types of technological barriers are regarded as public goods from which all people (in a certain geographical area) benefit. With the introduction of adaptive strategies such as the wet- or dry-proofing of buildings non-state actors such as developers, housing corporations and residents also may have to bear responsibility for adaptation. This necessitates multi-actor collaboration, often facilitated in the form of policy networks and other types of public-private governance arrangements. Private involvement may lead to more innovative and efficient adaptation measures. However, the multiplicity of actors and potential controversies regarding adaptation goals and solutions is expected to have implications for the legitimacy of new arrangements. In this paper we introduce a conceptual framework to analyze and evaluate governance arrangements for adaptive flood risk management. We then apply this framework to a case study involving an urban regeneration project in an un-embanked area in which adaptive flood risk management strategies have been integrated as a means to enhance the resilience to climate change. We analyze the governance arrangement for Heijplaat, Rotterdam, the Netherlands in terms of the division of responsibilities among public and private actors, and clarify this arrangement in terms of the key considerations behind this division of responsibilities. Finally we evaluate the input, throughput and output legitimacy of this multi-actor arrangement.

### 3.2.4 Climate change considerations in urban planning

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This presentation introduces recent studies on climate change considerations in urban planning. The aim of the studies is to promote adaptation to and mitigation of climate change in urban planning and, thereby, to reduce damages caused by floods and storms as well as to reduce greenhouse gas emissions. The focus in this presentation is on adaptation to climate change. The research was based on ongoing planning processes in six study locations in Finland. Plans were considered on the basis of local climate conditions and of the microclimate they will form. The bases for analyses were estimations about essential impacts of climate change in the case localities. Predictions of climate change with regards to extremes and certain average changes in the next hundred years were made for all the study localities. The predicted variables concerned temperature, wind speed, precipitation, snow cover and sea ice cover. Changes in many variables are significant and differences between localities are great. Important issues in plans at general levels are mapping of flood risk areas and avoiding location of functions in such areas. Wind conditions and increasing precipitation form challenges to detailed planning. Near shore areas, sea level rise and splash of waves, as the sea will be open longer, form special challenges. Results of the project are recommendations

of practical procedures and means for taking climate change into account in urban planning and impact assessment. Control of and adaptation to climate change should be an established practice in urban planning.

## Parallel Session 3.3: Natural resource management I

### 3.3.1 Adaptation of management of Norway spruce stands to changing climate

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Forest sector has successfully used stand simulators in forest planning; e.g. different forest management options are tested and regional harvest potential estimated with the help of stand simulators calibrated on empirical data. One of the current challenges in forestry is to understand how various ecosystem services, such as carbon sequestration and timber production, can be managed in the changing climate, i.e. how to adapt to conditions from where we do not have observations. Developed process-based models should be applicable for such analysis. The objective of this study is to assess adaptation options of forest management in changing climate. We will focus our analysis on management of Norway spruce stands, since the response of spruce stands to changing climate is the most debated issue in the management of boreal forests. In addition, spruce stands are susceptible to wide range of forest management options from conventional management practices and bioenergy harvesting to maintenance of biodiversity of fungi in decaying spruce logs. We simulated the development of an even-aged spruce stand in current and changing climate with a process-based growth model that is integrated with models describing soil nutrient cycling and soil water dynamics. With model simulations, we evaluated differences between alternative management scenarios in terms of timber production, bioenergy harvests and forest carbon sequestration (both in the trees and the soil). Our results show that both tree growth and potential carbon sequestration capacity will increase with the climate change. In the changing climate, growth of trees is increased both due to favorable climatic conditions and due to accelerated nutrient cycling. Since growth of trees and litter production are accelerated more than the decomposition of soil organic matter, boreal forest soils will act as a carbon sink mitigating changing climate. Enhanced stand growth allows more intensive harvesting and/or shorter rotation length. Results of the simulations will directly serve forest owners and forest extension services by providing information on effects of different management options in changing climate.

### 3.3.2 Spruce forests on their southern boundaries: to adapt or not to adapt

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Based on empirical evidence from Belarus, this paper looks at the role of adaptive approaches for enhancing bio- and landscape diversity governance in spruce forests. Spruce forests, covering 3.6% of the country's area, are unique for their ecosystem diversity and their southernmost location in lowland Europe. These forests provide a habitat for a number of animals, including the Black Stork (*Ciconia*

nigra) and the Brown Bear (*Ursus arctos*) disappearing in Europe. The climate change accelerated over recent decades poses new threats to the Belarusian spruce forest, aggravates many of old ones, and challenges forestry and conservation authorities to re-think their operations. Norway Spruce grows there on the limits of its natural range, and therefore is especially vulnerable to climate change and associated stresses (e.g. variability of hydrological regime). Besides common threats associated with global warming (e.g. droughts, forest fires, wind falls, invasive species, forest diseases, pest invasions), this problem also reinforces or about to reinforce a number of other local environmental impact, first of all the change of hydrological regime and groundwater levels resulted from large-scale wetland drainage projects implemented in Belarus in 1960-70s. To support re-thinking and evaluation of management practices in Spruce forests, we suggest a framework for evaluating the biodiversity governance that incorporates knowledge of biophysical conditions (including the change of abiotic conditions compared to the baseline period), and of the institutional context (rules, norms, habits, conventions, and values). After identifying the criteria of ecological and socio-economic sustainability relevant for our case study area, and / or the critical thresholds, we review institutional and biogeophysical settings relevant for biodiversity governance in the forests, classify these settings into institutional and biophysical domains, combine institutional and biophysical domains, and evaluate adaptation potential for each combination of the domains. Our approach for integrating and classifying biogeophysical data is based on the principle component analysis, while the institutional domains are spatially attributed to forest, water and biodiversity management mandates and various bodies executing them. The resulting evaluation indicates the likelihood of success of governance regimes set up for protecting and managing forest.

### 3.3.3 Mitigating the effects of climate change - Assisted Dispersal and regulation

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Assisted dispersal of plants and animals (here AD) has emerged as a new conservation tool for saving species from extinctions caused by rapid climate change. AD implies that we intentionally move species to areas where they would move on their own, but that they would probably never reach because of, e.g., fragmented habitats and limited time. In the scientific community, AD is currently receiving a lot of attention, as the strategy's pros and cons are being weighed. Despite its infancy, it has already been applied to save endangered species, for example the conifer *Torreya taxifolia* is being moved outside its native range by a group of volunteers. As the favorable ranges for several species are likely to shift towards the poles, northern countries like Finland, may play an important role in providing new suitable habitat, either by natural means or through intervening methods like AD. However, moving species in response to climate change raises not only ecological, but also legal challenges that need to be solved. Currently there are few laws that unambiguously regulate AD as a conservation tool. There are, however, many legal restrictions on the moving of species in both domestic and international laws. Some of these laws restrict the intentional moving of species while others are designated to protect the areas to which species may be transferred. One of the problems is that, the majority of current international nature conservation treaties (e.g., CBD, CITES) were formed before a more broad understanding of the impacts of climate change on species conservation had been reached. Therefore, research findings and new methods developed concerning AD may require improvement of the current conservation legislation. Alternatively, completely new comprehensive regulation mechanisms may need to be developed.

This will help to ensure that AD is safely implemented and coordinated. Here we present the legal framework of AD and current trends in the scientific discussion. We will also introduce the transdisciplinary Assisted Dispersal project recently launched at the Botany Unit of the Finnish Museum of Natural History, University of Helsinki.

### 3.3.4 Boreal protected area network as an adaptation means to preserve avian biodiversity in a changing climate

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Climate change causes major challenges for species adaptation, as species ranges are expected to move poleward. Two critical questions are how well and which species are able to track the warming climate and whether or not the future climatically suitable areas coincide with habitats preferred by the species. The protected area network is one of the main means facilitating adaptation to climate change and thus changes in protected areas are of particular importance. We investigated trends in bird populations in the protected area network in Finland by comparing bird densities in 1981-1999 vs. 2000-2009 in 96 protected areas. Between the two time slices, northern species declined and southern species increased in Finnish protected areas. This suggests that climate-induced northward density shifts in species populations are already on-going and that future species range shifts are to be expected. Bioclimatic envelope models may be used to assess relationships between climate variables and species distributions. By applying the derived models to climate scenarios, the changes in the climatic suitability of nature conservation areas (or other target areas) for the biota they currently hold can be projected. Here we estimated the future changes in climatic suitability for one hundred bird species of conservation concern in Finland, using climate scenarios for 2051-2080 for three alternative emission scenarios. We included also species which presently do not breed in Finland, but occur nearby south or southeast of Finland. The predicted future climatic suitability was compared with the modeled suitability (probability of occurrence) in 1971-2000 in the same 10 x 10 km grid cells. Predicted range shifts of bird species of different habitats (forests, mires, marshlands, and arctic mountain habitats) were studied in relation to protected areas and land cover of habitat types. The probability of occurrence of all species (except marshland birds) decreased according to all scenarios, the decline being greatest in southern boreal and smallest in northern boreal zones with significant differences between the zones. This decline was slightly larger in unprotected than in protected 10-km squares for species of forests, mires and mountain habitats. The results are relevant in developing protected area network in boreal areas under changing climate to maintain biodiversity.

## Parallel Session 3.4: Economic appraisal I

### 3.4.1 Impact Assessment, Costs, and Decision Making for Climate Change and Adaptation

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When deciding amongst a suite of various climate change adaptation options, decision makers have to balance uncertainties in potential physical impacts, economic costs, and political priorities. The impact assessment identifies areas of concern and quantifies potential

damages from extreme events. From here, a decision support matrix is developed to clarify the decision making process, highlight key uncertainties, and identify critical assumptions. A decision support matrix also allows decision makers to examine how different a priori stakeholder values can impact the adaptation decision. The decision support matrix is built up by adding more complexity through multiple adaptation options, multiple costs and economics risks, and multiple impact variables. The goal is to show where complexities enter into the decision tool, and then present ideas on how best to address these complexities under the context of adaptation planning. This process is highlighted using an example of increased flood risk from extreme flooding events in the city of Aarhus.

### 3.4.2 SALDO: the Social costs of Adaptation: approaches to an evaluation of aDaptation Options

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Implementing adaptation measures has a price and in times of shrinking public budgets an ex ante assessment of adaptation options might be useful for various policy scales. Furthermore, adaptation is set in a complex environment of sectors, stakeholders and policy makers. Thus, SALDO's prime objective is to develop a decision support tool to ease the selection of adaptation measures for diverse actors. The tool was developed in an Excel format to allow for a broad application by different user groups. The user is guided through a criteria and indicator catalogue to identify the pros/cons and constraints of a distinct adaptation measure. Comparing each measure criteria by criteria allows for a cumulative evaluation of different (up to five) measures at criteria level as well as a ranking of measures. Based on other national studies (namely UK, NL and D), SALDO encompasses economic (benefits and costs, avoided damages) as well as non-economic criteria such as urgency, synergies/trade-offs with mitigation, no/low regret measures, flexibility potential in response to the demands that uncertainty is putting on adaptation, and mainstreaming potential of measures in other policy domains while the latter criterion is not displayed as evaluation criterion as such. In addition to a basic variant with equal weighting of all indicators the user can choose between an ecological, economic or uncertainty-driven bias. The main contribution of the SALDO tool is on the one hand the visualization of impacts of a certain measure in terms of the decisive key criteria and on the other hand the identification of synergies and trade-offs with respect to different policy goals reflected in the criteria. Furthermore, the tool shows the information gaps necessary to be filled in order to get to information-based policy decisions for adaptation. The SALDO tool is foreseen to be tested in Austria at regional level. The user feedback will allow for a further enhancement and possibly an application at different scales.

### 3.4.3 Insure or Invest in Green Technologies to Protect Against Adverse Weather Shocks?

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This paper analyses investments in green technologies when insurance is also an option. Green technologies are defined as having the power to increase productivity and reduce the volatility of future revenues. The insurance options involve the scale and coverage of either crop yield insurance or index-based insurance. The stochastic process is a combination of an insurable stationary short-term process and a non-stationary long-term process. The optimal decision

rules are solved numerically by stochastic dynamic programming. The results suggest that index insurance maintains market-based incentives to invest in green technologies, whereas yield insurance substantially decreases investments, as expected. Actuarially fair yield insurance decreases investments by high productivity firms. But if the insurance premiums are supported to the extent that the net loading becomes negative, firms with the lowest productivity have strong incentives to collect the benefits of the subsidized insurance rather than invest in higher productivity and lower risks. Yield insurance is the most attractive option for low productivity firms, while index insurance is the most attractive for high productivity firms. Nevertheless, the demand for actuarially fair index insurance is also reduced amongst high productivity firms when the correlation between the yield and the index falls below 50%.

### 3.4.4 Interpreting welfare effects in induced economic impact evaluation of extreme events

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This paper deals with ex-ante assessment of the induced economic effects of natural hazards. For ex-ante assessments of economic impacts of natural hazards a variety of approaches is used. The unusual non-economic origin of the impact often makes it hard to represent the effects in standard models, even though gradually a growing collection of propositions and experiments is published (Hallegatte 2005; Steenge and Bočkarjova 2007; Rose 2007; Okuyama 2007). The article will in particular discuss the extent to which welfare effects could be misrepresented in model simulation of the induced effects. The simulation usually lean on production based indicators and in the special circumstances of disasters do not (sufficiently) account for the loss of welfare of consumers. More in particular the paper illustrates it for flooded real estate. Owner-occupiers effectively are consuming – at least for some time – degraded residence services from their homes. This loss of welfare is obviously the driver behind the repair boom, which usually occurs after such an event. On the other hand, model results tell us that an – understandable – urge for quick repair comes at the cost of slightly less growth in welfare in the future. The lesson is that repair booms should be managed in order to avoid or at least minimise their adverse effects. Managing in this case means among others attempting to spread out the extra demand for labour and material over a larger supply area, promoting market functioning by providing available alternative supplier information, and trying to be selective in the scheduling of repairs. This may also require changes in insurance policies. References: Hallegatte, S. 2005. Accounting for Extreme Events in the Economic Assessment of Climate Change. Nota di lavoro 2005.001, Fondazione Eni Enrico Mattei. 28 p. Okuyama Y. (2007): Economic Modelling for Disaster Impact Analysis: Past, Present, and Future, Economic Systems Research, Vol.19, No.2, pp.115–124 Rose A. (2007): Economic Resilience to Natural and Man-made Disasters: Multidisciplinary Origins and Contextual Dimensions, Environmental Hazards, Vol.7, pp. 383–398 Steenge, A.E. ja Bockarjova, M. 2007. Thinking about Imbalances in Post-catastrophe Economies: An Input-Output based Proposition. Economic Systems Research, Vol. 19, Issue 2, pp. 205–223.

## Parallel Session 3.5: Policy learning I

### 3.5.1 Integrating Stakeholders in Policy Development for Adaptation to Climate Change: Lessons and Experience from German Dialogue Processes

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Stakeholder participation is declared to be a central element of effective policy making for adaptation to climate change. Following this broadly accepted principle, the development of the German Adaptation Strategy, adopted by the Federal Cabinet in 2008, and the German Adaptation Action Plan, adopted in 2011, was based on diverse approaches for integrating stakeholders from research, business, administration and civil society. Participation processes initiated by federal authorities (ministries and subordinated authorities) in Germany pursued two central policy aims: (1) organize and support interdepartmental and multi-level cooperation in the development and implementation of adaptation strategies and actions, and (2) include the wider public (diverse local or sectoral representatives) as well as scientific experts in the identification of adaptation needs and possible measures and activities. Being aware of the novelty of adaptation issues federal authorities also support knowledge generation by funding research and policy advice projects for adaptation within the ministries regular research agenda. This study reviews the various participatory activities applied. We give a comprehensive overview on the objectives of stakeholder involvement, adaptation problems addressed, stakeholders involved, and participatory approaches and methods applied. Based on this extensive and comprehensive review central outcomes and experience concerning challenges and success factors of participation processes in policy development on a national level are drawn. The results show that a broad variety of stakeholders was involved in the development of adaptation policies and that various topics were addressed. However, certain groups of stakeholders, like policy-makers, company members or media representatives were only rarely involved. Moreover, researchers and public institutions should take care not to over-stress key stakeholders in the attempt to involve all relevant stakeholders in every process. If several initiatives are being active in the same region or in the same sector, exchange and cooperation between these projects should be granted to avoid annoyance of stakeholders and to take full advantage of possible synergies between complementary approaches. Moreover it is important that key stakeholders are not getting tired of discussing the same topics in different settings

### 3.5.2 Engaging stakeholders in identification of capacity development needs within disaster risk reduction by means of a think tank process

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CATALYST is designed to create a wide range of opportunities for existing networks, researchers, policy makers, members of nongovernmental organizations (NGOs), and small- and medium-size enterprises to identify and share knowledge about best practices related to natural hazards and disaster risk reduction and adaptation.

The ultimate goal is to bring knowledge of risk management to bear on economic development, water resources management and land use planning issues, and to make natural hazard and disaster risk reduction and adaptation critical components of the sustainability agenda. CATALYST will not seek to create new knowledge. Rather, it will explore ways to more effectively assemble, analyze and use the rapidly expanding knowledge base in this growing field of study. Specifically, CATALYST will focus on both climatic hazards (cyclones, droughts, heat waves and floods) and tectonic hazards (earthquakes, tsunamis and landslides) as it seeks to 1. facilitate knowledge exchange and strengthen the science-policy interface; 2. add value to the existing body of knowledge on natural hazard and disaster risk reduction and adaptation; 3. identify critical gaps in current natural hazard and disaster risk reduction and adaptation knowledge and research; reinforce networking capacity worldwide; 4 strengthen the capacity of nongovernmental organizations and small- and medium-sized enterprises to integrate natural hazard and disaster risk reduction and adaptation practices into their policies, plans and programmes. Disseminate project findings in ways that help bridge the gap between the scientific and policy communities. Key stakeholders are being involved in the Think Tank, as clients, advisors, experts and multipliers, in order to: 1. develop capacities in key stakeholder groups, globally and regionally (Client); 2. involve the stakeholders in specifying the content of capacity development activities, for them and other stakeholders (Advisor); 3. improve the quantity and quality of knowledge & analysis generated by CATALYST (Expert); 4. disseminate CATALYST knowledge and products within and between regions (Multiplier).

### 3.5.3 Participation and learning for climate change adaptation: Experiences from local urban planning and forestry in Sweden

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Researchers and decision-makers have begun to recognize the need to build capacity for adaptation to climate change at all relevant levels in society. Despite recent analyses of the links between learning, adaptive capacity and governance, there has been surprisingly little research on how learning could benefit adaptation decision-making and shape resilient livelihoods. By applying a participatory research approach in the context of local urban planning and forestry in Sweden, this research investigates the role of learning in advancing climate change adaptation. The main research questions are: How can participatory processes contribute to learning on climate change and adaptation? What characterizes this learning process and how, if at all, does it contribute to a self-perceived increase in the capacity to adapt to climate change? The paper addresses these questions by highlighting research findings from urban planning in the Stockholm region, and forestry in the counties of Kronoberg and Vasterbotten, Sweden. The empirical results indicate that the participatory process has yielded changes in expressed perceptions and learning about climate change effects, vulnerability and potential adaptation measures. Conclusions are drawn with respect to the value and shortcomings of, and potential for, taking a participatory approach to supporting local adaptation processes.

