

Report on
Workshop linking practitioners and researchers: Practical and methodological challenges of climate change adaptation

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1. Summary



Figure 1: Workshop attendees discussed adaptation challenges on how to deal with the impacts of urban flooding due to extreme precipitation events, which are currently happening more frequently across Europe, as for example the Boxing Day floods in North Yorkshire, UK in December 2015. Credit: Ron Hudson/Shutterstock.com

Considerable challenges continue to exist in the understanding of climate change, the associated impacts and the identification of potential adaptation options. Through the implementation of adaptation measures, the adaptive capacity of a system may increase and the sensitivity reduce, resulting in reduced vulnerability of society.

The adaptation process involves making decisions to reduce potential damages and taking advantage of new opportunities. However, the practitioners' information needs are not always met by what is available to them and they often lack appropriate decision support tools to present information on a cost/loss level such that adaptation actions can be explicitly included in city and state budgets.

The Center for International Climate and Environmental Research – Oslo (CICERO) and the Norwegian Computing Center convened a workshop in Oslo, Norway bringing together practitioners and researchers to discuss the practical and methodological challenges of climate change adaptation. Climate scientists, environmental economists, statisticians, climate service providers and practitioners in various decision contexts, mainly at the city and state levels, attended the workshop, which was structured around three themes: adaptation, uncertainty and visualization.

The participants identified open access to easily available data as one of the main challenges of climate change adaptation. This holds, in particular, for economic and insurance data in addition to the more traditional climate data. Such data sharing requires collaboration between governments, local authorities, the private sector and public agencies. Compelling results from a pilot study showed how local insurance loss data obtained from the insurance industry can enable informed decision making at the municipality level for reducing vulnerability to the impacts of water-related natural hazards in cities.

Furthermore, the various data types need to be coupled in order to assess impacts, the cost of the impacts and adaptation options. This poses two challenges. Firstly, new modeling frameworks are needed that can model the uncertainty of climate, impacts and cost/benefits in a joint fashion. Secondly, the decision support tools must be able to deal with uncertainty. For this, decision support tools that combine real options analysis and a portfolio approach are a flexible and appealing alternative in that investment decisions can be combined, timing of investment can be flexible and uncertainty in the impacts of climate change is accounted for.

Visualization and presentation of information was intensely discussed throughout the workshop. The participants agreed that there is a need for visualization tools for decision-making and adaptation options that are user-specific and simple without disguising the underlying uncertainty. The practitioners expressed a strong preference for uncertainty information being presented in terms of risks and likelihoods. In general, communication of information should focus on storytelling where scientists interact with practitioners to co-produce stories. Good communication and a common understanding between all the involved actors are vital for obtaining and implementing a successful climate change adaptation strategy.

2. Adaptation

The workshop's first session started with three presentations addressing different perspectives on climate change adaptation. Ole-Kristian Kvissel from the Norwegian Environment Agency gave an overview of the Norwegian national perspective. In Norway, the responsibility for climate change adaptation is considered a shared responsibility under the precautionary principle. The municipalities are in the front line of dealing with climate change and its consequences, due to the local character of the impacts of climate change. In addition, they are obliged by law to consider climate change, assess risks and vulnerabilities, and thus gain knowledge and competence. The national coordinator's role is to stimulate communication and cooperation, both at a national and an international level, to ensure that an up-to-date and strong knowledge base exists and is accessible, and to support the necessary capacity building at a regional and a local level.

Ingrid Vedeler and Guro Kjerschow from the City of Oslo then proceeded to discuss adaptation challenges in the country's capital which are mainly related to dealing with excessive surface water and storm surges. The speakers discussed a lack of vulnerability assessments for the city as well as socioeconomic and cost-benefit analyses in order to move from silo thinking to system thinking where physical, ecological, governance/economic and social factors are all accounted for. However, such a process is very resource demanding, requires political engagement and budget, and is yet another component to be integrated into an already overstretched workload.

In the session's third and last talk, Mia Ebeltoft from Finance Norway discussed how insurance data can increase resilience. She stressed the value of collaboration between governments, local authorities, the private sector and public agencies, in particular regarding data sharing. She presented the results of a pilot study demonstrating how local loss data from the insurance

industry can enable informed decision making at the municipality level for reducing vulnerability to the impacts of water-related natural hazards in cities.

