



Tools for long term planning for climate change

Decision making to become climate resilient

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Tools for flow, water quality, inundation, modelling, D-Flow Flexible Mesh (1D-2D-3D): (e.g.San Francisco Bay)



science for a changing world





Tools for ground water modelling e.g. Salinisation, water quality and fresh water supply



monitoring

points (mp)

250 m

9 december 2016

Tools for simulation from Catchment To Coast



fate and transport at different scales (Catchmod)



Lake ecosystems: ecological responses to climate change (ANT)



Interaction of suspended matter, nutrients, and macrofytes (WISER)



ecosystem processes in coastal waters (Knowseas) Deltores

Tools for forecasting: Delft-FEWS Early Warning System



Open interface to models

Delft FEWS independent of model - Key to philosophy of Delft FEWS

- Existing models available used operationally maintain investment (i.e. Mike11, HEC, HBV,...)
- No model available choose models from wide range consider suitability & available knowledge base
- New models from academia fast track science to operations
- Improvements4one = improvements4all



> 50 models of different nature

Delft-FEWS is not a model Delft-FEWS is not a model

Delft-FEWS worldwide

Delft-FEWS as platform for operational systems worldwide



- Delft-FEWS provides an open shell system for managing forecasting processes and/or handling time series data.
- Delft-FEWS incorporates a wide range of general data handling utilities, while providing an open interface to any external (forecasting) model.
- The modular and highly configurable nature of Delft-FEWS allows it to be used effectively for data storage and retrieval tasks, simple forecasting systems and in highly complex systems utilising a full range of modelling techniques.

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Enabling Delta Life

• Delft-FEWS can either be deployed in a stand-alone, manually driven environment, or in a fully automated distributed client-server environment.

New directions: Forecasting impact and support decisions



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Tools for Future water scenario development











Top-down approach to arrive at water management scenarios



UNCERTAINTIES

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Most recent set of scenarios for the River Rhine



Figure 4.20 Change in average monthly discharge cycle for Lobith according to CMIP5

Plan for the future

Given the uncertainties about the future,

How to plan for a resilient strategy?





Decision making for Global change Worldbank 2013



Decision making for Global change RAND, 2014





Decision making for Global change WorldBank, RAND, Deltares, Delft Univ. 2016

Progress in science??





Why are we adapting?





For a



Booming economy

Unique nature

Place attractive t live



Approach climate adaptation as an investment issue rather than an environmental issue.

What are the steps:





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Approach in a nutshell

Classical approach: What if...(climate) changes according to scenario x?

Adaptive management approach:

How much (climate) change can we cope with?

Adaptation tipping point

When will this occur?

sell-by date of tipping point for each scenario

What to do afterwards

Explore a sequence of policy actions to achieve targets under changing conditions (adaptation pathways)



Adaptation Tipping Point & Use by date of policy action

A stress test: How much (climate) change can we cope with?



Decision moment = f (time A, time B, lead time action)

Kwadijk, J.C.J. et al 2010 WIRES Climate Change DOI: 10.1002/wcc.64, Haasnoot et al 2012 Climatic Change

Examples of conclusions



Fresh water intake at Gouda no longer reliable (not before **2040**) Design criterium Maeslant barrier will be exceeded (not before **2060**) Protection of the coast by sand nourishment (**no problem in this century**)

ACCEPT uncertainties and act from there.

What could happen in the **FUTURE**, and what can we do **NOW** to achieve targets, despite how the future unfolds?

EXPLORE options and **MAP** different **PATHWAYS**

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Example: Adaptation Pathways

How to keep a river navigable in a changing environment that may result in lower water levels in the river?



Scorecard for Pathways

Haasnoot et al. (2012). Clim. Change.; Haasnoot et al. (2013) Glob. Env. Change. 10.1016/j.gloenvcha.2012.12.006

An adaptation pathways map shows **different possible** sequences of investment decisions. A scorecard helps to evaluate the decisions.



Costs and benefits of pathways

0

0

0

0

0

0

+

0

0

0

0

- - -

Haasnoot et al. (2012). Clim. Change.; Haasnoot et al. (2013) Glob. Env. Change. 10.1016/j.gloenvcha.2012.12.006

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Is it difficult to understand?

20140629-dirk-kuyt-adaptive-planning

Adaptive policy making applied to the 2014 world cup football

Dirk Kuyt after Netherlands-Mexico match



The good thing of this coach is that he **prepares** everything. He has **explored** what can happen in this match.

- Also this **scenario** has been discussed. So he needed to say only one thing... and everyone knew exactly what to do.
- It is nice to **switch between different actions**. We went from .. to .. to .. plan B. We scored and switch back to the original plan.

He can predict every thing. What did he say?

... predicting is not the right word. It is preparing for. The players know what they can expect.

Off course it does not always have to be like that.

If you experience in the 70th minute that you cannot do it as you would have liked to do.. And you know what is the next step, <u>it</u> <u>gives confidence.</u>



It's not the strongest species or the most intelligent species which will survive, but it is the one most adaptable to change.

Charles Darwin