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Effects of ridge cultivation on soil water dynamics during monsoon season in South Korea: An inverse modelling approach and parameter optimization

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The impact of monsoonal events during July and August in the Haean Basin, South Korea plays a key role in erosion, nutrient leaching, and groundwater pollution risk by the intense use of agrochemicals. In South Korea ridge tillage and foil covering of the ridges is the most common production type for dry crops such as potatoes, radish and cabbage. However, the effect of these ridge cultivation systems at dryland farming field sites, especially row covering by plastic foil, on infiltration pattern und soil water dynamics is poorly understood.
We set up a monitoring network of standard tensiometers as well as continuously recording tensiometers, frequency and time domain reflectometry probes in ridge and furrow positions in potato crops (Solanum tuberosum L.). Measurements of matric potential ψm and water content θ were carried out in 15, 30 and 60 cm depth at 30 minutes time steps with the continuously recording Tensiometers, FDR sensors and TDR probes and at a daily time step with the standard tensiometers during growing season 2010. Precipitation data was registered by a weather station, which was located about 350 meters away from our monitoring field site. Datasets of field monitoring network indicated strong differences between ridge and furrow positions. Water content in furrow positions was significantly higher than in ridge positions, whereas in ridge positions significantly higher matric potential in the topsoil was found.
The numerical model HYDRUS 2/3D was calibrated using the collected field datasets. Primarily we set up a two-dimensional inverse model at a daily time step, which simulates the entire growing season from end of May to late August 2010. Further we simulated a heavy rainstorm/typhoon event at hourly time steps, which occurred between 13th and 15th of August 2010. The module ROSETTA V1.0, which is implemented in HYDRUS 2/3D, estimates unsaturated hydraulic properties using pedotransfer functions (PTFs) based on neuronal networks. In our simulations the module was used to estimate water retention parameters according to Van Genuchten and the saturated hydraulic conductivity (Ks) based on measured soil texture and bulk density data.
Concurrently, optimization of the soil hydraulic parameters α, n and Ks is accomplished by minimization of the objective function using Marquardt-Levenberg nonlinear minimization method. The models will be validated by comparing observed and predicted matric potential and water content in different depths. The agreement between observed and predicted data will be shown. Based on these model results solute transport modelling will be facilitated.