Kennis voor Klimaat
Knowledge for Climate

Newsletter Decision Support Tools Theme 8 **Issue 5, October 2013**

Foreword

by Ekko van Ierland, consortium leader

The newspapers are regularly reporting about serious impacts on society of weather related events: forest fires in Portugal, Russia and in the neighbourhood of Los Angeles, landslides at locations where it did not happen before, flooding in the UK, Germany and many other countries in Europe and severe storm water damages in coastal areas, to mention just a few examples.

Whether all these specific events can be directly attributed to climate change is a question that is difficult to answer. Why? Because the weather has always been showing irregular patterns, and forest fires in sub-tropical areas are to some extent a frequently occurring and natural phenomenon.

However, the events are becoming very extreme and there are many indications that at least some of these impacts are related to climate change. This supports the evidence that early adaptation to climate change can be very beneficial in order to reduce the damages to society. It also supports the evidence that strong mitigation actions are justified in order to reduce the probability that even more serious impacts to society will occur.

This stresses the need to convince politicians and their electorate to vote for very stringent climate mitigation policies, and at the same time it makes adaptation to climate change very important.

In the context of the EU-Mediation program on adaptation at the European level researchers from Theme 8 have focused with their international partners on identifying the best assessment methods for analysing adaptation to climate change from a socio-economic perspective.

This has resulted in a detailed description of the assessment methods, including Multicriteria-analysis, cost effectiveness analysis, Portfolio analysis, cost-benefit analysis, real option theory and robust decision making.

For several case studies in different regions of Europe these methods have been applied and a systematic approach to select the most appropriate methods has been developed. The results of the Mediation project can be consulted at http://www.mediation-project.eu/, including the policy briefs and the platform to select the most appropriate tools to be used.

In close international cooperation with the leading institutes on climate adaptation in Europe, such as Potsdam institute for climate impact research (PIK), the International Institute for Applied Systems Analysis, the Stockholm Environment Institute (SEI) and Wageningen University and Research Center, the researchers of Theme 8 in Knowledge for Climate contribute to a better understanding of the adaptation challenges and the development and methods to identify efficient and effective solutions.

A recent publication on this topic resulting from Knowledge for Climate Theme 8 is:
van der Pol, T.D., E.C. van Ierland and H.-P. Weikard, 2013, *Optimal dike investments under uncertainty and learning about increasing water levels*, Journal of Flood Risk Management, 17 Sep 2013, DOI: 10.1111/jfr3.12063

It is available for you and the international community at http://onlinelibrary.wiley.com/doi/10.1111/jfr3.12063/abstract

If you are interested in these and other topics related to climate change, feel free to contact me at:
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In this issue

WP 1 Future land and simulated changes in urban heat island patterns

Eric Koomen and Jasper Dekkers

Release of new socio-economic scenarios

Some months ago, the updated land-use projections related to the *Global Economy (GE)* and *Regional Communities (RC)* scenarios have been released. These scenarios were initially developed by a consortium of Dutch research institutes (CPB et al., 2006) and translated into land-use projections in cooperation with PBL Netherlands Environmental Assessment Agency (Riedijk et al., 2007). The resulting land-use maps for 2040 were used in numerous research projects focused on climate adaption and mitigation in the Climate changes Spatial Planning programme.

A report that describes the updates and new model results in detail has been published and distributed among Knowledge for Climate partners (Figure 1). The projections are available to researchers in the Knowledge for Climate research programme to describe the socio-economic context for the development of new climate adaptation and mitigation strategies. Visit www.feweb.vu.nl/gis to download the report.

Meanwhile, we are updating the model configuration to the newest GeoDMS software version. This update will enhance flexibility in modeling approaches, increase calculation speed and ensure the continuation of technical support.

