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Evaluation of stem-flow effect on soil moisture distribution by an infiltration model: a method for sprinkler irrigation efficiency estimation improvement

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The reduction of precipitation amounts as well as the increase of air temperatures are expected to enhance water scarcity problems. In this context the calculation irrigation efficiencies becomes an important issue to understand how different irrigation systems are affecting water distribution patterns on the soil profile. In particular, in sprinkler irrigation crop canopies cause the stem-flow phenomenon that strongly influence the spatial soil water storage.
In order to study this topic a comparative analysis between self moving big gun and pivot sprinkler irrigation systems was carried out. The objective of this work is to obtain a detailed representation of the soil water distribution accounting for the spatial variability due to the stem-flow effect in maize (Zea mays L.) cultivations.
The soil water infiltration process was modelled by means of a software that simulates the two-dimensional infiltration process by solving the Richard's equation. Soil hydraulic field-scale parameters, needed to run the simulations, were determined from TDR (Time Domain Reflectometry) measurements and pedotransfer functions. Soil water contents were measured at different depths by TDR probes installed below maize rows and inter-rows. Watering volumes and flow rates were also monitored. Finally, measured water contents data were used to test and to calibrate the simulations.
The proposed method allow a better estimation of the amount of water actually stored during an irrigation event in the root layer, hence leading to a more accurate irrigation efficiencies calculation.