Karlsruhe Institute of Technology

The EUMETSAT Network of Satellite Application Facilities
LSA SAF Land Surface Analysis

Institute of Meteorology and Climate Research
Meteorological Satellite Analysis (MSA) Group
http://www.imk-asf.kit.edu/MSA.php

Validation results for Land Surface Temperature

- Assessment with measurements from permanent validation stations -

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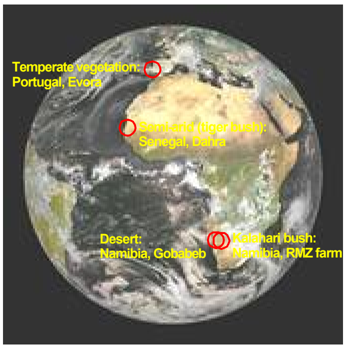


Introduction

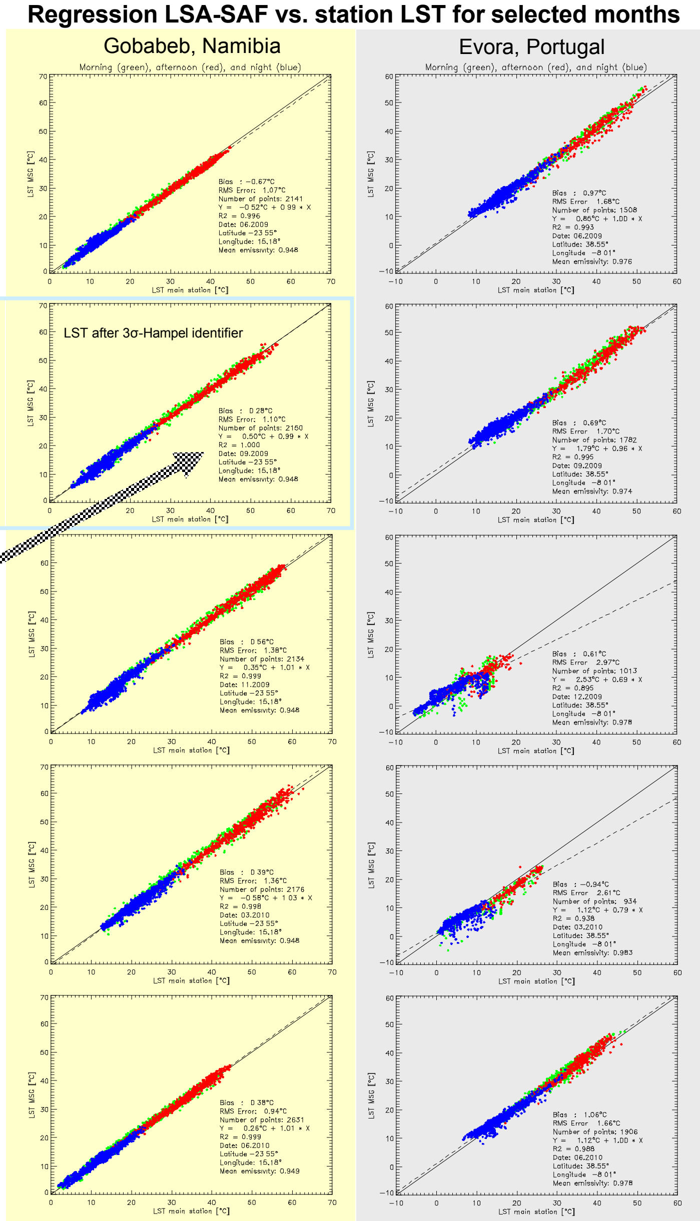
Land surface temperature (LST) is an operational product of the Land Surface Analysis – Satellite Application Facility (LSA-SAF). In order to validate LST products, KIT operates four permanent stations - the only long term LST validation stations within the field of view of the METEOSAT satellites. The validation work is carried out within the scope of LSA-SAF. Here, validation results from KIT-Stations "Gobabeb" and "Evora" are presented. Gobabeb station is located on the gravel plains of the Namib Desert at 405 m asl (Freitas et al., 2010), whereas Evora station is located in a cork-oak tree forest near the town of Evora, Portugal.

The data from September 2008 until September 2010 from Gobabeb are available, with the exception of December 2009. Data from Evora are available since February 2009 and, in a different configuration, since March 2008. Two further stations, "Dahra" (tiger bush, Sahel), Senegal, and "RMZ-Farm" (Kalahari bush), Namibia, were set up to validate LST products in different climates (see poster "*Intercomparison between SEVIRI LST-products and comparison with in situ LST measurements*" by Rasmussen et al.). The validation results demonstrate the excellent quality of the LST product operationally derived by LSA-SAF from MSG/SEVIRI data.

Supported by Eumetsat in the LSA-SAF

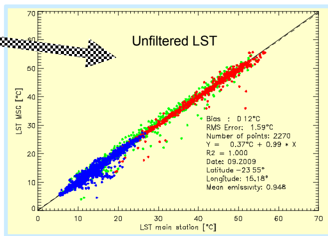
Station LST is determined with Heitronics KT15.85 IIP radiometers (9.6-11.5µm, accuracy ±0.3K); at least one radiometer observes the ground and one the sky. Operational LSA-SAF emissivity is used to derive LST. The colours in the plots for Gobabeb and Evora highlight data from sunrise to noon ("morning"), noon to sunset ("afternoon"), and between sunset and sunrise ("night"). The in-situ data were matched up with actual SEVIRI acquisition times to within one minute. By minimising RMSE between LSA-SAF LST and Evora station LST for August 2009, the fraction of tree cover in SEVIRI's FOV was estimated as 33%; this agrees well with the about 29% tree crown cover (TCC) determined from aerial imagery (Carreiras et al., 2006).

Regression LSA-SAF vs. station LST for selected months



Filtering

Linear regression of LSA-SAF LST vs. Gobabeb station LST for September 2009. The small bias & RMSE and the high coefficient of determination R^2 demonstrate the excellent quality of the SAF LST. However, there are clearly some cold outliers of SAF LST. The cold outliers are assumed to be caused by undetected clouds: they were removed with the "3-σ Hampel identifier", a filtering algorithm which uses robust estimates of mean and standard deviation to identify outliers.



The bias of the filtered Gobabeb data is slightly increased, but RMSE is reduced by 0.49 °C. In summer (Jan, Feb), RMSE can increase up to 3°C, but bias remains low. This is due to frequent undetected small clouds in the LSA-SAF and the station data.

Results

- RMSE below 1.5°C (Gobabeb) and 1.7°C (Evora)
- Bias generally below 1°C at both stations
- Slopes of linear regressions generally close to 1.0
- SAF algorithm tends to overestimate high LST

References:
Carreiras, J.M.B, Pereira, J.M.C., and Pereira, J.S., 2006. Estimation of tree canopy cover in evergreen oak woodlands using remote sensing. For. Ecol. Manage. 223, 45-53.
Freitas, S.C., Trigo, I.F., Bioucas-Dias, J.M., and Göttsche, F., 2010. Quantifying the Uncertainty of Land Surface Temperature Retrievals from SEVIRI/Meteosat. IEEE Trans. Geosci. Remote Sens. 48(1), 523-534.

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