EGU21-12870
https://doi.org/10.5194/egusphere-egu21-12870
EGU General Assembly 2021

Scale analysis of evapotranspiration estimates from an energy-water balance model and remotely sensed LST

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Remote Sensing (RS) information has progressively found, in recent years, more and more applications in hydrological modelling as a valuable tool for easy and frequent collection of geophysical data. However, this kind of data should be handled carefully, minding its characteristics, spatial resolution and the heterogeneity of the target area.

In this work, a scale analysis on evapotranspiration estimates over heterogeneous crops is performed combining a distributed energy-water balance model (FEST-EWB) and high-resolution remotely-sensed Land Surface Temperature (LST) and vegetation data.

The FEST-EWB model is calibrated on measured LST, based on a procedure where every single pixel is modified independently one from the other; hence in each pixel of the analysed domain the minimum of the pixel difference between modelled RET and satellite observed LST is searched over the period of calibration.

The case study is a Sicilian vineyard, with test dates in the summer of 2008. Meteorological and energy fluxes data are available from an eddy-covariance station, while LST and vegetation data are obtained from low-altitude flights at the high resolution of 1.7 metres.

After a preliminary calibration on LST data and validation on energy fluxes, the scale analysis is performed in two ways: model input aggregation and model output aggregation. Four coarser scales are selected in reference to some common satellite products resolution: 10.2 m (in reference to Sentinel's 10 m), 30.6 m (Landsat, 30 m), 244.8 m (MODIS visible, 250 m) and 734.4 m (MODIS, 1000 m). First, modelled surface temperature and evapotranspiration are aggregated to each scale by progressive averaging. Then, model inputs are upscaled to the same spatial resolutions and the model is calibrated anew, obtaining independent results directly at the target scale.

The results of the two procedures are found to be quite similar, testifying to the capacity of the model to provide accurate products for a heterogeneous area even at low resolutions. The robustness of the analysis is strengthened by a further comparison with two well-established energy-balance algorithms: the one source Surface Energy Balance Algorithm for Land (SEBAL) and the Two-Source Energy Balance (TSEB) model.