**3.5.4 Exploring the interactions between science, stakeholders and their implications for learning about climate change adaptation: Experiences from the Swedish Forestry Sector**

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This study explores the interactions between science, stakeholder and their implications for learning about climate change adaptation. It aligns with a growing body of literature that understands climate change adaptation as a socially negotiated and mediated process. In this mindset, learning has been acknowledged as a key mechanism to facilitated adaptive capacity building among different stakeholders. This study employs transformative learning theory to examine implications of scientifically guided stakeholder deliberations on individual learning about climate change adaptation. Transformative learning theory describes how individuals can change their preconceived opinions, beliefs and judgments about a problem through socially nested discursive processes. In detail changes to a person’s frame of references can be facilitated through instrumental learning i.e. acquisition of practical knowledge and skills and communicative learning i.e. better understanding of own and the interests and values of others. We ask three questions: a) How do participants in scientifically informed group deliberations frame climate change risks and adaptation? b) What kinds of transformative learning result from science, stakeholder interactions? and c) What contextual factors benefit or impede transformative learning? Data for this research derives from a series of science-guided focus group interviews and semi-structured follow up interviews with stakeholders in the Swedish forestry industry conducted as part of the Mistra-SWECIA project. The study finds that transformative learning incited by science, stakeholder interaction remained limited. Research participants concurred that scientific data so far lacks the accuracy, urgency and applicability to warrant large scale adaptive measures. This research also finds that previous experiences with natural disasters make learning more likely to occur. Persistent distrust in climate science on the other hand was found to be a major obstacle for individual learning and adaptive capacity building. The study ends with conclusions for science how to better connect its results with the opinions and daily grievances of stakeholders.

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## Parallel Session 4.1: National adaptation strategies II – Research

### 4.1.1 Selecting appropriate methods for adaptation decisions

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Adaptation to climate change involves a wide diversity of public and private decisions. These various decisions present widely varying tasks to be accomplished in order to choose an adaptation option. Public makers must consider influencing the adaptation of others, while private actors consider their own. In some cases, this means a decision may first require achieving consensus amongst stakeholders on what outcomes are desirable. In other cases, a decision may require the selecting of an appropriate decision-making framework in order to choose an option. This paper addresses the question of how to identify the tasks critical to choosing an adaptation option and selecting the appropriate methods to accomplish them. It does so both conceptually and empirically by considering how adaptation decisions in a large number of research and policy cases. Data was attained through documentation of adaptation decision-making processes as well as through conducting interviews with those involved in adaptation-related policy processes. For each case, we recorded data on the initial framing of the adaptation decision and the sequence of steps and methods applied, as well as on the criterion used to identify tasks and methods. Key criteria to identify the critical task are the role of the actor deciding, the hazard addressed, the set of options available, knowledge on outcomes of options, and the outcome attributes considered. The results are presented by way of decision-trees which guides the decision-maker to the identification of a critical task, and the appropriate methods to address this task. The typology of adaptation task and methods thus attained will be turned into a guideline for appraising adaptation decisions to be published by the Programme of Research on Climate Change Vulnerability, Impacts and Adaptation (PROVIA), a global research coordination initiative directed by UNEP.

### 4.1.2 Matching available climate change knowledge with adaptation strategies at the national level: an example from Portugal

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Portugal has officially adopted its National Climate Adaptation Strategy (ENAA) in April 2010. It includes 9 strategic sectors: land planning and cities; water resources; insurance; health; energy and industry; tourism; agriculture, forests and fisheries; coastal zones; and biodiversity. The Portuguese strategy defined 4 major strands of objectives: knowledge and information; reducing vulnerabilities and enhancing adaptive capacity; awareness raising, participation and communication; and international cooperation. The first of these strands is referred as being the basis of any adaptation approach and it focuses on the need to consolidate and develop a sound scientific and technical base. In fact, this strategy briefly presents the main climatic changes observed in Portugal, as well as some of the available scenarios for the country. This information has been collected from a small number of national flagship projects (SIAM and CLIMAAT II) plus some more global considerations taken from the IPCC Assessment Reports. It is usually recognised that it is often difficult to consider the entire spectrum of available climate change scientific knowledge in the development of a national adaptation strategy (if not impossible, e.g., due to sheer amount, different focus and terminologies). Nevertheless it has been argued that, in the Portuguese

case, because of its small dimension and relatively small number of research institutions dealing with this area, a more comprehensive review of available knowledge could have been performed. In order to assess this argument against the type and quantity of available information, we present a systematization of climate change related research in Portugal. This study is based primarily on the CIRCLE-2 Climate Adaptation InfoBase that currently contains adaptation research and applied projects, at national/local level, for most EU Member-States. For the scope of this exercise only Portuguese national projects are considered. The information is organised and critically evaluated according to the strategy's sectors. This will allow its use by national and sectorial decision-makers involved in the strategy implementation, by providing them with a more comprehensive perspective on available national/local climate change knowledge. This is the first attempt of this sort for Portugal. Recent reviews of National Adaptation Strategies in Europe reveal that this approach will most likely be useful for many other countries.

### 4.1.3 Synthesis of adaptation research in different sectors in Finland

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A synthesis of adaptation research in Finland was conducted in 2011 as a collaboration of tens of researchers of different disciplines. The core of the synthesis is the Climate Change Adaptation Research Programme, ISTO, which took place in 2006-2010. Finnish national adaptation strategy is planned to be updated by 2013 and for that purpose there is a need for comprehensive overview of adaptation research in Finland. Because the projects within the ISTO-programme did not cover all the sectors of society, it was decided to include to the also adaptation research conducted within other programmes to the synthesis. The aims of the synthesis were not only to present an overview of adaptation research in Finland, but also to make a cross-disciplinary analysis on vulnerabilities, adaptive capacity and economic assessments. However, the level and phase of adaptation research in different sectors vary a lot, and therefore the outcomes of research projects are not fully comparable. The most advanced sectors are agriculture, forestry and water resources, while on some other sectors the weather and climate dependence is not well known even in the present climate. Yet, according to the researchers, the results of adaptation research can already be utilized in practical adaptation measures. The uncertainty regarding climate change scenarios or impacts of climate change should not hinder the implementation of adaptation measures. Recognised adaptation measures may support also the other aims in the sectors. In planning of potential future adaptation research programmes the aim of synthesis at the end of programme could be set from the very beginning in order to steer the projects in the research. The programme should be able to provide enough resources to conduct multidisciplinary studies on impacts of climate change on the systems, and complex interactions within the system in order to recognise good and cost effective adaptation measures. In the presentation the generic conclusion from the synthesis of adaptation research will be presented together with selected highlights from different sectors and climate risk assessments.

### 4.1.4 Reframing adaptation? - responding to indirect impacts of climate change

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In both research and policy, climate change adaptation has so far mainly been framed as a domestic, territorial concern. For many countries, particularly the rich ones, it is however likely that the

impact of climate change on their economy, policy making and international engagements will not manifest primarily as direct changes driven by climate and weather events within their territory, but as indirect impacts from (more severe) effects elsewhere in the world. These impacts will together with global policy measures and changes in the global economy create changes in flows of goods, capital and people. They may also have severe conflict and security implications. All in all, these impacts present decision making with a very difficult analytical task and challenges the way we think about adaptation. A recent comprehensive analysis by the UK government argues that consequences linked to climate change overseas could be as important as domestic climate change, which suggests that the dominant understanding of adaptation as a challenge primarily driven by local, place-based change may i) not adequately capture the real decision making situation on the ground, and ii) lead to sub-optimal policy responses, since not all relevant climate change impacts are accounted for. The implications of indirect effects for decision-making and governance are poorly understood. Conceptual frameworks are lacking, as are methods to provide consolidated evidence to inform decision making. This paper aims to make conceptual contributions in order to support a more well-informed and structured discussion on the significance of indirect impacts of climate change. Drawing on an empirical analysis of how indirect effects of climate change are addressed in strategic documents analyzing the future global context for Swedish forestry, this paper also provides thoughts on the implications indirect impacts of climate change may have for adaptation policy and planning, and for the research agenda.

## Parallel Session 4.2: Urban planning II

### 4.2.1 The role of social strategy games in understanding the trade-offs between mitigation and adaptation in climate change decision-making in cities

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Addressing the challenges of climate change will be acutely felt in cities. Urban areas are crucial for both mitigating greenhouse gas emissions as well as in terms of adapting to the impacts of climate change and these actions involve a number of trade-offs, including densification of the urban structure, which can in turn lead to increased vulnerabilities in terms of surface run off, for example. Many of these impacts are hard to quantify and their interdependencies often hard to comprehend. Partly due to this there are a number of outstanding gaps in knowledge both in research and in practice in relation to how decisions are made between adaptation and mitigation objectives and what kinds of negative and positive synergies can be identified between them. This paper focuses upon how people understand the trade-offs between mitigation and adaptation measures in an urban environment, using social gaming as a method of data collection as well as a learning tool. One of the primary reasons that gaming is used in this study is to assess to what extent games can or cannot more effectively communicate the complex nature of climate change decision-making. Data is collected from Denmark, Finland and the US through questionnaires from organised gaming sessions. The conclusion highlights how games can be used to simplify complex trade off situations and improve understanding of strategies involved in urban climate decision-making.

### 4.2.2 Governing adaptation to natural hazards in land-use planning

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Development and planning of land use is a main responsibility of local authorities in many countries. The decision making process is complex, where private developers have strong interests, local decision makers may have conflicting views, and issues of national concern may be in conflict with the local concerns. In preventing natural hazards damage, the objectives of the different actors and levels of government involved in land use planning may differ, with possible negative consequences. For example, national governments often initiate means to prevent damage from natural hazards or provide compensation for possible losses. In these cases, the decisions made by local authorities will be subject to the expectations on the local level of the national government's responses in case of a natural hazard event causing losses. As a result of these expectations, natural hazards may be fully or partly ignored in the local land use planning process. If compensated, the local level can instead emphasize other needs and concerns in its land use planning. Lessons from many countries indicate that lack of coordination between levels of decision making and vague consciousness about responsibilities are indeed factors that cause higher losses of natural accidents. This study asks what the national government can do to motivate local authorities to take appropriate precautions to present and expected future losses related to natural hazards in their planning and development of land use. We propose incentive structures that aim at motivating local authorities to take the risk of natural hazards into account in land use planning to a larger degree than they do today. This implies a sharing of costs between local and national authorities, which is dependent on the asymmetry of information between the two parts. We further discuss possible ways to reduce the total social loss that is caused by this asymmetry of information.

### 4.2.3 Managing conflicting claims in planning: the example of climate change adaptation in local housing policy

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There is today a general awareness of the need to break away from the current course of development in all sectors and at all levels of society in order to come to terms with climate change and its implications. The local authorities are critical to this work, not least in Sweden where their monopoly on local planning gives them a key role in strategic decisions on land-use development. Research has identified the inertia and ineffectiveness of local climate change policy, singling out as key issues conflicting goals, a lack of policy integration, and weak institutional settings (Bulkeley et al. 2005; Uggla 2009; Storbjörk 2010). To this end, we target local spatial planning as an area of specific importance and study, in practice, what tensions and conflicts arise between the various planning interests, priorities, and goals when it comes to climate change mitigation and adaptation? Specifically, we have identified core concerns from actual physical plans handled by Swedish municipalities. The plans specifically addressed waterfront development and thus the classic safety versus scenery conflict but they also addressed other localisation issues. Based on the core concerns in these physical plans we have developed generic narratives. These narratives are combined and are used as input in focus group discussions. The focus groups consist of urban planners and local politicians from Swedish municipalities. The transcripts from the focus group discussions are analysed in relation to: conflicting goals, that is what issues are prioritized when the decision

is taken? What are the prospects for climate policy integration? What institutional settings would be required in order to foster systematic balancing of objective and create better opportunities for policy integration?

#### 4.2.4 Afraid of (Climate) Change? Institutional Implications in Local Climate Change Governance

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Local authorities are presently the main public actors in initiating climate change (CC). In planning this happens by either integrating CC into existing planning and/or by creating individual CC plans. Previous research has illuminated the challenges and possibilities that lie within the multi-level governance nature of CC. However, very little research has focused on how these challenges are perceived and dealt with when managed internally by a local public authority. This research builds on a previous study of eight Danish municipalities' integration of CC. It concluded that the cross-sectorial management stress institutional norms and cultures at various levels, creating inertia for CC plan implementation. The research presented here is an in-depth study of one of the eight municipalities with the aim to create knowledge on the institutional mechanisms that occurs when CC is integrated in a bureaucratic organization and to highlight how legitimacy can be built to secure implementation. The municipality studied can be regarded as an extreme case, thus it is characterised by the most bureaucratic form of government in Denmark. It is therefore expected that the institutional mechanisms found in this study, triggered by the cross-sectorial management of climate change, can be found in other municipalities. The study is based on particular governance and institutional theoretical positioning, and takes point of departure in a document study consisting of a CC proofing of the Municipality's current municipal spatial plan, the affiliated strategic environmental assessment (SEA), and three CC action plans. Qualitative data was collected initially through an examination of all meeting minutes held during the spatial planning process. This data was supplemented with 15 interviews with key decision makers in the CC and the spatial planning process. The conclusion shows that legitimacy building happens in new innovative ways and is approached differently for mitigation than for adaptation. Adaptation, more so than mitigation, follows existing spatial planning procedures; on the other hand, adaptation is increasingly used as an argument when spatial development issues are discussed. The research contributes to the emerging literature in 'innovation in governance', and also stresses the concept of institutional theory by adding perspectives on how institutional entrepreneurs act within bureaucratic structures.

### Parallel Session 4.3: Natural resource management II

#### 4.3.1 Significance of adaptation to forest management and economic returns in forests under transition due to climate change

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We used the process based approach to estimate the transient impact of different climate change scenarios on forest growth and development. We used the forest growth changes in economic

analysis of optimal forest harvesting scenarios and compared their outcome against current management regimes. We translated the stand level trends to alternative management principles and tested their impact to tree growing stock and supply of forest products. In the process based approach of climate change impacts on forest productivity, we combined observed tree responses from long term field observations and short term CO<sub>2</sub> exposures to tree canopy models to estimate climate related changes in leaf and crown specific gross primary production (GPP), respiration and net primary production (NPP). We used these NPP-values in process based tree growth models that allocate growth and estimate soil organic matter turnover to estimate climate change impacts on tree growth. We translated these tree growth changes to site index changes. Finally we used these site index changes to estimate regional forest growth changes using forest growth and yield models that are based on large forest inventory data. The process based tree growth models were used in combination with economic optimization algorithm to compute optimal forest management schemes in the transient climate. These results were translated into management principles that were applied to regional forest growth estimations to analyze the impact of transient climate change on regional standing stock, harvest and economic returns when comparing optimal adaptation with no-change scenario. Climate change scenarios (average temperature rise between 2 to 5 degrees) and the current measured responses of trees to temperature, precipitation and elevated CO<sub>2</sub> predict a 16-40% growth increase in South Finland and a 31-80% increase in Lapland. The faster nitrogen turnover rate had a big influence on the results while no large drought related problems were predicted. No single thinning regime showed to be optimal in the transient climate change but the outcome depended heavily on the stand conditions initially. Under the mildest climate change scenario, the growth changes start to clearly reflect on regional standing stock and harvest only after 2050.

#### 4.3.2 Modelling interactions of climate, crop management and phenology and their effect on barley yields in Finland (1971-2010).

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Climate is already changing and farmers have been and continue to adapt to these changes by adjusting agronomic practices and using (new) crop cultivars. To examine what the limits are to adapting agrifood systems to climate change, and how to enhance the resilience of such systems, we need to learn from historical adaptation measures and their limitations. This also entails to investigate whether the effects of such measures can be quantified by agro-ecosystem models. Without such evaluation, the models cannot be applied with confidence in assessing the effects of future adaptation options in conjunction with climate projections. The aim of this paper was to quantify what contribution changes in climate, agronomic practices (here planting and harvesting times), and barley cultivar characteristics (especially thermal requirements for phenological development) have made to spring barley yield development in Finland between 1971 and 2010. Crop growth simulation model WOFOST was applied to simulate barley yields for several long-term (MTT official variety) field trials in different parts of Finland. Model input included local daily weather data together with basic soil, cultivar and management information. Simulated yields were compared with the yields observed in the various trials, for which we also collected data on yield-reducing factors not captured by the model. Alternative modelling settings were applied to separate effects and quantify the relative importance of climatic,

management and crop phenological factors on yield. Results of the study provide important information regarding the model's capability to reproduce the historical trends in barley yields in Finland. In addition, the study shows the relative importance of the effects of climate, agro-management and cultivar development on the yield trends. The variable effects of socio-economic factors on yield trends are also being discussed, for example, how decreasing real crop prices have decreased farmers' incentives for attaining higher yields. While our analyses reveals interesting interactions and some unexpected dynamics of cultivar development and crop management, and their joint impact on historical yield trends, it is unlikely that the barley cultivars currently available will suffice to cope with projected climate changes in 2041-70. The evaluation results presented show good promise that our crop model can support planning of future adaptation measures.

#### 4.3.3 Identifying synergies between adaptation and mitigation strategies in agriculture

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Agriculture represents an important nexus between adaptation and mitigation. As a source of greenhouse gas emissions, the sector contributes to climate change; at the same time it is highly exposed to any changes in climate. Mitigation and adaptation are therefore both important responses in the agricultural sector. While there may be separate institutional dimensions and analytical approaches to considering mitigation and adaptation, there are likely to be distinct advantages in some areas of addressing the two goals together. There is the potential that pursuing one goal without consideration of the other may lead to successfully meeting the primary goal but undermining the other. Many of the challenges for considering interactions between adaptation and mitigation are avoided in the agricultural sector, where decisions regarding the two approaches are often made at the same level (often the individual farmer). Furthermore, there are likely to be considerable economic and efficiency benefits of integrating the two approaches. Mitigative and adaptive capacity are likely to be very similar, with many of the barriers to uptake of measures being common to both approaches. We review the existing literature, and provide an overview of methodologies for evaluating measures. We then develop a scoping matrix to set out the potential synergies and trade-offs between a comprehensive list of both mitigation and adaptation measures for the agricultural sector. The interactions are assessed as to whether they are synergistic, involve trade-offs, uncertain or whether there is no relationship. The development of a method for systematically identifying the relationships between adaptation and mitigation strategies will enable a focus on the synergistic strategies and highlight areas for caution where trade-offs are involved. Common areas of synergy or trade-off may be identified, such as energy use, and water availability and quality, so that advice and information for farmers takes account of broader considerations. At this stage the matrix is developed for United Kingdom agriculture, but the method can be applied to any system where sufficient information is available.

#### 4.3.4 Diversification as a means to enhance resilience of agrifood systems

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Climate change implies multidimensional uncertainty especially in spatial and temporal terms. Adaptation is further challenged by indirect consequences of climate change and by other global disturbances and variation. Therefore, attention to resilience, adaptive capacity and robustness have been increasingly called for to complement the post-scenario adaptation to projected long-term change. Functional diversity is known to enhance productivity and provision of ecosystem services, also in agro-ecosystems. Response diversity - diversity in response to disturbances - is mentioned as the first safeguard against the loss of ecosystem services in a changing world. However, little empirical evidence exists. We tested the hypothesis that diversity enhances resilience, using the agrifood system as a case. Cultivar diversity, cropping system diversity, farm pluri-activity and supplier diversity of retail were focused on. Resilience was operationalised as system performance when facing past documented variation in weather and market prices. Performance was assessed in terms of yield and production, environmental impact, economic revenue and food security. We found support to our hypothesis at several system levels. However, every form of diversity tested was not as useful. Cultivar diversity seems to enhance productivity over years and cropping system diversity reduces nitrogen surplus and thus liability to emit to waters and atmosphere. Our results indicate that farm pluri-activity has the potential to improve farm revenue and supplier diversity to stabilize food availability. The relative benefits of various dimensions of diversity for resilience will be reported.

