Geophysical Research Abstracts
Vol. 20, EGU2018-15586, 2018
EGU General Assembly 2018

The role of time-variant soil hydraulic properties on soil water storage and flow: insights from an integrated field and modelling experiment

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In agricultural landscapes, soil hydraulic properties can exhibit large temporal variability due to tillage, weathering, grazing and crop root growth as well as inherent soil variability. Despite a large body of evidence that soil physical properties such as water retention and hydraulic conductivity change over time, few hydrological models account for this potentially very large temporal change. Using data collected at several times during the growing season, from replicated areas in a field experiment exploring the impact of tillage practice on soil physical behaviour, we explore the spatio-temporal impact on modelled soil water storage and flow. The field experiment is a Cambisol with a sandy loam texture that was planted with continuous barley, with tillage treatments of conventional ploughing, reduced tillage and zero tillage. 1D solutions of Richards' equation were used to assess the water storage and fluxes under those varying conditions. Additionally, the modelling work was used to identify thresholds of changes in soil water properties where water dynamics in the soil are impacted by the various tillage practices. Preliminary results show that tillage had limited impact on the monthly water balance in the temperate maritime climate of the experiment, suggesting that changes in the soil properties over time in the upper layer of the soil may not play a major role in water movement for time scales larger than a day. In fact, at the sub-daily time scale, large peaks of infiltration or soil evaporation may occur, depending on the timing and intensity of related climatic events. We are currently extending this work to consider a range of soil types and different climates. It is anticipated that the importance of spatio-temporal variability will be much greater in regions with greater climatic extremes, such as sub-tropical regions where monsoonal rainfall may follow long dry periods.