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Monitoring and modeling flow and transport through vadose zones underlying various land uses

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Water percolation and solute transport through the vadose zone of three different land uses: a rain-fed crop field, an irrigated citrus orchard, and a natural sand-dune are studied in the coastal plain of Israel. The study implements a vadose zone monitoring system (VMS), which enables continuous measurements of the vadose zone water content and allows frequent sampling of the sediment pore water at selected points across the entire vadose zone (up to 30 m depth at this study). Hydrus 1D code is used to build models that describe water flow and chloride transport for the different sites. These models are calibrated and validated using the transient water content and chloride concentration data that are collected at the different sites with the VMS. Two year of continuous monitoring of the vadose zone under the three sites reveals significant differences in the solutes concentrations under the field and the orchard sites compared with the natural dune site. High chloride accumulation and relatively small masses of nitrate are found under the orchard reflecting high efficiency in water and fertilizer use. In contrast under the rain-fed crop field the vadose zone pore water is less saline than under the orchard but contain higher masses of nitrate. The calibrated models show larger groundwater recharge at the dune site. Running simulations of land-use change scenarios with the calibrated models can in light questions concerning groundwater quantity and quality changes that may follow the land use change. These include intensive agriculture cultivation at the dune site or cessation of any agriculture cultivation at the field and orchard sites.