Modeling the angular dependency of Land Surface Temperatures derived from the SEVIRI instrument onboard Meteosat Second Generation Satellites over the African Continent.

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Land surface temperature is a key input variable in many models, including hydrological models, energy-budget models, in plant-stress models and in regional and global circulation models. Further the land surface temperature can be used in conjunction with information on vegetation cover for estimation of evapotranspiration and plant stress monitoring. Most of these applications of land surface temperature data require data with an absolute accuracy of at least +/- 2 degrees. Currently, errors induced by differences in the illumination and viewing geometry are not corrected for in operational LST products as e.g. the LANDSAF MSG LST product and the MODIS LST products. This severely influences the accuracy of the products, and is in most cases not included as a factor in the accuracy assessment. Due to the nature of these effects, the errors can be expected to be largest in areas with moderate tree cover and with high view zenith angles. This study investigates the angular dependency of LST derived from the SEVIRI sensor over the African continent, by using the Modified Geometric Projection (MGP) model adapted to the view and sun geometry of the SEVIRIsensor.

The MGP model was run for three days during 2008; the solstices and at fall equinox. These dates represent the extreme cases of angular variation throughout the year, and should thus provide information on the worst cases of angle-induced errors in the LST-products. The model run was done using synthetic data on the temperatures of the different scene components, as no continental dataset is available. The model was run for all hours of daylight with an interval of 60 minutes over the entire African continent and Madagascar. The model results show differences between LST at nadir observation and LST MSGSEVIRI observation geometry of up to +/- 4 degrees. The biggest differences occur at equinox at noon when the sun is right behind the sensor. Significant differences also occur in areas with moderate tree cover a few hours before and after solar noon. Differences are also generally larger in the mid-morning and mid-afternoon than early morning and late afternoon. The results clearly show that errors introduced by viewing and illumination geometry can not be ignored if an accuracy of +/- 2 degrees is required. The errors depend on vegetation cover and illumination geometry that change over the course of the year. The magnitude of the errors therefore also changes by region and by time of year, limiting the applicability of uncorrected data for seasonal studies.

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