Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09946, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09946
EGU General Assembly 2008
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Impact of Climate Change on the Availability of Surface Water for Irrigation in England and Wales

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The water demand for irrigation is only a small part of the total water use in England and Wales, but the water used for irrigation is mostly not returned to the river and demands are at their highest at a time when river flows are low. High abstraction rates from surface waters at low flow conditions can impair the ecological quality of a river by causing lower flow velocities, lower oxygen concentrations and less dilution of pollutant inputs. Abstraction standards for reaching the good ecological status have recently been defined by the UKTAG. Climate change is forecasted to result in higher temperatures as well as decreasing summer and increasing winter rainfall in the UK. The aim of this study is therefore to investigate how important irrigation demands are in England and Wales compared to surface water available for abstraction and what the potential impact of climate change on the availability of surface water could be.

The water available for abstractions is calculated using a daily river flow model, automatically parameterised from catchment characteristics held in a GIS and driven by synthetic weather time series based on UKCIP02 scenarios for 1961-90 and for the 2050s. The model calculates the water balance based on hydrological response units defined by landuse and hydrogeology and routes the runoff to generate a river hydrograph. This also allows us to investigate the interannual variability of available water. Testing of the model on 22 catchments for which flow data are available and which are not influenced by abstractions generally shows a good performance, with an average

Nash-Sutcliffe efficiency for monthly data of 0.7 and an average bias of 0.15.

In about 30 % of East Anglia, the irrigation demand exceeds the surface water available for abstraction during summer months and this area increases to 60 % in dry years. Model runs with weather time series for the 2050s show an average decrease in annual runoff for England and Wales of 5 %. The spatial variation in the change in runoff is broadly similar to the change in rainfall and further differentiated by the spatial distribution of changes in actual evapotranspiration. In the wettest parts of the country actual evapotranspiration increases due to higher temperatures, but in the drier parts of the country it decreases. With an average decrease of summer flow in the range of 20 - 30 %, changes in summer flow are more pronounced than changes in annual flow. The greatest percentage reductions in summer flow occur in catchments with flashy river regimes whilst the lowest reductions occur in catchments dominated by baseflow, in which summer flows are partially maintained by the increased winter rainfall, which enters the groundwater store and is only gradually released. Decreasing summer flows, together with an increase in irrigation demands, is expected to compound low flow problems in the southeast of England in the future.