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Towards high temporal and moderate spatial resolutions in the remote sensing retrieval of evapotranspiration by combining geostationary and polar orbit satellite data

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Evapotranspiration (ET) is the water flux going from the surface into the atmosphere as result of soil and surface water evaporation and plant transpiration. It constitutes a key component of the water cycle and its quantification is of crucial importance for a number of applications like water management, climatic modelling, agriculture monitoring and planning, etc. Estimating ET is not an easy task; specially if large areas are envisaged and various spatio-temporal patterns of ET are present as result of heterogeneity in land cover, land use and climatic conditions. In this respect, spaceborne remote sensing (RS) provides the only alternative to continuously measure surface parameters related to ET over large areas.

The Royal Meteorological Institute (RMI) of Belgium, in the framework of EUMETSAT's "Land Surface Analysis-Satellite Application Facility" (LSA-SAF), has developed a model for the estimation of ET. The model is forced by RS data, numerical weather predictions and land cover information. The RS forcing is derived from measurements by the Spinning Enhanced Visible and Infrared Imager (SEVIRI) onboard the Meteosat Second Generation (MSG) satellite.

This ET model is operational and delivers ET estimations over the whole field of view of the MSG satellite (Europe, Africa and Eastern South America) (http://landsaf.meteo.pt) every 30 minutes. The spatial resolution of MSG is 3 x 3 km at subsatellite point and about 4 x 5 km in continental Europe.

The spatial resolution of this product may constrain its full exploitation as the interest of potential users (farmers and natural resources scientists) may lie on smaller spatial units. This study aimed at testing methodological alternatives to combine RS imagery (geostationary and polar orbit satellites) for the estimation of ET such that the spatial resolution of the final product is improved. In particular, the study consisted in the implementation of two approaches for combining the current ET estimations with RS data containing information over vegetation parameters and captured by polar orbit spaceborne sensors.

The first tested approach consisted in forcing the operational ET algorithm with RS measurements obtained from a moderate spatial resolution sensor. The variables with improved spatial resolution were leaf area index and albedo. Other variables of the model remained unchanged with respect to the operational version. In the second approach, a two phases procedure was implemented. Firstly, a preliminary approximation of ET was obtained as a function of solar radiation, air temperature and a vegetation index. The value was then statistically adjusted on the basis of the ET estimations by the operational algorithm.

The results of implementing the different approaches were tested against eddy covariance ET derived from measurements in Fluxnet towers spread across Europe and representing different landscape characteristics. The analysis allowed the identification of pros and cons of the tested methodological approaches as well as their performance in different land cover arrangements.