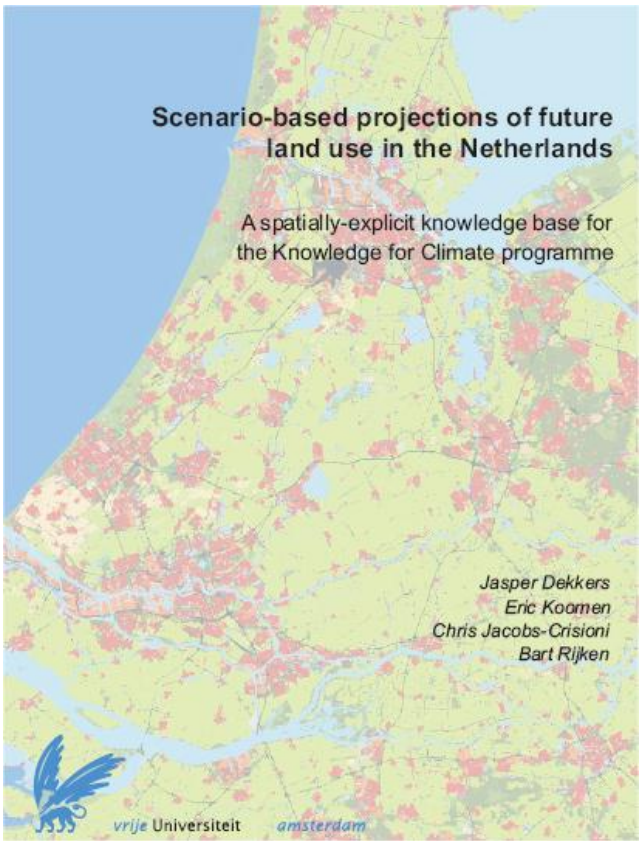


Figure 1. The new socio-economic scenario report

Simulating future urban heat islands using the socio-economic scenarios

Climate change is likely to affect living conditions in urban areas, causing, for example, an increase in the urban heat island effect. Understanding why urban areas have a higher temperature than their rural surroundings and finding appropriate adaptation measures are topics in the Climate proof cities research project (KfC theme 4). In our work package we have looked at the potential impact of future land-use changes on this phenomenon.

As part of the Urban Environment Lab course, students from the Amsterdam University College measured the urban heat island effect in Amsterdam using their bicycles and simple temperature and position loggers. The students linked the observed temperature differences to various urban characteristics and used scenario-based simulations of future use to explore potential future urban heat island patterns. The urban heat island measuring methodology and results were presented at the International Conference on Climate Change Effects in Potsdam, Germany on 27-30 May 2013. The observed and simulated urban heat island patterns for a typical summer evening (maximum daytime temperature of 20° C) are shown in Figure 2. The figure shows that a limited increase in intensity is to be expected as well as a gradual extension towards current suburbs.

In addition to the impact of land-use change we also explored the potential impact of climate change. See the full conference contribution for more information.

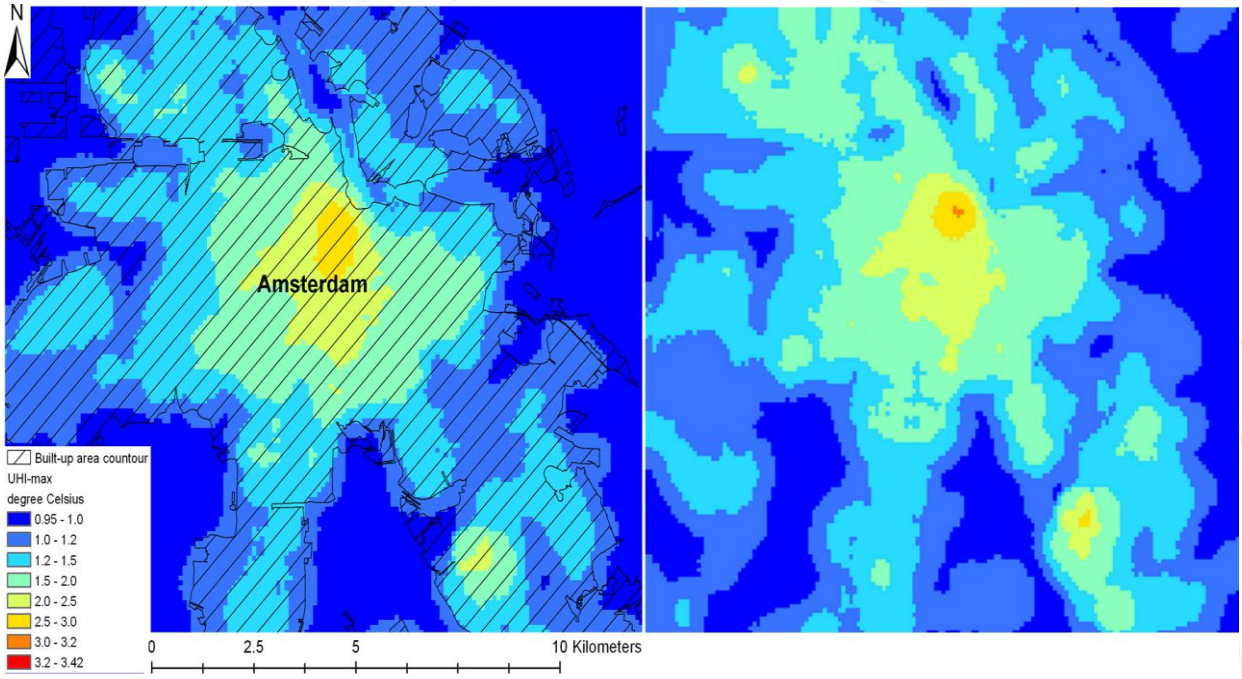


Figure 2. Observed urban heat island pattern for a typical summer evening in 2012 (left) and simulated urban heat island pattern for the Global Economy scenario using the same temperature conditions (right). Note that climate change is not included in this selection of results.

WP 2

Wouter Jonkhoff

Substantial progress has been achieved with three of the deliverables within WP2. This applies to both progress with the work as well as on presentation and discussion of the results. Links have been made to other themes within KvK and with international partners.

The PhD-student in WP2 has participated in a three month long Summer Programme for Young Scientists at the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Vienna.

