

DHI CASE STORY

# HELPING THE BERLIN-BRANDENBURG REGION ADAPT TO CLIMATE CHANGE IMPACTS

## Groundwater and surface water modelling for the INKA BB project

Actual climate research results shows that, due to climate change, Germany's Berlin-Brandenburg region will face a slight reduction in annual rainfall in the future, along with a significant increase in temperature-related potential evaporation. Both these factors will have a negative effect on groundwater recharge, which influences groundwater levels. As part of the INKA BB project, we modelled future groundwater flow and recharge in the region. In so doing, we were able to optimally visualise the future impacts on groundwater levels and quantify the deficits in water availability against the background of reduced groundwater recharge. Our study is helping authorities to objectively evaluate potential measures to counteract the future impacts of climate change on groundwater levels in the region.

### ADDRESSING CLIMATE CHANGE IMPACTS IN THE BERLIN-BRANDENBURG REGION

Although the Berlin-Brandenburg region in North-East Germany has numerous lakes and rivers, it's characterised by low annual rainfall. Moreover, the predominantly sandy soil in the area cannot retain much water. These natural conditions, combined with rising temperatures, make the region vulnerable to the expected impacts of climate change – such as reduced groundwater levels, droughts, and heavy, sporadic precipitation. These not only can cause significant damage to natural aquatic systems, but can also increase water scarcity conflicts in the local and regional context.

'Innovation Network for Climate Adaptation in Berlin-Brandenburg' (INKA BB) is a research project dealing with the impacts of climate change and possible counteractive measures in this region (www.inka-bb.de). This interdisciplinary network project is funded by the Federal Ministry for Education and Research (BMBF). DHI-WASY is one of the partners in the INKA BB consortium, which comprises ten academic institutions and three private companies.

Our study for the INKA BB was related to:

- understanding future groundwater recharge in the Berlin-Brandenburg region
- outlining possible future impacts of climate change-induced decreases in groundwater recharge on groundwater levels
- enabling the client to take informed counteractive measures to address lower groundwater levels in the coming years

### SUMMARY

**CLIENT**

Federal Ministry of Education and Research (BMBF)
FN: 01LR0803C

Federal Ministry of Education and Research

**CHALLENGE**

- Low annual rainfall and sandy soil with low water storage capacity
- Possible impacts of climate change on future groundwater recharge
- Need to evaluate current groundwater recharge and quantify future reductions
- Need to help local authorities make cost-effective and informed decisions about counteractive measures

**SOLUTION**

- Modelling groundwater flow and recharge and simulating the flow of surface water
- Evaluating several climate change adaptation strategies
- Moderating discussions with local authorities and institutions

**VALUE**

- Accurate quantification of deficits in water availability with respect to groundwater recharge reduction
- Visualisation of the impact of reduced groundwater recharge on decreased groundwater levels
- Empowering the authorities with a tool to effectively evaluate counteractive measures
- Enabling the authorities to get maximum benefit out of possible investments in these measures

**LOCATION / COUNTRY**

Berlin Brandenburg region, Germany

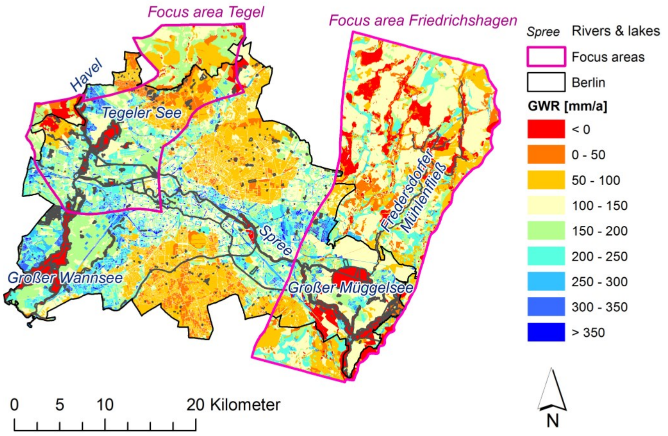
- developing methods and strategies for managing low water discharge conditions in small river (for example, technical and administrative actions, adaptations in organisation, governance and participation)

## MODELLING GROUNDWATER AND SURFACE WATER

Groundwater recharge – an extremely important process for groundwater management – generally occurs naturally through the water cycle. To study current and future groundwater recharge levels in the Berlin-Brandenburg region, we conducted several modelling studies, including:

- a soil-water budget model for groundwater recharge simulation, using SIWA on ArcView
- a groundwater flow simulation with FEFLOW – part of our MIKE by DHI software suite
- a surface water simulation with MIKE 11, using the option for integrated coupling with FEFLOW

We ran the soil-water balance simulator with climate data for two scenarios – T0 (no climate change) and T2 (temperature increase of two degrees Celsius until 2060). Based on the results, we concluded that groundwater recharge is likely to drop by 22-30% during the period of 2051-2060.




*Groundwater recharge model for Berlin covering the focus areas of Tegel and Friedrichshagen; average groundwater recharge for the period 1961-1990*

With the help of the three-dimensional (3D) groundwater simulation software FEFLOW, we were able to quantify the reduction of groundwater levels caused by decreasing groundwater recharge. The results showed a drop in groundwater level by several centimetres near lakes and rivers and a drawdown of more than half a metre in areas further than 2 km away from larger surface water bodies.

By using the surface water simulator MIKE 11, coupled with FEFLOW, we evaluated several climate adaptation strategies for the sub-catchment area of the stream Fredersdorfer Mühlenfließ. The latter is a small river north of the Großer Müggelsee – a bigger lake in the eastern part of Berlin. We established a water retention strategy and analysed the potential for two artificial groundwater recharge areas.

The results were the subject of a fruitful discussion with local experts, stakeholders, as well as governmental and non-governmental nature conservation associations. We moderated these discussions in order to shortlist regional adaptation activities for countering climate change impacts on the sub-catchment area of the Fredersdorfer Mühlenfließ.

*The stream Fredersdorfer Mühlenfließ, during dry and wet periods in summer*

## COUNTERACTING CLIMATE CHANGE IMPACTS WITH OUR TOOLS

All three of our models rendered actual measurements in single as well as coupled modes. The main benefits of our modelling studies included:

- quantification of possible deficits in water management (for example, the amount by which groundwater recharge is expected to decrease in the region  in future)
- visualisation of the impacts of reduced groundwater recharge on groundwater level decrease
- empowerment of local authorities with a tool for evaluating counteractive measures to climate change impacts prior to their implementation
- maximum benefits for potential investments by enabling optimal use of restricted financial capabilities of the local government

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