Geophysical Research Abstracts
Vol. 20, EGU2018-3794, 2018
EGU General Assembly 2018

Analytical Model for Evaporation from Deep Aquifers in Hyper Arid Environments

Tamir Kamai and Shmuel Assouline

Agricultural Research Organization, Soil, Water, and Environmental Sciences, Rishon LeZion, Israel (tamirk@agri.gov.il)

Evaporation is a significant part of the water cycle in hyper-arid environments. The subsurface of these deserts is characterized by deep groundwater with negligible recharge, whereby water flows from the water table to the surface and evaporates to the atmosphere. We propose an analytical model to predict evaporation rate and the position of the evaporative front. The model accounts for water table depth, atmospheric conditions, and soil hydraulic properties. We consider steady-state flow, with two distinct regions of liquid-phase flow from the water table and vapor-phase flow towards the surface, separated by an evaporative front. The driving forces are pressure head gradients for Darcian liquid flow, and thermal and relative humidity gradients for Fickian diffusive vapor flow. Evaporation rates are predicted for different soil types, and the impact of applied constitutive models for characterizing these soils is evaluated. Additionally, the effects of groundwater depth and atmospheric conditions are also incorporated.

Evaporation rates increase as groundwater levels are shallower, and as atmospheric temperatures increase and/or relative humidity values decrease. Evaporation decreases exponentially with groundwater depth, to being almost constant below $\sim$500 m, to about 0.02 mm per year under typical atmospheric conditions. The impact of soil type and other related uncertainties are important when groundwater is shallower than $\sim$300 m. The relative portion of the liquid phase region increases compared to that of the vapor one as evaporation rates increase. The actual size of the liquid phase flow region, however, increases with lower flow rates and is at its maximum when the water flux approaches zero at hydrostatic conditions.