

Midterm Report NWO/KfC

Project 'Bridging the gap between stakeholders and climate modellers: demand-driven adaptation assessment for uncertain changes in weather extremes'

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Project number: 830.10.008
Project period: September 2010–June 2013 (two postdocs 0.7 fte)
Reporting period: September 2010–June 2012
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Main objectives and expected results

Abstract (from the proposal)

Climatic change abounds with uncertainty, all the more so when we are interested in changes in extreme weather and adaptation options at the regional scale. Not only are uncertainties intrinsic in the climate science; societal actors also have different opinions on what specific aspects of climatic change constitute a problem and why. When analysts search for indicators to analyze and communicate information about climatic change, they therefore have to address both scientific and societal dimensions of the problem. In this project, we address two types of uncertainties. On the one hand, we address uncertainties that are inherent to climate modelling. On the other hand, we address uncertainties with respect to the risks as regards specific harmful impacts of extreme weather events on (sectors of) society, as stakeholders perceive them.

The general aim of the project is threefold; it is divided into a methodological, an empirical and a policy aim to contribute to: (1) an integrated (social and natural science) methodology for demand-driven assessment into uncertainties, risks and options for climate adaptation governance; (2) knowledge with respect to changes in weather extremes for the Netherlands, focusing on specific areas or sectors and including a thorough investigation of uncertainties; and (3) the identification and exploration of climate adaptation options, inter alia through a dialogue on weather extremes including climate scientists and stakeholders from various societal sectors.

Core research question (from the proposal)

Which indicators of changes in weather extremes are considered relevant by stakeholders in evaluating climate adaptation options and at the same time reliable by climate scientists, in which case they adequately represent both the policy dimension of the problem as well as the scientific knowledge as reflected in simulations of future climate?

Specific objectives (from the proposal)

- To articulate the various stakeholder perspectives related to weather extremes and their impacts on the Netherlands.
- To determine the uncertainty range of climate projections and decadal predictions of weather extremes in the Netherlands.
- To compare and, where possible, match the ideas put forward by stakeholders with scenarios developed by climate scientists.
- To explore and assess the pros and cons of adaptation options (related to contents as well as procedure for governance).

Tasks and results (from the proposal, but changed from 1.0 fte to 0.7 fte postdocs)

Month (1-34)	Activity postdoc VU	Activity postdoc KNMI
<i>Stage 1 – Identifying stakeholder perspectives (related to weather extremes and their impacts on the Netherlands) and scenarios (for changes in weather extremes in the Netherlands) (13 months)</i>		
1-3	Literature study; getting to know home institutions	Literature study; getting to know home institutions
4-6	Preparing interviews	Obtaining data and mapping of available simulations on changes in weather extremes in the Netherlands
7-10	Conducting 30 interviews (jointly)	
11-13	Statistical analysis of repertory grid data	Setting up statistical models and uncertainty analysis for different prediction horizons
<i>Stage 2 – Comparison and deliberation (6 months)</i>		
14-17	Joint comparative analysis of findings on perspectives and scenarios	
17-18	Preparing first stakeholder workshop	January-February 2012. Done
19	First stakeholder workshop: testing the repertory grid results, the appropriateness of the indicators and the communication of scientific uncertainty	
<i>Stage 3 – Improvement of scenarios / exploring options for adaptation governance (15 months)</i>		
20-23	Mapping of adaptation governance options	Development of Bayesian analysis of changes in extremes; improving indicators of extremes and uncertainty presentation based on user feedback
24-25	Preparing second stakeholder workshop	Performing simulations and preparing presentation of results
26	Second stakeholder workshop: exploring adaptation governance options	
27-29	Evaluation of process impact	Preparing and holding expert workshop on uncertainty communication with regard to regional climate change (with LSE)
29-34	Preparing report and two articles (jointly)	

Summary of conducted research tasks

Stages 1 and 2 have been concluded successfully and stage 3 has begun. Here the research activities of the two postdocs will be summarised (note that much of this work has been done jointly). The research outputs are listed too in Appendix 2.

