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Comparison between global hydrological models and observations: trends and drought analysis for a large sample of catchments in England and Wales

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Global hydrological models (GHMs) have been widely used in scientific studies to describe the hydrological cycle at large scale. Many improvements have been made to these models, e.g., to include human influences, such as reservoir operations, water uses and land cover changes. Given these enhancements, the question is now how well these models can reflect trends and drought characteristics found in streamflow observations of relatively small catchments, where flow might be altered by different (local) human influences.
To answer this question, this study compares discharge data from different GHMs with observations in 189 gauging stations around England and Wales. A common characteristic of the considered catchments is their relatively small size (10-10000 km2) and part of the challenge consists in studying the ability of the models to describe hydrological conditions and human influences at such small scale. The selected catchments consist of a mix of catchments with near-natural flow as well as catchments with different human influences, such as groundwater abstraction and reservoir management. For all catchments, discharges trends and drought event characteristics have been determined from both observed and modelled time series and outcomes have been compared.
Preliminary results show that these course resolution GHMs have larger catchments areas and, therefore, overestimate discharge. When corrected for the area, the agreement between observed and modelled discharge still varies widely per catchment and per model and there does not seem to be a clear spatial performances pattern. The identified trends and drought characteristics also vary among GHMs and from GHMs to observations. Most models, however, seem to reproduce the observed seasonal trends (negative in winter and positive in summer) which might be more related to trends in forcing data, then to trends in human activities. The influence of human activities on drought characteristics is not as clear, with only some effects of groundwater abstraction emerging in the most affected regions.
Part of the problem with this type of study is that, for both observed and modelled data, there are no time series data available on the amount of water abstracted or stored in a basin or grid cell. Additionally, differences in representative spatial scale of GHMs and catchment data has a strong impact on the time series comparison. Our large-sample study aimed to overcome these factors by using a large number of catchments with at least a qualitative information on the type of human influences, but further analysis should be carried out both to deepen the knowledge about human influences on the hydrological cycle and to connect and bring together larger and smaller scale.