### Parallel Session 4.4: Economic appraisal II

#### 4.4.1 Response to weather conditions and weather forecasts as a basis for assessing climate change adaptation

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Thanks to both national and EU programmes the number of climate change impact studies with more regional or sectoral detail has been abounding in recent years, also with respect to real estate and infrastructure. In the greater part of these studies system behaviour is however often rather rigid, with limited reflections on the various categories of responses (behavioural, technical and institutional) and their interplay, whereas often also a very limited number of response levels is considered. There is a growing number of studies indicating that assessment of current responsiveness to weather conditions and weather services can be very helpful in analysing effects of climate change and adaptation, e.g. Cools et al (2010), Nurmi et al (2012) for transport and Töglhofer et al (2011) for tourism. Projections of future frequencies of extreme weather events based on climate change projections cannot be directly translated damage projections, even if trends in land use and demographics are accounted for. An important reason for this is co-evolution of technical innovations, social dynamics and learning, and socioeconomic development, which together result in an accepted risk level which evolves over time (Nurmi et al 2012). Similarly Simmie and Martin (2010) emphasize the importance of co-evolutionary processes. In this contribution we will

introduce the Weather Service Chain Analysis (Nurmi et al 2012) as a means to analyse and decompose responsiveness to weather and weather service. We will illustrate a few applications and indicate how co-evolution could be taken into account and applied to climate change impact and adaptation assessment for various sectors. References: Cools, M., Moons, E., Wets, G. 2010, Assessing the impact of weather on traffic intensity, *Weather, Climate and Society*, Volume 2, pp. 60-68 Nurmi, V., Perrels, A., Nurmi, P. Seitz, D., Michaelides, S., Athanasatos, S., and Papadakis, M. (2012), Economic value of weather forecasts on transportation – Impacts of weather forecast quality developments to the economic effects of severe weather, EWENT report D5.2 Simmie, J. and Martin, R. (2010), The economic resilience of regions: towards an evolutionary approach, *Cambridge Journal of Regions, Economy and Society*, Vol. 3, pp.27–43 Töglhofer, C., Eigner, F., Pretenthaler, F. (2011), Impacts of snow conditions on tourism demand in Austrian ski areas, *Climate Research*, Vol. 46, pp.1-14.

#### 4.4.2 Effects of Climate Change on Inland Waterway Transport Networks

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The present paper specifically addresses the topic of climate change impacts and adaptation, taking inland waterway transport (IWT) as a case-study. The results figuring in the paper are based on the results of the EC funded ECCONET project, which is an interdisciplinary project combining the expertise gained from climatology, hydrology, transport-economics, ship engineering and inland waterway management. A quantitative approach is applied, using the results of existing climate ensembles, hydrological results from KLIWAS and the transport network models TRANSTOOLS and NODUS. The goal of the project is to provide policy advice to the EC, as well as guidance to stakeholders from the IWT sector. ECCONET uses the concept of the impact chain of climate change. The paper starts off with an overview of modeling results and shows how at each stage of the impact chain model results are linked to another. First is indicated how a climate impact scenario was selected from a model ensemble for both the Rhine and Danube regions. Both global and regional climate models are applied. Then we show how hydrological projections can be extracted for representative years in the near and far future, mainly based on projections of precipitation and seasonal snowmelt. The output takes the form of water levels on a day-to-day basis, on a number of river passages critical for navigation. Finally we explain how these projections of navigation conditions can be used in a transport economic model. The water levels are translated to transport costs through the maximal load factors that can be achieved through a set of calibrated cost functions. In parallel to the impact chain analysis, ECCONET evaluates targeted adaptation measures to climate change. The main concern for adaptation is coping with periods of low water levels, as these were empirically established as the most influential for the sector. Adaptation measures reviewed are split into four categories: ship engineering, waterway infrastructure, improved seasonal forecasting and logistic processes. We show how adaptation can be integrated with the transport network projections by impacting transport costs or otherwise facilitating the transport process, and how the measures can be processed for cost-effectiveness analysis and eventually policy advice.

#### 4.4.3 A way of assessing flood risks changes from hazard maps

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Economic losses from climate-related disasters are increasing, which is one reason why the EU adopted the EU Floods Directive (2007/60/EC). The Directive requires that each member state must carry out flood hazard and risk mapping. In Finland, the maps will be utilized to manage efficiently risks of climate extremes, as required by the introduced new flood legislation in October 2010 (620/2010). Thus we decided to develop a national methodology and a draft guideline, to assess the benefits of flood risk equally across the regions. This paper explores the developed methodology from flood hazard mapping to the assessment of climate change costs in one pilot area. In Finland, about 80 flood hazard maps have been saved to the national flood information system based on GIS technology. In addition, low-lying, potential flood prone areas have been calculated for about 50 watersheds with the help of a digital elevation model. These maps include information of flood prone area and water depths. Flood damages we estimated by a simple GIS overlay analysis using flood hazard maps and vulnerability data, such as GIS datasets for buildings, basic infrastructure, road networks, industrial establishments, and environmental protection. Preliminary monetary damage estimations we calculated for all flood hazard mapped areas and areas at significant flood risk for following factors: building fabric, household inventory items, building clean-up costs, traffic infrastructure and increased travel costs, emergency services, vehicle damages. Assessment of flood damage for buildings is based on synthetic depth-damage functions, as empirical data from past flood events was very limited. We assessed some low-regret measures when the symmetry of flood frequency was expected to change in the pilot area. We evaluated risk reduction benefits and dead weight loss, which was convex, for different climate change scenarios.

#### 4.4.4 Environmental and economic impact assessment due to sea-level rise in the Basque coast based on different scenarios obtained from the geological record

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Among the projected impacts of climate change, sea-level rise poses a major threat to coastal areas. These impacts are expected to be particularly serious considering that much of the world's population is concentrated in these areas. Spain, and specifically the Basque Coast, is not an exception. This study presents the projected impacts of climate change due to sea-level rise in the Basque Coast. The theoretical framework is based on an integrated approach which combines geological and economic methodologies to assess impacts on natural and socioeconomic systems. Along the history of Earth, both climate and sea level had important variations. The geological methodology is based on recent changes of sea-level studied through microfossils. This way, instead of using climate modeling to project future scenarios, we will use past data to estimate sea-level by 2099. We think this is an innovative approach, built on what already happened on Earth during different period of its history. The primary objective is to develop four future scenarios of sea-level rise using estimations for several geological periods, namely the Anthropocene (1900AD-present), Holocene (9000-1900AD) and Eemian (125.000 BP). The Eemian period is especially interesting as the global

temperature of the Earth is estimated to be +1-2°C, just as the lower warming scenario calculated by the IPCC. The second objective is to translate and monetize the mentioned scenarios into economic impacts on the potentially affected systems. The impacts will be measured considering three case studies: an industrial area (a petroleum refinery located in Muskiz), an urban area (Plentzia estuary) and a natural protected area (Urdaibai Biosphere Reserve). The third objective deals with adaptation policy that could be implemented at a regional level. A cost-benefit analysis of the different adaptation measures will be carried out, to identify and prioritize the most suitable policy options. Additionally, the role of ecosystem services provided by wetlands on damage mitigation due to sea level rise will also be addressed, as an adaptation option. The results of this project should contribute to raise awareness of regional policy makers and urgency of action to address adaptation to climate change. Furthermore, a range of economic impact estimates and a prioritization of policy options will be obtained, which could be useful for the policy making process.

## Parallel Session 4.5: Policy learning II

### 4.5.1 Dealing with ambiguity in climate change adaptation - conceptual framework

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Abstract A conceptual framework for climate change adaptation at local scale has been developed. The framework is based on an adaptive water resource management approach and theoretically inspired by a couple of EU research projects (NeWater and SWITCH). The concepts have been developed in the Nordic Network on Adaptive Management in relation to climate change (NONAM) and inspired by results from an EU Interreg project (CLIWAT) and Danish funded projects on climate change adaptation for the area around the city of Horsens, Denmark. The framework is based on three main steps: 1) Initiate a learning alliance and agree on scope of vision, 2) Participatory scenario development with identification of 3-4 exploratory and backcasting scenarios for the local/regional area and 3) Participatory modelling of impacts and adaptation options including an assessment of their uncertainties. The framework has been used at a case study on the city of Horsens and the wider catchment area of Horsens fiord focusing on themes like (i) surface water, sewage, waste water treatment plants and draining systems, (ii) groundwater, water supply and protection, (iii) agriculture and open countryside, (iv) infrastructure e.g. houses, roads and railways, (v) physical planning and (vi) cross cutting issues. Results from testing of the first step of the framework revealed that the ability to combine individual solutions from different sectors and consider the positive aspects of climate changes is crucial, since an optimal combination can actually create new values for society and address the challenges in a far less expensive way. Furthermore, there are considerable uncertainties on climate change impacts and sources of uncertainty differ greatly among the various problems. Finally, the uncertainties on adaptation measures are complex with ambiguity as a key uncertainty to address, and therefore the participatory scenario development and modeling is a must in any identification of innovative and robust adaptation options. The paper will present plans for design and further testing of conceptual framework. Furthermore, the last two steps will be discussed with references to the wider literature with special focus on identification of innovative and robust adaptation measures. Keywords: Adaptive management, learning alliances, participatory scenario development and modelling.

### 4.5.2 Conservation and/or Adaptation? Clashing Cognitive Frames in Adaptation Policy at the EU

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A policy analysis was conducted on EU level climate adaptation policy making within the FP7 Climsave project, using semi-structured interviewing with officials working for DG Agriculture, Clima, and Environment and a content analysis of policy documents. The research identified a clash between different framings of adaptation policy and explored the related organisational trajectories that support these frames. One frame, called Ecosystem-based Adaptation, posits that nature conservation and climate adaptation are the different sides of the same coin and consequently present the opportunity for a win-win game. The other frame claims that adaptation has been liberated from the conservation mind-set and constitutes a new way of thinking, challenging the privileging of conservation and accepting that change is inevitable. Another related tension exists between the functional separation of climate issues, including adaptation, and the call for climate policy integration in all policy fields. With the birth of a new DG responsible for climate policy making in EU bureaucracy, new internal power dynamics has been initiated, and the consequent tensions not yet been resolved.

### 4.5.3 Gendering the Local Climate Adaptation Process

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There is reason to believe that climate change will hit women disproportionately hard. Lack of political power, small economic resources, gender-bound patterns in the division of labour and entrenched cultural patterns contribute to making women and girls particularly vulnerable to extreme weather and other climate-related events (Denton 2002; Masika 2002; Brody et al. 2008). This is most evident in developing countries, but even in industrialized countries women generally have less capacity than men to cope with the effects of climate change (Hemmati 2005). In order to reduce long- and short-term vulnerability, adaptation policies are increasingly being adopted at local and regional government levels. This trend is expected to continue and will protect against some climate risks. However, just as changes in climate are likely to impact more severely on women than men, the costs and benefits of adaptation could be unevenly distributed between the sexes. Unless properly designed, adaptive responses may contribute to preserving gender-differentiated distributions of power, solidify stereotypical gender roles and reinforce women's vulnerability to climate change. Given that these are undesired outcomes, institutions and decision processes ought to be remodeled so as to guarantee that gender issues are adequately targeted within adaptation at all government levels. Gender needs to be mainstreamed throughout the adaptation decision process, from the stage where climate threats and vulnerabilities are mapped and adaptation options identified to the stage where options are assessed, implemented and evaluated.

**4.5.4 Cultural Differences in Handling Climate Change Adaptation**

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Abstract: Cultural Differences in handling Climate Change Adaptation  
The perceptions of threats and chances of climate change vary by different agents and social groups. Thus to identify appropriate governance strategies, cultural characteristics need to be taken into account. Knowledge varies locally depending on specifics like history, institutional arrangement and individual values and norms. Actors who want to implement climate adaptation measures, have to consider this local knowledge to be successful. We are interested in socio-spatial differences concerning the perception of climate change, reaching from the processes of construction of knowledge to the implementation of measures. Consequently our main research question is: How is knowledge constructed and which roles do space and culture play? We highlight the ideas of local actors on threats and chances and how they depend on these knowledge bases. By understanding how decisions on climate change are made we want to gain an insight into local governance processes with focus on Europe's coastal municipalities with a special focus on cities. We use three different modules bound by a triangulative research design: A discourse analysis explores the historical genesis of local knowledge. Qualitative expert interviews contribute to comprehend actor knowledge and network constellations. A quantitative survey helps to understand how values and worldviews influence the approval of measures. The triangulative research design allows us to quantify outputs from the qualitative modules and to test hypotheses generated by these modules. The outcome will help actors in politics and administration, economy and civil society to act adequately to challenges to come. Contact: IRS – Leibniz Institute for Regional Development and Structural Planning Flakenstr. 28-31 15537 Erkner, Berlin Tel. 03362-793-270 Fax: 03362-793-111 [heimann@irs-net.de](mailto:heimann@irs-net.de), [mahlkow@irs-net.de](mailto:mahlkow@irs-net.de) [www.irs-net.de](http://www.irs-net.de)

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## Parallel Session 5.1: Enhancing climate services

### 5.1.1 Understanding the landscape of climate services to inform adaptation decision-making

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Climate information and expertise/knowledge to inform adaptation decision and policy making is an evolving area of science and services. As adaptation evolves it is apparent that there is a spectrum of services required; more than just the provision of products, but includes providing and sharing knowledge and expertise. Fundamental to provision of these climate services is science related to generating and communicating knowledge and practices to support development and delivery of climate services. Multi-disciplinary science related to understanding the means of enhancing utility (relevance), accessibility and exchanging knowledge of climate services, as well as understanding users' needs and what constitutes 'good' climate services. This presentation provides insights into perspectives on climate services and the science needed to support its development and delivery. These insights arose as a result of a workshop involving users, purveyors and providers of climate information held in Oxford, UK in November 2011. During the workshop, participants explored users' needs for climate services, the ambitions of the UK research community and users in terms of the research that should underpin development and delivery of climate services, and actions that were needed to support climate service. The insights reflect the maturity and evolving nature of the understanding of the communities represented, the challenges associated with the science needed to support climate services, and perceptions of the roles and responsibilities of the different communities (users, purveyors and providers of climate services).

### 5.1.2 The German Climate Service Center: a national answer to a global challenge

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There is mounting evidence that the earth's climate has changed and will continue to do so in the future. However, the need for adaptation to probably unavoidable climate change is not yet fully recognized. In addition to the lack of understanding of the complex issues around climate change and society's vulnerability, the appropriate institutional structures to assess environmental and economic risks and opportunities and to facilitate the implementation of adaptation measures are often missing. To address this issue, the Climate Service Center (CSC) was created by the Federal Government in Germany in 2009. The purpose is to support the efforts of stakeholders to reduce society's vulnerability to climate change and to enhance society's adaptability to unavoidable changes. In close cooperation with its partners in research, the CSC facilitates the transfer of knowledge from science into practice and vice versa. CSC's products and services address the needs of policy makers in the public sector and of decision makers in the corporate world and are based on observations of the Earth's system, climate and climate impact models, data and information systems, interdisciplinary analyses and evaluations, and communication with stakeholders. In order to achieve its objective the work of CSC is organised along its five strategic goals, for each of which a growing number of examples can be given: 1) Integrate climate change research and adaptation practices in Germany. Develop an interdisciplinary network of research institutions that provides an up-to-date and comprehensive knowledge base such as expressed by the

"climate-navigator-platform". 2) Determine the needs of the various stakeholders for information on climate, climate impacts and adaptation through various dialogue forms and stimulate practice-oriented climate research. 3) Develop demand-oriented products and services in order to a) raise understanding of climate change and the related uncertainties, b) recognize threats and opportunities and c) support decisions on adaptation to climate change, such as various guidance materials as well as customer-specific products. 4) Intensify the dialogue among various stakeholders in order to enable all social groups to adapt to climate change. 5) Develop concepts, services and events that will facilitate and stimulate the institutionalization of climate services at the national and international level.

### 5.1.3 Strong wind exposure and wind-loss mapping in Norway\*

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On the 1st of January 1992 the "New Year hurricane" hit the north-western part of Norway hard. It was the strongest storm ever measured in mainland Norway. More than 50 000 buildings were damaged, some of them were totally destroyed. Total insurance compensation exceeded 200 million NOK. As an effect of global warming, it is anticipated that we may expect more of such extreme events in the future. Whereas Norwegian municipalities do have some control over flood prone areas and can use flood inundation and susceptibility maps in their climate change adaptation planning, no similar assessment exist for strong winds. While the devastating flood in Eastern Norway in 1995 gave the grounds for flood prone zonal mapping, to the best of our knowledge, no similar activity has been carried out to map storm prone areas. This is surprising since strong wind is the most economically damaging extreme weather event in Norway, with higher annual compensation than flood, storm surge, and landslides. With this paper, we aim to identify areas most exposed to strong winds by combining factors increasing places' vulnerability to storms such as distance from coastline, length of coastline, terrain complexity, forest, etc. In Norway, practically all buildings have insurance towards damage caused by natural hazards. The arrangement is managed by the Norwegian Natural Peril Pools. Using annual data from the Norwegian Natural Peril Pools backdated to 1980, the paper also provides a description on the spatio-temporal variability of strong wind compensation using static and dynamic cartographic visualizations. We will also use the compensation data to validate whether or not we were able to identify the storm prone areas. The results – maps and other visualizations – will be used further in dialog meetings with stakeholders who need to take decision regarding future climate change adaptation strategies. Feedback from these stakeholders will direct us in our development of web based visualization tools for strong wind vulnerabilities.

\*A computer demonstration on this topic will be offered in the poster session.

### 5.1.4 Headline Messages: decision-relevant messages on climate change adaptation for Scotland

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Adaptation to climate change has gained more prominence since the introduction of the Climate Change (Scotland) Act 2009 and Scotland's Climate Change Adaptation Framework. As Scotland prepares for a statutory National Adaptation Programme, as well as a number of regional and local initiatives, there is a need for clear

messages on climate change that are decision-relevant for the policy-maker and practitioner - and useful for wider engagement with the public on important issues. Adaptation Scotland is working with partners to produce a set of 'Headline Messages' for Scotland. Although messages have been used before, this approach aims to provide an explicit link to the underlying evidence. We propose a tiered structure with: (i) the high-level message - a couple of sentences - widely accessible; (ii) an information sheet that provides a summary; (iii) a supporting information resource for evidence-base that allows contributors to update and refine the resource (wiki type functionality). The Headline Messages will focus not only on climate impacts, but look at vulnerability and the consequences of climate change, as well highlight the type of actions that might be taken to reduce vulnerability and build adaptive capacity. Most work on understanding climate change impacts and developing adaptation strategies has been under-taken on a sectoral or themed basis (e.g. adaptation framework, UK CCRA, Adaptation Sub-Committee reports), and with good reason. However, it can be challenging to address important cross-cutting issues and identify inter-relationships. We see Headline Messages as being a useful tool to develop these links and provide a consistent set of shared messages that work across sector or theme boundaries. To approach has been developed by undertaking a first Headline Message on 'Adaptation to a Changing Coast' - this has been considered very much a learning exercise. A core working group was formed and this was followed by workshop in March 2013 that was attended by 47 participants from a broad range of organisations, including academics and a wide cross-section of the public sector from national policy makers to practitioners working in local authorities and with communities. This early participation in the process is critical to the approach, as we want a collaborative approach rather than one of dissemination. Adaptation Scotland will be further developing this approach in 2013.

