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Temporal and spatial variability of soil hydraulic properties with implications on soil moisture simulations and irrigation scheduling

Mouna Feki, Giovanni Ravazzani, and Marco Mancini
Politecnico di Milano, Department of Civil and Environmental Engineering, Milano, Italy

The increase in consumption of water resources, combined with climate change impacts, calls for new sources of water supply and/or different managements of available resources in agriculture. One way to increase the quality and quantity of agricultural production is using modern technology to make farms more “intelligent”, the so-called “precision agriculture” also known as ‘smart farming’. To this aim hydrological models play crucial role for their ability to simulate water movement from soil surface to groundwater and to predict onset of stress condition. However, optimal use of mathematical models requires intensive, time consuming and expensive collection of soil related parameters. Typically, soils to be characterized, exhibit large variations in space and time as well during the cropping cycle, due to biological processes and agricultural management practices: tillage, irrigation, fertilization and harvest. Soil properties are subjected to diverse physical and chemical changes that lead to a non-stability in terms of water and chemical movements within the soil and to the groundwater as well. The aim of this study is to assess the variability of soil hydraulic properties over a cropping cycle. The study site is a surface irrigated Maize field located in Secugnago (45[U+25E6]13’31.70” N, 9 [U+25E6]36’26.82 E), in Northern Italy-Lombardy region. The field belongs to the Consortium Muzza Bassa Lodigiana, within which meteorological data together with soil moisture were monitored during the cropping season of 2015. To investigate soil properties variations, both measurements in the field and laboratory tests on both undisturbed and disturbed collected samples were performed. Soil samples were taken from different locations within the study area and at different depths (surface, 20cm and 40cm) at the beginning and in the middle of the cropping cycle and after the harvest. During three measuring campaigns, for each soil samples several parameters were monitored (Organic matter, bulk density) together with soil hydraulic parameters. Soil water retention curves parameters were measured following the evaporation method, using the HYPROP-device (Hydraulic Property Analyzer; UMS Munich, 2010). The saturated hydraulic conductivity was measured in the laboratory using KSAT-UMS falling head method. Results show that soil properties, often considered as static within hydrological models simulations are subjected to significant changes, with implications on infiltration and soil moisture movement modeling, and prediction on stress condition that is fundamental for irrigation scheduling.