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Title: Mapping hydric status within a Mediterranean vineyard region: implication for validation, modeling and digital soil mapping.

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As an influence factor for topsoil and root zone moisture, daily Evapo-Transpiration (ET) contains valuable information for i) characterizing the hydrological cycle in relation to land surface boundary conditions, ii) forecasting vine production in relation to water stress at different growth stages, and iii) digitally mapping soil properties in relation to subsurface water transfers. We address here the mapping of daily ET at the regional extent over a vineyard watershed, by focusing on i) the validation exercise at the regional extent, ii) the remote sensing approaches to be considered over a row structured complex landscape, and iii) the informative value of daily ET for the digital mapping of soil properties. The study area is the 70 sq-km size Peyne watershed, located in southern France Languedoc-Roussillon region. The experiment spread over two vine growth cycles in 2007 and 2008.

The validation exercise is conducted at seven sites disseminated within the watershed, to capture spatial and temporal variations. In-situ daily ET is estimated from the HYDRUS-1D model that simulates water transfers within the vadoze zone. This allows to minimize experimental efforts, since the required observations can be collected automatically (meteorological forcing) or manually with a three week frequency (soil moisture profile and watertable level). HYDRUS-1D simulations are controlled through i) the residual error on model calibration against soil moisture profiles within all sites, and ii) the differences in daily ET against Eddy Covariance estimates within two contrasted sites. The results, about 10% in relative for temporal changes in soil water storage, and between 0.4 and 0.6 mm/day for daily ET, emphasize the relevance HYDRUS-1D simulations as ground truthing.

Given the complex parameterization to be implemented if considering a two source model that splits soil and vegetation, daily ET is derived from ASTER observations by using surface temperature differencing that minimizes data and parameterization errors. We select i) S-SEBI that relies on temperature differences and albedo only, thus avoiding delicate computations, and ii) WDI that refines the temperature differencing through the use of physical formulations rather than contextual estimates. Validation over the seven sites for 20 ASTER scenes indicates performances slightly better for S-SEBI (0.8 mm/day) than WDI (1.1 mm/day), whereas model intercomparison at the watershed extent showed differences about 1 mm/day. Sensitivity studies indicates S-SEBI is sensitive to the study area extent and WDI is sensitive to wind speed, with similar magnitudes (40% in relative). In both cases, sensitivity originates in the derivation of evaporative extremes for temperature differencing.

Regardless of differencing approach, the obtained maps of daily ET depict similar patterns throughout the experiment. We therefore assess to use of daily ET and Vegetation Indexes (VIs) as proxies of vine access to groundwater, where the latter is characterized by soil depth and watertable level, both highly variable within the Peyne watershed. ET and VI proxies are considered through temporal changes induced by water stress and vegetation growth. Additional proxies based on topography are also considered, to account for pedogenesis. Data mining with a classification and regression tree approach indicates two overlapping populations for daily ET, which relate to indirect or direct vine access to groundwater. VIs and ET provided a reasonable fit for soil depth ($r^2 = 0.53$) but inclusion of terrain attributes improves the fit ($r^2 = 0.90$). Directly modelling the watertable level is unsuccessful because of cross interactions. When watertable is accessible, it is not possible to identify any combination between i) shallow watertable with a shallow or deep soil or ii) deep soil and deep watertable.