## Parallel Session 5.2: Local adaptation plans

### 5.2.1 Implementing adaptation to climate change at the local level in Norway

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Adaptation to climate change has to various degrees been added to the political agenda in all industrialized countries. In most of these countries adaptation measures are yet to be implemented in legislation and are therefore in practice voluntary undertakings. At the local level of government, this means that adaptation has to compete with other non-mandatory issues. This raises the question to what degree adaptation can and will be implemented. This paper examines how implementation of climate adaptation measures has proceeded in eight Norwegian municipalities. These municipalities were among the first who initiated adaptation to climate change in Norway. In order to measure the degree of implementation a set of indicators has been developed and the eight case municipalities are analyzed according to these indicators. The four indicators are: 1) Assessment of the need to adapt in some sectors; 2) Qualitative vulnerability assessments and/or adaptation measures identified in plans; 3) Quantitative vulnerability assessments, adaptation measures identified in plans, and adaptation measures implemented in regulations; 4) Structural measures and / or adaptation mainstreamed into regular planning processes. We find that seven out of eight municipalities have implemented or have specific plans to implement adaptation measures. These findings show that municipalities are able to implement adaptation policies that are not initiated at the central level, but that it is contingent upon a number of factors: the efforts of individuals within the municipal organization, municipal size, and the use of external expertise.

### 5.2.2 Climate change adaptation and local private actors: a study case of the forestry sector in Wallonia (Belgium)

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Climate change is a growing challenge facing the entire world. Despite crucial mitigation efforts, adapting to remaining impacts will be unavoidable. Adaptation to climate change requires actions at different temporal, spatial and policy scales implemented by different kinds of actors. In other words, adaptation constitutes a multi-level governance issue. With regards to actors of adaptation more specifically, both planned public intervention (for example through climate adaptation strategies or plans and mainstreaming in existing policies) and bottom-up private initiatives are needed. Indeed the roles and responsibilities of public and private actors in this respect are complementary. In this contribution, we propose to focus on private economic actors. Indeed, discussions have recently been more oriented towards public adaptation initiatives than private engagement. There thus exists a knowledge gap in this field. Several reasons can explain this. On the one hand private actors have been more concerned with their role in climate change mitigation than adaptation. On the other hand, only a few businesses or individuals have already implemented adaptation measures, and if existing, there is a lack of hindsight because of their recent realisation. Empirical data are thus relatively scarce. As a consequence, better understanding why and how non-state actors decide or not to adapt constitutes a research challenge as well as a policy issue, namely in terms of incentives to activate. We enter this research object through a study case: the adaptation of local economic actors in the forestry and wood sector in Belgium (in the Walloon Region). This PhD thesis research particularly centres on the motivations of these actors to adapt their practices to climate change impacts as well as barriers hindering action. More specifically, we analyse "objective" motivations and barriers, namely economic, financial and technical barriers, as well as "subjective" ones, in other words so-called socio-cognitive variables relating to risk and adaptive capacity perceptions. Concretely, we will firstly present the theoretical and conceptual framework of our research, based on existing literature in the field. Secondly the qualitative methodology used for the fieldwork and first parts of results will be presented and discussed.

### 5.2.3 Risk and vulnerability analysis – a feasible process for local climate adaptation in Sweden?

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Climate change is an important new challenge for local authorities to handle. This study analysed the potential for using the Swedish mandatory process for risk and vulnerability analysis (RVA) as a vehicle to improve local climate adaptation work. An advantage with RVA is its comprehensive approach in dealing with all relevant threats and all vital functions of society. In order to test the applicability of incorporating climate adaptation into RVA, we studied practical experiences from three Swedish municipalities in which RVA was conducted in two steps; a pre-study to identify relevant climate-induced events, followed by more detailed analysis of the potential impacts of these events on the functions of the various administrations and companies within the local authority. Problems identified in successful integration of climate change into the municipal RVA process were lack of sufficient knowledge to identify the impacts of climate change on the level of the respective specialist

or district administrations, and lack of resources to perform the analysis. There were also some difficulties in including a long-term perspective relevant for climate adaptation into RVA, which usually focuses on current threats. A positive outcome was that work on extreme climate events in RVA provided a traceable method to identify events with a potentially great impact on the function of local society and results that could be fed into other ongoing processes.

#### 5.2.4 Generic constraints for adaptation in multi-level governance contexts: Lessons from Australia and Finland

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Climate adaptation has become an accepted component in the pursuit of addressing the projected impacts of climate change. Decision- and policy-makers are increasingly applying adaptation science and theory in order to make right decisions on how we can better prepare and enhance our resilience and adaptive capacity. However, many institutions struggle in accommodating climate adaptation in the already strained institutional agenda, let alone knowing exactly how to incorporate it into the everyday decision- and policy-making processes. Several groups of constraints impede the adaptation progress and delay its implementation. These constraints commonly relate to issues around governance, finances, socio-cultural aspects and knowledge. We apply a generic typology of adaptation constraints in examining how institutional adaptation processes are constrained in multi-level governance settings. Using specific examples from the urban regions of Helsinki (Finland) and the Gold Coast (Australia), we describe the array of constraints that arise when planning for adaptation. The comparative approach enables a robust approach in advancing our knowledge of the generic types of constraints while being mindful of their context-specificity. We identify constraints embedded among existing policy priorities, hierarchical and cross-sectoral governance structures, differing values and institutional and individual beliefs about the extent, magnitude and timing of climate change. Through this comparison of context-specific adaptations, we draw broader lessons in explaining how some of these constraints can be overcome and identify drivers that could enable adaptation to become a more relevant issue on the institutional agenda.

### Parallel Session 5.3: Projecting impacts and adaptation responses

#### 5.3.1 Impacts and adaptation options of climate change on ecosystem services in Finland: a model based assessment

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Ecosystems generate a range of goods and services important for human well-being, collectively called ecosystem services. Over the past decades, progress has been made in understanding how ecosystems provide services and how service provision translates into economic value. Nonetheless, the losses of ecosystem services continue more rapidly than ever. Research in this field is also of great need in national science and policy regarding topics such as ecological restoration, ecological compensation and sustaining ecological security. It has still proven

difficult to move from general pronouncements about the tremendous benefits nature provides to people to credible, quantitative estimates of ecosystem service values. Furthermore, climate change provides a major challenge for the sustainable management of key ecosystem services. These changes are affecting ecosystem structure and spatial patterns, driving changes in species distributions and numerous processes in both terrestrial and aquatic ecosystems. Sector-specific adaptation measures are therefore needed. These adaptation measures have to be based on the understanding of (i) the likelihood of change, (ii) vulnerability of the specific ecosystem services to the predicted change, (iii) information about trade-off relationships, and (iv) knowledge about the local-scale possibilities for adaptation. This paper synthesises the main results of a major recently finished project analysing the impacts of climate change on key ecosystem services in Finland (VACCIA-project, [www.environment.fi/syke/vaccia](http://www.environment.fi/syke/vaccia)). The results on impacts and thresholds were also used to assess adaptation options together with regional stakeholders and authorities. The results are currently utilized in the updating process of the Finnish national climate change adaptation strategy. The project was funded by the LIFE+ instrument of the EU. Co-ordinated by the Finnish Environment Institute (SYKE), it also had participants from the Finnish Meteorological Institute and the universities of Helsinki, Jyväskylä, and Oulu. The project was based on data and infrastructures of intensively studied areas belonging to the Finnish Long-Term Socio-Ecological Research network (FinLTSER, [www.environment.fi/syke/ltser](http://www.environment.fi/syke/ltser)). Climate change impacts in terrestrial, lake, coastal and urban ecosystems were studied, and adaptation options regarding the agriculture, forestry, fisheries and (nature-based) tourism sectors were assessed in the project.

#### 5.3.2 Adaptation to climate change in agricultural water protection – Catchment scale model analysis

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Risks for surface and groundwater quality are predicted in Finland's National Strategy for Adaptation to Climate Change. Expected increase in temperature by 3-6 °C and precipitation by 10-20% will lead to milder winters and increase in non-point source loading from catchments dominated by agriculture, due to enhancing runoff, floods and decay of organic matter. As a result, eutrophication of waters will increase. At the same time conditions during growing season will change which means that changes in agriculture and crop production are needed. In this work we created storylines for agricultural production influenced by climate change. We selected two well monitored catchments as case study areas in Finland. In both catchments nutrient loading to the river origin mainly from agriculture. The Lepsämänjoki catchment represents crop production areas while in the Yläneenjoki catchment main production line is animal husbandry. The Lepsämänjoki catchment belongs to the Finnish network of LTER sites and it was the study catchment in LIFE+ project 'Vulnerability assessment of ecosystem services for climate change impacts and adaptation'. Yläneenjoki is one of the major demonstration sites in the EU FP7 project REFRESH. REFRESH aims at developing a framework for designing cost-effective restoration programmes for freshwater ecosystems at catchment scale, that account for the expected future impacts of CC and land-use change in the context of WFD. We model the influence of changed climate on runoff and nutrient leaching with and without different water protection measures, taking into account the changes in agricultural production. Our aim will be to answer the question whether the concern of increase in nutrient loading due to climate change is justified, or is it possible to compensate that with either water protection measures defined in agri-environmental policy and other political targets, or climate change - induced changes in agricultural production. The results propose that one of the key targets in aiming at sustainable agriculture in changing climate, is to have more closed nutrient cycles in arable land. This could

partly be achieved by optimized fertilizing and increase of wintertime crop cover, but targeted adaptation in cropping systems and agricultural management practices is also needed.

### 5.3.3 New 30-year time series of agroclimatic indicators for present and future climate as a basis for assessing different adaptation strategies for crop production in Finland

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As a component of two studies that focus on exploring the limits of adaptation and on assessing and enhancing the resilience of agrifood systems in Finland, this paper presents a unique set of 30-year time series of nineteen agro-climatic indicators, generated for current (1971-2000) and projected future climates. The choice of 19 agroclimatic indicators is based on previous studies for Europe and Finland, but their calculation and high resolution mapping has been undertaken for the first time across the whole of Finland and for a new set of 32 climate scenarios. The specific objective of this paper is to identify areas in Finland where yield formation of spring barley is currently most prone to climate-induced stresses, and to evaluate how the severity of these stresses is likely to develop in time and space under a wide range of future climate projections. Such information can be valuable for appraising alternative strategies for adapting cereal cultivation to uncertain projections of future climate in Finland. To this end, we have developed a software tool labelled "arctic AgriCLIM" for the automatic generation of nineteen agroclimatic variables, describing basic agroclimatic conditions such as intercepted radiation over the growth cycle, late frost, heat and drought stresses during various growth stages of a spring barley crop. Calculations have been performed for 3829 grid boxes at a 10 x 10 km resolution covering the whole of Finland. Maps were generated showing long-term means for the baseline (1971-2000) and for three future time slices (2011-2040, 2041-2070 and 2071-2100). Time series spanning the 30-year periods are presented for selected indicators and individual grid boxes to illustrate local variations of interest. Ranges of projected changes in indicators of heat, drought and other crop-relevant stresses across the scenarios are considerable. Likewise, spatial patterns of change also vary widely. The various spatio-temporal patterns of future agroclimates and their likely consequences for barley cultivation and required adaptation measures are discussed. The results provide an opportunity to identify regions in which changes might be rapid or otherwise notable for cereal production. In particular, such regions can subsequently be targeted for detailed analysis with crop models to compare alternative adaptation strategies for future cereal cropping in the face of climate risks (e.g. strategies of diversification versus optimization).

### 5.3.4 Probabilistic assessment of crop adaptation options under a changing climate

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When modelling future crop yield a wide variety of uncertainties attributable to future climate projections, crop model parameters and assumptions of crop management should be accounted for. This study reports an approach for undertaking a simultaneous analysis of

these multiple uncertainties and model sensitivity to climate. The aim is to offer insights into future risks of yield shortfall and potential adaptation options. The approach involves the construction of impact response surfaces (IRSs) using a sensitivity analysis of simulated crop responses to changes in temperature and precipitation relative to the present-day, and assuming a scenario of future CO<sub>2</sub> concentration. Each IRS is overlaid with a probabilistic climate change projection, presented as a joint probability density function (pdf) describing uncertainties in ensemble climate model projections of temperature and precipitation for a future time period. The risk of yield shortfall is then estimated by defining a threshold yield level and calculating the region of the pdf describing climates that generate yields below the threshold. In the analysis changes in long-term mean average yields and in inter-annual variability are both considered. Using this procedure for the same IRS over different time periods produces an estimate of evolving risk attributable to uncertainties in future climate. Repeating the exercise across multiple IRSs constructed for different combinations of plausible crop and management parameter values applied to a crop model generates an ensemble of risk estimates encapsulating both climate and crop model uncertainties. The choice of parameters to vary and ranges of values for varying them is based on possible adaptation options available through the introduction of alternative cultivars and modification of management practices. The method is applied to yields of spring barley in south-west Finland, simulated using the WOFOST model, initially for a locally grown cultivar. Crop yields and climate change uncertainties are presented for 10-year intervals into the future assuming an SRES A1B scenario. Options for adapting cropping to a changing climate are then investigated by identifying parameter combinations with optimal performance for future time periods and comparing these with alternative crop cultivars currently grown outside Finland.

## Parallel Session 5.4: Energy and infrastructure

### 5.4.1 Adapting utilities to climate change – challenges, conflicts, and barriers in Germany

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Based on a multi-method approach, the study empirically analyses the role of private and public actors involved in adaptation to climate change in the German utility sector. We explore and analyze the different actor's perceptions and estimates of adaptation needs and options as well as their different interest and logics. The multi-method approach includes a quantitative survey, qualitative in-depth case studies on selected companies from the rail transport and power supply industries, and transdisciplinary multi-stakeholder workshops in the energy and transport sector. The most important results from the survey show (1) the perceived low tangibility of climate-related changes, (2) the dominance of other, short-term themes and goals, (3) the perceived low reliability of data on climate change induced weather changes and a high perceived uncertainty concerning scientific models and projections. The qualitative analyses confirm these results and reveal more specifically that energy companies perceive adaptation to climate change as less relevant than other challenges and pressures such as market dynamics and legislative and political changes in the context of the transformation processes in the German energy system. Although companies from both sectors have already experienced consequences of varied extreme weather events within the last years, they do not yet perceive these events as a clear cue for climate-related risk appearance that need to be acted on. Extreme weather events

remain to be considered as single and low-probability events that have already existed in the past. Furthermore, the study reveals unclear responsibilities and an institutional void, since private actors claim politics and regulators to provide financial and regulative incentives for adaptation. By the same token, public authorities regard companies as responsible for provisioning a functional and reliable infrastructure within the existing regulatory framework.

#### 5.4.2 Adaptation to climate change of engineering structures

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The intensity and frequency of extreme environmental events will change because of climate changes. Such extreme events pose a number of threats to engineering systems, infrastructures and structures in general, hence requiring adaptation of these structures. Adapting structures to climate change requires decision making under uncertainties. Uncertainties stem from the inherent randomness of the weather; from the necessary idealisations made in modelling physical processes, orography, etc.; from uncertainty regarding future releases of aerosols and GHGs in the atmosphere; from uncertainties regarding resulting effects and threats to assets. Due to the enormous values at stake, a rational framework for decision making under uncertainty is required. Det Norske Veritas (DNV) is developing a Recommended Practice (RP) for adaptation to climate change that aims at providing such a framework with a risk-based approach. The RP will assist engineers – as well as decision makers non-expert in climate science – in evaluating risks imposed by adverse climate change effects in their design or reassessment of structures. In this respect, DNV has developed a work flow that includes the main phases of a climate change adaptation analysis in a sequential manner. The work flow includes the following main phases: 1) description of the structure being analyzed, possible failure modes and identification of the hazardous weather events; 2) selection of plausible General Circulation Models capable to reproduce the climate phenomena underlying the weather events of interest; 3) downscaling and use of environmental models for impact assessment; 4) statistical and risk analysis. The final outcome of the work flow is a risk-based identification of adverse climate events, of the possible adaptive measures to be undertaken, along with recommendations to decision makers towards the minimization of the risks. Due to the paramount uncertainty involved with climate projections, the RP employs a definition of robustness in decision making that is used to quantify the robustness of the identified adaptive measures. Preliminary results from a test case will also be illustrated. The above work has been carried out in collaboration with a number of institutions: DHI (Denmark), The Bjerknæs Climate Research Centre (Norway) and the Niels Bohr Institute (Denmark)

#### 5.4.3 A Bayesian Classifier for Climate Model Ensemble Selection

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Several studies today are advocating for and using multi-model ensemble analysis because “there is evidence for combining multi-model ensembles increases the skill, reliability and consistency of model forecasts” and that “combining information from several models is reported to be superior to a single-model forecast”. However, most of the work carried out in this respect has mainly focused on the mean and, occasionally, on the standard deviation of

the probability distribution of meteorological variables. In the field of adaptation of engineering structures the capability to capture also tail behavior is essential; only few have addressed this aspect, see for instance Perkins et al. (2007). Bayesian methods have been used to identify optimal weights on ensembles (Rajagopalan et al. 2002, Robertson et al. 2004). In the present study we use an apparently similar Bayesian method to obtain the weights on the ensemble models. However, in our study we use a Bayesian network to set up the mathematical problem. This leads to a more intuitive understanding of the Bayesian model formulation. The updating is made by using the historical relationship between model forecasts of and observation records of the same variables. In the presentation we give a short introduction to Bayesian Networks before presenting the Bayesian classifier for climate model ensemble selection. The procedure will be illustrated by application to variables of interest in typical engineering cases for which estimates from different GCM-RCM combinations were available. The ability of the proposed method to arrive at an ensemble distribution reproducing also the tails of the observed distribution will be illustrated. Perkins, S.E., Pitman, A.J., Holbrook, N.J. and McAneney, J., 2007: Evaluation of the AR4 climate models' simulated daily maximum temperature, minimum temperature, and precipitation over Australia using probability density functions. *J. Clim.* 20(17), 4356-4376. Rajagopalan, B., Lall, U. and Zebiak, S.E., 2002. Categorical climate forecasts through regularization and optimal combination of multiple GCM ensembles. *Mon. Wea. Rev.* 130, 1792–1811. Robertson, A.W., Lall, U., Zebiak, S.E. and Goddard, L., 2004. Improved Combination of Multiple Atmospheric GCM Ensembles for Seasonal Prediction. *Mon. Wea. Rev.* 132, 2732–2744.

