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
www.imk-asf.kit.edu/MSA.php

Validation of Land Surface Temperature Products and Site Characterisation with Ground Based Radiometric Measurements

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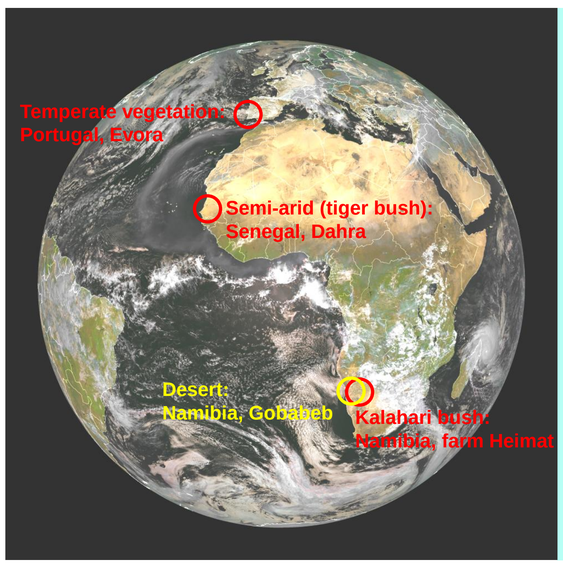

Land surface temperature (LST) is an operational product of the Land Surface Analysis Satellite Application Facility (LSA SAF). As a contribution to LSA SAF, KIT operates four long term LST validation stations within the field of view of the METEOSAT satellites (left figure). Validation of LST and Land Surface Emissivity (LSE) is complicated by the spatial scale mismatch between satellite sensors and ground based sensors: ground radiometers observe a few m^2, whereas satellite TIR measurements typically integrate over 1 to 100 km^2 (right figure). Therefore, validation sites have to be carefully selected and need to be characterized on the spatial scale of the ground radiometer as well as on the scale of the satellite pixel. The permanent validation station near Gobabeb, Namibia, is located on vast and flat gravel plains (several 100 km^2), which are mainly covered by coarse gravel, sand, and desiccated grass. The plains are highly homogeneous in space and time, which makes them an ideal site for validating a broad range of satellite-derived land surface products.

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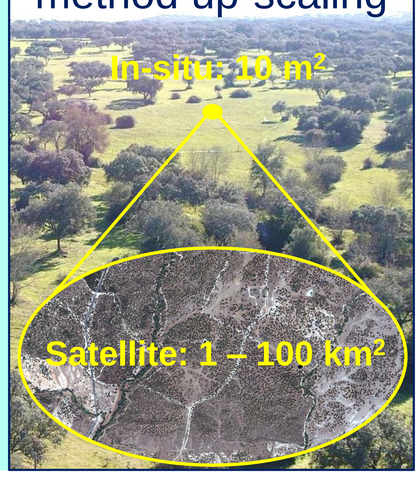
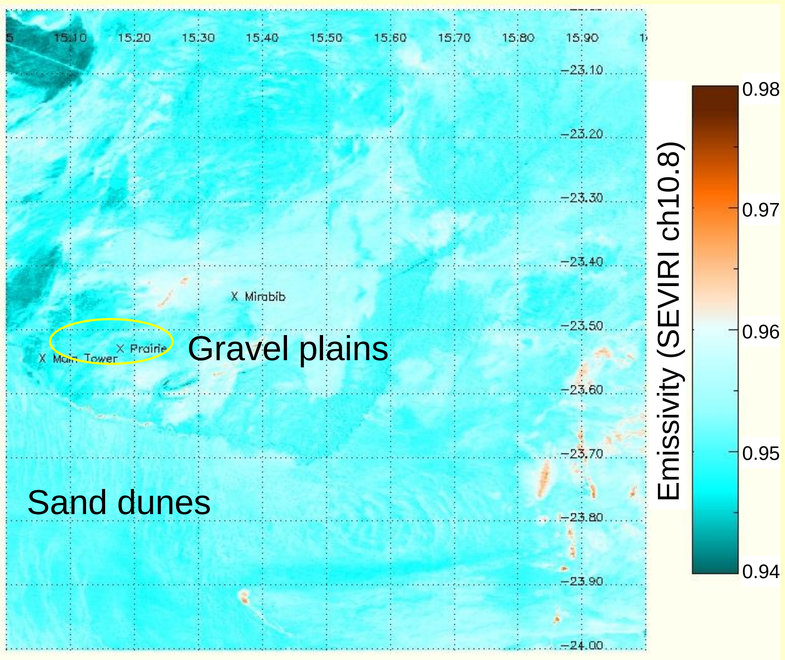
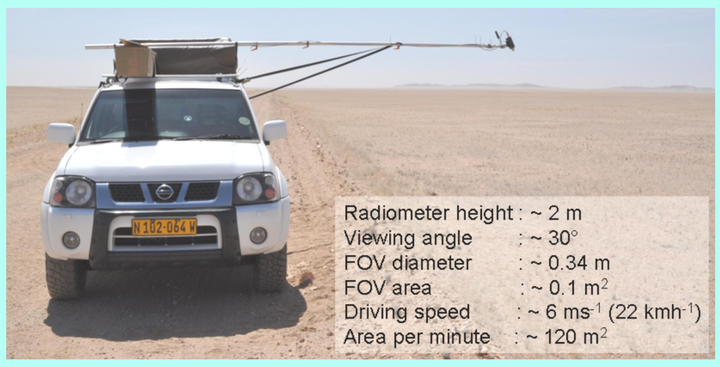
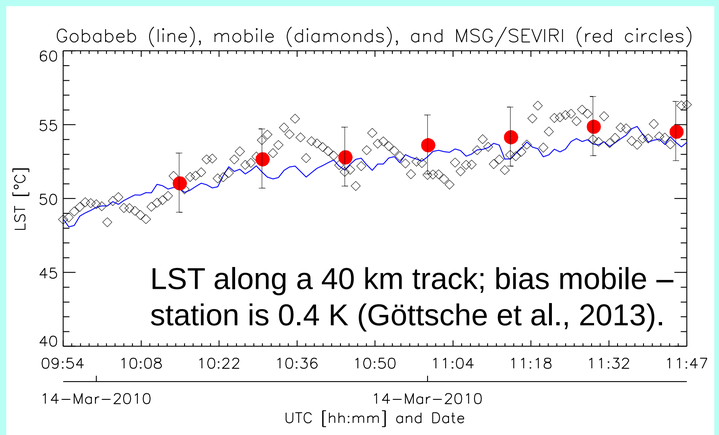
End-member cover method up-scaling