In a following break-out-group discussion, the workshop participants reflected on the existing challenges of adapting to climate change on the local, regional and national level as well as the interactions between the different levels. The group focusing on local needs found that the greatest challenge is good storytelling, that is, to tell the story behind the numbers and explain what the numbers really represent. Other important challenges include uncertainty quantification, alignment with sustainable development goals, the lack of coordination between local and national acts/frameworks, and mal-adaptation. On the last point, it was suggested that a form of “rubber stamping” for quality control of people and products could be useful.

The group discussing regional adaptation concluded that it is important to understand current adaptation planning with regard to consequences and incentives (to understand why people do what they do), to present information on a cost/loss level, such that actions can be included in city and state budgets, and to develop a good sense for which actors should be collaborating on what. Additionally, there is a need for better understanding of the influence of global events on the local scale (i.e. how does the Paris agreement relate to climate adaptation in Oslo?) and the value of blue/green structures, and better ways to implement and use quantitative research.

The break-out-group focusing on the national level of adaptation discussed the challenge associated with different time horizons of e.g. political strategies versus the lifetime of buildings or other infrastructure. Commercial interest/pressure often influences decision making regarding spatial planning and uncertainty may be used as a cover-up to build in floodplains. In general, holistic planning requires a better link between the national, regional and local levels. Another challenge is that it often takes a long time to alter laws and regulations, while at the same time those that are in place may be difficult to understand and implement. The group then discussed some data challenges, in particular the need for economic data and insurance data in addition to the more traditional natural science data. Furthermore, these various data types need to be coupled in order to assess impacts, the cost of the impacts and adaptation options. This is needed in order to move from impacts studies to actual adaptation.

3. Uncertainty

The second session on uncertainty started with a presentation by Susan Joslyn from the University of Washington on communicating, understanding and using uncertain information in everyday decisions. Her studies show that people can understand uncertainty information and make better decisions with uncertainty forecasts than with deterministic forecasts. People also show a greater trust in the forecast if the associated uncertainty is communicated. Especially for extreme events, people tend to underestimate the likelihood of the event due to high false alarm rates for such events and may even stop responding if there are too many false alarms. However, the presentation of the uncertainty is important, that is, the uncertainty information should refer to the event of interest and not e.g. to the opposite event.

In the next talk, Peter Guttorp from the Norwegian Computing Center presented work on projecting local sea level rise. In this semi-empirical approach, historical sea level change is related to historical temperatures and the relationship may then be projected forward using temperature projections. In a second step, local sea level is related to global sea level in a procedure that includes glacial isostatic adjustments. Such an approach makes it possible to propagate uncertainty through the modelling steps and the local sea level projections are provided with joint uncertainty bands over the time period of interest. In the on-going project “Statistical analysis of sea level projections” (eSACP), it is planned to provide such projections for all locations in Scandinavia.

Karianne de Bruin from CICERO/ Alterra-Wageningen UR gave the session's third talk on decision tools accounting for uncertainty. Climate adaptation decision making involves deciding on whether, what, how much and when to adapt. The main challenges of this process are methodological challenges related to dealing with uncertainty, challenges related to defining options and estimating costs and benefits, and the practical challenges of offering user-friendly tools. Decision support tools that combine real options analysis and a portfolio approach are a flexible and appealing alternative in that investment decisions can be combined, timing of investment can be flexible and uncertainty in the impacts of climate change is accounted for. Furthermore, a focus on good visualization will make the tools more user-friendly.

The break-out-group discussion in this session focused on three topics: Insurance and extremes, spatial planning in cities, and food production. The group discussing insurance and extremes identified urban flooding and extreme precipitation as the main issues with the calculation of risk and political priorities providing challenges. Also, in Norway, there is no incentive to prepare as the premium is "solidarity based". The current framework lacks good decision making tools, it is not clear how to combine knowledge from natural science with decision making tools, and the political decision of how much risk is acceptable needs to be answered.

The group discussing spatial planning in cities identified several challenges. There is a lack of regulations regarding how to account for future climate projections in the planning process. Adaptation decisions require economic values for (co-)benefits, and soft issues such as quality of life and general happiness need to be made more concrete; it is easier to assess and quantify changes in numerical values than non-numerical values. While spatial planning requires future projections for floods, not all available flood maps are publicly available. Also, there is a danger that too nice maps of deterministic projections may be treated as "the truth". Only about 20% of city spaces are public making the local authorities less flexible in the implementation of adaptation options as to make sure that all parties are involved in financial and implementing responsibilities. These challenges furthermore highlight the importance of good communications between all involved parties.