#### 5.4.4 Governing quasi-public network services for adaptation to climate change

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The climate is changing – and rapidly. While the mitigation of greenhouse gas emissions has dominated political and scientific attention for some years, it is now widely acknowledged that these mitigating efforts are neither going to be sufficient, nor happen quickly enough. It is necessary also to look into how we can adapt to meet the challenges of the changing climate. Climate change adaptation (CCA) can be undertaken by individuals, but often it is done by organizations, or at least within an organizational setting. CCA takes place in both private and public sectors, or as an interrelation between the two, and often under the realm of public regulation. For this reason it is important to look into what enables or disables organizational CCA in the public-private nexus, and what function public regulations and sector cultural context have in influencing adaptive capacity. This paper does this by analyzing quasi-public network service CCA capacity. The sectors represented by this term, like the electricity- postal-, railways- and telecommunications sectors, provide the public with vital services for the functioning of society. The paper utilizes empirical data from the electricity grid sector in Norway and Sweden to illuminate barriers and facilitators to adaptation. Such CCA capacity stems from formal (regulatory) structure and the organizational culture in the sector. Formal structure is the rules and regulations that determine which actors can do what, and what sanctions and incentives can be used, while organizational culture directs the attention towards the dominant norms and values within the sector. Quasi-public network services like the electricity grid sector usually represent natural monopolies to a varying degree and are providers of an important public good. They usually have to balance the need for robustness and quality of service supply with economic efficiency, all under strict public regulation. This has implications for CCA capacity. Against the backdrop of the reforms in all the mentioned sectors in the western world between

1990 and 2010 these characteristics make the network services and the electricity grid sector good examples for analysis of CCA capacity in the public-private nexus. This paper uses the example of the electricity grid sector to illustrate and discuss the more general implications for the capacity for CCA in the public-private nexus.

## Parallel Session 5.5: Health and well being

### 5.5.1 Climate change and infectious disease in Europe: Mapping future vulnerabilities

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Climate change and infectious disease in Europe: Mapping current and future vulnerabilities Jonathan E. Suk and Jan C. Semenza Global climate change can shift the distribution of infectious diseases. Europe has a number of distinct climatic regions with specific climate change vulnerabilities. The quantitative outcome of these impacts on infectious diseases is uncertain. Two surveys were conducted, one in 2007 and one from 2009/2010, with national infectious disease experts from 29 EEA countries. The aim was to capture their assessment of the projected epidemiologic situation for vector-, food-, water-, and rodentborne microorganisms under climate change scenarios and to identify the most pressing needs for adaptation in the health sector. Subsequently, we developed a series of indices, based upon climate change and socioeconomic scenarios, to identify which regions within Europe would be most vulnerable to vector-borne, water-borne and food-borne infectious diseases. The large majority of experts agreed with the epidemic potential of these pathogens as a result of climate change. The proportion of countries reporting concerns was 83% for vectorborne; 68% for waterborne; 70% for foodborne; and 68% for rodentborne diseases. Specifically, 83% of countries were concerned about borreliosis; 69% about West Nile fever; 63% about tick-borne encephalitis; 62% about leptospirosis and 60% about salmonellosis. We then developed a series of vulnerability maps identifying research gaps, key vulnerabilities, and adaptation requirements across Europe. We suggest that scarce public health resources can be allocated more effectively by conducting impact, vulnerability and adaptation assessments, on a regional or national scale. Surveillance activities, meanwhile, should be tailored to the most appropriate region, season, and pathogen and guide strategic adaptation to climate change.

### 5.5.2 Climate change and health - building resilience through eHealth

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Climate change is by many considered to be today's most pressing global issue and evidence is accumulating that we are approaching the point in time where it may have irreversible impact. As many as 85 of 102 diseases investigated in the 2006 WHO report Preventing Disease Through Healthy Environment is related to environment and many of them are expected to become worsened by global warming. Thus, there is an urgent need to design and implement adaptation strategies to decrease the society's vulnerability to climate change. Health information technology, i.e., eHealth or telemedicine, have great and so far relatively unexplored potential as climate change

adaptation approach. Examples of promising strategies are; the use of telemedicine to provide care in anthropogenic and natural disasters, strengthening of public health surveillance using mobile technologies, and promoting knowledge, awareness, and preparedness among the public and health workers in regions with large burden of disease through remote health education programmes. Ideally, strategies for building resilience to climate change should be climate neutral to avoid the dilemma where the adaptation strategy leads to further increases in green house gas emissions. Also from this perspective, eHealth is a promising solution, based on its potential to make health care a greener business, e.g., by reducing a substantial amount of travels for patients and medical professionals. Furthermore, eHealth is highly valued for its potential to improve the safety and efficiency of the health care and the opportunity to provide care to remote and poor regions, where health services are meagre or absent. The embracing of eHealth has been slow due to limitations in technological infrastructure, capacity and political will. Hence, there is a need for quantitative and qualitative assessments of the climate benefits of eHealth and evidence-based policy strategies to promote efficient implementation of eHealth as climate change adaptation and mitigation strategy.

### 5.5.3 Climate change adaptation in practical level tourism development

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This abstract discusses tourism development from standpoint of climate change by examining the infiltration of climate change awareness into practical level tourism development and its relation to sustainable principles. The presentation is based on the assumption that national and international policy processes create structures that guide, promote and sometimes limit certain types of tourism development and tourism consumption, while local policy governance networks and tourism stakeholders are in a major position in the implementation of these structures and guidelines. The findings of the study indicate that the theoretical idea of local and regional scale policy documents and strategies working as intermediates between local and global scales is not fully manifested in relation to climate change. With climate change being such a high level international concern, it is surprising how little advice the tourism strategies at different scales give on concrete planning and preparing for climate change. Sustainable tourism development, by comparison, has been transformed clearly towards goals and actions in all of the policy levels, while climate change remains abstract and avoids local scale strategies and actions. Thus, it seems that climate change awareness has not found its way to the practical level yet. One reason for this may be the small amount of research that has been conducted – or there are enough research publications and volumes, but policy-makers do not have access, knowledge or a perceived need to search them. In spite of the reason, there does not seem to be enough useful information available for decision-making and practical uses of the tourism industry. Research-driven participatory development projects may be of assistance in this matter, but active collaboration between the researchers and tourism stakeholders and the 'marketing' of study results may be more widely required in the future. Nevertheless, the analysis of tourism destination development plans indicates that also the general development objectives of the tourism destinations – sustainability and year-round tourism – may support and actualise as adaptation to climate change. It is also worth noting that the high natural variability of the climate in Finland has given the tourism industry a good basis for adaptation to permanent change in climate.

**5.5.4 Climate change vulnerability indicators for cross-country skiing**

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Winter tourism and recreation sector in Finland is vulnerable to anticipated climate warming. Physical impacts on snow cover will have adverse effects on skiing conditions, social impacts are expected including reduced well-being and an erosion of skiing tradition, and economic impacts brought about by a decrease in participation. Overall, vulnerability to climate change is expected to differ regionally, but there has been little work to develop and refine quantitative measures for the sector. In this study, quantitative indicators of regional vulnerability are proposed, which can be applied as a mapping tool across Finland developed by MAVERIC (Map-based Assessment of Vulnerability to Climate Change Employing Regional Indicators) project. An approach to measure vulnerability of cross-country skiing is introduced. Such vulnerability assessment based on physically-based information from observations, and socioeconomic information obtained from extensive survey data of skiers living in climatically different regions is unique. We focus primarily on the socioeconomic indicators of vulnerability, which are structured around skiers' actual, self-reported, and anticipated preferences, perceptions, and behaviour. The indicators consists of three main dimensions of vulnerability: Exposure describes the direct climate change effects on (regionally adjusted) skiing conditions, Sensitivity refers to the assumed (hypothetical) reaction to changed conditions, and Adaptive capacity is the ability to cope with changing conditions, which was subdivided into attributes of Awareness (the personal identification and perception of changed conditions), Action (the tendency to adapt by adjusting behaviour and preparedness and willingness to invest time and money for skiing), and Ability (skiing skills and available equipment). The individual indicators could be quantified and combined into composite indices describing each dimension of vulnerability separately, and as an overall vulnerability index, and tested at different sub-regions. The Finnish winter tourism and recreation sector exhibits regional variations in vulnerability to climate change. These can be explored using indicators of physical and socioeconomic vulnerability, and displayed individually, or combined into vulnerability indices, and further utilized in a practical mapping tool. This study serves as a national assessment, but also offers insights at regional and local level.

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## Abstracts of Poster Presentations

### P1 Climate Information: Using the Spotfire platform to improve data visualisation and accessibility of UK climate projections\*

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Adaptation Scotland has been supporting the development of climate information on Scotland's Environment Website - a Life+ project to provide a gateway to environmental information. The UK Climate Projections (UKCP09) provided ground-breaking access to the data set and a variety of data visualisations. However, accessing this information remains a significant barrier for many who want to use climate information to understand the implications of climate change for their locality or organisation. Scotland's Environment website project has provided the opportunity to use the Spotfire software platform to develop innovative approaches to deliver data visualisation and analysis through a web-based platform. We have been able to progress fairly quickly, benefitting from the flexibility and short development time of the platform - it is hoped that initial public releases will be from mid-2013.

\*A computer demonstration will also be offered on this topic.

### P2 Property managers compliance in property insurance policies, focus on flash flooding

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Extreme weather events such as droughts, heavy raining and floods are increasing due to water cycle acceleration. Seen mostly in Central Europe, major flooding caused by heavy raining in urban areas can be possible also here in Finland. Heavy raining especially near built-up areas can cause severe economical damages to regional economy since sewer networks are not designed to lead vast amounts of excess water during flood peaks. In worst case scenario heavy rain flooding or better known flash flooding can halt economic productivity in regional economy and cause negative impact far in to the future. Insurance coverage of the area however can affect to how fast regional economy can recover to normal growth rate after the damages of flash flooding. In my Master's thesis assigned for the Finnish Meteorological Institute I focused reviewing condominium and real estate property insurances especially covering flash flooding damages. Building managers appointed by the condominium apartment owners are responsible at following protection guides and rules written in the property insurance policy. If protection guidelines are not followed, it is possible that the insurance company will not compensate losses when the risk occurs fully or in worst case at all. This leaves condominium and real estate owners to pay the spread not covered by the insurance company. In my study I did a quantitative research using electronic questionnaire to 1 258 property managers in Finland. Response rate was 20.5 % so in total 258 property managers responded to my survey. Result of this study showed that the building manager's knowledge about the property insurance coverage was relatively good. However the most important factor, knowing the protection guides and rules in property insurance policy, was poor. About 79 % of property managers surveyed neglected the protection guidelines set by the insurance policy and about 66 % of property managers admitted themselves straight that they do not know very well protection guideline requirements set in insurance policies. If flash flooding occurs in Finland near urban areas there is a significant danger that buildings will not get full coverage from the insurance and this will have negative effect in regional economy in general.

### P3 Adaptation to coastal flooding on household level: To what extent is it determined by nationality?

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Household-level adaptation in coastal areas can effectively contribute to enhanced resilience to increased flood frequency and intensity due to sea-level rise. Nationality or characteristics of individuals may however influence coastal dwellers' decisions on whether to adapt and to what extent. This study explores proactive adaptation of coastal dwellers to future changes in coastal flooding. Surveys using quantitative questionnaires were conducted in coastal areas with similar exposure in Greece and Denmark. Adaptation was assessed by a list of 21 single measures, which are feasible in both countries. Individual variables such as personal experience, fear and reliance in public protection were investigated. Results show that adaptation depends both on the nationality and on the characteristics of individuals.

### P4 MAVERIC: interactive mapping of vulnerability to climate change at a municipality-scale in Finland – online demonstration of an internet mapping tool\*

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"Map-based assessment of vulnerability to climate change employing regional indicators" (MAVERIC) is a project that aims to map quantitative measures of vulnerability to climate change at municipality scale across Finland. Vulnerability is defined as the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change. It can be characterised as a function of the exposure, sensitivity and adaptive capacity of a system to climate change. Indicators of exposure, sensitivity and adaptive capacity for present-day and mid-21st-century have been developed on three themes: the elderly, winter outdoor recreation and agriculture. The indicators combine information of the physical conditions with socio-economic data obtained from various sources. Scenarios were developed to project these indicators into the future. An internet-based, interactive mapping tool was developed for visualizing these indicators and combining them into user-selected indices of vulnerability. The tool allows users to explore individual indicators through an interactive map server application and to map combinations into indices of vulnerability. The tool is designed to allow users to explore these aspects (e.g. by selecting indicators of

interest, mapping them alone, weighting them, combining them, and/or looking at them in conjunction with exposure indicators under different climate scenarios), rather than predefining the factors that influence vulnerability. Uncertainty in several indicators is represented by the use of scenarios which can be compared in the tool. The vulnerability mapping tool potentially can aid in regional adaptation planning. It is available online at: [www.iav-mapping.net/MAVERIC](http://www.iav-mapping.net/MAVERIC).

*\*This presentation will be in the form of a computer demonstration.*

## **P5 Co-operating efforts within the Nordic Framework for Climate Services**

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During 2011 a framework for Climate Services was initiated within NORDMET co-operation between the Nordic National Meteorological Services. The aim of NORDMET is to achieve better cost efficiency by sharing resources in such areas as observation, information, production and education. The main objective for the new group Nordic Framework for Climate Services, NFCS, is to boost the availability of climate information in the Nordic countries, by developing and sharing best practices in data handling, products and communication. NFCS activities on climate are complementary to those carried out by the National Meteorological and Hydrological Services (NMHS) and focusing on elements where integration could be beneficial. An operational working group within NFCS has been active since the autumn of 2011. The group identifies and proposes high-priority activities and develops strategies to advance visibility and usability of Nordic NMHS' climate services for user communities. Within this work meetings and workshops are organized to develop methods and concepts of climate services for various user groups. There is also collaboration on provision of data and expertise, on developing tailored climate products, and promotion of joint methodological development. Another collaborating effort concerns ways of communicating the scientific content of climate information to different user groups. Furthermore, NFCS will contribute to international collaboration on climate services, GFCS, EUMETNET, GMES, Arctic activities and so forth. Within the NFCS the NMHS have shared experiences on calculating climate normals. Most of the Nordic NMHS' have calculated normal values for the period 1981-2010. Analyses performed for Fennoscandia and Iceland within NFCS show higher average temperatures during 1981-2010 than for the standard normal period 1961-1990 for all seasons and for all parts of the region. Members from the NFCS working group have also gathered for a meeting where sharing good examples of communicating climate change and climate adaptation was in focus. During 2012 the group continues with collaboration on homogenization of long time series of climate data, web portals as well as efforts in the field of heavy precipitation and storm water management. In addition, other NMHS will learn from the Finnish Meteorological Service example of climate change education for journalists. Further, a Nordic end user meeting will be organized by the working group.

## **P6 Visualization supported dialogue for climate adaptation in the Baltic Sea Region**

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This proposed presentation focuses on the potential of visual representations and interactive visualization tools to support data analysis, communication and capacity building within climate change adaptation. This paper presents a recent pilot study on visualization supported dialogues for climate adaptation in the Baltic Sea Region as part of a Baltic Sea Region Workshop: Adapting agricultural practices and production to climate change. This workshop brings together a number of stakeholders from each Baltic Sea country (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia, Sweden), with representatives from farmer's associations, agricultural extension services and agricultural administration, from the national, regional to the local level. The aim of the workshop is to identify long-term goals for the agricultural sector in various parts of the region, through a discussion of opportunities and challenges for climate adaptation and an identification of environmental impacts. The inherent complexity of climate change adaptation calls for new ways of communicating and analysing indicators, assessments, and monitoring as well as the linkages between sustainability challenges. Visualization can be an effective tool to support researchers, decision makers and the general public in these tasks. This presentation focuses on the evaluation of an visualization supported workshop and what role visualization plays in decision support on climate adaptation focusing both on participatory dynamics as well as functionality and perception of the visualization platform. The project is a collaboration between the BaltAdapt project (INTERREG Baltic Sea Region (BSR), [www.baltadapt.eu](http://www.baltadapt.eu)) and the Nordic Centre of Excellence for Strategic Climate Adaptation NORD-STAR ([www.nordstar.info](http://www.nordstar.info)).

## **P7 LandCaRe-DSS, an interactive, model-based decision support system for scenario-driven climate change adaption in agriculture**

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The expected change of climate will influence agriculture in a multidimensional manner. Every dimension by itself can be well covered by existing approaches, whether model based or through qualitative assessments. The real challenge today lies in the interaction of these dimensions. Few tools support an integrated assessment of agriculture and ecosystems whereupon the decision makers build. The LandCaRe-DSS, a decision support system for climate change adaption in agriculture, tries to close this gap. It is designed as a user friendly, interactive, model-based and spatial-oriented information and decision support system for a wide range of stakeholders and spatial scales. The system supports long-term and ensemble simulations with a high spatial scale while trying to stay fully interactive. Spatial scales are bridged by a zooming user interface well known from systems like Google Maps® or Google Earth®. The LandCaRe-DSS incorporates the analysis of climate data, models for indicators of agro-landscapes (soil erosion risk, regional water run-off, arable- and grassland productivity, irrigation water need, etc.) at the regional level, an agro-ecosystem model at the local scale as well as economic assessments at the farm-level; all coupled with climate and agro-economic scenarios. Additionally the system is designed to be extendable with further modules for different tasks. The LandCaRe-DSS particularly assists strategic planning in agriculture and sustainable

development of rural areas and provides answers concerning the effects and costs of possible adaptation measures to climate change and the future climate-induced variability of both. Just stepped out of prototype state, the LandCaRe-DSS is parameterised and validated for two regions in the North-Eastern part of Germany, being used for scientific studies in the Federal State of Saxony and in the near future extended to support land-use change studies under climate change conditions in southern Amazonia/Brazil.

### **P8 Bridging the gap between Science and Society**

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During the present century, the global society and the ecosystems of the earth will experience multiple and rapidly increasing effects of climate change. The societal needs and research questions connected to both global and local scales are large and complex. For the scientific community to be able to deliver the knowledge needed to assess the risks humanity is facing from global change, and for the society to be able to make informed decisions on mitigation and adaptation, it is necessary to bridge the gaps both between research disciplines and between research facilities and the society. This can be done by combining interdisciplinary research collaboration within strong independent research facilities, with integration of stake-holder needs and requirements into the scientific process. Providing such a node, Lund University in Sweden has started an integrated cross-disciplinary research centre, the Centre for Environmental and Climate Research. Among other tasks, the Centre hosts a cross-faculty venture, the Climate Portal, designed to coordinate information and knowledge of climate-related research and to facilitate multidisciplinary communication within the university and to the society. Reference groups with stake-holders from different sectors within society have been invited to participate in the development of strategic research areas, to participate in an ongoing dialog to contribute ideas and research needs, and to respond to the research carried out at the Centre. Our stake-holders include private companies, NGOs and government authorities. The stake-holder cooperation has been particularly useful in the development of three interdisciplinary strategic research areas hosted at the Centre and involving several universities and research institutes. The first research environment is producing knowledge and tools for guiding the development of a sustainable agriculture, where biodiversity and ecosystem services are managed as assets to society. The interdisciplinary approach integrates the chain governance - land use - landscape structure - biodiversity - ecosystem services. The second research area is addressing biodiversity and ecosystem services, and the consequences of ecosystem changes for human beings and socio-economic systems. The third strategic research area combines high profile research using global and regional Earth System models, with improving the societal relevance and information transfer of the modelling results.

