

# science summary

## Climate change and river flows in the 2050s

Science Summary SC070079/SS1

**The total annual river flow in England and Wales could drop by as much as 10–15 per cent by 2050, says a new report from the Environment Agency. This is one of the findings of a study that looked at the effect of climate change on river flows across England and Wales by the 2050s.**

The study is the first to use catchment-level models to look at river flows across the whole of England and Wales. Its finding that total annual river flow could drop by as much as 10–15 per cent by the 2050s is a result of lower summer and autumn river flows and higher winter river flows.

The work has been carried out using the Continuous Estimation of River Flows (CERF) model. This is a regionalised rainfall-runoff model developed by the Environment Agency and the Centre for Ecology and Hydrology (CEH)<sup>1</sup>. The model uses time series data of precipitation and potential evaporation demand to model time series of daily river flows.

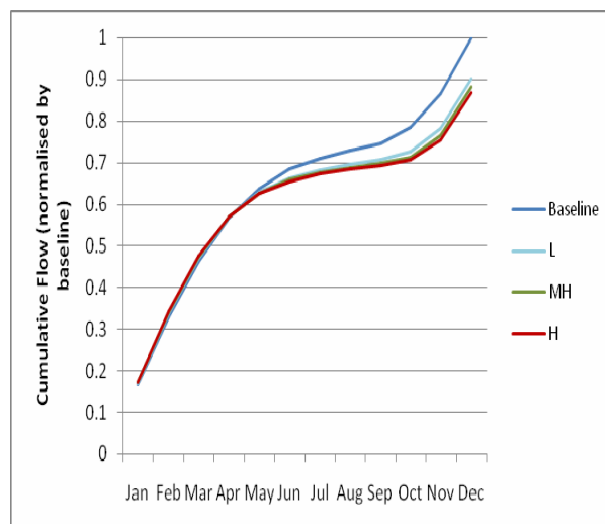
The CERF model was applied to catchments with areas greater than 150km<sup>2</sup>, although exceptions were made for small but significant river basins, such as those within Cornwall. The scientists first ran the model with baseline daily rainfall and evaporation data to simulate historical flows. The baseline daily climate data was then perturbed with the UK Climate Change Impacts Programme 2002 (UKCIP02) medium-high scenario factors for changes in rainfall and potential evaporation by the 2050s and the model run again. This produced 2050s scenario river flows across England and Wales. The scientists then repeated the process for the UKCIP02 low and high scenarios.

Next, they calculated the percentage differences in monthly mean flow statistics between the baseline and scenario simulations for each catchment and mapped the results across England and Wales as colour-coded reaches within river networks. The maps at the end of this

summary show the change in mean monthly flow under the UKCIP02 medium-high emissions scenario.

These results show a possible decrease in mean monthly river flows during the summer and autumn months of around 50 per cent, with a fall of up to 80 per cent in some areas. They also show a corresponding increase in mean monthly river flows during the winter months of up to 15 per cent. Even though the absolute change in flow will be much less when flows are lower, these changes are still very significant.

The study suggests that the number of months where river flows increases will be less than the number of months where river flow decreases. When combined with increased temperatures – and hence increased evaporation – this pattern is likely to affect the total annual river flow.



Using the Lower River Severn as an example, the above graph shows cumulative monthly river flow throughout the calendar year as a proportion of baseline total river flow. The dark blue line is the long-term average cumulative river flow for the current climate. The other three lines are the cumulative river flow predicted for the 2050s under the three UKCIP02 scenarios as a proportion of the

<sup>1</sup> Environment Agency Science Report SC030240/SR "Continuous Estimation of River Flows", ISBN 978-1-84432-874-1, April 2008, Product Code SCHO0308BNVZ-E-P

baseline values. The scenario lines all clearly fall below the baseline by late spring/early summer and by the end of the year are considerably lower than the dark blue line.

The scientists produced these flow curves for seven major catchments across England and Wales – the Bedford Ouse, the Dee, the Medway, the Mersey, the Severn, the Thames and the Yorkshire Ouse. All of them show a potential reduction in total annual river flow by the 2050s of between 10 and 15 per cent when compared to today's values.

The maps showing the change in mean monthly river flow suggest that nowhere in England and Wales is likely to escape the effects of reduced river flow. Wales and the north and west of England are predicted to see significant reductions in river flow throughout the summer months (June, July and August). The south and east of England see the same percentage reduction but not until later in the year (September and October), with even river flows in November dropping to almost half their current volume. This delayed reaction is due to the predominance of underground aquifers in the south and east, which help to support river flows until later in the year. However it also means that the start of the recharge season would be delayed which could affect groundwater storage as well.

The results for the low and high UKCIP02 emissions scenarios support those from for the medium-high scenario. The pattern and timing of changes in river flow are similar, but the magnitude varies slightly.

This study was carried out to support the Environment Agency's water resources strategy, which is due to be launched in early 2009. The strategy will set out the actions that the Environment Agency believes it and others need to take to manage water resources in the future. The findings of this study are also being used to help define further areas for scientific research.