Regarding food production, the third break-out-group concluded that there are issues such as uncertainties related to geopolitics, climate change (in particular extreme events), diet changes and diseases, which directly and indirectly impact primary food production. To reduce the uncertainty, research should focus more on the links between weather, climate, plants and agriculture. In particular, in Norway, there is a lack of research connecting climate and agriculture/food. In addition, better seasonal predictions are needed as well as a change in attitude of both consumers and producers on understanding how climate change impacts food production and how to adapt to these changes.

At the end of the session, Rasmus Benestad from MET Norway provided personal reflections on the workshop discussions during the first day. He noted that meteorological services have long experiences in advisory and they thus have valuable experiences that can be utilized for adaptation. Also, as models and knowledge are still under development, adaptation tools and techniques must be flexible and allow for updates and upgrades. The main take-home message from this first day is a call for holistic thinking and collaboration across sectors.

4. Visualization

The session on visualization started with a talk by Astrid Arnslett from CICERO on current visualization tools for climate information. She discussed the move from information sharing through traditional tools such as a press release towards digital storytelling. In digital storytelling, it is important to have a strong focus on the message and to pay attention to the atmosphere that is

established. A crucial message to drive engagement for climate change is to be a part of something larger than oneself. When creating such stories, it is also important to be playful and to dare to fail. Short videos can prove a very powerful tool for information sharing due to the amount of information they can convey in a short period of time.

Subsequently, Hasse Goosen from the Climate Adaptation Services/Alterra-Wageningen UR gave a talk on climate adaptation services for the Netherlands and the power of visualization. The goal of the adaptation services is to bridge the gap between the climate data and the spatial planning community. There is currently an overload of climate data, it is fragmented and supply driven. The data is commonly not useful for local applications and it is presented in an uninspiring and text-heavy manner. Scientists need to interact with users to co-produce stories. It is important to keep the message simple through visualization and storytelling, to communicate “what if” and not “we don’t know”, and to keep in mind that climate adaptation is only one of a large number of factors that the decision maker needs to account for. Also, it is necessary to be flexible as users have different needs that may change throughout the adaptation process. Two key challenges are: open access data sharing, and the conflict between keeping it simple and conducting high-level research, in particular, visualization and communication are commonly not considered research activities.

The two talks were followed by a break-out-group discussion in two groups focusing on visualization related to spatial planning in cities, and insurance and extremes. The first group on spatial planning in cities concluded that there must be a dialog between the different actors where agreeing on a common language is an important step. The visualization should be kept focused and rather than visualizing the uncertainty itself, various risks and likelihoods (stories) should take the center stage through a flexible process that accounts for the practitioners’ different needs. Generally, practitioners like phrases such as “most likely” and “if...then...”.

The group discussing visualization for insurance and extremes came to similar conclusions. In general, it is important to simplify and distil the essence of the information through storytelling (use “what if”) and to use recent experience if possible, to have awareness of the audience, and to ask how the information is used for decision making. Priorities are often chosen based on budget. A common understanding of the underlying basis is important; an understanding of why we make the choices we make. If the information we provide is used as input to research, we should get involved (co-production). Specifically regarding visualization, the information should be provided as a single map and it needs to be communicated on beforehand what is needed. Perception is important, both in general and perception of spatial scale.

5. Way forward

The final session of the workshop was a brainstorming session where the participants identified practical and methodological challenges of climate change adaptation, dealing with uncertainty and visualization. A full list of the challenges identified by the participants is given in Annex B. Some common themes that emerged are listed below.

