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Impact of the soil hydrology scheme on simulated soil moisture memory in a GCM

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Soil moisture-atmosphere feedback effects play an important role in several regions of the globe. For some of these regions, soil moisture memory may contribute significantly to the development of the regional climate. Identifying those regions can help to improve predictability in seasonal to decadal climate forecasts. The present study investigates how different setups of the soil hydrology scheme affect soil moisture memory simulated by the global climate model of the Max Planck Institute for Meteorology (MPI-M), ECHAM6/JSBACH. First, the standard setup applied for the CMIP5 exercise is used, in which soil water is represented by a single soil moisture reservoir. Second, a new five soil layer hydrology scheme is utilized where the previous bucket soil moisture now corresponds to the root zone soil moisture. In the standard setup, transpiration may access the whole soil moisture that is exceeding the wilting point over vegetated areas. However, in the five layer scheme, soil water below the root zone cannot be accessed by transpiration directly, but only be transported upwards into the root zone by diffusion following the Richard's equation. Thus, this below the root zone, which is not present in the standard setup, can act as buffer in the transition between wet and dry periods. A second notable difference between the two setups is the formulation of bare soil evaporation. In the standard setup, it may only occur if the whole soil moisture bucket is almost completely saturated, while in the new setup, it depends only on the saturation of the upper most soil layer. As the latter is much thinner than the root zone (bucket), bare soil evaporation can occur more frequently, especially after rainfall events. For the second setup, two further variants are considered: one where the bare soil evaporation was modified and one where a new parameter dataset of soil water holding capacities was used. Soil moisture memory of the different setups will be analysed from global ECHAM6/JSBACH simulations forced by AMIP2 SST. Areas will be highlighted where the regional climate seems to be sensitive to the improved representation of soil hydrology in the new setup and its variants. First results indicate that soil moisture memory effects play a role in regions where a soil moisture buffer is present below the root zone.