Deltas in Depth scientific sessions		
Deltas in Depth 11. Decision support tools and risk assessment		
DD 11.4 Decision support tools and risk assessment in the Netherlands		
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In this session, an overview is presented of the latest tools and methods for climate adaptation decision support that are being developed and tested in the Netherlands. The tools and methods are mostly focusing on the planning phase. An overall conclusion that can be drawn from this session is that most of the presented methods seem to be complementary to each other, and efforts should be made to learn from each other and work together.

Delta Scenarios

The Delta Scenarios were build for the Dutch Delta Programme, in order to support strategic decisions to be taken in that programme. The scenarios explore possible futures regarding climate change and socio-economic developments together with their impacts on various land-uses and the challenges this may generate for water safety and the provision of freshwater in the Netherlands. The four scenarios 'Busy', 'Steam', 'Rest' and 'Warm' were presented in words (story-lines) as well as images (sketched maps, artists impressions) and figures (GIS-maps, databases). The Delta Scenarios play an important role in the Delta Programme, it was obliged for the subprograms to use them. Also outside the Delta Programme the scenarios were used in various ways. The scenarios raised awareness among policymakers for the long term and they facilitate communication among policymakers. They inspire strategy development related to water management and land-use planning and they help to test alternative strategies on their robustness and flexibility for future developments.

Integer programming approach for safe dike heights at minimal costs

Optimal dike heights are of crucial importance to the Netherlands as almost 60% of its surface is under threat of flooding from sea, lakes, or rivers. The dunes and dikes require substantial yearly investments of more than 1 billion euro. A new method *Diqe-Opt* is presented for finding economical optimal safety standards, with an application on the Ijssel Lake in the Netherlands. This method aims to find a protection standard for embankments based on the lowest total costs, and is based on work by Van Dantzig and Eijgenraam, two Dutch economists who are responsible for the economic reasoning behind the Delta Works (in the sixties) and the recently adopted new protection standards for the Netherlands. The most important advantages of this model include:

- Simplicity: the model is easy to implement with the use of standard software
- Flexible: it can be adopted to all kinds of data that is available)
- Optimality: proven optimal solutions are found for all problem instances

Anticipating change by exploring adaptation pathways

Exploring adaptation pathways offers the possibility to evaluate the performance of a policy choice in the course of time, and under changing conditions. The Dynamic Adaptive Policy Pathways (DAPP) method is presented as an approach to support the development of adaptive strategies that can cope with changing, uncertain future conditions. The recently developed DAPP approach was tested in the Delta Programme and was used to simulate policy planning in the Dutch Rhine delta and to analyse how it is applied in practice. Pathways were explored across multiple scenarios, using an ensemble of possible climate realisations, and promising pathways were checked for consistency for multiple policy objectives. This case study demonstrated that the approach can be applied to a real-world decision making problem. Parts of DAPP have already been used in practice. The DAPP approach inspired the Dutch government in the development and application of the concept of Adaptive Delta Management (ADM), a key strategy in the Delta Programme.

Monitoring & evaluation system for climate change adaptation

In 2016 the new National Adaptation Strategy will be launched in the Netherlands. Good adaptive management requires a robust approach to monitoring and evaluating (M&E) the effectiveness of this National Adaptation Strategies and the policies, measures and actions upon which these are based. A monitoring and evaluation system that is currently being developed focuses on two central questions: 1) "*are we doing the right things?*" referring to (long-term) strategic policy decisions and their consequences; 2) "*are we doing the things right?*" referring to the implementation of these policies and subsequent actions. The framework focuses mostly on the 'processes' associated with the development of adaptation policies for multiple sectors and actors. A follow up will take into account the 'outcomes' of adaptation actions at successive stages in the adaptive management cycle. The framework is now being designed for use in the Dutch Delta Programme, where it encompass the domains of flood protection, fresh water supply and the urban environment. In the next phase it will be developed further for use in other domains relevant to the National Adaptation Strategy (e.g. agriculture, biodiversity, energy, health, transport and infrastructure, and ICT).

Simulating urban land use change and local flood damage calculation

The focus of this presentation is on the reduction of potential flood damage to houses, particularly through 'flood proof urban (re)development'. The potential damage reduction that could be attained by minimizing (regional) chances of flooding or by adaptation to its potential (local) effects is very uncertain, especially on the local scale. It depends on a wide range of interrelated processes, most importantly those driving future urbanization. A land use model framework is presented which is able to simulate urbanization on a 100 x 100 meter scale, including residential density changes occurring within urban areas. The specific policy instruments which' effects can be explored are, amongst others, regional urban intensification targets and local zoning. The application of the model framework is demonstrated by zooming into the city level of the Drechtsteden. It is shown that the model framework provides a useful toolset to help planners explore where, to what extent, and under which specific circumstances (scenario's, policy packages) potential flood damage to housing could be reduced.