Soil Moisture Retrievals from Unmanned Aerial Systems (UAS)

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Quantification of the spatial and temporal behavior of soil moisture is vital for understanding water availability in agriculture, ecosystems research, river basin hydrology and water resources management. Unmanned Aerial Systems (UAS) offer a great potential in monitoring this parameter at sub-meter level and at relatively low cost. The standardization of operational procedures for soil moisture monitoring with UAS can be beneficial to understanding and quantify the quality of retrieved soil moisture (e.g., from different platforms and sensors).

In this study, soil moisture retrieved from UAS using different retrieval algorithms was compared to collocated ground measurements. The thermal inertia model builds upon the dependence of the thermal diffusion on soil moisture. The soil thermal inertia is quantified by processing visible and near-infrared (VIS-NIR) and thermal infrared (TIR) images, acquired at two different times of a day. The temperature–vegetation trapezoidal model is also used to map soil moisture over vegetated pixels. This trapezoidal model depicts the soil moisture dependence of the surface energy balance. The comparison of the two algorithms helps define a preliminary standard procedure for retrieving soil moisture with UAS.
As a case study, a typical cropland area with olive orchard, cherry and walnut trees in the region of Monteforte Cilento (Italy, Salerno) is used, where optical and thermal images and in situ data were simultaneously acquired. In the Alento observatory, long-term studies on vadose zone hydrology have been conducting across a range of spatial scales. Our findings provide an important contribution towards improving our knowledge on evaluating the ability of UAS to map soil moisture, in support of sustainable natural resources management and climate change studies.

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