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Geoscientific Model Development Discussions

Interactive comment on "Using observed river flow data to improve the hydrological functioning of the JULES land surface model (vn4.3) used for regional coupled modelling in Great Britain (UKC2)" *by* Alberto Martínez-de la Torre et al.

Anonymous Referee #2

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This paper describes the implementation of a new topographical parameterization scheme in the JULES model and shows an improved model performance in simulating river flow over 13 catchments in Great Britain. This new scheme has already been incorporated in the latest JULES version, so the documentation of the scheme interests the model users and a wider GMD reader community. The rationale and procedures of the implementation is explained well and the results are shown clearly. However, there are a few issues that need to be addressed before this paper can be accepted for publication.

1. The comparison of two runoff generation schemes The authors tested the performance change from altering parameters in two runoff generation scheme options representing subgrid variability, the PDM and TOPMODEL. Runoff generation includes surface and sub-surface components. For PDM the equation computing saturation fraction (for surface runoff computation) is shown but not how the sub-surface runoff is computed (although it is described to be free drainage at the bottom of the soil column). For TOPMODEL the authors explain that saturation fraction is not tunable so the sub-surface runoff equation is provided. Changing the parameterization in different components (surface and sub-surface runoff) of the two schemes then comparing their performance change does not seem convincing or fair to me. It also seems that the freedom in tuning PDM is much higher. In exploring the parameter space, more rationale should be provided on the choices of different tests and whether some parameter choices have a physical base (i.e., is S0/Smax=0 or 0.75 realistic? Why alpha=2000 was not examined if it was reported in previous studies?). As such, the results need to be interpreted more carefully. Although the subsurface (surface) runoff component in PDM (TOPMODEL) cannot be changed with new parameterization, their equations should still be provided for the readers to better interpret the results.

2. The possibility of error compensation The authors acknowledged the reported excess of evaporation by JULES at the global scale. It is not clear whether the excess evaporation is due to choice/parameters in the evaporation scheme or a wet bias in soil moisture and subsequent underestimation of river flow. Changes in parameters for runoff generation as analyzed in this paper, while improved simulation results, might not always be for the right reasons. One example is that changing surface runoff generation in PDM improves results in base flow dominated basins without directly changing base flow, is this realistic? Such questions are certainly tricky in model development and require lots of efforts checking other components of the model against other observation dataset, so it is perhaps beyond the scope of this paper. However, I would like to see more discussion and a more careful approach interpreting the results.

3. Representativeness of rivers in Great Britain The authors claim that Great Britain presents diverse climatic and topographic situations. While the precipitation do vary a lot, the island's climate does not represent the whole world: parameters suitable for Great Britain might yield poor results in dry/semi-dry regions (annual precipitation<400mm) or tropical areas. While it is not the focus of this paper, performance change in such regions in other parts of the world should be tested before knowing whether the new parameterization improves the model's performance globally. This caveat needs to be discussed in the paper. I am also curious to know if this update based on 1km version also translates to performance change at 0.5 degree global simulations in JULES. Such results will be quite interesting to the global modeling community and may support the "key message" which is yet to be developed fully for this paper.

Minor comments:

-There are a number of grammatical/structural errors, such that a careful further proofreading is necessary. As of now, I have not attempted to compile an extensive list but here are some examples and suggestions for change:

P1L15: parametrization -> parameterization

P3L3: "a community land surface model widely used" -> "a widely used community land surface model"

P12L19: "This dataset availability" -> "The availability of this dataset" or something similar.

-More details should be provided for the cross-spectral analysis as it is related to a section of the results; the logical transition between NS/bias analyses to cross-spectral analysis also needs to be better.

-P6L7: why 272 simulations? PDM: 25 b, 4 S0; TOPMODEL: 8 f, 4 a; VG and BC approach for both, so the total is (25*4+8*4)*2 or am I missing something?

-P10L19: where does the results show that alpha=1 and f=5.0 produce best results for TOPMODEL (Fig. 8 does not differentiate alpha values)?

-Please explain briefly the BC and VG approach such that the readers do not necessarily need to check back the referred papers.

-Fig.1. Better to label the outlets with basin names instead of station number (the latter can be included in legend as it is now)

-Fig.5. It is difficult to tell if the slope dependent b tests produce better results as the median of all possible b values for most basins.

-Fig.6. Is the number of dots in each figure supposed to be 13 (for the basins)? Please double check.

-Fig. 10. Please explain what the red/blue colors mean in the figure caption.

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