The research project, which will be submitted to the KvK as a deliverable as well as, eventually, to a journal, is entitled “What if the Dutch started worrying about flood risk?”The work has been carried out with Reinhard Mechler from IIASA as a supervisor, and will also be submitted as a IIASA report. The research question was to investigate the macroeconomic effects of a partial change in risk allocation from the public to the private sector, where the approach involves the use of the Spatial Computable General Equilibrium model RAEM.

To this end, the investment function in the recursive dynamics part of the model has been altered to account for the probability of capital destruction. So far the data used as input has come from earlier simulations, however there is a recognition that this part needs further elaboration.

In order to get the numbers right we will be co-operating with other Themes under the KvK programme. A first draft which presents results from the first simulation-exercises was presented during final presentations at IIASA. The empirical paper on the effects on population dynamics resulting from the flood in 1953 and from the construction of the Deltaworks has been presented at the European Regional Science Association (ERSA) conference in Palermo. The presentation was well received. Comments afterwards contributed to the paper and provided ideas for further work. The paper is currently being resubmitted to the Journal of Regional Science.

Another deliverable under the programme which involves a model of household decision-making under flood risk, has just been presented at the EAERE Summer School on Disaster Risk in Belpasso, Italy. The presentation created fruitful debate. The comments afterwards provided substantial inputs on how to move forward with the paper. The work with this paper is carried out with Tatiana Filatova from Deltares and University of Twente as a co-author. The paper will be submitted as a journal article within the coming months.

WP 3 Using geodesign to develop a spatial adaption strategy for south east Friesland

Ron Janssen and Tessa Eikelboom

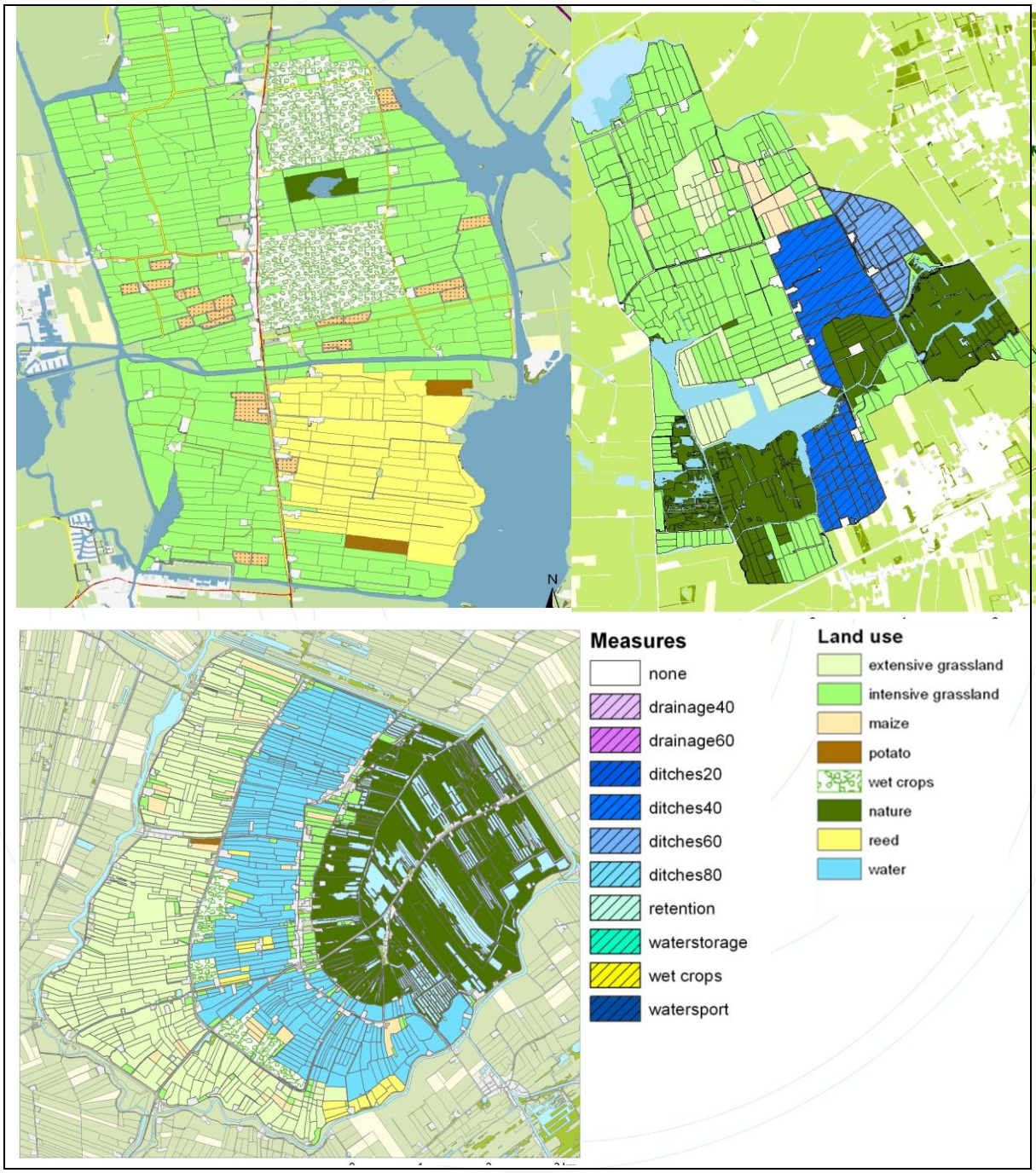


Figure 1. Plans for three pilot regions: Hommerts (top), Buitenveld (right) and Groote Veenpolder (bottom)

