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The groundwater buffering effect on heat waves and precipitation: coupled groundwater-atmosphere simulations over Europe and North America with a WRF-LEAFHYDRO system.

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We present coupled atmosphere-hydrology simulations with the WRF regional climate model and the LEAFHYDRO LSM, including groundwater dynamics. Simulations are carried out for the coupled system for the growing season (February to October) over Europe at 2.5km resolution over land and 20km over the atmosphere. Initial conditions for the land surface, groundwater and rivers are from 10 year off-line simulations, performed continuously over the same domain and period, forced by atmospheric data from the Earth2Observe FP7 project. We show that the presence of a shallow water table over portions of the European continent enhances evapotranspiration in dry periods under increasing atmospheric demand. The impact of the coupling between groundwater and the soil vegetation system on land surface fluxes results in decreases in air temperature and an increase in low level mixing ratios, which under certain convective regimes induces more precipitation. We illustrate for the heat wave of 2003 that models that do not include this groundwater buffering effect may enhance significantly the intensity of such temperature extreme cases. The effect on precipitation is mostly seen over inland areas where warm season convection is important. We show with results of additional simulations over North America, where summer convection over the interior of the continent is very relevant, that the effect of groundwater-enhanced evapotranspiration may have a sizeable impact on climate at the global scale.