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Enhancing the soil hydrology of the MPI-M Earth system models to meet biosphere modelling requirements

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In climate research, the so-called bucket model has been widely spread where the soil water is represented by a single soil moisture reservoir, such as it is still the case in the current operational climate models of the Max Planck Institute for Meteorology (MPI-M), ECHAM6 and REMO. But in the transition of these climate models to comprehensive Earth system models, this single soil moisture layer is no longer sufficient. Here, biosphere processes must be coupled to the hydrological processes using bio-geochemical models. But these models usually need a vertical discrimination of the soil water storage. This was, e.g., raised as a key issue for bio-geochemical model requirements at the MPI for Biogeochemistry and the MPI for Chemistry within the ENIGMA (Earth System Network of Integrated Modelling and Assessment) network. In addition, the higher vertical discrimination is also needed for the implementation of permafrost related processes, especially soil moisture melting and freezing, which is currently being conducted by T. Blome at MPI-M.

Therefore, one objective within ENIGMA is to achieve an improved representation of hydrological processes in the MPI-M Earth system models, especially of those that play an important role in the coupling to bio-geochemical processes. To this end, a five soil layer hydrology scheme has been implemented into the JSBACH scheme (the land surface component of ECHAM6) that is consistent with the five temperature layers already included in the ECHAM physics used in JSBACH and REMO. The new scheme will be presented, as well as results from first validation simulations conducted with AMIP2 SST forcing at T31 and T63 resolution.