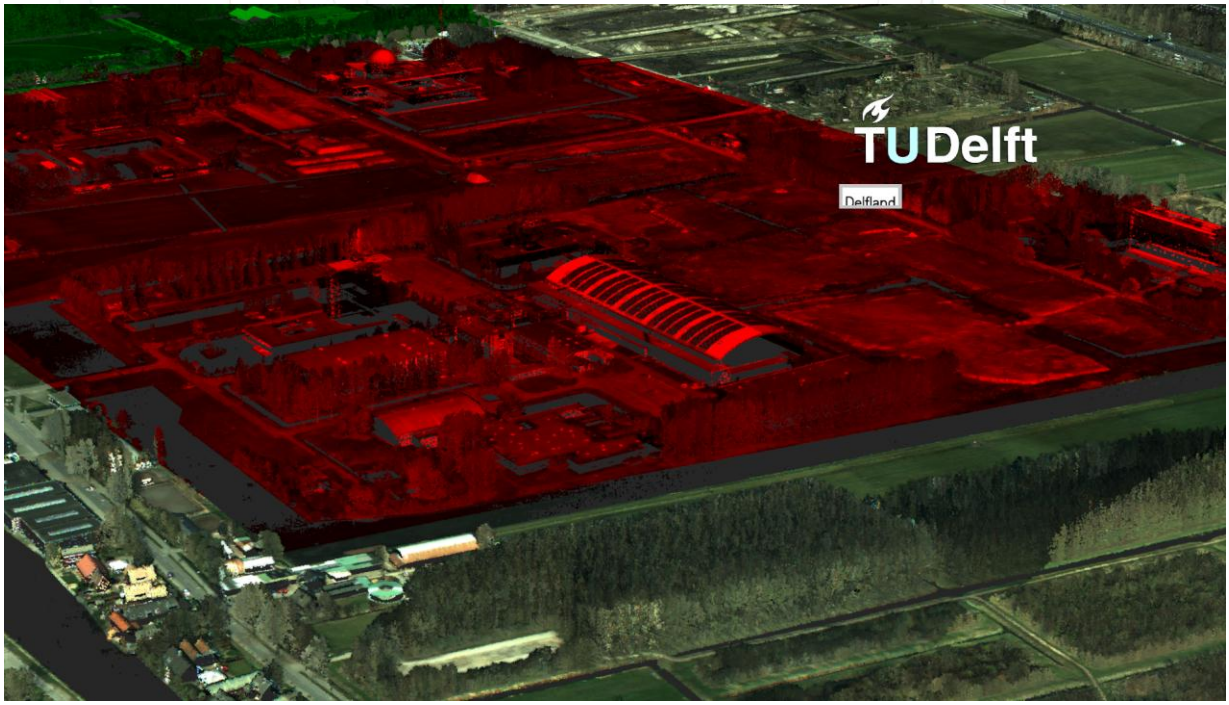
WP 4

Tim Tutenel

In our 3Di project, we connect research on rendering of massive point clouds with the visualization of large-scale, realistic flooding simulations. 3Di is a system that is designed to enable interactive discussions of flood scenarios between water boards, decision makers, hydrologists and further water experts. The open AHN-2 (Actueel Hoogtebestand Nederland) dataset is our foundation for the visualization. This is a full-scale aerial laser scan of the whole Netherlands in a resolution of 30 points per square meter. For the entire Netherlands, this results in a dataset of around 15 TB, therefore we need Level-of-Detail rendering algorithms to interactively display this data.

