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A soil moisture network in Switzerland: Analyses from the Swiss Soil Moisture Experiment

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Soil moisture is an essential terrestrial variable as it strongly affects land-surface fluxes with consequent impact on runoff generation, temperature, and evapotranspiration. Measurements of soil moisture are crucial to investigate processes in hydrology as well as in climate and environmental science. However, soil moisture is still not routinely measured and there is a lack of observations in many parts of the world. Within the Swiss Soil Moisture Experiment (SwissSMEX, www.iac.ethz.ch/url/research/SwissSMEX) the large-scale and long-term SwissSMEX soil moisture network was established in 2008/2010 in Switzerland. The network has a spatial extent of about 150x210 km and consists of overall 19 sites at 17 different locations, including 14 grassland, 4 forest, and 1 arable land site. For each site measurements of soil moisture and soil temperature down to 120 cm, as well as detailed information about the topography, soil characteristics, and the main meteorological variables are available. The analyses conducted using the SwissSMEX soil moisture data set provide helpful insights on the performance of soil moisture sensors, distinction in soil moisture behavior across different land covers, as well as on the spatio-temporal dynamics of soil moisture.

Here we present the design of the SwissSMEX soil moisture network as well as an overview on the analyses based on the developed data set. As for any measurements the performance of the sensor is important, we will focus on the evaluation of the applied capacitance-based 10HS (Decagon Devises, United States) soil moisture sensor. Its measurements agreed well for low volumetric water contents using both laboratory and field measurements. A considerable limitation is found in the decreasing sensitivity of sensor reading for volumetric water contents variations above 0.4 m3/m3. In addition, the applicability of a laboratory calibration function is limited due to a dependency of the sensor on soil characteristics. However, with site-specific calibration functions the measurement error of the 10HS sensor can be decreased and the day-to-day variability of soil moisture is captured (Mittelbach et al., 2011). Furthermore, we present a comparison of soil moisture recession over grassland and nearby forest sites with consequent impact on evapotranspiration, as well as on the spatio-temporal variability of soil moisture within the network using 14 grassland sites (Mittelbach et al. 2012).

Reference:
Mittelbach, H., F. Casini, I. Lehner, A.J. Teuling, and S.I. Seneviratne, 2011: Soil moisture monitoring for climate research: Evaluation of a low-cost soil moisture sensor in the framework of the Swiss Soil Moisture Experiment (SwissSMEX). Journal of Geophysical Research, 1616, D05111.

Mittelbach, H. and S.I. Seneviratne, 2012: A new perspective on the spatio-temporal variability of soil moisture: Temporal dynamics versus time invariant contributions. Submitted to HESS.