The VU postdoc and her colleagues have performed the following research tasks:

- 1) A literature review on factors affecting perceptions on extreme weather events, and the state of the art related to adaptation to extreme weather, with a focus on perceptions. Parts of this review have been included in the submitted paper (submitted to *Regional Environmental Change*, see below under 6).

- 2) Preparation and conducting of 41 interviews with different stakeholders in the following sectors: crisis management, public health, water sector, tourism, hospitality sector, urban transportation, vulnerable individuals. A table with the interviewees, and their organisations is provided in Appendix 1 Table 1. Interviews were conducted with the repertory grid technique as envisaged in the proposal, using fifteen different photos of extreme weather events and their impacts. The interviews were transcribed verbatim, and some material from this has been used in the submitted paper (see below under 6).
- 3) Analysis of the quantitative results (factor analyses of six different perspectives of extreme weather events) and presentation of the results in three international conferences.
 - a. Eleftheria Vasileiadou, Matthijs Hisschemöller, Arthur Petersen, Channah Betgen, Iris de Hoog, Wilco Hazeleger, Erik Min (2012), 'Adapting to extreme weather events: Perspectives of social actors', presentation at the Governance of Adaptation Symposium, Amsterdam, 22-23 March
 - b. Erik Min, Eleftheria Vasileiadou, Channah Betgen, Iris de Hoog, Wilco Hazeleger, Arthur Petersen, Matthijs Hisschemöller (2011), 'Adapting to extreme weather events: Perspectives of social actors', presentation at the IGS SENSE conference Resilient Societies, University of Twente, 19-21 October
 - c. Eleftheria Vasileiadou, Channah Betgen, Iris de Hoog, Wilco Hazeleger, Arthur Petersen, Erik Min, Matthijs Hisschemöller (2011), 'Adapting to extreme weather events: Perspectives of social actors', presentation at the 11th EMS International Conference/ 10th European Conference on Applications of Meteorology, Berlin, 12-16th September.
- 4) A poster on the project was presented in the Planet Under Pressure Conference, London, 26-29 March 2012.
- 5) Invited seminar for the LIAISE Network of Excellence Winter School on "Tools and Modelling in Impact Assessment", Leipzig, 9-13th January. Vasileiadou E. (2012), 'Social rationality and the use of participatory tools in environmental policy making'.
- 6) A submitted paper (to *Regional Environmental Change*, March 2012), on perceptions of social actors of extreme weather events, with links to changes in extreme weather events information from the KNMI. The paper (also included in the additional material) is currently (15 August 2012) still under review.
- 7) Guidance of three successful MSc theses for students in the Environment and Resource Management Master programme of the IVM. Two master's theses related to different perspectives on extreme weather events, on focusing on urban adaptation (hospitality, tourism and urban transportation sector), and one focusing on sectors responding to extreme events (crisis management, public health, water sector). The third master's thesis was on the "Adaptation strategy for heat waves: The Dutch National Heat Plan 2007" and the student conducted 9 interviews with stakeholders in different sectors to understand how the heatwave alarm system of the KNMI functions, and, more importantly, what are the problems and difficulties it creates and how they may be resolved. In collaboration with the Kinderdagagenda, a short document was prepared on heat waves in the Netherlands and how they may affect young children, and possible prevention measures. It was included in the Agenda, and distributed to more than 3000 childcare institutions in the Netherlands.
- 8) A paper in preparation on the determinants of the level of concern towards extreme events. This relates to additional material from the interviews which has not been analysed for the already submitted paper. The investigation in this paper is the extent to which the level of concern on extreme events is influenced by their:
 - 1) level of informedness on extreme events
 - 2) sector of interviewee (distinction whether they are mainly affected by extreme events, or mainly responding to as professionals)
 - 3) personal negative experience with extreme event.
 The stage of this paper is only at the level of the statistical analyses.
- 9) Organisation of a stakeholder workshop in Amsterdam on 8 March 2012, with 17 different stakeholders (outside of the project team). A table of the participants, as well as the discussions summary can be found in the Appendix. The aim of the

