Reviewer #2

#RC2.1 We still do not have a concise summary of the conceptual / process-representation differences between the two hydrological models; are there differences that affect the water balance (other than cp and exc), e.g. via computation of ET ?

We agree with this comment and we have significantly extended the section 5.6 dedicated to the comparison between the two hydrological models. We have tried to summarize the main differences between the two models for each of their components (spatialization, PET/AET, snow module, runoff production, routing). In a nutshell, SMASH and MORDOR-SD use similar formulations of the main processes of the hydrological cycle but MORDOR-SD has additional flexibility using additional parameters and reservoirs. On the other hand, SMASH is a distributed model that might represent more adequately some dynamics at the scale of the catchment (e.g. quick surface runoff).

#RC2.2 Would be nice to have an idea of mean precipitation of the catchments (Table 1), mean streamflow and mean simulated evaporation. This would help understand how important ET is compared to precipitation and if the different models assign a similar amount of water to ET (rather than runoff). Furthermore, the reader could understand if water balance closure problems (counterbalanced with cp or exc) can be related to the underestimation of ET. Without this information, we do not have a complete picture of the hydrological evaluation of meteorological forcings. While this might be a detail here, the fact that model calibration acts on ET is often overlooked in modelling studies, and it would therefore be good to mention here.

We also fully agree with this comment. It would be important to relate water balance closure problems to the different aspect of the hydrological models. However, we have one major technical issue related to the fact that this version of SMASH did not return the actual evapotranspiration (ETR) in the outputs. This would require re-running all the simulations with the current version of SMASH. Beside this technical limitation which is not insurmountable, some previous results (not shown) showed that the identification of the water balance closure problems is not an easy task. For example, it was not possible to see similar effects of cp and exc. As explained in section 5.1, the SMASH parameter exc enables water exchanges but is only applied to a part of the streamflow production (direct runoff branch) and has only an indirect effect on the water balance. Conversely, MORDOR-SD was designed to reproduce the water balance using two specific parameters (cp and cetp) which can act either on the precipitation inputs or the PET, respectively. Even if the parameter cetp is not used in this study, SMASH and MORDOR-SD are not really comparable concerning these questions because they have not been developed for the same purposes. MORDOR-SD seeks to reproduce all the components of the hydrological cycle (water balance, interannual variability, low/high

flows, etc.) whereas SMASH targets primarily the reproduction of flood events, which also explains why MORDOR-SD returns AET as an output and SMASH does not.