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Increasing accuracy of daily evapotranspiration through synergistic use of MSG and MERIS/AATSR

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Daily Evapotranspiration estimates are important in many applications. Evapotranspiration plays a significant role in the water, energy and carbon cycles. Through these cycles evapotranspiration is important for monitoring droughts, managing agricultural irrigation, and weather forecast modeling. Drought levels and irrigation needs can be calculated from evapotranspiration because evapotranspiration estimates give a direct indication on the health and growth rate of crops. The evaporation of the soil and open water bodies and transpiration from plants combine as a lower forcing boundary parameter to the atmosphere affecting local and regional weather patterns.

Evapotranspiration can be estimated using different techniques: ground measurements, hydrological modeling, and remote sensing algorithms. The first two techniques are not suitable for large scale estimation of evapotranspiration. Ground measurements are only valid within a small footprint area; and hydrological modelling requires intensive knowledge of a too large amount of processes. The advantage of remote sensing algorithms is that they are capable of estimating the evapotranspiration over large scales with a limited amount of parameters.

In remote sensing a trade off exists between temporal and spatial resolution. Geostationary satellites have high temporal resolution but have a low spatial resolution, where near-Polar Orbiting satellites have high spatial resolution but have low temporal resolution.
For example the SEVIRI sensor on the Meteosat Second Generation (MSG) satellite acquires images every 15 minutes with a resolution of 3km, where the AATSR/MERIS combination of the ENVISAT satellite has a revisit time of several days with a 1km resolution. Combining the advantages of geostationary satellites and polar-orbiting satellites will greatly improve the accuracy of the daily evapotranspiration estimates.

Estimating daily evapotranspiration from near-polar orbiting satellites requires a method to extrapolate the instantaneous estimates to daily values. In the Surface Energy Balance System (SEBS) algorithm the SEBI method is used. The method introduced an evaporative fraction that provides information on water-limiting cases for evapotranspiration. SEBS calculates the daily evapotranspiration assuming like many other researches the evaporative fraction constant per day. However recent investigations have shown that this is only valid in certain cases, and that in particular scenarios the evaporative fraction has a diurnal cycle.

The objective of this research is to improve the accuracy of the daily evapotranspiration estimates through the synergistic use of MSG and AATSR/MERIS. The research investigates the methodology of coupling the two evaporative fractions in order to merge high temporal and high spatial resolution data.

In order to extrapolate the instantaneous evapotranspiration estimates, the diurnal evaporative fraction from the geostationary satellite is coupled to the instantaneous high resolution spatial resolution of the AATSR/MERIS. The result of this coupling is a evapotranspiration map with high-temporal and high-spatial resolution. Also the comparison of instantaneous evapotranspiration by MSG and AATSR/MERIS creates a method for quantifying objectively the uncertainty in the evapotranspiration estimates.