EGU2020-347, updated on 04 Aug 2021
https://doi.org/10.5194/egusphere-egu2020-347
EGU General Assembly 2020

Investigating spatio-temporal variability of soil moisture in a small farmland: from point to catchment scale

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Many studies in recent years have focused on spatio-temporal variability of soil moisture and its value in hydrology and agriculture. The highly dynamic of soil moisture is controlled by soil properties, topography, landuse, climate conditions, and anthropogenic impacts. However, the understanding of soil moisture dynamics is limited by measurement restrictions. The aim of this study is to analyse spatio-temporal patterns of soil moisture using various soil moisture monitoring techniques and numerical modelling approaches that have been developed for application at differing scales at the Nucice experimental catchment (0.53 km^2), which is located just outside of Prague, the Czech Republic.

The experimental catchment is dominated by agricultural activities. To identify spatio-temporal patterns in the catchment, we have implemented shallow soil moisture measurements at point-scale, hillslope-scale, and catchment-scale. We have deployed FDR (frequency domain reflectometry) sensors at different depths for point-scale measurements. The monitoring of hillslope-scale and catchment-scale have been mostly accomplished by field surveys with HydroSense II sensors. Subsequently, we have applied geostatistical analyses (Kriging and inverse distance weighting interpolation) for the measured soil moisture data to discover spatial patterns in soil moisture across the catchment. Besides, numerical models Hydrus (1D and 2D), MIKE-SHE, and SWAT have been set up at this study site. These models have been calibrated with event-based data and soil moisture measurements, which present a better image of the hydrological processes and spatio-temporal dynamics of soil moisture at various scales. The modelling outcomes have not only fit agreeably with the observed discharge and the temporal dynamics of soil moisture but have also identified wet zones along hillslopes.

Further research will intensify the soil moisture monitoring at the catchment-scale by using remote sensing and Comsic-ray soil moisture probes. Also, anthropogenic impacts (e.g. influence of wheel track) should be considered in the modelling approach. Ultimately, we should be able to understand and predict the spatio-temporal dynamics of soil moisture in small scale agricultural catchments under different climate conditions.

This research has been supported by project H2020 No. 773903 SHui, focused on water scarcity in European and Chinese cropping systems.