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

Land Surface Temperature
Comparison methods and regional validation initiative

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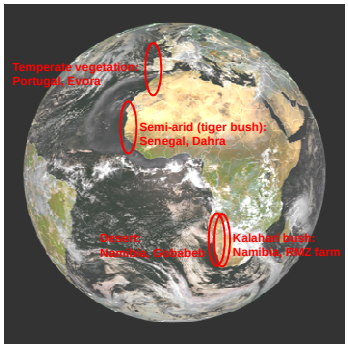

Overview

Land surface temperature (LST) is one of the key quantities in the EarthTemp Network. Its accurate determination from satellite data (S-LST) is a central task in the network. S-LST is retrieved from top of atmosphere (TOA) brightness temperatures and needs validation as well as comparisons among different S-LST products.
Real validation in a strict sense requires ground based measurements of LST that are completely independent from the data used in the S-LST retrieval algorithms.
Cross comparisons of S-LST from different instruments and/or algorithms support the investigation of its quality. In the so-called 'radiance-based validation', S-LST is compared with NWP LST data that fit the satellite TOA-BT.

In order to investigate the strengths and weaknesses of the validation and comparison approaches, a strategy for a regional validation initiative has been developed.
Comparisons and validations are carried out in selected, representative and well characterized regions with an in-situ ground based station as core element – see figure on the left.

The regions were selected according to the following criteria:
- Homogeneous on various scales over at least 100 km²
- Limited number of well defined end members, e.g. tree & grass
- Surface cover variation only due to seasons
- Relevant surface and climate within FOV of METEOSAT
- Stable political situation and reasonably safe access

Validation and comparison methods

green box: positive aspect
red box: negative aspect

independence
all data acquired at the station

error separation
by use of measured or data used in retrieval

measured clouds
radiometry at the station allows cloud detection

limitation
limited number of sites excellent characterisation

pixel representation
upscaling 20 m² → 20 km²

in situ
S-LST
versus
LST at a station

gobal
applicable to LEO and GEO

timing
NWP data for given times

no access to errors
source of errors is not traceable

radiance based
calculated
TOA radiances from satellite
versus
NWP model

continental scale
LEO and GEO

detect weaknesses
deviations give hints
no definite answers

anisotropy
consider in comparisons
use comparison for analysis

timing for LEO
reference to GEO

common errors
influence is not visible
aerosol
common atmospheric data

cross comparison
satellite
versus
satellite

Clouds

Measured cloud cover at validation stations

Cloud masks (CM) for intercomparisons

1. CM from S-LST dataset → *high dependency on CM*
2. Extended around cloud borders
3. Improved CM (temp. & spatial analysis) → low *dependency on CM*

Input Data

(underlined quantities should be included in comparison dataset in GeoTiff, lat/lon)

Current data	Slow variation	Static
• TOA temperature	• Emissivity	• Elevation
• Atmospheric profiles	• Surface cover	• Geology
• Cloud mask	• Anisotropy	
• View angle	• Satellite calibration	
• Time of observation		

Validation

Validation of S-LST against in-situ LST at four KIT stations
- SAT-CM, improved CM and measured clouds: Error from CM
- Sat-emissivity and measured emissivity: Error from emissivity
- Anisotropy investigation including station LST and in-situ data

Regional inter-comparison

Homogeneous region ~ 100 km x 100 km around validation sites
Data with improved CM
- S-LST differences (reference SEVIRI, no timing problems)
- Emissivity differences
- Anisotropy study over the region

Validation and comparison sites

Evora, Portugal: oak trees and grass, 200 m asl,

Dahra, Senegal: "Bush", 40 m asl, 15 North

Gobabeb, Namibia: gravel desert, 500 m asl 23 South

RMZ farm, Namibia: Kalahari bush, 1400 m asl, 23 South

Ideas for additional investigations at the validation sites or in the inter-comparison regions are welcome. The sites are regularly visited, have solar power supply and daily data transfer to KIT.


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