### **P9 Skiing on thin snow? – Assessing the usability of a planning support tool on climate change-related vulnerability of winter outdoor recreation in Finland**

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Planning support systems (PSS) are at an increasing pace being developed to aid the planners in their work that is increasingly complex, demanding knowledge from many different fields and

requiring co-operation from a large number of actors. In its simplest form, a PSS consists of baseline information, models working on it and visualization of the acquired results. Often, but not always, the data is geocoded to include a GIS component (Geertman & Stillwell 2009). Challenges in using models to aid real-life decision making are numerous however. As stated among others by van der Hoeven et al. (2009) and te Brömmelstroet (2011), planning or (in a more confined sense) decision support tools or systems should at the same time be simple, user-friendly and exciting, but also trustworthy and transparent in terms of modeling choices made and datasets used. However, the inherent uncertainty present in doing forecasts on underlying issues such as socio-economic development and the impacts of climate change make achieving these goals difficult – especially so when we are dealing with long-term strategic planning. As a part of the MAVERIC-project (Map-based assessment of vulnerability to climate change employing regional indicators, Finnish Environment Centre, 2009-2012), YTK - Land Use Planning and Urban Studies Group at the Department of Surveying and Planning, School of Engineering, Aalto University in spring and summer 2012 conducted a series of workshops to test the usability of a map-based tool produced in the project, measuring the impact of climate change on winter outdoor recreation in Finland. A total of three workshops took place in Northern (Lapland), Eastern (North Savo) and Southern Finland (Uusimaa and Southwest Finland). This paper addresses the results of these workshops in terms of a critical assessment on the suitability of model-based tools in assisting long-term climate-proof decision making, from public and private actors' point of view.

### **P10 Smart Phone Application for Promoting Climate Change and Food Safety Awareness**

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Since the main causes of climate change are mostly attributable to human consumption, it is critical to target consumers. Inducing behavioral changes in consumers is a very difficult process, but it is necessary and must be conducted. The most comprehensive and basic method for this is persuasion through education. This study intends to develop content suitable for consumers to provide them with easy and accurate information on climate change and food safety. Promotional medium selected was a smartphone-based mobile application in consideration of the promotional effect and accessibility. It will describe Definition of Climate Change, Climate Change & Food Safety, Climate Sensitive Foods, CSF, and Activities and Actions for Consumers. Each menu makes use of behavioral elements, moving left and right, and in particular, in the part of climate sensitive foods, it explains to users the *Staphylococcus aureus*, *Salmonella* and *Bacillus cereus* with video images that make application easy and convenient. The application will have features that help users easily understand and enjoy a subject that may seem difficult by making use of interactive functions and characters. It is expected to educate them as to how to properly deal with household food safety issues created by climate change.

### **P11 Building adaptive capacity through inter- and transdisciplinary scenario planning: Findings from a case study in Rostock, Germany**

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Social-ecological resilience is considered to be a promising conceptual framework to analyse the issue of climate adaptation and to design sustainable adaptation strategies. It is argued that in order to increase resilience, i.e. the ability to maintain desirable system states under extreme conditions or to alter the state of the system when the current state is untenable, the capacity of the actors in a system to manage resilience has to be increased. This capacity is commonly known as adaptive capacity or adaptability. There is so far little empirical work on the issue of adaptive capacity, as seen from a resilience perspective, and the question how the adaptive capacity within a system can be increased. In order to contribute to this growing field of research, the authors present empirical results of a scenario planning process, started in 2010 and completed in 2012, in Rostock (Germany), reflecting on the contribution of the scenario process to build adaptive capacity. The conceptual and methodological development of the term adaptive capacity stems from vulnerability and resilience frameworks, each with a slightly different conceptualization of the term. In this paper, the authors adopt a resilience perspective, in line with the social-ecological resilience perspective as used in the scenario process in the case study region. Adaptive capacity is in this context understood as the capacity of humans to influence the resilience of the system by facilitating the interactions between the social system and the ecological system. A range of features that could influence the capacity to manage resilience are identified and two of these are further explored in this paper: uncertainties and knowledge. The inter- and transdisciplinary scenario process in the case study under investigation ultimately aims to develop resilient adaptation strategies to climate change at the regional level, using scenario planning as a tool to deal with uncertainties, surprising events and to integrate different kinds of knowledge. The results of this process reveal interesting insights in learning among the participants, the use and exchange of knowledge and the way in which uncertainties are managed in the adaptation strategies. These results are linked to uncertainties and knowledge as features that influence adaptive capacity, as such the authors reflect on how the scenario process contributes to building adaptive capacity in the region.

### **P12 Minding the uncertainties**

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Nowadays, estimates of changing climate are commonly embedded into numerous societal applications. These estimates are obtained through numerical climate model simulations, which is the only plausible way for assessing the development of physical variables in a future. Climate models produce continuous time series reaching into the future and using this actual data "as provided" might be very appealing for various purposes. However, this should never be done as the interpretation of quantitative model output is tremendously complicated through uncertainties from multiple sources. Broadly, these can be separated to those caused by scientific, socio-economic and subjective processes. Every possible physical interaction in the Earth System constitutes a scientific process. Trying to identify the most important ones and programming them into the climate models is a huge task. However, our knowledge from the unknown future environment is dependent on these climate models and whether the most relevant phenomena are sufficiently represented in them.

Model simulations are always uncertain and new scientific knowledge can increase this uncertainty even further! Pathways of future climate are also dependent on the socio-economic decisions, which constitute the largest uncertainty over the long time scale. The effect of different socio-economic choices is incorporated into climate simulations as boundary conditions, even though they are also affected by climate (e.g. European heatwave of 2003). Decisions on a global scale affect local climate, so proactive adaptive decisions can only be made if all plausible pathways of socio-economic pathways are identified. Subjective error is present in all stages of climate modeling: definition of boundary conditions, development of climate models and interpretation of the actual results. This uncertainty is unknown, as risk assessment is constantly done in different phases of the modeling process. Adaptive measures should never be based solely on the model output, which often is too narrow to represent all these uncertainties. Risk assessment integrating the information and results from the whole modeling chain is needed for meaningful adaptive measures. This involves inter-disciplinary expert judgement and appropriate tools (preferably quantitative). The option is that the end users do the risk analysis themselves with improper knowledge. Large uncertainty is an inevitable part of climate-related decision-making.

### **P13 Methods for assessing vulnerability**

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The projected bio-geophysical and social effects of climate change compound the complex challenges that regions and municipalities already face in their strategic planning. Assessing what areas, societal groups or sectors that are most vulnerable and in what way, are the first steps in creating a more robust society. Previous research has argued that guidance in this work is much needed. Nordic researchers have developed a number of methods that aim to help organizations assess vulnerability. A toolbox for facilitating integrated vulnerability assessments, developed in collaboration with communities in Sweden, South Africa and the Baltic countries, scans the vulnerability of organizations, sectors and groups within three dimensions i.e. their exposure, sensitivity and adaptive capacity. The methodology is based on a sequence of participatory exercises that facilitate a structured analysis of vulnerability and adaptation in the targeted area, including mapping of climatic and socio-economic stressors, especially sensitive actors and areas, and capacities to adapt to various changes. The process culminates in a concrete action plan outlining relevant adaptation measures and steps for implementation including delegation of responsible organizations and realistic time plans. Vulnerability can also be spatially mapped according to key socioeconomic and physical characteristics in order to aid the identification of areas where strategic measures can best be applied.

### **P14 Institutional challenges of water governance to adapt to a changing climate – a case study of the Rhine**

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In the literature we can identify many articles discussing and evaluating the management system of the Rhine (e.g. Mostert 2009, Wilken 2006). It is used around the world as a pattern for well functioning transnational water management regime (Huisman et al. 2000, Frijters and Leentvaar 2003). The governance system of the

Rhine can be described as a polycentric governance system (Pahl-Wostl et al. 2011). 'Polycentric Systems exist when multiple public and private organizations of multiple scales jointly affect collective benefits and costs' (Ostrom 2010a). Originally developed in the 1960s to describe metropolitan governance (V. Ostrom 1961), recent publications adopted the concept to the issue of climate change, but with a focus on climate change mitigation (Ostrom 2010b). It is argued in this article that the theory of polycentric governance systems with its practical implications is also applicable to climate change adaptation. Coming back to the case study, the leading research questions of this paper are: How is adaptation to climate change incorporated into the polycentric governance system of the river? How does the governance system of the Rhine react on climate change adaptation? Does the governance system change? If, yes, how and how should this be interpreted in a broader context of environmental governance? The methodology applied in this paper is the social ecological systems framework (SES) developed by Ostrom (2007, 2009). The SES framework is used to structure the case study of the Rhine governance system. The framework was developed to analyze the governance of complex social ecological systems. In its current form (McGinnis and Ostrom 2011), four building blocks (resource unit, resource system, actors and governance system) with sub-variables are the core of the framework. Originally developed to analyze SES on a local level it is argued in this paper that the framework is also appropriate to be used on superior levels of analysis. Researches using this framework mostly focus on the micro level, individuals being the smallest unit. The action situations in this case study are on diverse levels, actors are inter alia governmental agencies and companies. Following this, the paper also aims to contribute to the question how the SES-Framework can be scaled-up. The paper concludes with reflections on advantages and disadvantages of polycentric river governance systems and their ability to cope with climate change adaptation.

#### **P15 How do municipalities in Sweden deal with uncertain sea level rise in their planning?**

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With the progression in the science of climate change new findings emerge about possible and/or plausible changes in sea level rise during this and the coming centuries. Recent estimates indicate that sea levels could rise by as much as 1.9 meters by 2100, a considerably higher estimate than those made a few years ago by e.g. the IPCC. Municipalities in Sweden are responsible for comprehensive and detailed planning as well as granting building permits to facilities that may have a life-time of almost a century or more. They are obliged by law to consider risks for flooding in their planning process. However, it is not known how common it is for municipalities to consider rising sea levels in their planning and if they do so it is unclear which information about sea level rise estimates they base their decisions on? Another issue is whether these estimates reflect the range of scientific estimation and the continual evolution of estimations and if the municipalities use them in a transparent way? In this study we examined planning documents from the 67 coastal municipalities in Sweden most affected by sea level rise and traced the origins of the estimates of sea level rise that they use, with the ultimate aim of discovering how uncertainties in sea level rise are handled by the municipalities. The origins were traced in several steps, sometimes starting with information from a particular consultant or a particular employee in a government agency and ending up in a particular scientific synthesis or peer reviewed article whenever possible. The transparency of municipalities' handling of information as well as the transparency within the authorities/research institutions that produce estimates of sea level rise is discussed. The results are put into the context of different approaches to management: adaptive, flexible and robust.

#### **P16**

#### **Land use planning and emergency provision for a changing climate**

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This paper presents a newly started project on adaptation to climate change, land use planning and emergency provision in Western Norway. As the climate in Northern Europe get warmer, wetter and wilder, municipalities in Western Norway struggle to allocate and plan physical infrastructure such as housing areas, roads and power lines that are not prone to climate related natural hazards. In the years to come, a projected increase in temperature and precipitation are expected to increase flood risk in autumn, winter and spring and an increased risk of snow and debris avalanches. The recent years has also seen several disasters with flood avalanches and rock fall, even though these hazard's relation to climate change is poorly understood. Furthermore could projected sea level rise cause an increase in damages by storm surges. At the same time, disasters are not caused by natural hazards in itself. The increased concentration of people and infrastructure in hazard prone areas are the main cause of disasters. But climate change can render areas previously considered safe into hazard prone areas. This project will analyse historical weather related natural disasters- and events and asses the role of land use planning and the planning process in the final outcome of the disastrous events. Furthermore will the linkages to climatic factors be analysed and the return interval of the natural hazard under projected climate change assessed. The lessons learned from these analyses will be presented for a limited number of municipalities and their ongoing land use planning processes in order to develop and test new steering tools for regional and local land use planning. The goal is to enhance resilience to climate related natural hazards through land use planning.

#### **P17 How to design a successful stakeholder dialogue on adaptation to climate change?**

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Adaptation to climate change is a cross-cutting issue that addresses a broad variety of actors, ranging from politics and administration to business and civil society. Developing and implementing adaptation measures hence needs the involvement of different actors and coordinated action among them. Stakeholder dialogues can support a joint understanding of adaptation needs and the coordinated development of adaptation actions with shared responsibilities. Based on our experience with twelve dialogues accompanying the German Adaptation Strategy we address success factors and pitfalls in conducting stakeholder dialogues. These dialogues are mostly sector specific (e.g. energy, transport, chemical industry, insurance) and partly address cross-cutting issues such as standardization or vocational training for adaptation. During these one-day workshops about 25 participants discussed adaptation challenges and developed ideas for adaptation measures. Before the workshops the participants received a background paper, during the workshops all discussions were visualized and afterwards participants got a documentation and had the possibility to send comments on this document before it was published online. Participants' feedback and a comparison of the dialogues show that stakeholders can be motivated to take action if concrete sector-related challenges and practical examples of possible adaptation measures are presented. It is crucial to identify relevant stakeholders in advance and to sensitize them for participation. If stakeholder workshops are jointly organized with sector associations follow-up processes can more easily be

achieved. Moreover, a motivating workshop design including a mixture of presentations and activating working tasks is supportive. The “world café” method proved to be a valuable approach since it supports intense knowledge exchange and networking. The combination of private and public actors within the workshops allowed identifying their respective responsibilities as well as collaborative measures. The high transparency of the dialogue with visualization and documentation also proved to be essential to gain participants’ commitment. Through the combination of a background paper, workshop, documentation and a feedback process, participants were involved over a longer time period.

### **P18 Corporate Adaptation to Climate Change: A Learning Challenge**

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Ongoing and aggravating climate change poses increasing challenges for companies: Direct consequences arising from climate change such as rising summer temperatures or an increase in the frequency and intensity of extreme weather events put companies’ infrastructure, production processes, logistics and supply chains at risk. Moreover, societal responses to present and future climate change are leading to transformations in political and market conditions. Companies trying to tackle these changing environmental conditions and related uncertainties need to engage in organisational learning processes. The acquisition and interpretation of climate-related knowledge is essential for the anticipation of future climate-related risks and opportunities as well as the development of strategic responses to climate change. Although different researchers on corporate adaptation have identified organisational learning as essential precondition for corporate responses to climate change and for developing adaptive capacity a thorough analysis of organisational learning in the context of adaptation is still lacking. Based on organisational learning theories various factors promoting or constraining corporate adaptation to climate change are theoretically and empirically explored. Favourable conditions for organisational learning on climate change include amongst others the existence of awareness and concern, past experience with extreme weather events as well as established channels and fora for internal and external knowledge exchange. We will show that organisational learning on climate change is hampered by mental models and filters, by the absence of a strategic approach to climate adaptation and by the fact that knowledge of weather-related effects is too dispersed within the organisation. On the basis of a comprehensive literature review and explorative empirical studies we will present a conceptual framework of corporate adaptation as well as empirical results from the energy and the transportation sector in Germany.

### **P19 NGOs and Climate change adaptation: Whose interest matters???**

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As a result of the increasing realization that mitigation (reducing green house emissions or enhancing their sinks) will not be sufficient to prevent serious climate change impacts, several researches have concluded that there is a need to prepare for and adapt to the consequences of some inevitable climate change. Adaptation to climate change is thus considered a necessity and relevant particularly for developing countries, where societies are already struggling to meet the challenges posed by existing climate change

and variability. However, while there is a well established body of scholarship focusing on climate change adaptation and its related concepts namely resilience, adaptive capacity and vulnerability relatively little research has focused on the role of institutions particularly Non Governmental Organizations (NGOs) in shaping or facilitating the adaptation process of local people particularly in developing countries. Therefore, it is against this background that this research seeks to fill in this gap by investigating how NGOs are enhancing climate change adaptation practices in their various project works. Thus, in this research I aim to ascertain power relations embedded in local people’s climate change adaptation. I will examine how NGOs particularly those externally funded, working in developing countries are responding to reduce the risks of climate change and variability. I also seek to investigate whether the process of climate change adaptation take into consideration the local communities’ perspectives in decisions concerning their adaptation. This research is imperative as it profoundly contributes to the formulation of pro-poor adaptation policies for the vulnerable societies in developing countries. The research will also contribute to the understanding of the political ecology of climate change adaptation process.

### **P20 Networking global climate adaptation actors: A concept from climate-sensitive Taiwan**

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As climate change may adversely effect humans, there is an urgent need on climate adaptation to cope with this global challenge. However, few studies used a climate-sensitive island as global hotspot for examining a variety of adaptation actions. In this regard, this paper uses the island country of Taiwan as potential hotspot for promoting global climate adaptation research. It is of particular concern that Taiwan is a much densely populated area facing drastic climate extremes in the recent years. Moreover, Taiwan offers high-tech basis for promoting climate adaptation technology. As such, Taiwan may be the suitable climate adaptation platform on networking international research resources. It highlights the innovation of global coping strategy and technology in a diverse but integrated manner. On the global network design, this paper first indicates that climate adaptation refers to the complex coupled natural-human systems across sectors, scales and levels that many countries are facing. Second, we recognize that climate change is the key issue in the context of global sustainability and environmental change. In so framing, we conceptualize a networking model based on the Driver-Pressure-State-Impact-Response (DPSIR) framework. This model is placed on the importance of transdisciplinary implication of vulnerability for identifying key indicators from a regional geography perspective. Finally, we relate the key indicators to different regions that are comparative on climate-sensitivity at international level. As a result, we demonstrate an integrative systematic matrix from both sectoral and spatial dimensions. Throughout comparative studies on natural exposure, built-environmental sensitivity and stakeholder adaptability, those regions studied are networked centering on Hotspot Taiwan. To conclude, we highlight this research network linking climate-sensitive Taiwan to the global may contribute to innovating climate adaptation technology and fostering climate governance at international level on the one hand, and on the other hand encourage Taiwan to strengthen climate risk management building international partnership.

### P21 Decision Support for Climate Change Adaptation

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Adaptation to the consequences of the climate change is an integral element of climate policy. However, from policy initiation to termination of policy process there exists multiple phases. There are several ways to describe the policy process, here called the management cycle. For example following steps can be identified. Firstly there must be recognition of need for adaptation. Often this may arise from experience of impacts caused directly by weather and climate phenomena. Secondly, the problem has to be defined and promoted. Thirdly, choices need to be identified and assessed. This can facilitate strategy development and selection of policy measures. Furthermore, policies should be implemented and their execution needs to be supported. So far, rarely reached phase in adaptation policy is appraisal of policies. In complex environmental problems like adaptation to climate change science one can and should provide input to policy processes throughout the management cycle. Vogel et al. (2007) provide a framework for describing science's influence on decision-making related to environmental problems. Utilizing this framework the influence of research on climate change adaptation to decision-making is examined. The focus of presentation is on research, science communication, policy-making, and policy implementation in Finland. The success of decision support requires science communication. Traditionally science communication has been viewed as simple, linear knowledge transfer from researchers to practitioners. In reality, this is only one of the communications among actors engaged in research and policy. Based on recent surveys some of the problems in the interface between science and policy making are discussed.

