Evapotranspiration and soil moisture in a generalized land surface scheme: impact of soil parameters and forcing

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Abstract Land surface schemes describe the exchange of water and energy fluxes at the land surface. In many climates, the amount of evapotranspiration is limited by the availability of soil moisture. The soil moisture balance itself is dominated by precipitation input, and the losses resulting from drainage and evapotranspiration. Both type of losses strongly depend on the physical properties of the soil. Hence, any errors in soil parameters will propagate through the soil moisture balance and influence evapotranspiration and the surface energy budget. In a full numerical land surface scheme, the effects of errors in soil parameters might be largely masked by compensating effects. For example, an underestimation of the available soil moisture due to an overestimation of the wilting point might be compensated by an overestimation of the rooting depth. To isolate the effects of soil parameters and conceptualization from effects of vertical discretization and root distribution, we study the impact of soil parameters on evapotranspiration in a generalized land surface scheme. This land surface scheme considers the root zone to consist of a single layer (Fig. 1), which allows for analytical rather than numerical solutions. We study: a) the drydown characteristics in absence of rainfall forcing, and b) the steady state probability distribution of soil moisture and associated mean evapotranspiration. Soil parameterizations from three land surface schemes (TESSEL, ISBA, TERRA-LM) used within the European Land Data Assimilation System (ELDAS) project are used within the generalized model to quantify the potential effect on evapotranspiration and soil moisture. Preliminary results show large differences between the soil parameters between the different models, which can explain the fact that different models often have different soil moisture climatologies. Unification of soil parameters and pedotransfer functions is necessary for improved exchangeability of volumetric soil moisture and data assimilation.

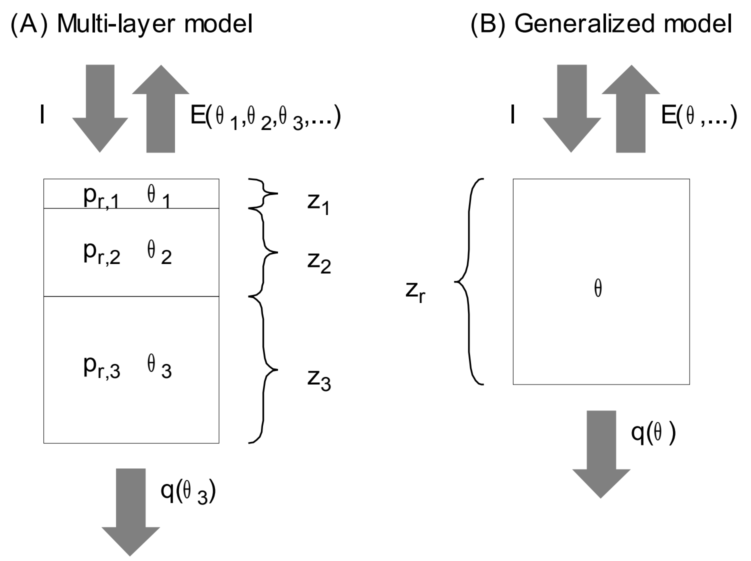

Figure 1. Illustration of the generalized model with the dominating water fluxes: infiltration I, evapotranspiration E, and drainage q. (A) Full land surface scheme with multiple layers, each of different thickness z_i, and with different soil moisture θ_i and root fraction $p_{r,i}$. (B) Generalized model with single layer, with a depth equals to the root depth z_r.