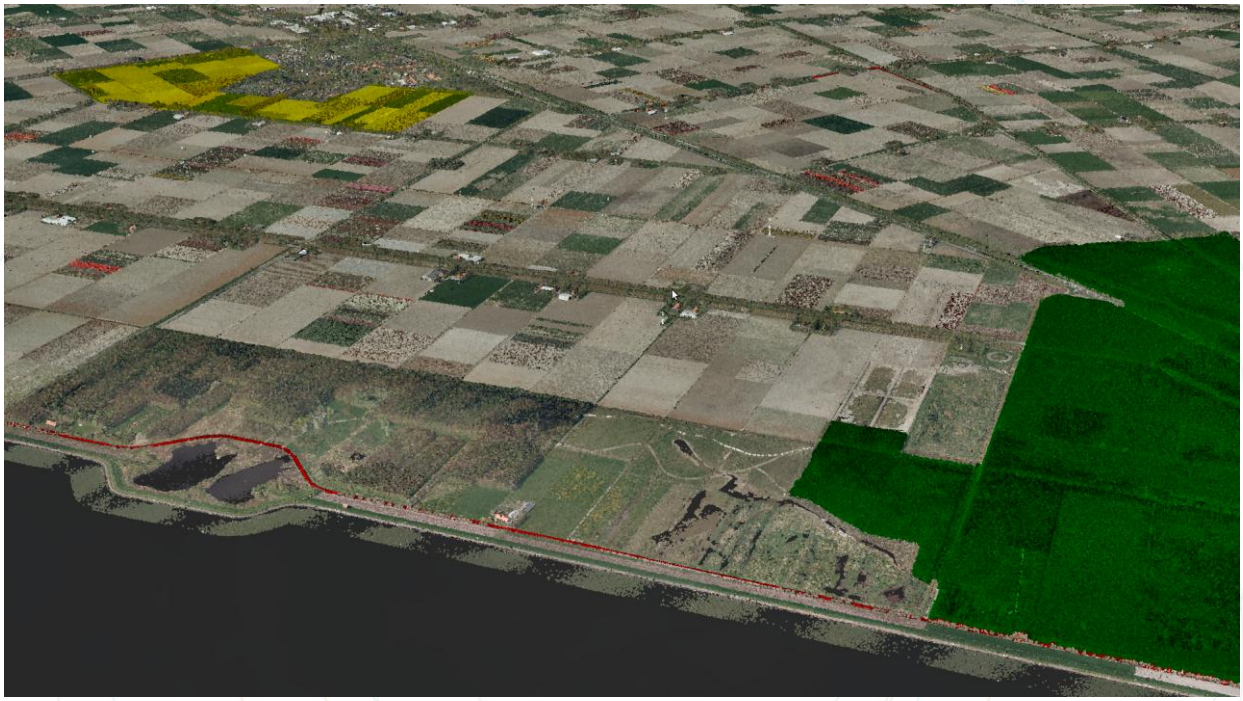
This geographic dataset can successively be used in Visual Analytics to study a diversity of climate change phenomena. Our project focuses on the study of flood events by combining our AHN-2 rendering with the visualization of Sobek simulation- and Subgrid-method output. First results show that this kind of visualization helps in understanding the behaviour of historical floods (like the North Sea flood of 1953) as well as in discussing new flood protection mechanisms and evacuation policies. To support this analytical process, particularly in urban environments, 3Di is able to render the scene in 3D stereo mode. For this purpose, a workbench with a 3D projection surface is used in the INSYGHTlab at the TU Delft.

The latest addition to the viewer is the real-time coloring of the point clouds based on geospatial information, captured from e.g. a google maps drawing (see Figure). Changing the color on all the billions of data points would make this process too slow for real-time interaction, therefore the geospatial data is first organized into a tree-based subdivision structure. This data is sent to the graphics card and a shader handles the coloring of the point cloud. This techniques allows users to view information about e.g. evacuation strategies or prevention measures, facilitating the decision making process.



An point cloud rendering with two areas marked in red and green

The 3Di project is a collaboration project between Delft University of Technology, Deltares and Nelen & Schuurmans. The launching customers are Knowledge for Climate, Waterkader Haaglanden and the water boards of Delfland and Hollands Noorderkwartier.



An point cloud rendering with two areas marked in yellow and green, and a road marked in red

WP5 Modeling and Estimating the Direct and Indirect Economic Impacts of Water Scarcity in an International River Basin Context

Jason Levin-Koopman and Roy Brouwer

Several climate change scenarios foresee a reduction in the reliability of fresh water supplies for agriculture, both in terms of a predictable and steady rainfall and the availability of irrigation water.

Although there already exist detailed crop growth models that determine the extent of damage to agricultural production from a lack of (timely available) irrigation water, little is known how this affects the economy as a whole. In WP 5, recently a paper was completed (Levin-Koopman et al., 2013)which asks the question how does the damage assessment from water scarcity in the Netherlands change when the analysis is placed within the reality of global markets for food products?

To explore this question data was used from a Deltares study within the Delta Program, which assessed the direct damage to Dutch agriculture if the extremely dry summer of 1976 were to occur again today. The direct damage results were incorporated into a model of the world economy, which was adjusted to focus specifically on the economy of the Netherlands and its river basin neighbors. We then examined how the damage assessment changes when global markets adjust to the new availability of Dutch agricultural products under extreme drought conditions.

We find that for all agricultural activities distinguished in the study rising prices partially compensate farmers for their loss of product. However, the scale of the compensation differs depending on the market conditions facing the different agricultural activities. The key factor in determining the market response is the ease with which consumers can switch between different sources of these products. If consumers found it difficult to switch to different producers of a product, for example with sugar beets or cereal crops, demand would remain high despite the rising prices. Dutch farmers would then adapt where possible to focus as much as possible on producing these crops despite the relative scarcity of water.

These adaptation possibilities are not possible in the direct crop growth models and incorporating market responses in the assessment of the economic impacts of water scarcity results in a significantly different picture of which agricultural activities are most affected. Modeling the market response also allows for an assessment of the effects on the non-agricultural economic sectors as well as for an examination of the shadow price of irrigation water which increased by 180 percent under extreme drought conditions.

