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Land surface scheme conceptualisation and parameter values for three sites with contrasting soils and climate

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Abstract. The objective of the present study is to test the performance of the ECMWF land surface module (LSM) developed by Viterbo and Beljaars (1995) and to identify primary future adjustments, focusing on the hydrological components. This was achieved by comparing off-line simulations against observations and a detailed state-of-the-art model over a range of experimental conditions. Results showed that the standard LSM, which uses fixed vegetation and soil parameter values, systematically underestimated evapotranspiration, partly due to underestimating bare soil evaporation, which appeared to be a conceptual problem. In dry summer conditions, transpiration was seriously underestimated. The bias in surface runoff and percolation was not of the same sign for all three locations. A sensitivity analysis, set up to explore the impact of using standard parameter values, found that implementing specific soil hydraulic properties had a significant effect on runoff and percolation at all three sites. Evapotranspiration, however affected only slightly at the temperate humid climate sites. Under semi-arid conditions, introducing site specific soil hydraulic properties plus a realistic rooting depth improved simulation results considerably. Future adjustments to the standard LSM should focus on parameter values of soil hydraulic functions and rooting depths and, conceptually, on the bare soil evaporation parameterisation and the soil bottom boundary condition. Implications of changing soil hydraulic properties for future large-simulations were explored briefly. For Europe, soil data requirements can be fulfilled partly by the recent data base HYPRES. Sandy and loamy sand soils will then cover about 65% of Europe, whereas in the present model 100% of the area is loam.

Keywords: land surface model; soil hydraulic properties; water balance simulation

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