Drainable Porosity of Unconfined Aquifers during Evapotranspiration from the Shallow Water Table

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Drainable porosity (γ) (or specific yield) of unconfined aquifers is an important parameter that influences the water table (WT) dynamics induced by the conditions at aquifer boundaries. Accurate estimation of this parameter is essential for studying WT dynamics in such areas as wetlands and poorly drained agricultural lands. Under shallow WT environments, it plays a critical role in development of water management system through efficient subsurface drainage and irrigation. Drainable porosity depends on the depth to WT and moisture retention properties of the soil. Usually it is calculated assuming hydrostatic equilibrium conditions above WT to account for capillary properties of soils. However, in shallow WT environments vertical soil moisture flux due to evapotranspiration can be a significant component of the water balance which also affects the magnitude of γ. In this study, an analytical expression of γ was developed considering the soil moisture profile during steady flux from WT. The results showed that when evapotranspiration from WT is taken into account, magnitude of γ becomes smaller than equilibrium condition, especially when WT is near the soil surface. This decrease in γ was more significant in soils with finer texture (e.g. clayey soils). Use of steady state expression of γ also resulted in better agreement with observed amplitudes of WT fluctuation as compared to an equilibrium equation. Results indicate that the steady state expression of γ can have implications in improving the estimation of groundwater evapotranspiration and subsurface water flow in shallow unconfined aquifers under different types of vegetation.