The results of this study carried out in Work Package 5 in Theme 8 (Tools for adaptation strategies) were presented at the OECD workshop on Water Allocation and Green Growth in November 2012 at Wageningen University and the 20th Annual Conference of the European Association of Environmental and Resource Economists at the Toulouse School of Economics in June 2013.

Levin-Koopman, J., Kuik, O., Tol, R.S.J. & Brouwer, R. (2013). The Economic Impact of Water Scarcity for Climate Change in an International River Basin Context.

WP 6 Optimal Dike Investments under Uncertainty and Learning about Increasing Water Levels

van der Pol, T.D., van Ierland, E.C. and Weikard, H.-P. (2013) Optimal Dike Investments under Uncertainty and Learning about Increasing Water Levels. *Journal of Flood Risk Management*, forthcoming.

We are pleased to announce that the above paper has been accepted for publication and will appear soon.

Policy summary

In this paper we study the problem of optimal dike height under uncertainty and learning about increasing water levels. Dike heightening is expensive, and economically efficient investment is therefore important. Van Dantzig (1956) described that dike investment is a cost minimisation problem, after a large flooding in the Netherlands in 1953. In essence, higher dikes reduce expected damage costs, but investment costs increase exponentially in dike height. A balance has to be found between expected damages and costs of dike construction over time. We say over time, because decisions on dike height are recurrent for a number of reasons, for example, economic growth, climate change impacts on water levels, or soil subsidence. On the one hand, it is not optimal to build a dike for once and for all because that would result in excessive investment costs with only little benefits. On the other hand, dike heightening, like most large investment, has fixed costs, and therefore, yearly investment is not optimal but rather a solution where a dike is revised at longer time intervals, for example, half a century.

Eijgenraam (2005), (2006) and Eijgenraam et al. (2012) re-addressed the problem of optimal dike height with economic growth. The solution of this problem resembles a classical inventory model solution, in the sense that it is conjectured to be periodic: constant dike increments and fixed intervals between consecutive dike heightening (Eijgenraam et al. 2012).

Water defences protecting land from large-scale flooding events typically offer protection against events with long return periods (e.g. 10000 years), but events that we now consider to be extremely rare, will become less rare in the future due to climate change. The rate with which the extreme value distribution is shifting is uncertain. Various approaches have been considered to incorporate uncertainties related to the dike heightening problem in previous work ranging from sensitivity analysis (Eijgenraam 2006) to minimisation of regret (Brekelmans et al. 2012) or mean-variance minimisation (Kuijper and Kallen 2012), and pragmatic rules (Hoekstra and de Kok 2008). We introduce a probability distribution for the structural water level increase in the Eijgenraam et al. (2012) model. We introduce learning as a single stochastic event at which uncertainty is fully resolved.

The problem is solved with dynamic programming. See Figure 1 below.

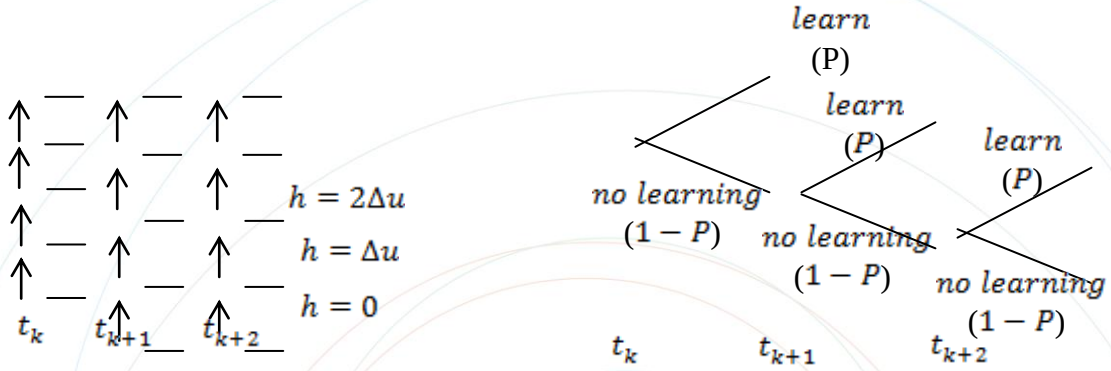


Figure 1 Graphical representation of the discretised dike height states (h), dike increment decisions (u: arrows), at those moments in time (t_k) (left panel), and perfect learning event tree (right panel).

We define the total expected value of information as the difference between the total expected costs associated with the uncertainty benchmark strategy without learning, and the total expected costs associated with the optimal flexible strategy. We also calculate reactive strategies, which do not anticipate information arrival but do implement best responses on the basis of new information. We find that the total expected value of information can be substantial; especially under a heavy-tailed distribution for the structural water level increase. For one case under a relatively low discount rate and relatively high standard deviation we find that future learning may reduce total expected costs with more than half. The results also suggest that the initial differences between the uncertainty benchmark strategy and the optimal flexible strategy are mostly small. In contrast, we find that perceptions of the likelihood of climate change impacts have a significant effect on initial investments. Prior distributions are therefore important to improve decision making on dike height.