workshop was 1) to present on-going results, in the form of presentations of KNMI and IVM; 2) to validate the factor analysis results of the different perspectives on extreme weather events (analysis of this material is on-going) 3) to obtain feedback and stakeholder guidance towards the next step of the project, which is moving towards adaptation governance priorities. The presentations to the workshop are given in the additional material. Also the outcomes of the workshop are included there.

The KNMI postdoc and his colleagues have performed the following research tasks:

- 10) Based in part on earlier KNMI stakeholder consultations, on the Hot Spots identified in the Climate Changes Spatial Planning programme, and on a shared interest in urban areas and vulnerable individuals, heat extremes ('hottest day of the year') were chosen as a first weather indicator relevant for Dutch adaptation strategies.
- 11) A literature study of Extreme Value Statistics was conducted, and an ESF COST workshop on Extreme Environmental Events (13-17 December 2010, Cambridge) was attended.
- 12) Data from the EU FP7 ENSEMBLES and CMIP3 was obtained, as well as data from the ESSENCE ensemble, the ERA-40 and ERA-interim reanalyses and the E-OBS and HadGHCND observational datasets. The relevant parameters (daily averaged, minimum and maximum temperatures as well as several of their extremes, summer averages, heat wave durations, number of days exceeding certain thresholds etc.) were extracted.
- 13) The aforementioned data was analysed using several statistical techniques. Extreme value distributions were used, but for communicational purposes also simple linear trends were considered. On shorter timescales (decades) the results are similar.
- 14) A first analysis was made of the contribution of different types of uncertainties to the outcomes of the EU FP7 ENSEMBLES regional climate models (RCMs). Annual variability within the RCMs and observations, model spread between the RCMs and driving global models (GCMs) and internal variability in the boundary conditions (GCM) were found to be of comparable order, often non-linearly intertwined and therefore hard to separate.
- 15) The first analyses mentioned above suggested that RCMs had considerable difficulty reproducing observed trends in extremes. The focus of the research was shifted to characterising this property of RCMs.
- 16) Results of this comparison between RCMs and observations have been presented and discussed internally at KNMI, most importantly to the core group working on the upcoming new climate scenarios (KNMInext).
- 17) This work was presented as an oral presentation at the international Planet Under Pressure conference.
 - a. Erik Min, Geert Jan van Oldenborgh, Andreas Sterl, Wilco Hazeleger (2012), 'Unravelling contributions to uncertainty in regional projections of trends in high temperature extremes in Europe', presentation at the Planet Under Pressure International Conference, London, 26-29 March
- 18) A paper has been submitted to *Geophysical Research Letters* on the comparison between trends in mild heat extremes as found by RCMs and observations.

With respect to the joint operation and learning from each other, the KNMI Postdoc (E. Min) and the VU Postdoc (E. Vasiliadou) work together closely and have regular meetings. The KNMI postdoc has assisted in the selection of repertory grid photos, the finalisation of the interview protocol, has participated in and conducted some of the interviews and presented the work on the repertory grid analysis at the ISG SENSE conference in Twente (see task 3). He has also participated in the organisation of the stakeholder workshop in Amsterdam, 8 March 2012, in particular in inviting stakeholders and in leading one of the three discussions.

