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Understanding the spatio-temporal variability of soil moisture by integrating cosmic-ray neutron probes with SoilNet wireless sensor netwoks under a seasonal Mediterranean-climate regime

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A Critical Zone Observatory (CZO) was recently established in the Alento River Catchment (ARC; southern Italy) within the TERENO (TERrestrial ENvironmental Observatories) long-term ecosystem infrastructure network. In 2016 SoilNet wireless sensor networks and cosmic ray neutron probes (CRNP) were installed in the upper part of this catchment and specifically in two experimental sub-catchments (MFC2 and GOR1) characterized by different topographic, pedological, land-use, and weather conditions. The Soilnet end-devices are monitoring soil moisture and matric potential at two different soil depths (15 cm and 30 cm) in 20 locations around the cosmic ray neutron probe. We evaluated the the relationship between Soil Moisture Index (SMI) and rainfall deficits (considered as rainfall minus potential evapotranspiration) at monthly time scale. The cropland site on the south-facing hillslope of ARC is characterized by more extreme dry and wet conditions. Another goal is to identify the dominant controls that most govern the spatial soil moisture patterns in these two different sites. The relationship between the CRNP-based soil moisture and spatial variability of SoilNet-based soil moisture is nearly linear in the case of the cropland site (MFC2) but follows a fairly concave curve in the case of the forestland site (GOR1). The majority of the spatial variance in MFC2 is explained by terrain attributes, i.e. slope-induced during wet conditions and aspect-induced during dry conditions. In GOR1 the spatial variance of soil moisture data is mostly explained by topographic factors under wet conditions during the rainy season. In both sites the soil texture is able to explain only less than 10% of spatial variability of soil moisture data.