Validation of Land Surface Temperature/Emissivity derived from SEVIRI and AATSR over African sites

J. A. Sobrino[1], J. C. Jiménez-Muñoz[1], A. Ruescas[2], O. Danne[2], C. Brockmann[2], C. Mattar[3], G. Hulley[4], F. M. Göttsche[5]

[1] GCU/IPL, University of Valencia, Valencia, Spain (sobrino@uv.es); [2] Brockmann-Consult, Geesthacht, Germany;
[3] LAB, University of Chile, Santiago, Chile; [4] JPL/Caltech, Pasadena, USA; [5] KIT, Karlsruhe, Germany

The African continent offers some unique regions suitable for validation of Land Surface Temperature (LST) derived from low resolution sensors, since it includes widespread bare areas located over desert and sand dunes sites. In this work we present the results obtained in the validation of two recently developed LST/emissivity products over some African sites: i) the Temperature and Emissivity Separation (TES) product obtained from MSG/SEVIRI data (SEVTES), and ii) the LST product with associated emissivity based on a NDVI approach obtained from synergy between MERIS and AATSR as a future benchmark for the Sentinel-3 OLCI/SLSTR products (SEN4LST).

Algorithms

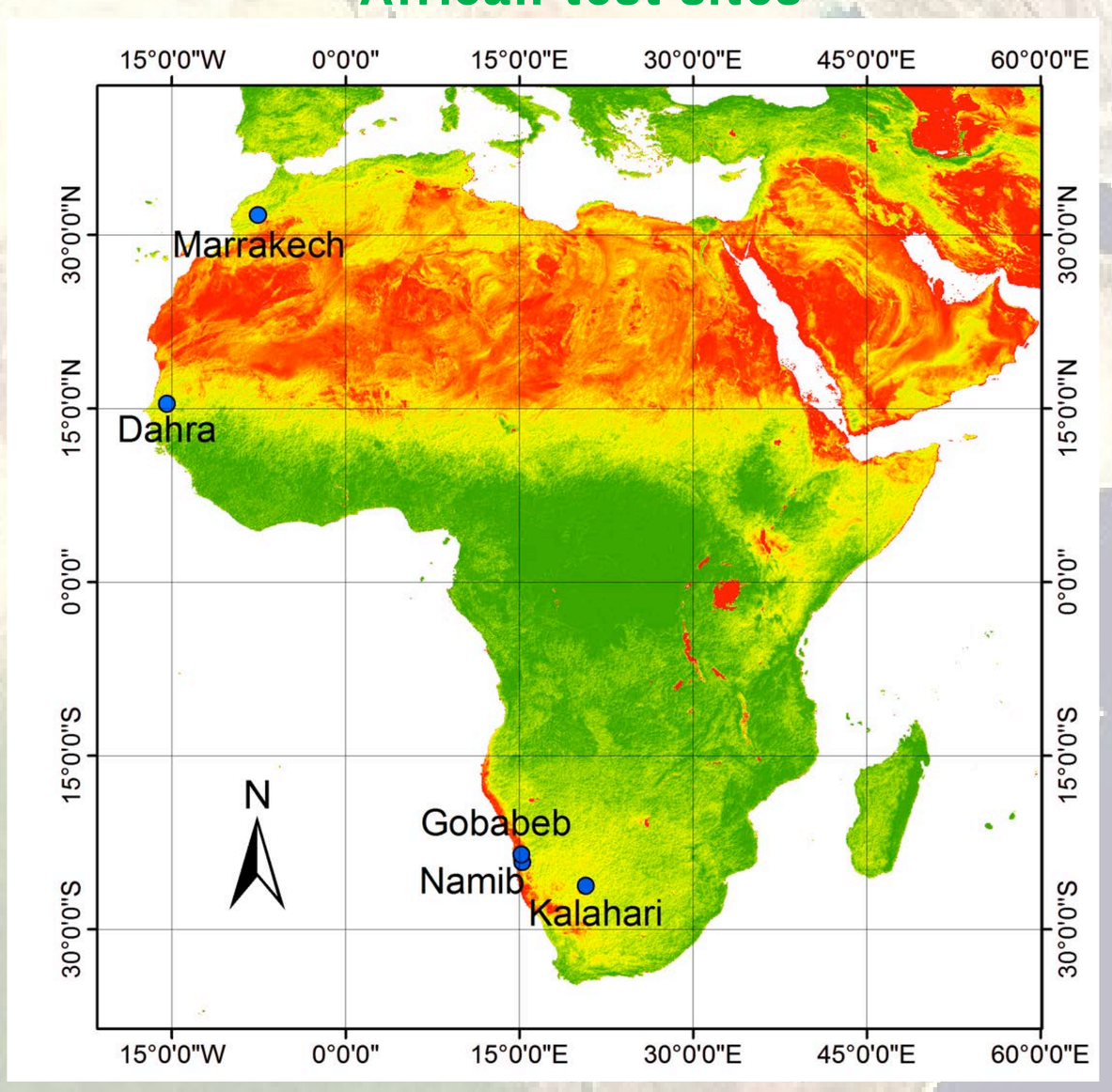
SEVTES: Temperature and Emissivity Separation (TES) algorithm allows the simultaneous retrieval of surface emissivities and LST from multispectral TIR measurements (**Gillespie et al. 1998**). The algorithm requires accurate atmospheric correction. One of the key aspects of TES is the relationship between minimum emissivity (ε_{min}) and spectral contrast (MMD). This algorithm was applied to three TIR bands of the MSG/SEVIRI instrument (**Jiménez-Muñoz et al., 2014**).

