Soil moisture drydown curves after flooding events across an irrigated farmland

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Abstract

Soil moisture (θ) is a key variable for agriculture, however a gap remains in observations at intermediate scales, the cosmic-ray neutron sensor (CRNS) is a novel tool for such applications. We designed an experiment using a CRNS and time domain reflectometry (TDR at vegetated and bare soil sites) to measure θ in the Yaqui Valley, where wheat (*Triticum spp*) is the main crop and water is managed by flooded irrigation. We used a drydown analysis of the daily rate at which θ is lost (θ_{decay}) after every irrigation, and the amount of θ that represents 1/3 of the remaining θ as soil dries ($\theta_{threshold}$). Statistical analysis included multivariate correlations (Spearman) and a principal components analysis (PCA) using θ , meteorological variables, and vegetation greenness. With TDR's we observed differences in θ_{decay}, it was higher at the vegetation site θ_{decay}= 0.53 cm3/cm3 /day, while $\theta_{threshold}$ was higher at bare soil site 0.33 cm3/cm3. The θ_{decay} observed with the CRNS was higher for the 2nd and 3rd irrigation (0.7 cm3/cm3 /day and 0.16 cm3/cm3 /day, respectively). After each irrigation, the meteorological variables correlated with θ varied, highlighting air temperature (T_{air}, r=-0.7) in the 1st irrigation, evapotranspiration (ET, r>0.5) and vapor pressure deficit (VPD, r=0.6, r=-0.8) for the 2nd and 3rd irrigation, and normalized difference vegetation index (NDVI, r=0.8) for the 3rd irrigation. The variation explained by PC1 and PC2 increases with each irrigation event, relevant variables in PCA where θ, T_{air}, VPD, NDVI, and precipitation. The results of this study suggest that CRNS is a suitable technique at field scale and that drydown curves are useful to quantify soil dryness and the influence of meteorological variables and crop development, thus providing an opportunity for water management in agriculture.