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Observation of field- scale preferential flow in soil landscapes with kettle holes as internal drainage system

Horst H. Gerke

Leibniz-Zentrum für Agrarlandschaftsforschung (ZALF) e.V., Institut für Bodenlandschaftsforschung, Müncheberg, Germany (hgerke@zalf.de, +49 33432 82280)

Complementary to pedon-scale phenomena (e.g., macropore flow in structured soil), preferential flow may be also defined at larger scales mainly along impeding structures that allow for the development of transient 'local' non-equilibrium in water potentials depending on characteristic boundary conditions. The phenomenon is then related to a 'global' system (i.e., field, hillslope, or catchment). Larger scale preferential flow processes have recently been hypothesized although full conceptual understanding for model development remains challenging.
The objective of this contribution is to discuss field observations of area-scale preferential water flow for improving the conceptual model.
Examples are from a typical post-glacial landscape with kettle holes (i.e., site Grünow, north East Germany) as internal catchment systems where surface runoff and lateral subsurface flow occur. Where soils are developed from the till, and predominately used for agriculture, water moves along the surface as runoff or within highly conductive soil regions before it enters the central depression. From there it may either evaporate or eventually lead to depression-focussed recharge. Observations show lateral flow 'bypassing' relatively dry subsoil in most of the catchment and re-wetting the subsoil near the depression by lateral infiltration from the pond indicated by reversal of hydraulic gradients. Results suggest that surface runoff is dominating the hydrological regime during the winter when the soil is frozen and in the summer during storm events. The lateral exchange fluxes between pond and surrounding soil suggest that additional geomorphologic and pedologic structures affect the hydrological function of the system. Ponds can trap large volumes of surface runoff and control seepage function. The field-scale lateral preferential flow can strongly control percolation and discharge and may be a possible route for ground water contamination.