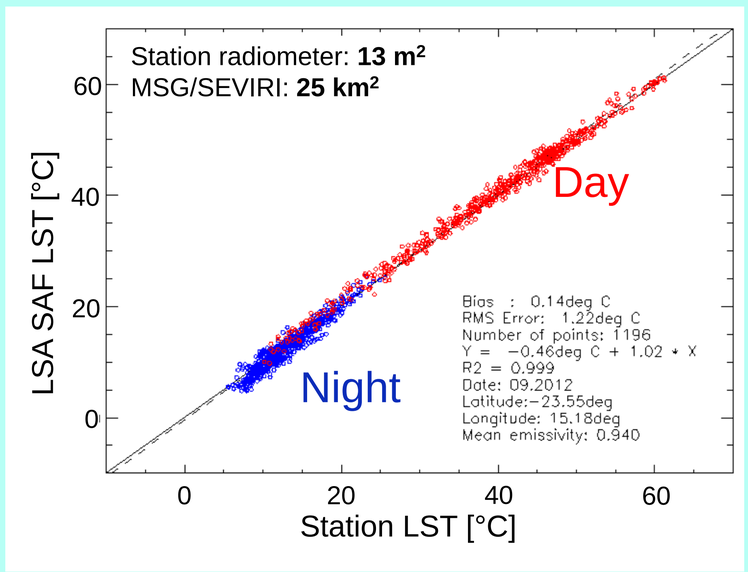




ASTER-TES LSE (120 m resolution) transformed to SEVIRI ch10.8 (Göttsche & Hulley, 2012). Each grid cell covers 11x11 km^2 . Within the yellow ellipse (chosen SEVIRI pixel location) LSE is nearly constant at 0.95.