### P22 Farmers' perceptions on climate change: Information needs and barriers for implying mitigation and proactive adaptation

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Climate change mitigation actions and implementing adaptation are both important for the future of practicing agriculture when policy actions, mitigation goals and global price variation increasingly influence farms and their livelihood. Further, the predicted growing incidence of weather extremes creates the need for preparedness and risk aversion. Building resilience and adaptive capacity of agriculture are essential in preparing for the direct and indirect changes caused by climate change. However, the actual mitigation and adaptation measures have so far been limited at the farm level and are dependent on farmers' knowledge of both regional impacts and options for taking early action. The aim of this study was to compare the regional information needs among farmers and rural stakeholders in various topics covering climate change within Finland and explain their perceptions of the opportunities and challenges of taking the knowledge into practice. A questionnaire survey was conducted to collect regional information needs of farmers and to gather perceptions on whether climate change will affect their actions in the near future. In addition, barriers and incentives for proactive preparing towards climate change at the farm level were inquired. The respondents had most interest for the policy and economic changes influenced by climate change (84%) as well as themes concerning renewable energy (71%). Also novel crop species, protein self-sufficiency, unexpected weather events, local food production and energy efficiency were highlighted. Information needs varied by region in Finland. Only 55 % of the farmers and rural stakeholders believed that climate change will affect their activities in the near future. According to the respondents, the failure of practical enough climate change

communication and economic barriers hindered considering climate change as important to prepare for. Apart from suffering from the excess of information flow in the media, climate change information was perceived as hard to understand and difficult to implement at the farm level. Many believed that economic encouragement would be needed for farmers to take action towards mitigation. Farmers hoped to get a clearer perception on the different policy options that climate change may bring about and practical information about adaptation and mitigation actions. Information on adaptation was considered more interesting and acute than knowledge of mitigation.

### P23 Structuring tools for municipal climate adaptation planning - process and impact analysis

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Tools are important to support the municipal planning- and analysis work, taking into account the impact of climate change on society and the environment. The poster presents a process model for dealing with climate change and its complexity. Important features of the model are transparency, a holistic view and clarity. Equally important is that the model handles multiple levels of government and several dimensions such as time and space. Specifically, that means taking into account the municipality's geographic area, long time horizon and goals and plans in relation to municipal activities. A very important input value to the process is political support in the form of a climate strategy/ policy so that the issue is a priority of the municipality. The poster describes in words and pictures the different stages and parts. The main steps are: 1. Specify and analyze vulnerabilities 2. Assess actions, costs and responsibilities 3. Prioritize, select and implement measures 4. Follow up, evaluate and revise documents. The first two steps are handled on the municipality's management comprehensive level to obtain the holistic view, as well as the revision stage. The other steps are implemented at the appropriate management, where the measures/actions naturally belong. Each step includes several stages. Steps 1 and 2 provide a climate and vulnerability analysis and a climate adaptation plan, which is the core of the work. The practical implementation of measures is carried out in Step 3. Step 4 makes the process move forward, and kept alive through monitoring, evaluation and revision of the municipal plans. The process cycle is tailored to the municipality's specific characteristics and other planning. A key part of the analysis of impacts and vulnerabilities is the structuring of the problem, which is done by using the morphological analysis tool. Morphological analysis is a way to describe a problem and its character through its principal parameters and what values they may assume. The poster shows an example of such a problem structuring in a morphological field. This systematic and structured process work means that the various municipal plans remain current, and that climate change is taken into consideration in municipal operations in an efficient manner.

### P24 Synergies, Conflicts and Trade-offs: Findings from a comparative case study of Copenhagen and Portland

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As it becomes clearer that GHG emissions are intimately tied to specific development pathways, planners are faced with the challenge of integrating climate change strategies into broader sustainable development goals. This paper examines selected

synergies, conflicts and trade-offs present within the municipal climate strategies of Copenhagen, Denmark and Portland, Oregon in relation to existing urban development goals. The findings of the research suggest that effective policy integration will require broadening the criteria beyond the current focus on environmental and energy policy. Social equity goals and economic development priorities, among others, will need to be accorded a higher priority in the planning process when formulating and implementing climate strategies.

### **P25 Mitigating the impacts of extreme weather originated disasters by simulating the effects of different preparation and action decisions of crisis management**

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The CRISMA project develops an integrated planning and decision support tool set for crises response to potentially disastrous events with immediate, extensive, and lasting consequences for population and society. The envisaged integrated tool set encompasses a set of simulation models for evaluation of the effectiveness, limitations and resource allocation implications of prevention and remediation measures taken in hypothetical - yet feasible - scenarios in the context of education, training, planning and reviewing of crisis response organizations, infrastructure and personnel. Thanks to the inclusion of cascading and multi-risk effects, also more complex vulnerability assessments are feasible. Similarly, cascading and multi-risk effects aggravated by the interaction between physical and societal processes can be accounted for when the system applied to long term planning questions. The project includes five elaborate pilots, which function as testing ground for the models and concepts (further) developed in CRISMA. Two of these pilots concern severe Nordic winter storms and Western-European coastal flooding respectively, thereby representing extreme weather events which are typically expected to occur more frequently in many parts of Europe as a result of climate change. The envisaged model system should not only generate benefits for crisis management operations as such, but also regarding the technical, organisational and social preparedness of a region or set of regions with respect to natural hazards. The project also considers the operational and strategic implications of improving border crossing co-operation in crisis management and related planning. Therefore, all in all, the envisaged system can be considered as a contribution to a reduction of vulnerability and increase of resilience with respect to natural hazards, as inter alia recommended in the IPCC SREX report and pursued in many national adaptation plans in Europe. The system is meant to be used for short term and long term planning, as well as reviewing and training purposes, and aims indeed at a better integration and related presentation of crisis management information. However, the various end-user-stakeholders tend to emphasize the different capacities to a differing extent. The ambitious data-integration entails extensive use of geo-data, such as from GMES (Global Monitoring for Environment and Security – a programme of the European Community; <http://www.gmes.info/>). The CRISMA project ([www.crismaproject.eu](http://www.crismaproject.eu)) is co-ordinated by VTT Technical Research Centre of Finland and funded by the European Community's 7th Framework Programme under grant agreement no. 284552. The consortium counts 17 partners from 9 countries. The project ends in August 2015.

### **P26 Stakeholder analysis of flood risk management reduction strategies in Paz River catchment, Guatemala-El Salvador**

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The floods due to the recent meteorological events that impacted Guatemala and El Salvador have had severe consequences. Hurricane Mitch in 1999, Stan Tropical Storm in 2005 and Agatha Storm in 2010, have revealed the extreme vulnerability of the countries towards these phenomena. Floods are a recurrent phenomenon that under certain conditions poses a threat over the life, infrastructure, economy, environment and livelihood. On the other hand climate change is expected to intensify the occurrence of hurricanes, four out of the ten strongest hurricanes in Central America have occurred in the last 10 years. This paper describes the strategies for climate change adaptation towards floods on the Paz River catchment in Guatemala-El Salvador through stakeholder analysis. The stakeholder analysis is performed under the assumptions of the hydrological response of several flow regime responses simulated with conceptual water balance models (HBV and WASMOD). Key words: floods, Guatemala, El Salvador, climate change adaptation, flood management, Paz River

### **P27 Rural Transformations: Livelihood adaptation to climate change in Uganda.**

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The incertitude of climate change presents major challenges to the adaptation process. Although adaptation is concerned with actors, actions and agency; the evaluations of adaptive actions are static in nature and may not provide the flexibility needed to deal with uncertainty. Current thinking suggests governance and management approaches to climate change need to evolve away from rigid, linear, path-dependent structures towards more robust, adaptive strategies that are resilient in the face of uncertainty and change. Central to this concept is the role of adaptive management which proclaims the importance of pro-active leadership, trust, information and knowledge flow, sense-making and strong, institutional networks, and the role of social learning which reflects multi-stakeholder engagement in collective experiential learning leading to more desirable futures and outcomes. Integral to these processes are actions that are flexible, iterative, reflexive and experimental. The case study Uganda has already witnessed the vagaries of unpredictable rainfall variability and rises in temperature. Agriculture employs 73% of the population. Climate variability and extremes have serious implications for these communities whose livelihoods are already marginalised and heavily dependent on natural resources. Research into present and past livelihood responses to climate variability is imperative in understanding the adaptation process, and to assess existing vulnerabilities and potential transformability. The case study focuses on rural mixed-farming communities with considerable exposure to external institutional intervention. The resilience lens is used to reveal the transformative processes, strategies and structures that are contributing to the adaptive capacity of the institutional governance and livelihood systems of these communities. The coping and adaptive mechanisms used to strengthen livelihoods to challenging climatic events are explored. Further analysis reveals the informal and formal governance pathways that contribute to flows of knowledge which support learning and innovation and how these have operated over

temporal and spatial scales. Critical evaluation of these processes provides a valuable insight into livelihood resilience hence contributing to the current discourses and decision-making on adaptation to climate change.

### **P28 Adapting to climate change: households' response strategies to hailstorm and drought in Lijiang, China**

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The paper purports to document rural households' perceptions of and response to climate extremes in three villages in Lijiang, Yunnan Province, China. This is important as people's perceptions and current coping behavior serve as a starting point for future adaptations. Although farmers in the study area are prone to multiple hazards, here the focus is on hailstorm and drought as their impacts have been particularly salient in recent years. Primary data was collected from 162 households following a proportional random sampling procedure and household heads were interviewed using a structured questionnaire. The results indicate that more than half of the sampled households have perceived more frequent occurrence of hailstorm and drought up to the present. In general, households perceived hailstorms to be a more drastic event than drought. The most important coping strategy for both hailstorms and droughts was for households to resort to non-agriculture activities as alternative sources of income. In addition, there were coping strategies which were threat specific. In the case of hailstorm, migrant work and assets depletion (e.g. selling livestock) were important while multiple strategies to solve water shortage (e.g. saving water, searching for external water source, irrigation) were deployed in the case of droughts. Furthermore, there were differences among the three villages with regard to the degree of perceived sensitivity and responses despite seemingly similar exposure to climate extremes. These differences are partly related to differences in the households' socio-economic status such as income and livestock ownership, which also determine in part the households' ability to cope. The study suggests that in addition to immediate post-disaster food relief provision, more efforts from government could be directed to revitalize livelihood-related activities such as non-farm employment, food production and water conservation assistance in order to improve households' coping capacity.

### **P29 Impacts of climate change on multiple ecosystem services: processes and adaptation options at landscape scales (CLIMES)**

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Ecosystems generate a range of goods and services important for human well-being, collectively called ecosystem services. Spatially explicit values of services across landscapes - of central importance also to inform land-use and management decisions - are still lacking. Furthermore, climate change provides a major challenge for the sustainable management of the key ecosystem services and hence sector-specific adaptation measures are needed. CLIMES is a three-year project, funded by the Academy of Finland and the Chinese

Academy of Sciences 2012-2014. The project seeks to increase the process understanding and develop the methodologies in the context of climate change impacts and adaptation options for spatially explicit values of services across landscapes. The focus of the work lies on two key ecosystem services: i) water services (water resources, water purification) and ii) soil/ecosystem carbon sequestration. This poster presents the aims of the CLIMES project, the study areas and the main methods applied. The work will be carried out both at highly instrumented research sites that belong to the international LTER-network in China and Finland, and at larger landscape scales, using the large data and modelling infrastructures of the participating national research institutes. The integrative project consists of field studies (in LTER areas), statistical analyses of long-term and regional data, modelling, GIS and remote sensing, and ecosystem service accounting. We expect to produce: • New process understanding about the controls, interactions and trade-offs of ecosystem services of key national importance. • Development and application of advanced mathematical and extrapolation tools for simulating impacts of future climate and land-use scenarios, and assessment of adaptation options. • Enhanced cooperation and integration of knowledge between ecosystem researchers in China and Finland. • Training of students and opportunities for Post Doc researchers.

### **P30 Livelihoods, Vulnerability and Adaptive Capacity: A Case Study from Rural Lao**

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Poor households in rural and remote villages of Southern Laos are highly dependent on climate-sensitive natural resources and vulnerable to seasonal weather fluctuations. The speed and magnitude of climate-induced changes may seriously challenge their ability to adapt. It is important to understand how local communities may be vulnerable and their coping and adaptive behaviours. Participatory group discussions and 271 household surveys in three villages highlight current vulnerability and adaptive capacity toward climatic variability and risks. Vulnerability cube and index was built to visualize and operationalize three dimensions of vulnerability framework. The results show rice cultivation, forest product collection and fishing are the mainstays of food security and income sources. Majority of vulnerable households are featured with low adaptive capacity and less income diversification. Floods and drought have put the poor under threats thus led to various coping mechanisms. However, both awareness and capability of long term adaptive strategies remain very low among all households. The outcome of the participatory adaptation consultation implies that integrated approach to mainstream climate change adaptation into community natural resource management and livelihood improvement are most preferred by local community and may lead to better results in adaptive capacity building.

### **P31 Investigating the relationship between mortality and temperature and a possible acclimatization effect in Finland**

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Complex interactions exist of heat exchange with the human body. The thermoneutral temperature under optimal conditions has been quantified with +27°C. Extreme and prolonging cold or heat

conditions increase the risk of adverse effects on humans and these can often be seen in morbidity and mortality statistics. The summer 2003 heat wave increased mortality in several regions in central Europe, especially in France. It is estimated that in Finland during the July 2010 heat wave about 400 extra deaths took place. Among the groups most vulnerable to extreme weather conditions are the elderly. Several studies have found U- or V-shaped dependences between mortality and temperature with increasing mortality during both heat waves and cold spells. The minimum mortality is found at different temperatures varying from one climate zone to another. In Finland, daily mortality is highest in winter; however, Finns have acclimatized to cold climate better than people in warmer climates. Climate dependence of mortality in Finnish population was studied by comparing daily mortality with daily mean temperature as aggregated values over hospital districts in Finland during the period 1971-2010. The daily mean temperature for each hospital district was calculated based using on the gridded temperature data set of Finnish Meteorological Institute FMI. The V-shaped relationship between mortality and temperature fits in general better than U-shaped in the data in our study. Long time series utilized in this study made it possible to estimate regional differences in the temperature-mortality relationship and changes in the relationship potentially due to acclimatization of the Finnish population over the decades. Projections of mortality under future climatic conditions were estimated with an ensemble of climate projections. In the presentation the role of possible further acclimatization will also be discussed. Results are used to visualize and quantify municipal-scale indicators of potential impact in an assessment of climate change vulnerability of the elderly in the MAVERIC project ("Map-based assessment of vulnerability to climate change employing regional indicators").

### **P32 Stratified climate vulnerability analysis for heat waves in a Swedish city: who is vulnerable and why?**

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Different groups in society, and in cities, are affected differently by climate change. This is due to their varying degree of exposure, sensitivity and adaptive capacity to climate induced risks. Building on a desktop study of earlier literature in the fields of vulnerability to natural hazards and social vulnerability, this paper discuss factors contributing to vulnerability of different population segments in relation to thermal comfort. Earlier research suggest that vulnerable population segments might include the elderly, children, people with mental or other disabilities, people with diabetes or diseases related to respiration, heart or kidneys, the unemployed, people with low income or low education, people without car etc. The study qualitatively explores a few such groups in terms of how various factors shape their vulnerability in relation to thermal comfort. . The design includes a focus group study with the aim of gaining a deeper understanding of the exposure, sensitivity and adaptive capacity of population segments identified as vulnerable. The focus group participants are divided into homogenous groups of people who come in contact with these issues at different levels in a society, such as municipal level planners (soft and hard administrations), operational staff in social welfare organisations, and groups of individuals who would be described as vulnerable according to the examples of vulnerability presented in literature. Issues explored

include perceived vulnerability with regard thermal comfort and existing knowledge and strategies (short and long term) to deal with risks affecting vulnerable groups. The study is carried out within the project "Adapting cities to climate induced risks – a coordinated approach" using an urban area in Gothenburg as a case study, and brings together experts in urban climate, atmospheric science, geo technique, socio-economy with local city planners in an integrated research effort. The preliminary results are presented in this paper. The results from focus groups and literature study will be used to design an easy-to-use tool for conceptualising and assessing vulnerability in different population segments, which can be used by municipalities of various sizes or other organisations who wish to better understand vulnerability. The tool will be tested at an early stage in the same urban area of Gothenburg.

### **P33 Exposure to Heat and Occupational Health in a Warming World**

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Background and Objective: it is widely accepted that the climate is changing in an accelerating pace, with implications for human systems already documented. Therefore in the light of climate change adaptation, the purpose of the literature review was to explore new and old research into the impacts of heat stress on humans in an occupational health setting in the context of a warming climate due to climate change. Current status and research needs: it was found that heat stress has been researched extensively in the past however, in the contemporary context of climate change, information is lacking, especially in an occupational health setting. Factors exacerbating heat stress in the current and future workplace is the 'heat island effect', outdoor work, lack of information on vulnerable groups such as the elderly, individual differences, and the developing country context where technological fixes and certain control measures are often not applicable. As work productivity reduces with increasing temperatures, world economic productivity will be condensed, affecting developing countries in the tropical and sub-tropical regions disproportionately. To address these current and future occupational health problems, sustainable solutions must take into account social, economic, environmental and technical aspects of the problem. Both mitigation and adaptation measures shall be considered, sometimes in combination and including both preventative and control solutions, to get multiple benefits. Additionally, capacity building and involvement of all levels of society is needed to address this. Future research into the occupational health impacts of climate change is needed in the context of both developed and developing countries. It is important to involve all academic disciplines to take a multidisciplinary approach in this complex research field.

### **P34 Planning a sustainable and climate-proof built environment: the special case of real estate value formation and residential qualities**

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The proposed paper presents an ongoing PhD project on the spatio-economic aspects of climate change adaptation in the urban built environment. The study focuses on the effects of climate change on the formation, spatial distribution and change of urban real estate values, and on the implications for the use of ecosystem services in sustainable urban planning. From a methodology point of view, a

spatial analysis framework is adopted, drawing from the fields of urban economics, urban planning, and human geography. In order to shed light to the researched theme, the main analytical focus of the study is the formal organization of the built environment, and several environmental, economic, and meteorological variables are constructed and analysed. The discussion aims to present three particular subtopics of the project: first, the challenge of understanding urban dynamics in relation to climate change; second, the subsequent challenge of translating the aforementioned knowledge into knowledge about climate-proof sustainable urban planning; and third, a few distinct theoretical issues that surround the topic. Overall, the main argument put forth is that a detailed understanding of the behaviour of the urban system in relation to its climatic challenges depends on a dense set of specific information related both to urban planning and unplanned urban behaviour. Moreover, without a strong theoretical framework, meaningful understanding of the issue is limited regardless of the measured variables.

### P35 Dynamics of mixed-species forests in changing climate – how different species combinations adapt to climate change?

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Adaptation of forest management to changing climate may require remarkable changes in the tree species composition. In the warmer climate, deciduous species are predicted to be favoured, but the competitive capacity of different tree species is not analysed in detail. We evaluated biomass production and carbon sequestration potential of a forest stand with competing tree species in changing climate. The EFIMOD model combined with the model of soil organic matter dynamics ROMUL has been used which simulates spatially explicit competition of trees for light and nutrients. The scenario for the current climate was based on measured data (1961-2007) by the Finnish Meteorological Institute. Climate change scenarios were based on the runs of the ECHAM5 GCM. We focused our simulations on mesic site (Myrtillus type), which is the most common site type in southern Finland covering half of the forest area. The average values of carbon and nitrogen pools in forest floor and mineral soil in southern Finland were used as initial soil data. The model was thoroughly calibrated and verified using yield tables and data from field observations. We analyzed main sources of uncertainties; a Monte-Carlo procedure was applied to evaluation of the robustness of coefficients. We simulated the dynamics of two- and three-species mixtures (Silver birch, Scots pine and Norway spruce) with different initial proportions. Initial stand density was set to 10,000 st/ha, with 2,000 st/ha regeneration every 10 years. In mixed pine-birch stands dominant species maintained its position, but the portion of pine in birch-dominated stands was declined by the end of simulation. In spruce-birch stands, spruce replaced birch at any initial density. In spruce-pine mixed stands in the beginning of the stand development pine grown faster and increased its proportion of biomass by 10-20%. In mixed stands of three tree species spruce tended to dominate by the end of 100-year simulation period independently from initial proportions. In general, climate change resulted in increase of stands' productivity; the most favoured species was pine. In addition, soil was affected by species composition: increased portion of pine resulted in increasing carbon stocks in floor and mineral soil while the effect of spruce was opposite. Climate change negatively affected accumulation of organic matter in soil, especially in the spruce-dominated stands.

