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Evaluating sources of uncertainty for RAPID streamflow simulations using the JULES and Noah land surface models with cross-spectral analysis: Case study of the Thames basin, United Kingdom

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An advent of advanced computational resources has enabled streamflow modeling at a high spatio-temporal resolution. Considering the differences in how individual models represent these physical processes, use of a single model output may have significantly varied source of uncertainty and equifinality. Hence, comparison of multiple hydrologic models at a finer spatial resolution over a large domain is yet to be explored. This study compares the large scale river routing model (Routing Application for Parallel computatIonal Discharge, RAPID) streamflow results using surface and subsurface runoff data from two land surface models (LSMs): the Joint UK Land Environment Simulator (JULES) and the Noah LSM, at 1 km x 1 km resolution. These LSMs have been extensively implemented in the United Kingdom and the United States respectively. The modeling framework is setup for the Thames River Basin, U.K., and run from Jan 2000 to December 2008. The LSMs are run with atmospheric forcing data obtained from a) WATCH Forcing Data methodology applied to the ERA-Interim reanalysis (WFDEI) and b) Princeton Global Forcing derived from the NCAR-NCEP reanalysis (PGF). Three configurations of JULES are used, a global configuration (gl6) and a regional configuration (ukv) which is more appropriate for the km scale, along with an optimized regional configuration for improve hydrology as the land component of a fully coupled environmental prediction system. Hence this study aims to identify uncertainty from a number of sources including atmospheric forcing data, physical models, configuration of the physical models and ancillary datasets. Cross-spectral analysis is used to assess mismatches of the modeled discharge against daily observations in terms of variability, and separately phase, across daily to decadal time scales.