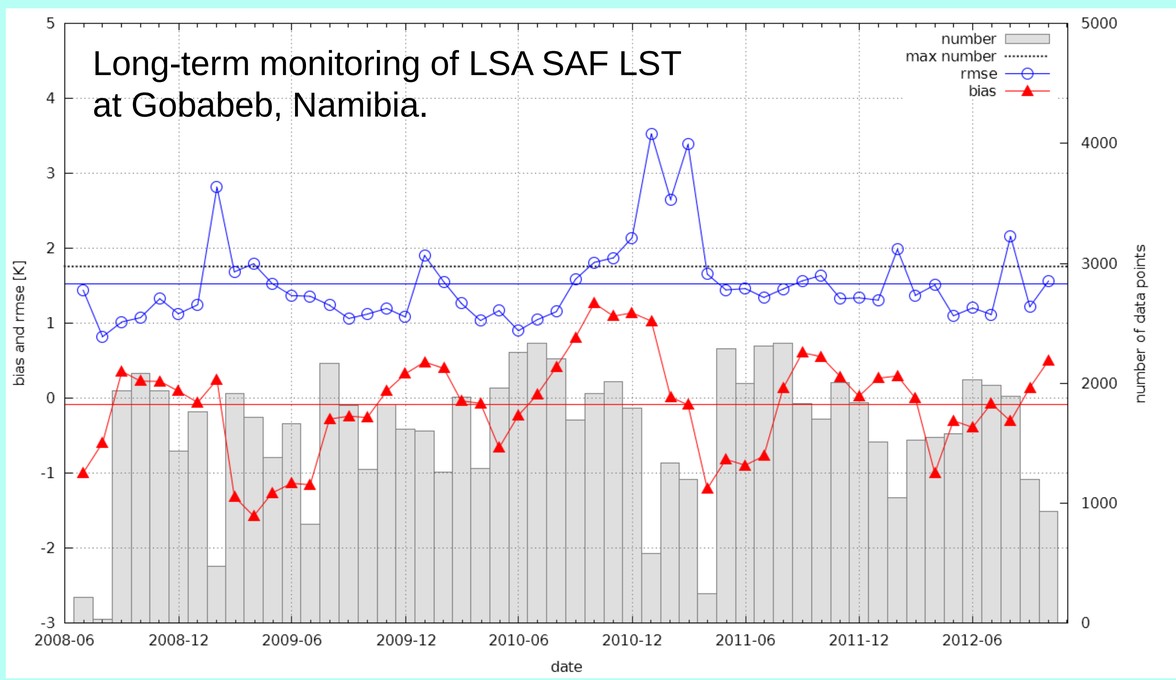


LSA SAF LST derived from MSG/SEVIRI vs. Gobabeb station LST (Sep. 2012, 1196 data points). The shown temperature range exceeds 55 Kelvin: the SAF LST algorithm performs well at nighttime and at daytime.

Land Surface Emissivity (LSE) at Gobabeb

Using the 'one-lid emissivity box' method and laboratory spectra, Göttsche and Hulley (2012) estimate a SEVIRI ch10.8 emissivity of 0.944 ±0.015 for the gravel plains (e.g. within the yellow ellipse in centre figure above). The table below shows corresponding LSE from operational algorithms and from MODTES (a three channel algorithm based on ASTER-TES; new operational MODIS product 'MOD21').

LSE product	Min	Max	Mean	Stderr
LSA-SAF SEVIRI Ch10.8	0.948	0.951	0.949	0.001
MODIS MOD11A2.C5 Ch31	0.964	0.966	0.965	0.001
MODIS MOD11B1.C4.1 Ch31	0.900	0.974	0.950	0.017
MODIS MOD11B1.C5 Ch31	0.964	0.964	0.964	0.000
ASTER-TES Ch10.8 at 3 km	0.947	0.957	0.951	0.002
MODIS MODTES Ch31	0.945	0.954	0.949	0.002



Each data point summarizes a month of data (as shown in the scatter plot for Sep. 2012 above). The mean bias is -0.1 K and mean rmse is 1.5 K. The bias varies by about ±1K and appears to be partly seasonal. The small (Oct/Nov 2010) and the big rainy season (Jan/Feb 2011) were exceptionally wet and cloudy.

Summary of Results for Gobabeb, Namibia

- Absolute mean and monthly **bias** (LSA SAF LST – in situ LST) is **generally less than 1 K,** while mean rmse is 1.5 K
- Slopes of monthly linear regressions are generally close to 1.0
- Causes for observed negative biases (i.e. LSA SAF LST too cold) during southern Winter are currently investigated.
- The operational LSA SAF LST product **consistently achieves its absolute target accuracy of 2.0 K**

References:
Göttsche, F.-M., and Hulley, G. C., 2012. Validation of six satellite-retrieved land surface emissivity products over two land cover types in a hyper-arid region. Remote Sensing of Environment, 124, pp. 149-158..
Göttsche, F.-M., Olesen, F.-S., and Bork-Unkelbach, A., 2013. Validation of land surface temperature derived from MSG/SEVIRI with in-situ measurements at Gobabeb, Namibia. Int. J. Remote Sensing, 34(9-10), pp. 3069-3083.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