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Implementing a physical soil water flow model with minimal soil characteristics and added value offered by surface soil moisture measurements assimilation.

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Soil moisture is a key variable for many soil physical and biogeochemical processes. Its dynamic results from water fluxes in soil and at its boundaries, as well as soil water storage properties. If the water flows are dominated by diffusive processes, modelling approaches based on the Richard's equation or the Philip and de Vries coupled heat and water flow equations lead to a satisfactory representation of the soil moisture dynamic. However, It requires the characterization of soil hydraulic functions, the initialisation and the boundary conditions, which are expensive to obtain. The major problem to assess soil moisture for decision making or for representing its spatiotemporal evolution over complex landscape is therefore the lack of information to run the models. The aim of the presentation is to analyse how a soil moisture model can be implemented when only climatic data and basic soil information are available (soil texture, organic matter) and what would be the added of making a few soil moisture measurements. We considered the field scale, which is the key scale for decision making application (the field being the management unit for farming system) and landscape modelling (field size being comparable to the computation unit of distributed hydrological models). The presentation is limited to the bare soil case in order to limit the complexity of the system and the TEC model based on Philip and De Vries equations is used in this study.
The following points are addressed:
o the within field spatial variability. This spatial variability can be induced by the soil hydraulic properties and/or by the amount of infiltrated water induced by water rooting towards infiltration areas. We analyse how an effective parameterization of soil properties and boundary conditions can be used to simulate the field average moisture.
o The model implementation with limited information. We propose strategies that can be implemented when information are limited to soil texture and climatic data. The strategy takes profit of all work made on soil texture as a proxi of soil hydraulic through pedotransfer functions. It also takes into account the constraints in soil moisture variations after important precipitation events. Performances on soil moisture are assessed by considering both the soil moisture accuracy and the ability of detecting a soil moisture threshold.
o The added value of soil moisture measurements. The aim is to evaluate to which extent we can improve soil moisture simulations by assimilating a few soil moisture measurements made in the surface layer (ploughed layers). We focus on such a layer since moisture can be derived from remote sensing observations or by using in situ sensors (capacitance sensor, TDR) with minimal effort. The validity of such measurements to represent the soil moisture at the field scale is analysed. It is shown that relative variations in soil moisture are much easier to obtain than an absolute characterisation of the soil moisture measurements. We evaluate the value of assimilating surface measurement in the TEC model and how we can deal with a measurement of relative soil moisture variations (in order to prevent a tedious calibration process). Again the performances of the approach are evaluated with the soil moisture accuracy and the ability of detecting a soil moisture threshold.