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Fusion of Sentinel 2 and 3 imagery for estimating heat fluxes in a vineyard in California: The ESA's Sentinels for Evapotranspiration (SEN-ET) project

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The combined use of Sentinel 3 and 2 constellation of satellites provides a unique opportunity for providing operational estimates of actual evapotranspiration. Sentinel 3 SLSTR instrument acquires daily thermal infrared (TIR) information of the surface at 1 km scale. However, the reliable estimation of evapotranspiration in agricultural and heterogeneous landscapes requires that the model's spatial resolution matches the dominant landscape feature scale, usually tens or hundreds of meters. Sentinel 2 lacks a TIR instrument but carries an optical sensor with a spatial resolution ranging from 10 to 60 m and 5 day revisit time with Sentinel 2A & B satellites combined, which can resolve part of these scaling issues. Even though a number of satellite mission concepts are (or have been) proposed, a high-resolution TIR satellite mission which could act as a companion to the high-resolution optical Sentinel-2 satellites is not expected to be launched within the closest number of years. Therefore sharpening and/or disaggregation methods are required to bridge the spatial gap between the currently available Sentinel constellation's thermal and optical observational capabilities, in order to optimally exploit the synergies of both types of sensors for field-scale ET estimations.

For that purpose, the Sentinels for Evapotranspiration project (SEN-ET) project aims to develop an open source software application incorporating Sentinel-2 and Sentinel-3 data into accurate and operational modelling of instantaneous evapotranspiration at tens of meters scale. After a comprehensive model literature review, the SEN-ET project is implementing three remote sensing ET and two thermal sharpening methods, and testing these models against eddy covariance towers over different climates and vegetation types, such as croplands, savannahs, grasslands and forests. In this work we show the results for one pair of the candidates models, Two-Source Energy Balance (TSEB) ET model with Data Mining Sharpening method for increasing spatial resolution of temperature observations, in two adjacent vineyards in California for 2017. The spatial distribution of sharpened temperature and disaggregated fluxes at Sentinel 2 scale is also evaluated using Landsat 8 thermal imagery on specific dates. In addition the effect on ET estimates of modelling specific wind attenuation and radiation transmission present in this type of crops is also evaluated, showing the importance of accounting for these processes under row-structure crops