Scientific value of the research

The research makes several valuable contributions to science. Three publications (one submitted, two in preparation) are attached to illustrate this:

- Vasileiadou, E., Hisschemöller, M., Betgen, C., de Hoog, I., Hazeleger, W., Min, E., Petersen, A.C., 'Adaptation to extremes: focusing on perspectives', submitted to *Regional Environmental Change*.
- Min, E., Hazeleger, W., van Oldenborgh, G.J., Sterl, A., 'Evaluation of regional modelling of trends in high temperature extremes in North-Western Europe', submitted to *Geophysical Research Letters*.
- Hazeleger, W., van den Hurk, B.J.J.M., Min, E., van Oldenborgh, G.J., Wang, X., Petersen, A.C., Smith, L.A., Stainforth, D.A., Vasileiadou, E., 'Tales of future weather', in preparation for *Nature Climate Change*.

In a nutshell, following the results of these three papers (and our first three research objectives):

- We have articulated six stakeholder perspectives related to weather extremes and their impacts on the Netherlands. These perspectives are: 'Very disastrous, rescue needed'; 'New versus old extremes'; 'Prepare for (material) damage'; 'Persons involved'; 'Beyond imagination'; and 'Natural resource management'.
- We have studied the uncertainty range of climate projections of temperature extremes in the Netherlands using Regional Climate Models (RCMs) and found that the ensemble of RCMs significantly underestimates the observed trends, not only in the Netherlands, but over most of the North-Western European land surface. Individual models do not fare much better, with even the best performing models underestimating observed trends over large areas. We conclude that care should be taken when using this data for adaptation decisions.
- We found that traditional approaches to inform society on changes in the weather, involving extensive simulations and the provision of probabilistic information, do not work well. Recognizing the inherent predictability limits of climate and the different epistemic values held by different groups of experts, we argue for a different approach. Narratives describing existing knowledge of the physics of extreme weather events accompanied by simulations of extreme weather events in well-calibrated numerical weather prediction models in present-day climate and a potential future climate setting provide a realistic and physically consistent picture of both the types of events that need preparatory actions and the impacts of the adaptation decisions taken.

How and to which broader debate and/or societal issues does the project contribute

The projects aims to contribute directly to climate adaptation governance through stakeholder dialogues. This happens not only via the end results of the project but also via the research process itself. The workshop of 8 March 2012 is a concrete societal outcome of the project that has already materialised (see attachment).

In brief, with respect to the information needs of stakeholders, it turned out to be of major importance to have information available from different sources that are of relevance to adaptation to extreme events and that meteorological information has to be integrated with other relevant information, such as socio-economic information, information about the vulnerability of groups, organisation-specific information and medical information. With respect to limitations in the provision of information to stakeholders, limitations were highlighted of the extent to which people can be warned; these limitations are also dependent on the specific risk. Finally, with respect to adaptation policy, the differentiated responsibilities of different actors – from the individual to organisations to experts and government.

Appendix 1. Interviewees and workshop participants

Table 1. Interviewees

Interviewee	Institute	Function
1	Rijkswaterstaat, IJsselmeer area	Connected to future exploration Afsluitdijk
2	Water board Zuiderzeeland	Head of department water management
3	Vitens drinking water	Policy advisor water Flevoland
4	Waternet	Strategic advisor
5	Province of Flevoland	Works on water policy
6	Municipality of Almere	Senior advisor environment and water
7	GGD Flevoland	Doctor in medical environment science
8	Health center Filmwijk	Medical practitioner
9	PBL	Senior policy researcher, health expert
10	Red Cross/ Red Crescent	International work on climate adaptation
11	Hospital Flevoziekenhuis	Head of lung disease department
12	Asthma fund	Communication advisor
13	Fire department Bergen	Regional commander
14	Fire department Almere Safety region	Commander fire department Flevoland
15	Safety region Flevoland	Water functionary IJsselmeer area
16	Police department Flevoland	Head of conflict/crisis management bureau
17	Tennet energy	Assistent operation concept
18	Staatsbosbeheer	Policy maker and district head
19	Le Champion, organizes sports events,	Senior event manager
20	De Fietsersbond, organization for bicycle users	Traffic adviser
21	Rover, interest group for commuters	representative region Amsterdam
22	hospitality Interest Group Leidse Buurt	Secretary
23	De Uitkijk, Holland ´s oldest filmtheater	Employee
24	Arcadis, consultancy and design of infrastructural buildings	Senior specialist
25	Hortus Botanicus, botanical garden	Chief garden and collection
26	Hoogeboom Taxi, transport on demand	Taxi driver
27	Boat tour through the Canals	Captain
28	hospitality Interest Group Rembrandtplein and Thorbeckeplein	Chairman
29	Dutch Hotel Chain	Employee marketing and sales

