The wrong type of rain?

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Analysing the hydrology of droughts and floods

After two consecutive dry winters, which caused a critical drought with groundwater levels at record lows at many aquifers in the South-East and English Midlands, weather conditions have changed dramatically since the beginning of April. One of the UK's worst supra-seasonal droughts has turned into the wettest April on record, with water levels of many rivers responding quickly and fast-rising water levels in many areas causing wide-spread flooding.

With the aim of quantifying the environmental risks associated with an increasing frequency of hydrological extremes, we are investigating the impacts of events such as the current UK drought and flood conditions on surface water and groundwater resources. As the current conditions prove, the particular implications of hydrological extremes for water quality and ecological conditions of freshwater habitats are still insufficiently understood.

The reduction of soil moisture deficits caused by the recent intensive rainfalls raised the hopes for considerable groundwater recharge and rising groundwater levels. In response, regulators have reacted quickly and partly lifted water conservation measures including the current hosepipe ban. Although, the intensive rainfall events of the last weeks have resulted in an easing of the drought situation in the country, regulators, decision makers and scientists will be well advised to stay alert and proceed in cautiously monitoring the water resource situation.

Due to its high intensity (the amount of rainfall per time), in many areas a considerable amount of the recent precipitation will not have infiltrated into the soils but caused overland flow, which has been responsible for the observed quick rise in river water levels over the previous weeks. In consequence, groundwater recharge rates are likely to be smaller than the sum of recent precipitation, reducing the expected increase in groundwater levels. In addition, groundwater aquifers are reacting with a time lag to precipitation. The length of this time lag can differ significantly based on the local geology, with groundwater levels in chalk rising faster than in limestone or sandstone aquifers.

Considering the amount of recent precipitation, the intensity of the preceding drought, and the response times of groundwater levels, we cannot exclude the possibility that critically low river water levels might be experienced in groundwater discharge dominated baseflow conditions, despite the current intensive rainfall.

Advanced modelling approaches, as currently being developed in the Water Research Group at the University of Birmingham, will improve the accuracy of predictions of interlinked surface water and groundwater responses to meteorological extremes in the future, and will provide regulators with the tools required to support decision making in a changing environment.

Recent events have clearly demonstrated the importance of understanding the environmental and societal implications of hydrological extremes. At Birmingham we are developing a new initiative on hydrohazards which we hope will include scientists, regulators and stake-holders from water industries and politics to discuss these issues.

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