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Estimation of daily evapotranspiration over Africa using MODIS/Terra and SEVIRI/MSG data

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ABSTRACT

Most existing remote sensing-based evapotranspiration (ET) algorithms rely exclusively on polar-orbiting satellites with thermal infrared sensors, and therefore the resulting ET values represent only “instantaneous or snapshot” values. However, daily ET is more meaningful and useful in applications. In this study, daily ET estimates are obtained by combining data from the MODIS sensor aboard the polar-orbiting Terra satellite and the SEVIRI sensor aboard the geostationary-orbiting MSG satellite. The procedure consists of estimating the instantaneous evaporative fraction (EF) based on the MODIS/Terra land data products, and estimating the daily net radiation and daily available energy based on the 30-min SEVIRI/MSG data products. Assuming constant EF during the daytime, daily ET is estimated as the product of the SEVIRI/MSG-based daily available energy and MODIS/Terra-based instantaneous EF. The daily ET estimates are evaluated against flux tower measurements at four validation sites in Africa. Results indicate that the synergistic use of SEVIRI/MSG and MODIS/Terra has the potential to provide reliable estimates of daily ET during wet periods when daily ET exceeds 1 mm/day. The satellite-based daily ET estimates however tend to underestimate ET by 13% to 35%. The daily ET estimation algorithm can further be improved by incorporating a temporal data-filling interpolation technique to estimate the unavailable net radiation information during cloudy sky conditions, and by improving the accuracy of the instantaneous EF. The assumption of constant evaporative fraction during the daytime is reasonable, and does not result in substantial errors in the daily ET estimates.