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Local and non-local controls of temporal stability of water content in the sandy soils of the Doñana National Park, SW Spain

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Temporal stability of soil water content (TS SWC) has been observed throughout a wide range of soils and environments. Knowledge of time-stable SWC patterns and their statistical characteristics provides insight into the spatio-temporal dynamics of SWC in an area and can be used to simplify monitoring applications and ultimately infer patterns of soil physical properties. Despite a significant effort to understand and explain the TS SWC phenomenon, little is still known about the factors that control TS SWC in different environments.
Temporal stability of SWC was analyzed in an area nearby the Palacio de Marismillas within the Doñana National Park, SW Spain, where SWC is being monitored since 2008. We focus on three locations that are perpendicularly aligned with the dunes and located at different heights, and where SWC dynamics were found to be spatially related.
The analysis was performed studying normalized SWC data at three depths within the vadose zone (surface, intermediate and deep horizons). Observed differences were carefully analysed, comparing the SWC variations among these three points throughout different hydrological years.
Results show that SWC dynamics are not affected by topography or rainfall depth and frequency, as water content variations are produced only at specific moments of the year at specific depths. The erratic occurrence of precipitation during winter and spring, triggers the SWC variations, while the rainfall depth determines the magnitude of the SWC variations. At one of the three points, pine trees were trimmed during the studied period, causing an increase of the average SWC near the soil surface. The lack of water demand for transpiration produces this increase. Our analysis elucidated the ecohydrological behaviour of this water limited system and showed that vegetation was one of the dominant locally controlling factors of TS SWC.