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Integrating hydrology within a fully coupled environmental prediction system

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Historically the hydrological community and the community developing the land surface component of atmospheric models have both been tasked with representing the terrestrial hydrological cycle, but have focused on different ends, namely streamflow and evaporation respectively. To date the lack of computational resources and representative observations have limited the integration of the skills within these two communities. However, this is no longer the case. In addition, the drive toward fully integrated high resolution environmental prediction systems, coupling atmosphere, land and ocean on regional domains, requires an accurate representation for all aspects of terrestrial hydrology. Hence a new focus is emerging to integrate improved hydrological processes within the land surface components of atmospheric models.

The UK Environmental Prediction (UKEP) project is a research experiment aimed at understanding the potential benefits for detailed environmental forecasting from a fully coupled atmosphere/land/ocean system at km-scale resolution for the UK. The prototype model utilises the Joint UK Land Environment Simulator (JULES) as its land surface component, coupled to the RFM river flow model. Although JULES has been previously used for climate studies that close the global water cycle, the JULES/RFM system has not been comprehensively evaluated for its ability to simulate river discharge.

In this study we attempt some initial evaluation of the JULES/RFM system for all aspects of the terrestrial hydrological cycle, including evaporation, soil moisture and streamflow. In addition, comparisons are made between the results from the fully coupled environmental prediction system and stand alone JULES/RFM simulations forced by atmospheric driving data from the UK weather forecasting model. This provides an opportunity to assess the impact of fully coupled versus a one way coupled response for terrestrial hydrology.

Finally we consider the potential for coupling JULES to a hydrological model to utilise the strengths from the components of the two modeling communities. This will consider the challenges that need to be overcome in order to progress a fully coupled modelling system that could deliver improved real-time hydrological forecasting.