### P36 Carbon balance of forest land in Finland under the effect of different levels of wood use and climate change

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The Finnish forests are providing (on about 80 per cent of the total area) a considerable amount of wood for industrial use. In spite of active use of timber, growth has exceeded the drain during the last 30 years by more than 20 per cent. It is anticipated that due to the ongoing reshaping of forest industries the industrial use of wood will decline in the future. The use of wood for bioenergy is rapidly increasing and there are government plans to raise it to a considerable level in the future. Climate models project increasing temperature and precipitation in Scandinavia. Changing environment will increase forest growth but on the other hand also increase rate of decomposition of organic matter that may affect carbon balance of forest soils considerably. To assess the effects of these factors to the carbon balance of Finnish forests, we combined the large-scale forestry model MELA with the soil carbon model Yasso07 for mineral soils. Peatland forests comprise ca 30 per cent of forest land, for the carbon balance of their soils we used a method based on emission factors in the same way it is done in the Finnish greenhouse gas inventory. MELA simulates the stock, growth, total drain and mortality under different scenarios of wood use; we use biomass functions and litter production coefficients to convert tree volumes to carbon and litter production from living trees. Cutting residues and natural mortality contribute to litter. The estimate of litter production is used as input to Yasso07 and peatland C balance calculation. We present estimates of carbon balance of forest land for 30 years with varying levels of industrial and bioenergy wood use and assess the effect of climate change with IPCC SRES A1B scenario that has been localized to Finland. The projections of the industrial and bioenergy wood consumption that we apply in the simulations are likely development paths (high and low industrial and bioenergy wood use) that are presented in separate studies. We analyze how the total carbon balance and its components (biomass, mineral and organic soils) are affected by wood use and climate change.

### P37 How does climate change affect forest carbon balances and damages – Climforisk, EU Life+ project

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Climate influences carbon and water cycles of forests, and it causes variation to their annual balances - even at large spatial scales. Extreme weather years also pose risks for the functioning of the entire ecosystems. Complex interactions between climate, vegetation and damaging biotic agents can trigger wide-spread disturbances, which negatively feed back to the carbon balances of forests. For example, pine defoliators (e.g., Neodiprion sertifer; Diprion pini, Bupalus piniarius, Panolis flammea), which are capable of damaging forests on wide areas benefit from drought and warmth. Understanding the factors that predispose forests to damages is crucial for sustainable management of forest ecosystems. Forest inventory of Finland has collected an enormous body of data with

tens of thousands of sample plots measured, which can be merged to other sources of data on forests, such as remote sensing images and digital soil map. Merging these data sources to models and climate data offers a possibility to construct high resolution estimates of forest carbon balances for the whole country. The occurrence of biotic damages in Finnish forests, on the other hand, has been monitored for several years using permanent sample plots. Forest inventory data also collects information on damage observations. Using these data it is possible to identify climatic, edaphic, structural and spatial factors that predispose forests to damaging pests/pathogens. The aims of the Climforisk-project are to i) merge several existing, but to date separate, forest data sources together, ii) use models to predict how carbon sinks and sources are distributed with Finland, iii) investigate factors predisposing forests to damages caused by most important pests/pathogens. Our project will provide information for designing adaptation measures to climate change. Key results of the project will be disseminated to relevant stakeholders and general public.

### **P38 The impact of climate-change-induced storm risk on the optimal rotation period in Finnish forests**

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In Europe, high-impact storms and strong winds are most likely during autumn and winter. These storms have caused large damage for forests, especially in western and central Europe. In December 1999, the damage caused by "Lothar" and "Martin" storms was approximately 200 m<sup>3</sup> in western and central Europe; and in January 2005 damage due to storm "Gudrun" was around 100 m<sup>3</sup> in southern Sweden and surrounding countries. Compared to these, Finland has had smaller damages, < 10 m<sup>3</sup>. However, from a forest owner's perspective, storms in Finland may pose a severe threat to the timber yield and also the value of harvested timber and affect the optimal management of a forest stand. Furthermore, secondary damages may appear afterwards; because broken and uprooted trees provide breeding material for insects and are consequentially a possible target for detrimental insect attacks. Financial losses could have a substantial impact on the optimal rotation of a forest stand, thus reducing the forest owner's profits. Primary wind damages are (a) uprooting and (b) stem breakage. Norway spruce has suffered the most, because of its vulnerability to uprooting when the soil is wet and unfrozen. The deep soil frost depths support the anchorage of trees in Finland. Towards the end of the 21st century, this support is projected to be lost due to climate warming, at least in the southern and central Finland. Climate warming increases risks for storm damage, especially due to increases in forest growth, decreases in frost-season length and soil-frost depths. Based on the modified Faustmann rotation model incorporating the risk of a catastrophic event, we estimate the impact on the optimal rotation period of Norway spruce of the climate-change-induced increase in storm risk. The risk of storms is modelled as a stochastic, non-homogeneous Poisson process. The results are used to estimate the effect on forest owner's decision making and risk management.

### **P39 Modelling Growth from Stem Diameter Changes during Drought of Scots Pine**

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Drought is one consequence from climate change which greatly affects the ecophysiology of trees. Studies have shown that drought hinders growth within the tree and systematically shuts down

biochemical and physiological processes (i.e. net photosynthesis) in order to maintain basic functions. Examining trees under stress enables researchers to understand which activities are affected and how these are able to respond to climatic variability. This study examines the dynamics of radial dimensions in Scots Pine (*Pinus sylvestris* L.) using stem diameter measurements collected during the summer with gradual development of drought. By observing stem diameter changes, we can recognize the drought responses in ecophysiological processes (i.e. photosynthesis, growth, and transpiration processes) which have been reflected directly to tree stem diameter – as they cause variation in xylem tension and phloem osmotic pressure. Furthermore, interpreting stem growth changes allows greater understanding to adaptations to external environmental conditions (i.e. precipitation, soil water potential, and temperature) in response to drought. The field data consist of changes in xylem and whole stem diameter (outer bark excluded). A model function is used to determine growth (and osmotic concentration) by separating the inner bark change dynamics into xylem transpiration-driven and inner bark concentration change and cambial growth-driven irreversible change. The model assumes the inner bark variation that cannot be explained by xylem water status changes must be due to the osmotic concentration changes in the inner bark. Stem diameter data has been collected in the summer of 2006 between April and October from University of Helsinki field station in Hyytiälä, Finland. Analysis of the field data is done by examining growth against the micro climate and micro-cores. By studying the distribution and relatedness of the environmental variables, it will give a greater understanding of how growth is understood in the field and which processes are affected by drought. Keywords: climate change, drought, stem diameter change, growth, xylem, phloem

### **P40 Autumn frost hardening development of Scots pine and Norway spruce seedlings in future climate**

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In forest tree reproduction one suggestion to prepare for warming climate is to translocate material from more southern provenances. However, both the intensity and the duration of autumn cold extremes in northern Europe may not decrease, which may hinder the development of seedlings with southern origin. Also the photoperiod differences may cause problems. We studied the effect of elevated summer temperatures and CO<sub>2</sub> concentrations combined with dry or wet soil moisture on frost hardening development of one-year-old Scots pine and Norway spruce seedlings from Nordic and more southern origins. Seedlings were grown under the prevailing summer conditions in southern Finland and in greenhouse conditions under the expected future summer temperature and CO<sub>2</sub> levels for the years 2030 and 2100. In greenhouse conditions two alternative irrigation treatments were used, corresponding to dry and wet soil conditions. Seedlings were freeze tested during seven to eight week period after the growing season, and primary needle injuries were characterised. In general, northern origins showed earlier hardening development than their southern counterparts. In Scots pine needle injury levels were higher in seedlings grown under the temperature conditions for year 2100 than under the conditions for year 2030 or under the local, present growing conditions. Similarly, the needle injury levels in Norway spruce were higher in seedlings grown under the condition of year 2100 with elevated CO<sub>2</sub> levels than under the conditions for year 2030 or under the present growing conditions. Needle injuries were higher in Scots pine seedlings grown in dry soil moisture than in seedlings grown in wet moisture. In Norway spruce irrigation level itself had no effect on the injuries, but dry moisture combined with high temperatures increased the injuries. Scots pine seedlings grown under dry irrigation/elevated CO<sub>2</sub> showed highest needle injury, dry irrigation/present CO<sub>2</sub>, wet irrigation/present CO<sub>2</sub>,

and wet irrigation/elevated CO<sub>2</sub> followed with decreasing injury levels. It seems to be possible to utilize nearby southern origins, even though it means a higher risks for injuries. In Germany and Poland, where the present temperature conditions are close to those which has been predicted to be in the year 2100 in Finland, the photoperiod is so different, that material from those origins will face heavy injuries during the autumn frost hardening period both in present and future conditions.

#### **P41 Estimating carbon fluxes by combining climate-sensitive process models, NFI data and Landsat satellite images**

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A new approach to estimate regional level gross primary production (GPP), net primary production (NPP) and the net ecosystem exchange (NEE) was developed by combining climate-sensitive summary models of forest growth and soil processes, national forest inventory (NFI) data and Landsat images. First the carbon fluxes were predicted for all NFI plots located in mineral soil forests in Central and North Finland. The plot-wise estimates were then generalized to regional level using the k nearest neighbour (k-NN) imputation based on satellite images. Regional level estimates were produced for Central Finland and Lapland areas based on daily weather data from 2004-2008. Reliability of the imputations was examined by leave-one-out cross validation. RMSE of the imputed estimates was slightly better in Central Finland (27%) than in Lapland (36%), the bias staying at a similar level (0.2-0.6%). Simulations were also compared with Eddy covariance (EC) measurements from Hyttiälä and Sodankylä. Simulated results were rather well in line with the EC measurements, except with Sodankylä NEE estimates, which were remarkably biased. The main strength of the developed approach is that it allows producing large-scale carbon flux estimates with high output resolution (30 m) based on commonly available data sources, which can be easily utilized for climate change research as well as for decision and policy making purposes. The approach will be developed further in EU LIFE+ Climforisk ([www.metla.fi/life/climforisk](http://www.metla.fi/life/climforisk)) project at the Finnish Forest Research Institute.

#### **P42 Ecosystem modeling of vegetation growth and risk for damage– linking user needs to model development**

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A warmer climate will extend the growing season, creating opportunities for planting new trees species and crop varieties in the Nordic countries. Climate change will however also influence the risk for damage caused by extreme weather events and attacks by pests and pathogens. Until recently the ecosystem models have simulated climate impact in relation to changes in monthly mean temperature and precipitation, not considering the effect of extreme events. Modeling of insect pests has mainly been related to the potential geographical distribution, and few models consider the population dynamics and risk for damage. Few studies focus on management decisions in relation to the probability and uncertainty associated with climate change projections. Stakeholder communication with the agricultural and forestry sector is essential for exploring what information is required to get a picture of the adaptation potential:

How can climate/ecosystem modeling help to better define and expand the decision space? Which management options are available and feasible? How can information from impact model runs driven by data from an ensemble of climate model runs be used? Which spatial and temporal resolution would be needed? These questions have been explored in a series of stakeholder meetings and seminars organized by the Mistra-Swecia Research Programme. Transformed into the world of modeling, these questions are closely related to which ecosystem processes and interactions should be included for the model to provide useful and relevant results. Several modeling steps can be included in a climate change impact assessment, starting with a phenological description of the plant species, continuing by including the effect of harmful weather events and risk for attacks by important pests and pathogens. Provenance specific adaptations should be taken into account. Finally, model simulations of management, economy and policy for handling uncertainties associated with climate change can be carried out. The last step is highly relevant to stakeholders, needing information on how to adapt in relation to limited resources. Potential goal conflicts should be evaluated, e.g. assessing the effects on production capacity, expected economical outcome, environmental considerations and preservation of biodiversity.

#### **P43 A survey study on nature conservation in semi-natural grasslands and forests in a changing climate**

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The objective of this poster is to learn how to better protect biodiversity of semi-natural grasslands and forest areas and facilitate the natural adaptation of species in Southwest Finland and Pirkanmaa regions in the face of a changing climate. In the survey study we focus on the different adaptation measures (human intervention via conservation and management) and aim to assess their effectiveness for nature conservation and acceptance to stakeholders. With climate change, many species are predicted to shift towards higher latitudes and altitudes. However, the viability of such projected range shifts will largely depend on the availability of suitable habitat networks. Semi-natural grasslands are already in decline in Finland (as in other parts of Europe), due to agricultural intensification and abandonment of marginal areas. The forest area under conservation in southern Finland is also not sufficient to protect biodiversity and provide a network of habitats to species. Several species are likely to face difficulties in migrating across fragmented landscapes to new climatically suitable areas. Semi-natural habitats have very high species diversity in northern Europe and their persistence is crucial for the protection of biodiversity and the ecosystem services they provide under a changing climate. Farmers and forest owners can have a significant impact on biodiversity conservation by managing these habitats. The survey will be sent to farmers and forest owners in two regions, Southwest Finland and Pirkanmaa in at the beginning April 2012. The aim of the survey is to collect farmers' and forest owners' views on the condition of wildlife and biodiversity in farmlands and on the types of interventions that can promote resilience of species and their habitats to climate variability and change. Secondly the survey data is used to explain what economic, ecological, social and institutional perceptions influence farmer's decision making in farm and forest management and conservation. This poster presents first preliminary results of survey carried out as in a case study of the A-LA-CARTE and MEDIATION projects.

#### P44 Perceptions on Resilience in Finnish Food Supply Chains

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The aim of the poster is to present how the concept of resilience appears in our three-region study on climate change adaptation in the Finnish food supply chain. In this study the concept of food supply chain is understood to include the key food production process phases right from the initial farming phase, through to product consumption. Respectively, the concept of resilience implies flexibility and agility. In terms of supply chain, resilience refers to the chain's capability of preparing for unexpected events, responding to failure in distributions, and recovering from the crises. Our poster is based on an online census survey conducted in the autumn of 2011. The population consisted of 551 food enterprises from the regions of Central Finland, Pirkanmaa and Southern Savo. Due to low number of respondents (71) and consequently an overall response rate of only 12,8 per cent we use the survey data mainly to show some descriptive preliminary findings indicative of eventual food systems' resilience. The main themes of the survey were: respondent profile, enterprise, products, supplier chain, customer chain and perceptions on climate change adaptation. According to the results we can identify some factors that enhance vulnerability of the food chain. According to our data, it seems that entrepreneurs and managers of the food enterprises take seriously the threat of climate change. They think that more local co-operation is needed in climate change adaptation. On the other hand, they are not willing to change their field of business or portfolio of products because of climate change related considerations. Finally, we propose that resilience is dependent upon the size of enterprise, production sector and vulnerability of the delivery chain. Findings of the survey are presently used as instructive background information while structuring subsequent data collection phases with qualitative method.

#### P45 Pre-anthesis high-temperature acclimation alleviates damage to the flag leaf caused by post-anthesis heat stress in wheat

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The objective of this study was to investigate the effect of pre-anthesis high-temperature acclimation on leaf physiology of winter wheat in response to post-anthesis heat stress. The results showed that both pre- and post-anthesis heat stresses significantly depressed flag leaf photosynthesis and enhanced cell membrane peroxidation, as exemplified by increased O<sub>2</sub><sup>-</sup> production rate and reduction in activities of antioxidative enzymes. However, under post-anthesis heat stress, plants with pre-anthesis high-temperature acclimation (HH) showed much higher photosynthetic rates than those without pre-anthesis high-temperature acclimation (CH). Leaves of HH plants exhibited a higher Chl a/b ratio and lower chlorophyll/carotenoid ratio and superoxide anion radical release rate compared with those of the CH plants. In addition, antioxidant enzyme activities in HH plants were significantly higher than in CH. Coincidentally, expressions of photosynthesis-responsive gene encoding Rubisco activase B (RcaB) and antioxidant enzyme-related genes encoding mitochondrial manganese superoxide dismutase (Mn-SOD), chloroplastic Cu/Zn superoxide dismutase (Cu/Zn-SOD), catalase (CAT) and cytosolic glutathione reductase (GR) were all up-regulated under HH, whereas a gene encoding a major chlorophyll a/b-binding protein (Cab) was up-regulated by post-anthesis heat stress at 10 DAA, but was down-regulated at 13

DAA. The changes in the expression levels of the HH plants were more pronounced than those for the CH. Collectively, the results indicated that pre-anthesis high-temperature acclimation could effectively alleviate the photosynthetic and oxidative damage caused by post-anthesis heat stress in wheat flag leaves, which was partially attributable to modifications in the expression of the photosynthesis-responsive and antioxidant enzymes-related genes.

#### P46 Enhancing adaptive capacity of Finnish agrifood systems: a Delphi based survey on stakeholder views

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Successful climate change adaptation requires both proactive adaptation strategy building and stakeholder involvement to assess various adaptation options and their feasibility. Participatory approaches allow forming a wider perspective on how to prepare towards future climate and socioeconomic changes, as opinions of various actors and stakeholders can be taken into account. Future oriented approaches like the Delphi method are well suited to defining optional solutions for a complicated issue, for which no single optimal solution exists. We conducted a Delphi technique based study to define key factors for adaptive capacity and resilience of Finnish agrifood systems. For this, we had a discussing workshop and two web questionnaire rounds with selected stakeholders from varied levels of the food chain, from farm level to consumers. Factors important for system performance as a whole and for each actor level involved were discussed in various alternative future scenarios for Finnish agrifood systems and finally, irrespective of the scenario (to mirror the uncertainty of climate change impacts: in a situation where any of the futures may arise). The most important factors raised as important for adaptive capacity were open and active communication within the food system, energy and nutrient self-sufficiency, level of agricultural and information technology, co-operation with research, flexibility, level of education and knowledge and infrastructure. Stakeholder involvement was found useful for supporting proactive adaptation to climate change. Many novel factors compared to literature-based determinants were raised.

#### P47 Green roofs as an adaptation tool: Cost-benefit analysis

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Climate change is expected to cause increases of the occurrence and intensity of extreme downpours in many parts of Europe, including Finland. Similarly, the occurrence and length of heat waves may grow. Green roofs can be a cost-effective adaptation solution at the urban level regarding mitigating flooding risks of intense rainfall and reducing heating and cooling needs. Cities are dependent on the ecosystems beyond city limits but they also benefit from internal urban ecosystems. Most of the problems of which many are going to get worse under the changing climate are locally generated and require local solutions. Green roofs provide ecosystem services such as storm-water regulation and building-heat regulations and increase the level of adaptability of an urban system. However, many of the benefits are intangible such as improved urban biodiversity or noise insulation, and hard to value. For this reason, some or most benefits of ecosystem services are often neglected in ordinary cost-benefit analysis and the lack of commensurate valuation restrains us from comparing where scarce resources should be allocated. The valuation of these ecosystem services



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