30	Camping Zeeburg	Manager
31	Café van Zuylen, restaurant	Owner
32	1900, catering and restaurant	Owner and staff manager
33	Connexxion, public transport and transport on demand	Communications and planning and analysis taxi on demand
34	Tropenmuseum, museum on the Tropics	Senior marketing
35	Rijksgebouwendienst	Project manager
36	Allard Pierson Museum, archeological museum	Collection management
37	Amsterdamse Bos	Ranger / forester
38	netwerkbureau kinderopvang	Director
39	Catholic organisation for seniors (KBO)	Member and volunteer
40	Gezondheidsinstituut NIGZ	Director
41	Senior person	-

Table 2. Participants in workshop, March 2012

Name	Organisation
de Bruijn, Jos	Gemeente Amsterdam
de Jong, Bas	Koninklijke Horeca Nederland
De Vries, Hylke	Koninklijk Nederlands Meteorologisch Instituut
Hartog, Paulien	Waternet
Jaarsma, Krista	Planbureau voor de Leefomgeving
Mijderwijk, Jan Willem	Stichting Sportevenementen Le Champion
Molendijk, Marcel	Koninklijk Nederlands Meteorologisch Instituut
Nanninga, Willemien	Rode Kruis
Rozema, Ben	GGD Amsterdam afdeling milieu en gezondheid
Sahar Tushuizen	DRO Gemeente Amsterdam
van Dijk, Willem	Waterschap Zuiderzeeland
van Hees, Ad	Staatsbosbeheer
Visser, Hans	Planbureau voor de Leefomgeving
Vlaming, Ilse	Bureau plan d, communicatie en advies verduurzaming kinderopvang
Vonk, Chris	Rover Reizigers
Vredeveld, Geert	Vredeveld Training en Advies
Wijdema, Ernst	Horeca Belangenvereniging Rembrandtplein en Thorbeckeplein

Appendix 2. Project outputs

Articles (all three attached)

- Article submitted to *Regional Environmental Change* (Vasileiadou et al.), March 2012, title: "Adaptation to extremes: Focusing on perspectives"
- Article submitted to *Geophysical Research Letters* (Min et al.), July 2012, title: "Evaluation of trends in high temperature extremes in North-Western Europe in regional climate models"
- Article in preparation for *Nature Climate Change* (Hazeleger et al.), June 2012, title: "Tales of future weather"

Stakeholder workshops

- First stakeholder workshop March 2012: Presentation Hazeleger (in Dutch)
- First stakeholder workshop March 2012: Presentation Hisschemöller (in Dutch)
- First stakeholder workshop March 2012: Outcomes (in Dutch) (attached)

Conferences and seminars (for specifications see "Summary of conducted research")

- Conference presentation Berlin, September 2011 (Vasileiadou et al.)
- Conference presentation Enschede, October 2011 (Min et al.)
- Seminar Winter School LIAISE Leipzig, January 2012 (Vasileiadou)
- Conference presentation Amsterdam, March 2012 (Vasileiadou et al.)
- Conference presentation London, March 2012 (Min et al.)
- Conference poster London, March 2012 (Vasileiadou et al.)

MSc theses (for specifications see "Summary of conducted research")

- MSc thesis Terry de Jongh, August 2011
- MSc thesis Channah Betgen, September 2011
- Msc thesis Iris de Hoog, October 2011