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Daily evapotranspiration at sub-kilometre resolution through surface energy balance modelling and Random Forest-based downscaling

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Evapotranspiration (ET) is the flux of water from the Earth's surface into the atmosphere. This water flux results from water evaporation and plant respiration and its estimation is required for a number of applications as it provides valuable information on the water cycle and the Earth's surface energy balance.

The Royal Meteorological Institute of Belgium (RMI) has developed - in the framework of the EUMETSAT's LSA-SAF initiative - an operational service for estimating ET in near-real time (http://lsa-saf.eumetsat.int). This product adopts the extent and spatial resolution of the observations by the SEVIRI sensor onboard the Meteosat Second Generation (MSG) satellite. The high temporal resolution of the LSA-SAF ET product is a big asset as it captures diurnal ET patterns. The spatial resolution, however, can still be too coarse for applications over non-homogeneous areas. In this respect, further research is on-going at the RMI to evaluate the opportunities given by recent satellite-derived products to enhance the spatial detail of ET estimates.

This work explored the use of data derived from the Proba-V satellite in the estimation of ET. The target spatial resolutions were those of Proba-V grids: $\sim$1 km and $\sim$300 m and the target product was daily ET. The procedure consisted in, first, running an energy balance model (based on the algorithm driving the LSA-SAF ET product) at $\sim$1 km spatial resolution. The model was forced by meteorological variables taken from ECMWF forecasts, downwelling radiation terms taken from LSA-SAF radiation products, a number of land cover-related parameters and seasonal vegetation patterns derived from Proba-V LAI. In a second phase, the obtained results were further downscaled to the $\sim$0.3 km Proba-V grid by training and implementing a Random Forest model.

The study was conducted over the upper Biebrza catchment in Poland, a protected wetland site with diverse land cover types: forests, crops, pasture, etc. The daily ET estimated were compared with validation ET estimated derived from flux tower measurements. The time series of modelled ET at both resolutions exhibited a great degree of agreement when compared to the validation data series.