Practical challenges:

- Good communication, common understanding and language, and transparency between scientists from different disciplines, decision makers, other practitioners, stakeholders and the general public
- Open access data that is easy to find;
- Information on the costs and (co-)benefits of adaptation options
- How to expose and present uncertainty; how to choose the correct/appropriate uncertainty information to present

Methodological challenges:

- Improved decision support tools that go beyond classic cost/benefit analysis:
 - Light touch tools
 - Tools that combine risk avoidance and value creation
 - Tools that compare multiple options, e.g. incremental vs. large intervention
 - Tools that combine decisions on multiple levels (multiple decision makers)
- Modelling frameworks that can model the uncertainty of climate, impacts and benefits jointly
- Visualization tools for decision making and adaptation options which are user-specific and simple without disguising uncertainty

Annex – A. List of participants

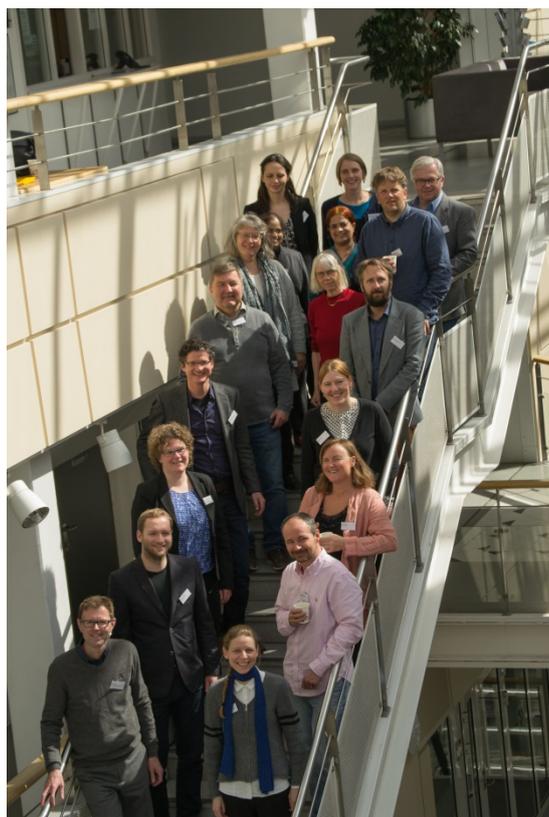


Figure 2: The workshop participants.

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Annex – B. Full list of challenges identified by the workshop participants

Adaptation	
Practical Challenges (1)	Methodological Challenges (4)
<ul style="list-style-type: none"> a) For municipalities: How to find information? How to use it? How to make politicians listen? b) Better understanding of adaptation costs c) Collect cost/benefits of adaptation options (kentalen boek) d) Get an understanding of what is needed... e) Ensure better understanding of “other” sciences with natural sciences f) Transparency: Public – Stakeholder – Decision makers; “Do they know?” g) Bridge the understanding/gap among researchers in them trying to understand the needs of municipalities h) Bridge the knowledge and research gap in the municipalities for them to actively take part in the discussions with researchers i) Present adaptation projects that haven’t been successful but with explanations as to why they weren’t successful and what could have been done better j) Create open access data base of risk and vulnerability maps k) Be explicit on what research can do to help those who need/want to adapt. If research cannot help these people, what are we providing? l) Value added 	<ul style="list-style-type: none"> a) Light touch decision support tool b) Decision tool that combines risk avoidance and value creating approach c) Find the right method! d) How is the information used for decision making; “sausage factory aspect” e) The benefits of adaptation including marginal costs, incremental vs. large intervention f) Quantification of costs/benefits -> climate <u>change</u> adaptation g) How do we integrate knowledge on “challenges to adaptation” that address different decision makers, e.g. level h) The international adaptation agenda vs. the national adaptation agenda i) How does our information fits within a decision context? Options? j) Alternative to cost/benefit? Better alternative? k) How should cost/benefit analysis be used? l) What makes the “best” decision?
Uncertainty	
Practical Challenges (2)	Methodological Challenges (5)
<ul style="list-style-type: none"> a) -> How to cope with uncertainty in your decisions b) Be aware, ... How to make the uncertainty a resource? c) Lack of time, resources and understanding d) Identifying the “right” uncertainty to present e) Communicate the likelihood; determine the “need for uncertainty”? f) How to expose the uncertainty g) Extreme event probability predictions (precipitation, wind storm) as input for decision making models h) Don’t be the judge on whether there is sufficient certainty, policy makers are responsible i) What do we achieve by better estimates of the 	<ul style="list-style-type: none"> a) The uncertainty is uncertain – how to deal with that (methods, communication) b) What are we (actually) predicting? c) How can we transform climate model or physical model uncertainties to relevant information about uncertainty to decision makers d) Put the climate/impact/benefit uncertainty together in a framework e) Develop game tools for exploring uncertainties f) Why? What’s the consequences g) Minimum skillful scale (relation to PostClim project) h) Limitations of downscaling – what do the numbers represent (relation to PostClim project)

