Probabilistic estimates of climate change impacts on UK water resources

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Climate change will increase temperatures and change rainfall across the UK. In turn, this will modify patterns of river flow and groundwater recharge, affecting the availability of water. There have been many studies of the impact of climate change on river flows in the UK, but coverage has been uneven and methods have varied. Consequently, it has been very difficult to compare different locations and hard to identify appropriate adaptation responses.

A multi-organisation partnership

The NERC British Geological Survey (BGS) is working with the NERC Centre for Ecology and Hydrology (CEH), and Wallingford Hydrosolutions (WHS) to carry out a **consistent assessment of the impact of climate change on the water resources of England, Scotland and Wales**. This is in collaboration with the Environment Agency, DEFRA, and UK Water Industry Research, who jointly fund this £0.5 m research project. The project is using the latest UKCP09 probabilistic climate change projections from the Met Office's Hadley Centre to quantify changes in river flows and groundwater levels over the coming century.

New downscaled climate projections for the water resource end-user community

Specifically, UKCP09 provides two datasets that are most useful for water resource applications:

i. Eleven-member ensemble of 1950–2099 climate time-series simulated by the Met Office's HadRM3 regional climate model.

ii. Ten thousand-member ensemble of changes in monthly climate for selected future greenhouse gas emission scenarios and 30-year future time slices to the end of the 21st century.

Whilst these are of great value they are provided at a relatively coarse scale and need to be downscaled to catchments if they are to be used to quantify impacts on individual rivers and groundwater units. As part of the project CEH have downscaled these datasets, and corrected the biases contained within them by comparing them to observed rainfall and temperature patterns. **The project has produced an ensemble of daily 1 km gridded rainfall and potential evaporation climate time-series from 1950 to 2098 for England, Scotland and Wales**.

Future changes in river flows

Similarly, the downscaled climate projections have been used by CEH and WHS to drive hydrological models to generate transient daily river flow time-series for 283 catchments. Hydrological models have been used to estimate river flow changes for the 2050s across Great Britain (Figure 2), **which provides, for the first time, a national picture of the impact of climate change on river-flow statistics that incorporates climate change uncertainty**. Finally, for 30 catchments the probabilistic ensemble of 10 000 climate change factors has been used to capture the fuller climate change uncertainty and to put it into context the 11-member ensemble of projections.

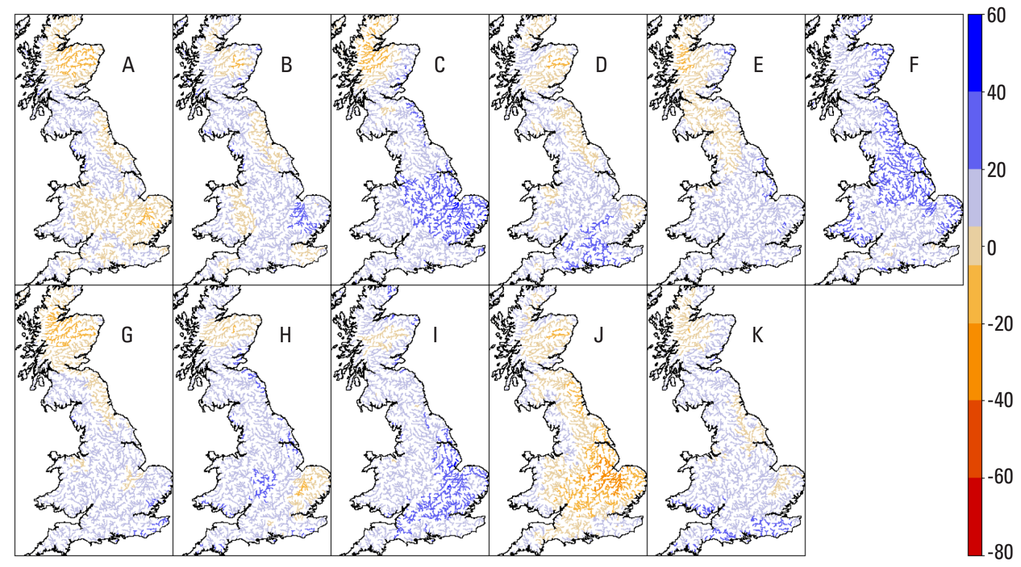


Figure 2 Example maps of percentage changes in winter mean river flow simulated using the CERF hydrological model and the bias-corrected 11-member ensemble of RCM climate projections.

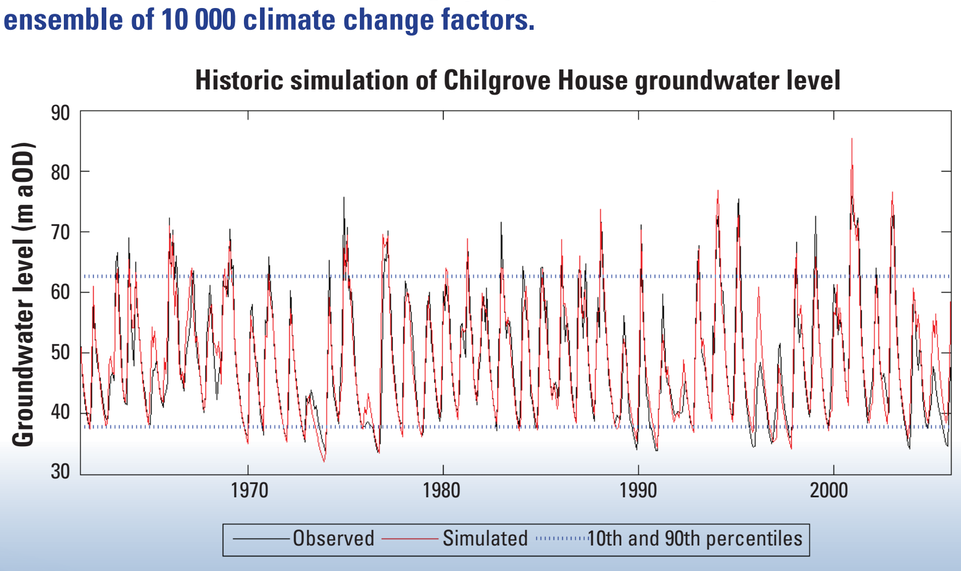
Delivery to stakeholders and researchers

