New HYDRUS Modules for Simulating Preferential Flow, Colloid-Facilitated Contaminant Transport, and Various Biogeochemical Processes in Soils

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We have dramatically expanded the capabilities of the HYDRUS (2D/3D) software package by developing new modules to account for processes not available in the standard HYDRUS version. These new modules include the DualPerm, C-Hitch, HP2/3, Wetland, and Unsatchem modules. The dual-permeability modeling approach of Gerke and van Genuchten [1993] simulating preferential flow and transport is implemented into the DualPerm module. Colloid transport and colloid-facilitated solute transport, the latter often observed for many contaminants, such as heavy metals, radionuclides, pharmaceuticals, pesticides, and explosives [Šimůnek et al., 2006] are implemented into the C-Hitch module. HP2 and HP3 are the two and three-dimensional alternatives of the HP1 module, currently available with HYDRUS-1D [Jacques and Šimůnek, 2005], that couple HYDRUS flow and transport routines with the generic geochemical model PHREEQC of Parkhurst and Appelo [1999]. The Wetland module includes two alternative approaches (CW2D of Langergraber and Šimůnek [2005] and CWM1 of Langergraber et al. [2009]) for modeling aerobic, anaerobic, and anoxic biogeochemical processes in natural and constructed wetlands. Finally, the Unsatchem module simulates the transport and reactions of major ions in a soil profile. Brief descriptions and an application of each module will be presented. Except for HP3, all modules simulate flow and transport processes in two-dimensional transport domains. All modules are fully supported by the HYDRUS graphical user interface. Further development of these modules, as well as of several other new modules (such as Overland), is still envisioned. Continued feedback from the research community is encouraged.