DHI CASE STORY

HELPING VIDAA ADAPT TO CLIMATE CHANGE

Assessing dike safety and flood risk in the Vidaa river system

It is important to incorporate the expected impacts of climate change in current spatial planning, where long-term investments are envisaged. In particular, the risks posed to infrastructure by expected increases in heavy precipitation and catchment runoff & sea level rise (such as river dikes) have become a major concern today. The Vidaa River system is one such example, where flood risk and dike safety are of concern with respect to climate change. We conducted extensive studies on the Vidaa River system with our hydrological and hydraulic models as well as our extreme value and risk analysis tools. We also conducted comprehensive analyses of the flood risk and the probability of dike overtopping in the near and distant future. We based these analyses on downscaled regional climate model projections. Informed decisions on climate adaptation can now be taken on the basis of our projections.

EXTREME WATER LEVELS IN THE VIDAA RIVER SYSTEM

The Vidaa River system is a 1,342km^2 cross-border catchment located in the southern part of Jutland, Denmark and northern Germany. The river discharges into the Wadden Sea through a tidal sluice. The low-lying part of the catchment is protected by river dikes. During storm surges, when the sluice gate is closed for an extended period of time, extreme water level conditions occur in the river system. This can be further amplified by increased runoff from the catchment owing to heavy precipitation. With climate change, rising sea levels, more severe storm surges, and heavier extreme rainfall events are expected in the future. In light of these future scenarios, it has become necessary to evaluate the changes in flood risks and dike safety.This was carried out in the EU Interreg4A Project “Grenzwasser/Grænsevand”.

Vidaa River catchment. Photo: Kurt Gabs © Tønder Municipality

SUMMARY

CLIENT

Municipality of Tønder, Southern Jutland, Denmark

CHALLENGE

Impacts of climate change on the Vidaa River system – increased risk of floods and threat to dike safety

SOLUTION

- Integrated hydrological and hydraulic model for the Vidaa river system (MIKE 11)
- Downscaling of future climate scenario projections
- Extreme value analysis and flood risk assessment

VALUE

- Accurate knowledge of future impacts of climate change on the Vidaa River system
- Capability of taking informed decisions, based on future climate projections

LOCATION / COUNTRY

Southern Jutland, Denmark

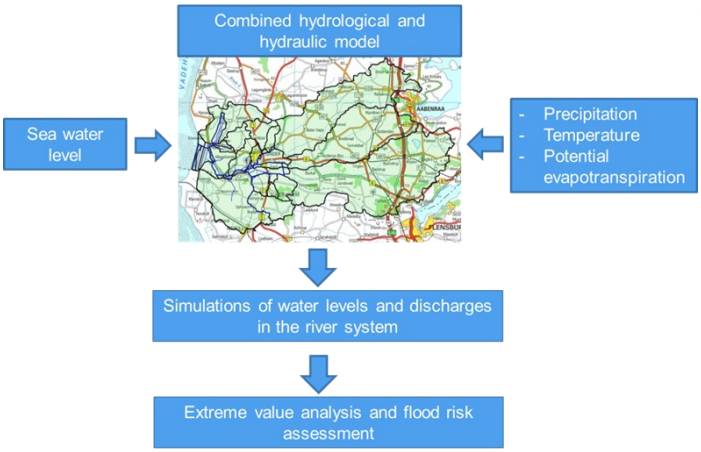
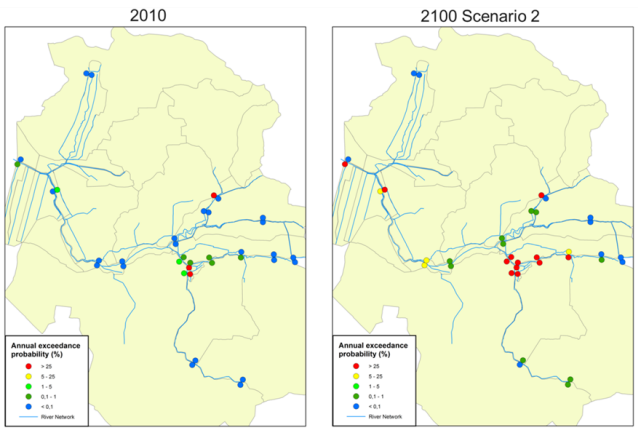


Illustration of the modelling approach. The hydrological and hydraulic model is forced with climate and sea water level time series representing current conditions and future 2050 and 2100 conditions



Comparison of flood risk (annual probability of exceeding dike level) for current (2010) and future scenario (2100)

AN INTEGRATED MODEL HELPS US ASSESS CLIMATE CHANGE IMPACTS

We set up and calibrated a MIKE 11 integrated hydrological and hydraulic model of the Vidaa River catchment. The model enabled us to generate accurate simulations of water levels in the river system for current and future conditions. Subsequently, we used these simulations for extreme value analyses and flood risk assessments.

PROJECTING CLIMATE CHANGE IMPACTS

We used Regional Climate Model (RCM) projections from the ENSEMBLES data archive for two projection horizons – years 2050 and 2100. We statistically downscaled precipitation, temperature and evapotranspiration data from the climate models. We then used these downscaled data as input for rainfall-runoff model simulations. An ensemble of 15 RCMs was downscaled to account for the uncertainties in the projections of future climate.

Estimations of the changes in sea water level at the Vidaa sluice were based on:

- global increase in mean water level due to thermal expansion and melting of glaciers and ice caps
- local change in mean water level due to changes in water density and circulation patterns
- local change in mean water level due to isostatic change
- local change in storm surge levels due to changes in extreme storm intensities and changes in mean water level

We used different scenarios for the future sea water levels in 2050 and 2100 to account for the uncertainties in the projected sea water level rise.

ANALYSING RISK WITH EVA

We used the Extreme Value Analysis (EVA) software package – part of our MIKE by DHI software suite – for the risk analysis studies. With EVA, we projected a significant increase in the risk of dike overtopping in this area. In 2050, with a low mean sea level rise scenario, the risk is still small, but with the high mean sea level rise scenario, the risk increases considerably. In 2100, the increase in risk is considerable. We estimated that in the worst case scenario, the risk of dike overtopping rises sharply at some critical locations in the river system. It shows an increase from an event that is expected less than once in 1000 years to a one in 10-year event.

AND VIDAA IS PREPARED FOR THE CLIMATE OF THE FUTURE

The project showed how much flood risk is expected to increase in the future due to climate change. The results obtained in the study are currently used for evaluating different adaptation options for reducing future flood risks in the long-term planning of the area.

CLIENT TESTIMONIAL

> *The project has given us essential knowledge on, what to expect and how to plan in the long term. Further, we now have a tool to analyse, compare and evaluate the effects of new adaption measures considered*
> *Jørgen Nicolaisen— Project manager —Municipality of Tønder*

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