Geophysical Research Abstracts
Vol. 14, EGU2012-4740, 2012
EGU General Assembly 2012

Seasonal and event-scale dynamics of spatial soil moisture patterns at the small catchment scale

H. Bogena (1), R. Rosenbaum (2), M. Herbst (1), J.A. Huisman (1), T.J. Peterson (3), A.W. Western (3), and H. Vereecken (1)

(1) Forschungszentrum Juelich, Institute Agrosphere (IBG-3), 52425 Jülich, Germany (h.bogena@fz-juelich.de), (2) Zentralinstitut El Gouna, Technische Universität Berlin, 10587 Berlin, Germany, (3) Department of Infrastructure Engineering, University of Melbourne, 3010 Victoria, Australia

Due to measurement constraints, our knowledge of short- and long-term dynamics of spatial soil water content (SWC) patterns at the small catchment scale has reached an impasse in recent years. The wireless sensor network technique has the potential to continuously monitor SWC fields with high spatial and temporal resolution and coverage, i.e. to detect seasonal and event-scale changes in SWC patterns. This research aims to examine seasonal and event-scale spatial SWC dynamics in the top- and subsoil throughout the small spruce covered TERENO test site Wüstebach, Germany, using highly detailed four-dimensional data from the wireless sensor network system SoilNet developed at Forschungszentrum Jülich and univariate and geostatistical methods.
We found high variation of spatial SWC patterns in the topsoil as response to climate forcing, whereas in the subsoil, temporal dynamics were diminished due to soil water redistribution processes and root water uptake. The relationship between topsoil SWC variability and mean soil water content (STD(MSWC)) showed a 'convex parabolic shape' as it is typical under temperate climate conditions. Observed scattering in topsoil STD(MSWC) in the intermediate SWC state was explained by seasonal and event-scale STD(MSWC) dynamics, possibly involving hysteresis at both time scales. Clockwise hysteretic STD(MSWC) dynamics at the event-scale were generated under moderate SWC conditions after precipitation events that rapidly wet the topsoil and in which SWC variability is mainly controlled by spruce throughfall patterns. This hysteretic effect was increased by larger precipitation magnitude, reduced root water uptake and high groundwater level. Intense precipitation on dry antecedent topsoil abruptly increased STD but only marginal increased SWC. This was due to different soil rewetting behaviour in drier upslope areas (hydrophobicity and preferential flow caused minor topsoil recharge) compared to the moderately wet valley bottom (topsoil water storage) leading to a more spatially organized pattern. Our work demonstrated that the wireless sensor network SoilNet is able to capture both short-term and long-term SWC dynamics of spatial SWC patterns. The SWC patterns in the test site varied with depth, catchment wetness, seasonally and in single wetting and drying periods controlled by multiple factors like soil properties, topography, climate forcing, antecedent catchment wetness, vegetation and groundwater.