OVERALL COMMENT TO REFEREE COMMENTS AND SHORT COMMENT

We thank the three referees, Prof. Keith Beven, Dr. Dai Yamazaki and Anonymous #3 for their insightful comments, which have been a great help in improving the quality of our paper. We address all referee comments individually and point-by-point, and here we address the main concerns shared by the referees.

Both Prof. Beven (comment #9) and Dr. Yamazaki (comment #11) raise the important limitation that the potential evaporation datasets do not account for land cover. Indeed, one should not expect the potential evaporation over for example wetlands or forest canopies to be well represented by the CRU and $WATCH_{PM}$ potential evaporation estimates that are based on the FAO reference crop or $WATCH_{PT}$ that is based on the Priestley-Taylor formula. The results in the study clearly highlight the importance of considering land-cover types for potential-evaporation estimates since inferred actual evaporation often exceeds potential-evaporation estimates in areas like, for instance, the Amazon basin where the FAO reference-crop method is likely to underestimate potential evaporation. However, in previous studies it has not been uncommon to use potential-evaporation estimates that do not consider vegetation type in GHMs (e.g. Fekete et al., 1999; Döll et al., 2003; Widén-Nilsson et al., 2007; 2009) or to use crop coefficients only to estimate demand for irrigated crops (e.g. Döll and Seibert, 2002; Wisser et al., 2008, 2010), although some consider vegetation type in the calculation of the potential evaporation (e.g. Arnell, 1999; Gosling and Arnell, 2011). It is reasonable to assume that taking land cover into account would alleviate some of the data inconsistencies found; however, accurate estimation of potential evaporation on these large scales is not a trivial task. The nonlinear nature of the processes governing evaporation makes accurate estimations difficult since the low resolution at which data is available on the global scale often prevent considerations of the highly heterogeneous and sometimes time-variable nature of many of the variables needed for the estimations.

We used the potential evaporation data as are, since this paper was intended as an initial data screening to highlight the need of proper data scrutinisation before any modelling exercise. The discovery of inconsistent data should then lead to a search of methods to resolve those issues (e.g. gauge-measurement corrections, surface-dependent estimation of potential evaporation, and consideration of anthropogenic influences) if possible, but that is beyond the scope of this paper.

We have included more detailed discussions about the potential-evaporation data and the implications of detecting areas with inferred actual evaporation higher than the potential evaporation in section 3.2 (Method) and section 5.2 (Discussion) of the manuscript.

This discussion also connects to the effects of non-represented sub-grid variability, highlighted by Dr. Yamazaki (comment #10). E.g., temporally inundated floodplains can substantially increase evaporation in a basin and potential evaporation estimates not taking such effects into account are likely to be substantially underestimated. We agree that the negligence of sub-grid variability may result in inaccurate grid-cell averages and may be an important reason for data inconsistencies for both precipitation and potential evaporation. Potential evaporation estimates are highly sensitive to climate data input because of the non-linear nature of the processes. The problem is how to represent such variability given the limited information that is usually available at the global or large scale. The initial data screening we performed can lead to

detection and recognition of such effects and thereby pose questions about how to deal with these, both in terms of forcing data and in terms of model structure. We have added a discussion on the effects of sub-grid variability to section 5.2 (Discussion).

Our responses to the comments of the individual referees are given separately, but we would also like to thank Mark Amo-Boateng for his interest and comments on our article. We agree that scaling effects, in combination with deficiencies in raw data, are important issues for representativeness of data.

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