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van Dantzig, D. (1956) Economic Decision-Problems for Flood Prevention. *Econometrica*, **24** (3), 276-287.

WP7 Monitoring of adaptation in the Region Haaglanden and Rotterdam Urban Region

Judith Klostermann

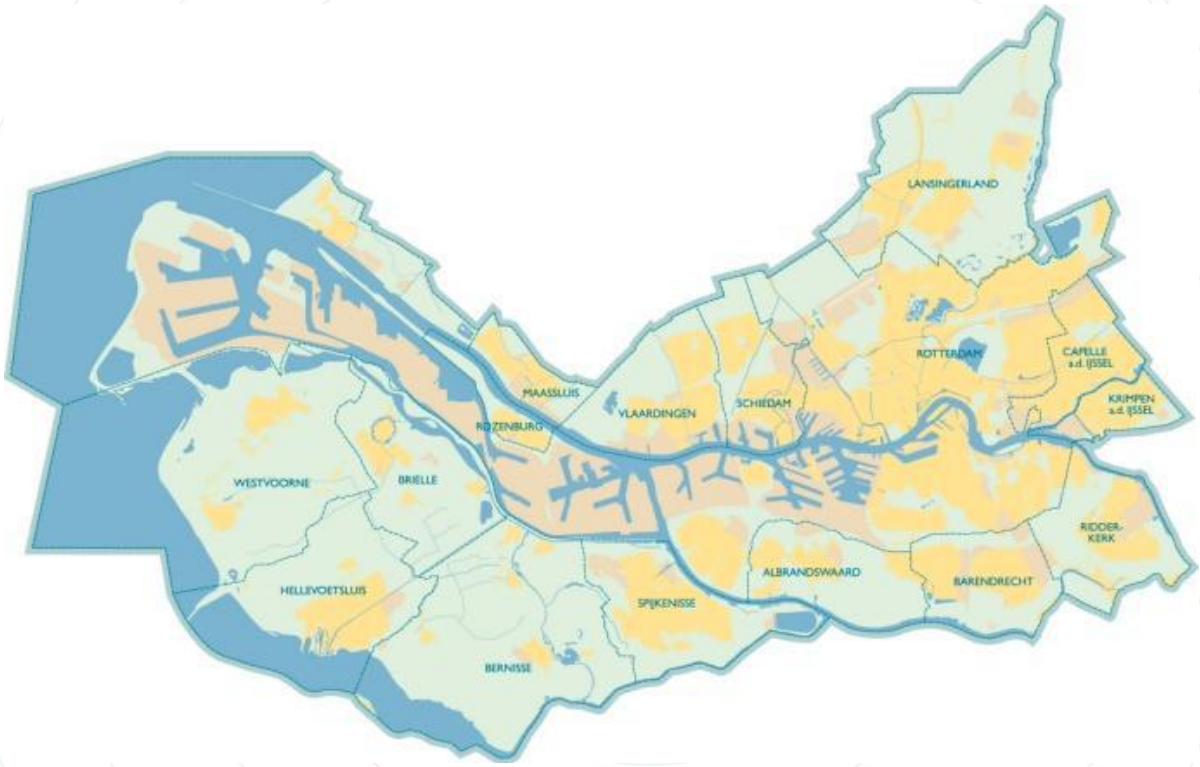
Haaglanden and the Rotterdam Urban Region are both writing a regional adaptation strategy. A team from Theme 8 is going to support them to add a monitoring paragraph. Case studies were started this year in parallel of the writing process in these two regions.

In Haaglanden, the region consists of 9 municipalities, such as The Hague, Wassenaar, Delft and Zoetermeer. Themes for adaptation in this region are described under the headings of 'Grass; Glass; and City'. The Grass stands for the rural peatlands that may suffer from prolonged droughts, salinization and soil subsidence.

The Glass refers to the greenhouse region in Westland, where new technologies are explored for water buffering. And the City of course refers to the urbanized areas that may suffer from the heat island effect. These three areas most likely will require different sets of indicators to monitor the outcome of adaptation. However, monitoring of the process towards implementation of adaptation measures might be quite similar.

In Rotterdam Urban Region some of the 16 municipalities comprise Hellevoetsluis, Vlaardingen, Rotterdam and Barendrecht. So far a detailed strategy has already been prepared for the Rotterdam municipality, and the challenge is now to involve all other municipalities as well and tease out their specific adaptation themes. Thinking about monitoring may help in this process.

Our slogan will be: “Uncertainty is not a reason to delay monitoring but a reason to start monitoring.”



A framework has been developed within KvK Theme 8, Work package 7, to support the development of a programme for monitoring of adaptation.

The framework has 4 elements: 1) Requirements for the monitoring organization; 2) Description of the system of interest; 3) Guidance for selection of indicators; and 4) Description of procedures. This framework will be tested in the case studies.