uncertainty (why is it important to have common idea about uncertainties)	
j) Risk of maladaptation	
Visualization	
Practical Challenges (3)	Methodological Challenges (6)
a) Involve visualization/communication at proposal development stage, throughout projects -> not only at the end b) Highlight success stories. Visualize what effect a project has made. Show how risk from climate change has decreased. c) Don't trade communicative power for uncertainty visualization. A map should be clear. d) What information is really needed? e) Uncertainty is quite hard to visualize because it is difficult to know what the reader/decision maker grasps (both nr. 2 and 3) f) Presenting uncertainty in a way that people can understand (both nr. 2 and 3) g) Understand what the stakeholder really needs h) Agree/define agenda for communication of risk/uncertainty. Use the language of the IPCC? i) Decision = "most likely" is the message	a) Simple visualizations -> does it hide the reality? (both nr. 3 and 6) b) Simple visualization should not disguise uncertainty c) I think we agree that mapping is key for spatial planning but it is hard to find the right level of information to fulfil expectations d) How can I distil the right information from the data? e) Simplicity is the message f) Visualization tools for decision making and adaptation options g) Develop user specific visualization -> prototyping and testing

Annex – C. Program

Day 1 - Monday, April 25, 2016

09:00 - 09:30	Registration and coffee
09:30 - 10:00	Opening
09:30 - 09:50	Karianne de Bruin (CICERO, Norway) and Thordis Thorarinsdottir (NR, Norway) <i>Introduction to the workshop</i>
09:50 - 10:00	Kristin Halvorsen (Director CICERO, Norway) <i>Opening remarks</i>
10:00 - 12:15	Session A: Climate change adaptation Moderator: Karianne de Bruin
10:00 - 10:25	Ole-Kristian Kvissel (Norwegian Environment Agency, Norway) <i>A national perspective on climate change adaptation and the use of data in</i>
10:25 - 10:50	Ingrid E. Vedeler and Guro Kjerschow (Oslo Municipality, Norway) <i>Climate change adaptation at the municipality level</i>
10:50 - 11:15	Mia Ebeltoft (Finans Norge, Norway) <i>How can insurance loss data increase climate resilience?</i>
11:15 - 11:25	Comfort break
11:25 - 12:15	<i>Group work reflections on the national, regional and local perspective, and their interactions</i>
12:15 – 13:15	Lunch

13:15 - 16:30

Session B: Uncertainty

Moderator: Thordis Thorarinsdottir

13:15 - 13:30

Plenary reporting back from Session A

13:30 - 14:00

Susan Joslyn (University of Washington, USA)

Better decisions with uncertainty

14:00 - 14:20

Peter Guttorp (NR, Norway)

Projecting local sea level rise

14:20 - 14:40

Karianne de Bruin (CICERO, Norway/ Alterra-Wageningen UR, the Netherlands)

Decision tools accounting for uncertainty

14:40 - 15:10

Coffee break

15:10 - 16:00

Break-out group discussions on dealing with uncertainty

16:00 - 16:15

Summary of break-out group discussions

16:15 - 16:30

Rasmus Benestad (MET Norway, Norway)

Closing reflection for Day 1

19:00

Dinner at Theatercaféen (Stortingsgaten 24/26, Oslo)

Day 2 - Tuesday, April 26, 2016

09:00 - 12:00

Session C: Visualization

Moderator: Karianne de Bruin

09:00 - 09:15

Reflections on Session B and introduction to Day 2

09:15 - 09:45

Astrid Arnslett (CICERO, Norway)

Current visualization tools for climate information

09:45 - 10:15

Hasse Goosen (Climate Adaptation Services, the Netherlands)

Climate adaptation services for the Netherlands: the power of visualization

10:15 - 11:00

Coffee break and demo of visualization tools

11:00 - 11:55

Break-out group discussions on the needs and challenges of visualization of climate change, adaptation and uncertainty

11:55 - 12:15

Summary of break-out group discussions

12:15 - 13:00

Lunch

13:00 - 14:00

Session D: Way forward

Moderator: Thordis Thorarinsdottir

13:00 - 13:30

Group discussion on the way forward – Developing an agenda for collaboration

13:30 - 13:45

Plenary feedback

13:45 - 14:00

Conclusion

14:00

End of workshop and safe trip home