Validation of satellite land surface temperature products using ground-based measurements and heritage satellite data – Protocol, limitations and results

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Land Surface Temperature (LST) products derived from satellite thermal infrared observations provide key information for monitoring Earth surface energy and water fluxes. Because users of satellite products put a high priority on the provision of uncertainty estimates, validation of LST products is of crucial importance for estimating the accuracy of standard products and understanding the potential and limitations of satellite observations.

This work presents different approaches to evaluate quantitative uncertainties in satellite-derived LST products using ground-based measurements and heritage satellite data. For most vegetated landscapes composed of various land cover types or soils, the LST measured by a station at one specific location does not represent the surrounding area that is part of the coarser satellite sensor pixel. Furthermore, depending on illumination and viewing direction configurations, satellites measure different surface radiometric temperatures, especially over sparsely vegetated regions with directionally varying radiometric contributions from soil and vegetation. In addition to comparisons with in situ data, inter-comparisons of satellite LST products provide important quality information regarding the overall consistency between remotely sensed products, as well as characterization of spatio-temporal patterns in the LST differences. Based on multi-sensor analysis, we present the complexity involved in each approach, identify the limitations associated with spatial variability or directional effects, and outline validation protocols.

The satellite data used in this study are from the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument onboard the Suomi - National Polar-orbiting Partnership (Suomi-NPP), the MODerate resolution Imaging Spectrometer (MODIS) instrument onboard Terra and Aqua satellites and from the Spinning Enhanced Visible and Infrared Imager (SEVIRI) onboard the geostationary Meteosat satellite. Field measurements are from NOAA's Surface Radiation (SURFRAD) network and from permanent validation stations operated by Karlsruhe Institute of Technology.

This work is part of the EarthTemp initiative, the main goal of which is to develop more

integrated, collaborative approaches to observing and understanding Earth’s surface temperatures.

References :

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Land surface temperature, remote sensing, ground measurement, validation, scaling

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