**This summary relates to information from Science Project SC070079. For further information, contact [wrstrategy@environment-agency.gov.uk](mailto:wrstrategy@environment-agency.gov.uk)**

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January

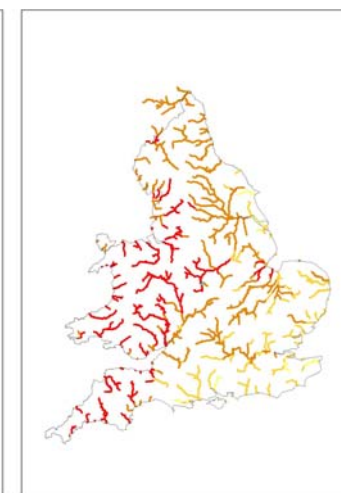
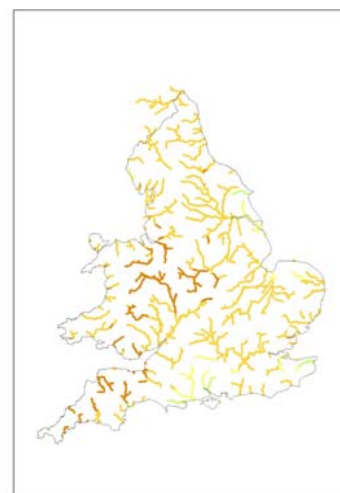
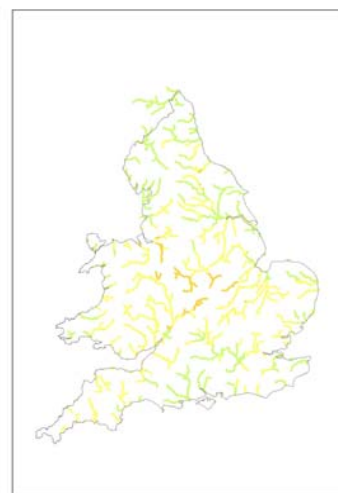
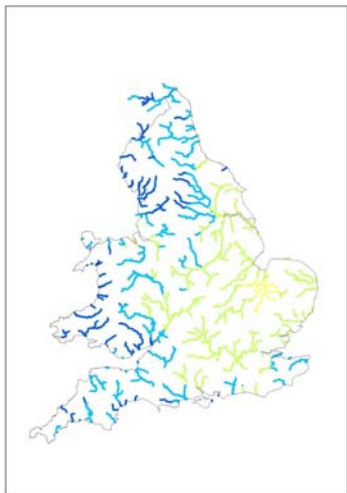
February

March

April

May

June



July

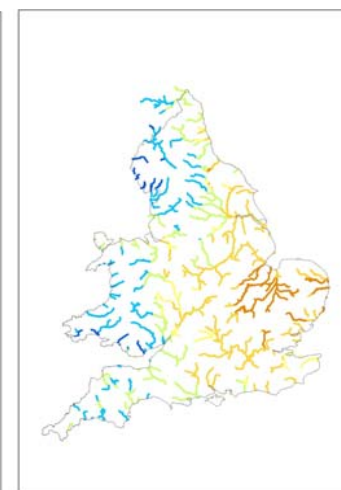
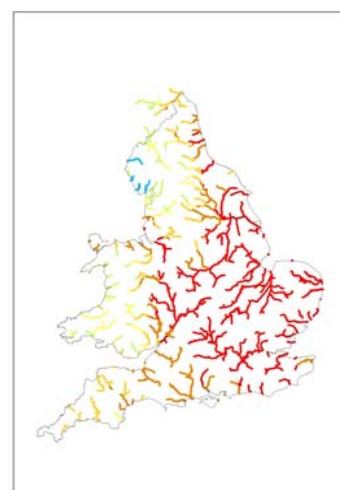
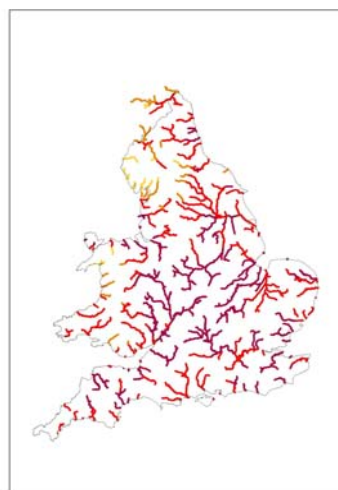
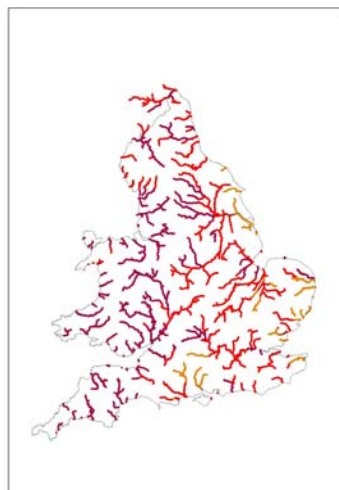
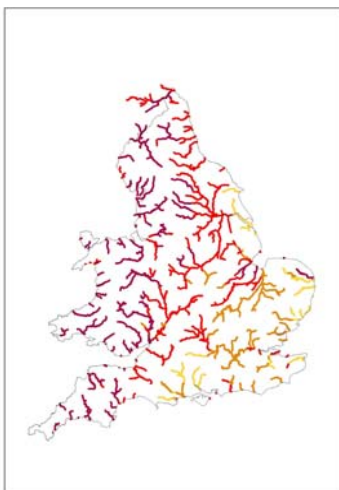
August

September

October

November

December



**Percentage change in mean monthly flow between now and the 2050s using the medium-high UKCIP02 scenario**

