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Generalized Structure Function applied to Soil Water Content during surface and subsurface drip irrigation in a loamy soil.

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The spatial variability of soil water content (SWC) and its temporal evolution are two essential factors to optimize the irrigation efficiency. This work presents an application of the Generalized Structure Function (GSF) to analyse the SWC evolution during two types of drip irrigation: surface and subsurface. In this way, we will compare both types of irrigation.

The GSF has been normally applied on time series. In our context we have used is on transect series of SWC measured at two different soil depth and at different times. From this type of analysis, two parameters are calculated: Hurst Index (HI) and Multifractality (DH). A set of experimental runs were performed in two irrigated plots with either surface or subsurface drip irrigation. SWC was estimated through the cumulative temperature (T_{cum}) from a Distributed Temperature Sensor (DTS) recordings aided by the Active Heated Fiber Optic (AHFO) technique. The fiber optic cable was deployed at 5 and 25 cm underneath the soil in both plots. Soil was a loamy sand textures (77% sand, 16% loam and 7% clay), 982 $kg \cdot m^{-1}$ bulk density, 3.67 $mm \cdot min^{-1}$ saturated hydraulic conductivity and 62% porosity.

The SWC evolution during the experiments in subsurface irrigation presented an HI around 0.50 (random) and more constant than in surface irrigation. The spatial and temporal variability of data revealed a HI>0.50 (persistent character) at the upper layer of the surface irrigated plot caused by the unequal distribution of ponded water around certain emitters and a subsequent anti-persistent character (HI<0.50) at the bottom because of the heterogeneous infiltration. The DH values estimated from surface irrigated plot with wider variation range that those from subsurface irrigated and greater similarity between both depths in the subsurface irrigated plot.

The results are discussed from an agronomic point of view providing an insight into the required adaptation of both irrigation water depths and frequency to avoid water loss in either surface or subsurface irrigation systems.