EGU22-4269
https://doi.org/10.5194/egusphere-egu22-4269
EGU General Assembly 2022

Estimating global scale evapotranspiration using soil-based evaporation characteristic length and root zone depth distribution

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Evapotranspiration (ET) modeling is central to resolving water and energy balances and linking the terrestrial water and carbon cycles. An important challenge remains how to partition the ET flux into transpiration (T) and soil evaporation (E). We expand the surface evaporation capacitor model of Or and Lehmann (2019) by considering concurrent root water uptake. The original capacitor model simulates surface evaporation (focusing on stage-1) and internal redistribution following rainfall events. The thickness of the evaporation-active soil layer is defined by an intrinsic soil property termed the evaporation characteristic length (deduced from soil water characteristics and hydraulic conductivity functions). The modified model considers water extraction by plant roots from the capacitor layer as well as water redistributed into deeper layers (sheltered from soil evaporation but accessible for root water uptake). Depending on the amount of water leaking below the capacitor depth, vegetation can take up this natural storage at rates limited by the hydraulic properties of the rhizosphere. To model evapotranspiration and its partitioning at the global scale, we use spatial information on (i) maximum root depth and (ii) soil hydraulic properties defining the depth of the capacitor layer. We assess the performance of the ET capacitor model in comparison with results from available land surface models and estimates based on remote sensing products.