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INFLUENCE OF NON-GAUSSIAN SOIL STRUCTURE AND ROOT UPTAKE STRATEGIES ON FLOW IN THE UNSATURATED ZONE

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Summary. Water scarcity in aride areas leads to limited water uptake by roots and thus to restricted growth and eventually to wilting of plants. In order to develop effective irrigation strategies, a broad understanding of the factors which influence the distribution of the water potential under dry conditions is in demand. Soil structure is supposed to have a large impact on the interactions of soil water budget and root uptake especially under dry conditions when the variability of soil parameters is increased. For field applications, predictions of the water flow are needed for large scales where the scarcity of measurements leads to a high level of uncertainty about the detailed distribution of soil parameters. Thus stochastic methods in which heterogeneity of soil is described by a random parameter field are used.

In this presentation, the interrelation of root uptake and heterogeneity is analyzed by comparing simple soil structures in one dimension as layered or column media using analytical perturbation solutions to more complex structure with Gaussian and non-Gaussian distribution. The goal of this comparison is to test conditions, for which simple analytical solutions can be used to estimate pressure head profiles and variability profiles. Transpiration is in the model considered in a macroscopic way as a sink term with a prescribed potential extraction rate at each node, determined by the density distribution of the plants and with restricted uptake due to unfavorable conditions as lack of water and oxygen (modeled according to the Feddes - Function). With this basic model, the occurrence of dry spots - regions in which roots dry up to the wilting point has been observed for two dimensional random fields with isolated high extreme values in conductivity under dry conditions which seems rather unrealistic. Thus other approaches are analyzed in comparison to the basic model where additionally optimizing mechanisms as preferential uptake in wet domains are included. With this setup the influence on the hydraulic variables and total root uptake term is investigated in order to gain a deeper understanding of the joint effect of soil structure and root uptake.