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Modeling plant water deficit by Richards'equation with a non-local root water uptake term

Wednesday 24 May 2023 12:15 (15 minutes)

In this talk we present a novel way to mathematically frame the concept of *ecological memory* of plant water stress in the context of root water uptake in the unsaturated flow equation.

As reported in [1], ecological memory can be defined as "the degree to which an ecological process is shaped by its past modifications of a landscape". Inspired by recent eco-hydrological papers (see in particular [2], [3]), we model the water content dynamics in a soil plant system by Richards'equation with a non-local root water absorption term. In order to account for this memory term, an integral equation is defined, and sufficient conditions are provided which ensure existence and uniqueness of its solution: in particular, the memory term carries a weight function and takes into account 1) the *length* of the memory; 2) the *temporal pattern* of the memory; 3) the *strength* of the memory.

Finally, tailored numerical methods are implemented, and numerical simulations are also provided: in particular, we show the behaviors of memory terms with exponential weight and with fractional weight.

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2. X. Wu, Q. Zuo, J. Shi, L. Wang, X. Xue, A. Ben-Gal, Introducing water stress hysteresis to the Feddes empirical macroscopic root water uptake model, Agricultural Water Management 240 (2020) 106293. doi:https://doi.org/10.1016/j.agwat.2020.106293

3. A. Carminati, A model of root water uptake coupled with rhizosphere dynamics, Vadose Zone Journal 11 (2012). doi:doi:10.2136/vzj2011.0106.

Participation

In-Person

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