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Combined evaluation of MPI-ESM land surface water and energy fluxes

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In order to assess the robustness of projected changes of the hydrological cycle simulated by an Earth System Model (ESM), it is fundamental to validate the ESM and to characterize major deficits. As the hydrological cycle is closely coupled to the energy cycle, a common large-scale evaluation is highly beneficial, even though this has been rarely done up to now. Consequently, the purpose of the present study is the combined evaluation of land surface water and energy fluxes from the newest ESM version of the Max Planck Institute for Meteorology, MPI-ESM, which was used to produce an ensemble of CMIP5 (Coupled Model Intercomparison Project Phase 5) simulations for the forthcoming 5th IPCC assessment report. Here, we focus on model results from a three-member ensemble for current climate conditions obtained for the end of the 20th century. On one hand, these results will be evaluated using observational and re-analysis data sets. With regard to the energy fluxes, we make use of most recent satellite based datasets of surface albedo and surface solar irradiance from MODIS, CERES and the CMSAF. On the other hand, MPI-ESM results are compared to CMIP3 results from the predecessor of MPI-ESM, ECHAM5/MPIOM, which was used for the 4th IPCC assessment report, as well as to results from the atmospheric/land part of MPI-ESM (ECHAM6/JSBACH) forced by observed SST. Analyses will focus on regions where notable differences occur between the two ESM versions as well as to the SST driven simulations. First results show that the simulated precipitation of the full MPI-ESM notably differs from that of ECHAM6/JSBACH over the Amazon and Ganges/Brahmaputra catchments. For the first catchment, the coupling to the ocean leads to large negative precipitation bias, while for the latter, the coupling significantly improves the simulated precipitation. Similar effects are also seen for the previous ESM version. A considerable improvement of net shortwave radiation flux is observed for MPI-ESM compared to its predecessor which is attributed to an improved simulation of surface albedo in the MPI-ESM land surface model (JSBACH) with interactive vegetation dynamics as well as to an improved atmospheric radiation scheme in the MPI-ESM.