Contact: Judith Klostermann, WUR-Alterra Judith.klostermann@wur.nl

Highlight

Interactive Climate Atlas for the city of Rotterdam

WP 4 – Hasse Goosen

Rotterdam has the ambition to become climate proof by 2025. The city of Rotterdam is developing a Rotterdam Adaptation Strategy (RAS). Researchers from theme 8 (Tools for Adaptation Strategies) have contributed to the communication of the RAS by developing an interactive climate atlas. This interactive atlas summarizes, integrates and visualises available climate information. Its aim is to reach stakeholders involved in adaptation planning and spatial planning.

Climate change is a complex phenomenon affecting many sectors and land use functions, and is surrounded by uncertainties. Because of the various scenario's, multiple models used, and multiple aspects, the amount of information is often overwhelming and too complex for stakeholders to comprehend.

The interactive atlas attempts to make this abundance of scientific information available in a user friendly way. The visualisations are based on theories about how stakeholders frame climate change differently. These frames determine user requirements and the types of visualisations offered.

The maps have been developed by PhD candidate Monique de Groot who is performing her PhD research on visualisation within theme 8. The success of the interactive atlas has led to a request from the Rotterdam region (the surrounding municipalities) for a similar product. The atlases can be found on the website of the Climate Adaptation Services foundation.

(click on the image to link to the interactive climate atlas)

Highlight

Governance and Assessment of Public Private Partnerships (PPP) for Urbanizing Deltas: Integrated Coastal Development in Jakarta, Indonesia (GPU-Jakarta)

WP 6 - Pini Wijayanti

On June 19 2013, the team members of the consortium preparing the full proposal for the GPU Jakarta project organized a stakeholder and definition workshop in Jakarta. The project focusses on the development of new approaches for PPP investments in infrastructure in the Ciliwung (Jakarta) Delta. The main objective of the project is to assess governance modes and PPP structures under conditions of uncertainty. Participants to the workshop were Indonesian Governments, academicians, and International Consultants in Jakarta.

The goals of the definition workshop were:

- to help embed this scientific project well into the institutional PPP- and contextual setting of the integral urban and coastal development of Jakarta;
- to mutually exchange ideas between the experts of the most relevant stakeholders and the scientific team;
- to identify issues that the stakeholders consider relevant, and can be considered important embed into the research proposal.
- to lay a foundation for fruitful cooperation in the project for the coming years;
- to explore options for practical implications and agreements for cooperation (such as exchange of information, further meetings).

Outcome of the workshop

The participants gave valuable suggestions for elaboration of the project and specification and focus of the research questions. Conflicting interests between public and private stakeholders should be involved in the research project. According to many stakeholders the study will be challenging due to its complexity: multi-stakeholder, many stakeholder interactions, multi-level governance, multi sectoral, institutional fragmentation, and a high degree of uncertainty. However, such a study is needed. The risk exists that the area and scope of this issue are too broad for a single academic research project. Perhaps one could focus more on a few certain issues or (sub) projects NCICD is currently working on. At the same time, the participants acknowledge the fact that the complexity must be accepted and that the research project could look at ways to manage this complexity.

An important question is the way in which the private sector can be involved during the early stages of the PPP negotiation and bargaining process. Also the willingness of other stakeholders to participate and ways to involve them should be part of the research.

The study might focus on developing collaborative management of resources. The study should focus on optimizing PPP and (other) governance models that allow for attracting sufficient market parties, while at the same time providing the conditions in which public values are met, and (policy) goals will be achieved effectively, and efficiently, and costs and benefits will be fairly distributed among stakeholders in society. This (PPP/governance) model should be designed in such a way that an optimized equilibrium will be reached. Tariffs charged by private companies to finance infrastructure investments may reduce use of infrastructure, especially by the poor.

The study should take a wider perspective than only focusing on PPP-models. It is recommended to look at other financial arrangements as well. PPP should be seen as a possible output of the process, not as a goal in itself. Other (public-private) constructs may also be an output of the process.

Recent and upcoming events

2013

September 30	**Progress meeting Knowledge for Climate Theme 8, Amsterdam (on invitation only)**
October 7	**Haaglanden, the Hague Discussion on draft regional adaptation strategy of Haaglanden (on invitation only)**
October 8-9	**University of Bath, UK Kick off meeting of the EU-funded program ECONADAPT on the economic aspects of climate adaptation in Europe (on invitation only)**
November 6	**Universidad Politécnica de Madrid (UPM), Madrid, Spain PhD defence of Paloma Esteve, titled: 'Water scarcity and climate change impact and vulnerability in irrigated agriculture in Mediterranean River Basins'**
December 3	**Climate Shocks and Household Behavior, Berlin, Germany Deadline paper submission: 10/20/2013. See inomics.com**

2014

June 28 – July 2	**5th World Congress of Environmental and Resource Economists, EAERE, AERE, Istanbul, Turkey**
September 24-26	**DELTAS IN TIMES OF CLIMATE CHANGE II, International Conference, Rotterdam**

Publications and reports related to Theme 8 can be found at:
www.kennisvoorklimaat.nl or www.knowledgeforclimate.org

Reminder for WP leaders - Reminder for WP leaders

Your accepted papers have to be uploaded on intranet.
Please contact wil.denhartog@wur.nl for further steps.

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