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Use of geostationary satellite imagery in optical and thermal bands for the estimation of soil moisture status and land evapotranspiration

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For water and agricultural management, there is an increasing demand to monitor the soil water status and the land evapotranspiration. In the framework of the LSA-SAF project (http://landsaf.meteo.pt), we are developing an energy balance model forced by remote sensing products, i.e. radiation components and vegetation parameters, to monitor in quasi real-time the evapotranspiration rate over land (Gellens-Meulenberghs et al, 2007; Ghilain et al, 2008). The model is applied over the full MSG disk, i.e. including Europe and Africa. Meteorological forcing, as well as the soil moisture status, is provided by the forecasts of the ECMWF model. Since soil moisture is computed by a forecast model not dedicated to the monitoring of the soil water status, inadequate soil moisture input can occur, and can cause large effects on evapotranspiration rates, especially over semi-arid or arid regions. In these regions, a remotely sensed-based method for the soil moisture retrieval can therefore be preferable, to avoid too strong dependency in ECMWF model estimates.

Among different strategies, remote sensing offers the advantage of monitoring large areas. Empirical methods of soil moisture assessment exist using remotely sensed derived variables either from the microwave bands or from the thermal bands. Mainly polar orbiters are used for this purpose, and little attention has been paid to the new possibilities offered by geosynchronous satellites. In this contribution, images of the SEVIRI instrument on board of MSG geosynchronous satellites are used. Dedicated operational algorithms were developed for the LSA-SAF project and now deliver images of land surface temperature (LST) every 15-minutes (Trigo et al, 2008) and vegetations indices (leaf area index, LAI; fraction of vegetation cover, FVC; fraction of absorbed photosynthetically active radiation, FAPAR) every day (Garcia-Haro et al, 2005) over Africa and Europe. One advantage of using products derived from geostationary satellites is the close monitoring of the diurnal variation of the land surface temperature. This feature reinforced the statistical strength of empirical methods. An empirical method linking land surface morning heating rates and the fraction of the vegetation cover, also known as a 'Triangle method' (Gillies et al, 1997) is examined. This method is expected to provide an estimation of a root-zone soil moisture index. The sensitivity of the method to wind speed, soil type, vegetation type and climatic region is explored. Moreover, the impact of the uncertainty of LST and FVC on the resulting soil moisture estimates is assessed.

A first impact study of using remotely sensed soil moisture index in the energy balance model is shown and its potential benefits for operational monitoring of evapotranspiration are outlined.

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