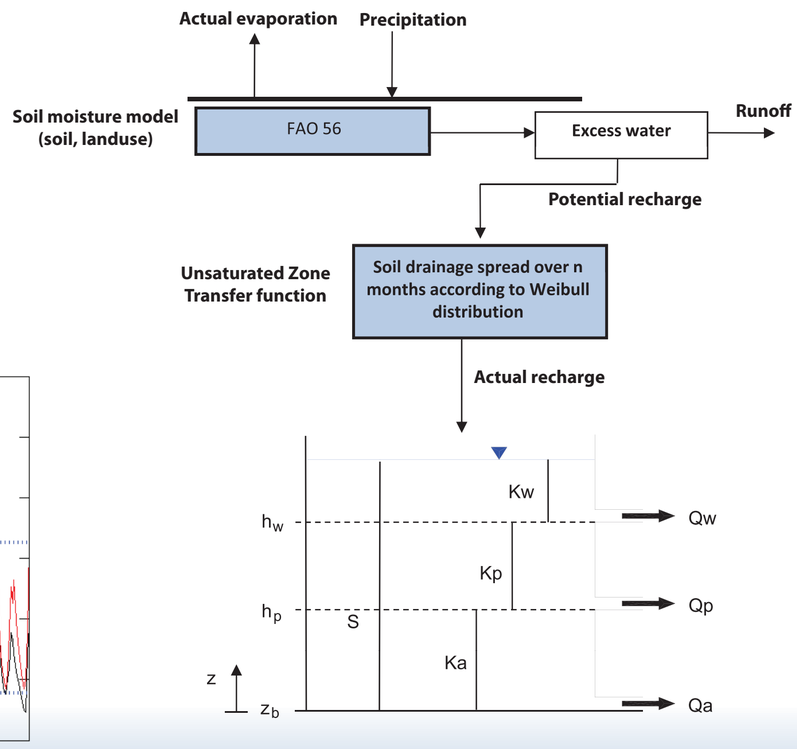
The project will deliver the downscaled climate projections and results of all of the modelling by the end of March 2012. **All the outputs of the project will be made freely available to the public** for non commercial use via the National Water Archive (www.ceh.ac.uk/data/nrfa/index.html), BGS OpenGeoscience web pages (www.bgs.ac.uk/opengeoscience/) and the CEH Information Gateway (www.gateway.ceh.ac.uk/).

Future changes in groundwater levels

BGS have used these downscaled climate projections to quantify impacts on UK groundwater resources using (i) detailed regional groundwater models, and (ii) parsimonious lumped catchment groundwater models (Figure 1) of the major aquifers across the country.

Climate change impacts have been assessed for the major groundwater resource units of England, Scotland and Wales using both the 11-member transient climate change projections and the probabilistic ensemble of 10 000 climate change factors.





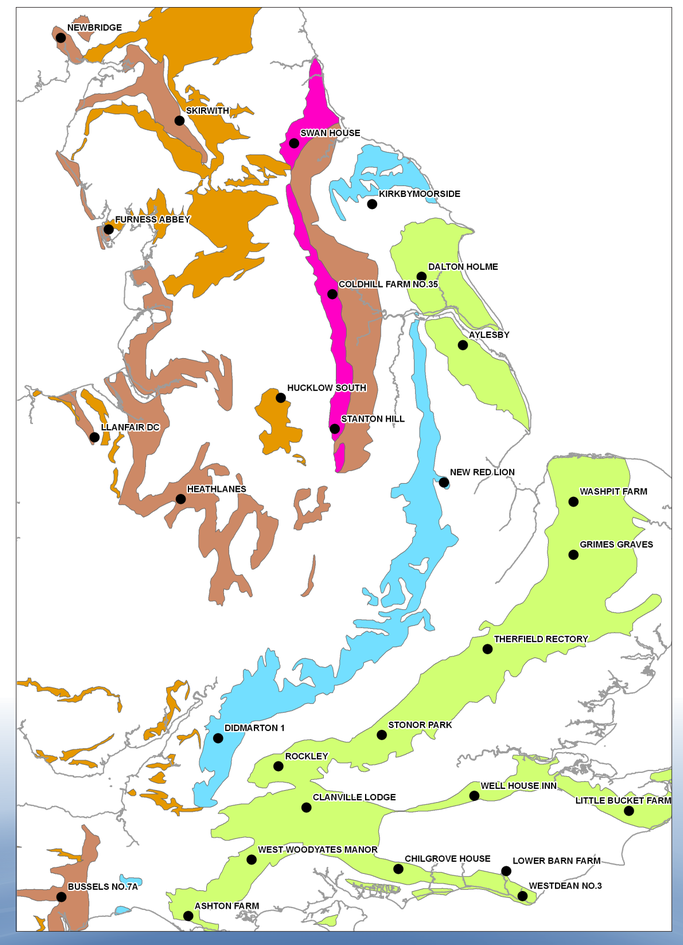


Figure 1 Sites modelled using BGS R-Groundwater code.

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