SEN4LST: A split-Window (SW) algorithm based on the mathematical structure proposed by **Sobrino et al. (1996)** was developed to be applied to the two TIR bands (11 and 12 mm) of AATSR:

$$LST = T_{11} + 1.084(T_{11} - T_{12}) + 0.277(T_{11} - T_{12})^2 - 0.268 + (45.11 - 0.73W)(1-\varepsilon) + (-125 + 16.7W)\Delta\varepsilon$$

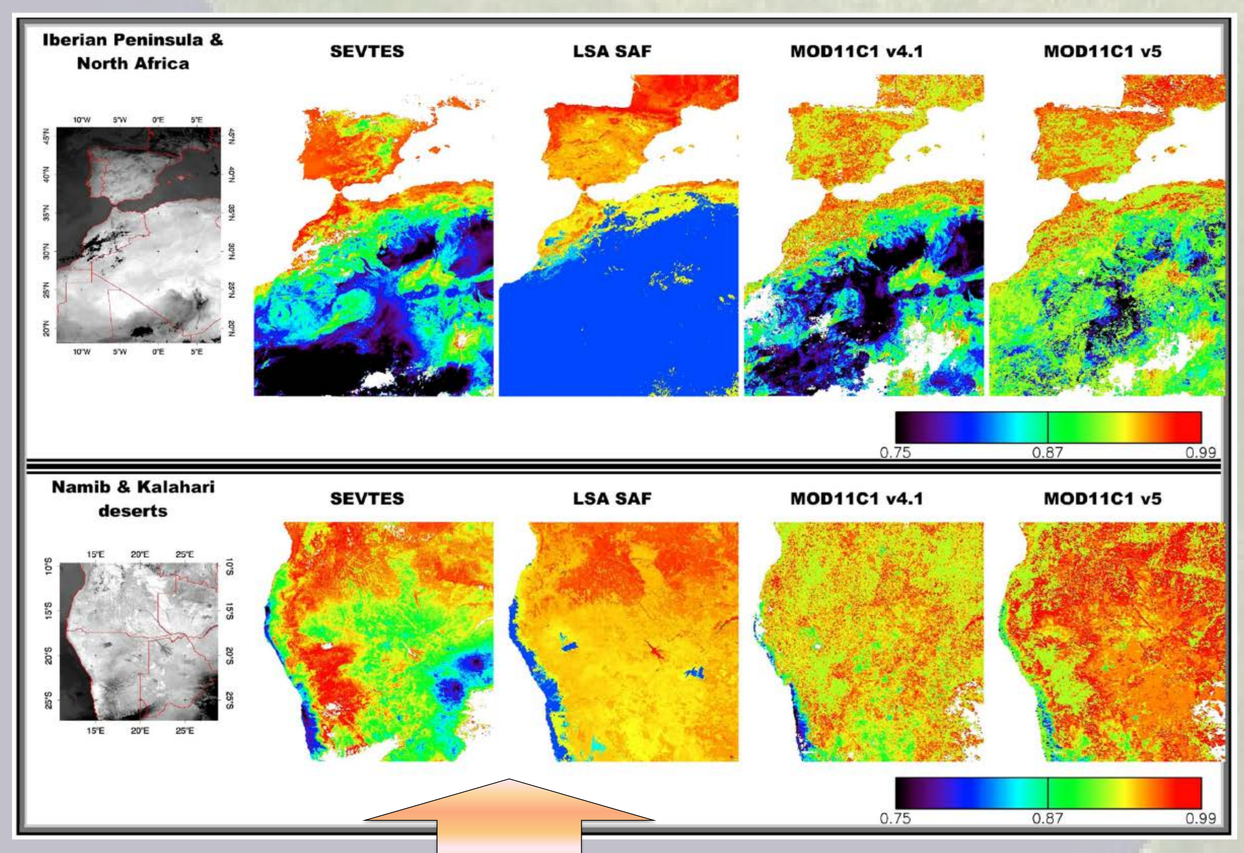
T_{11} and T_{12} are the brightness temperatures; ε is the mean emissivity, $\varepsilon = (\varepsilon_{11} + \varepsilon_{12}) / 2$, and $\Delta\varepsilon$ is the emissivity difference, $\Delta\varepsilon = (\varepsilon_{11} - \varepsilon_{12})$. W is the atmospheric water vapour content.
The SW coefficients were obtained from regression analysis using a simulated dataset (errors < 1.5K). MERIS products with higher resolution were used for the cloud mask, the atmospheric water vapour, and the estimation of surface emissivity using a NDVI approach. This algorithm was developed in the framework of the ESA's SEN4LST.

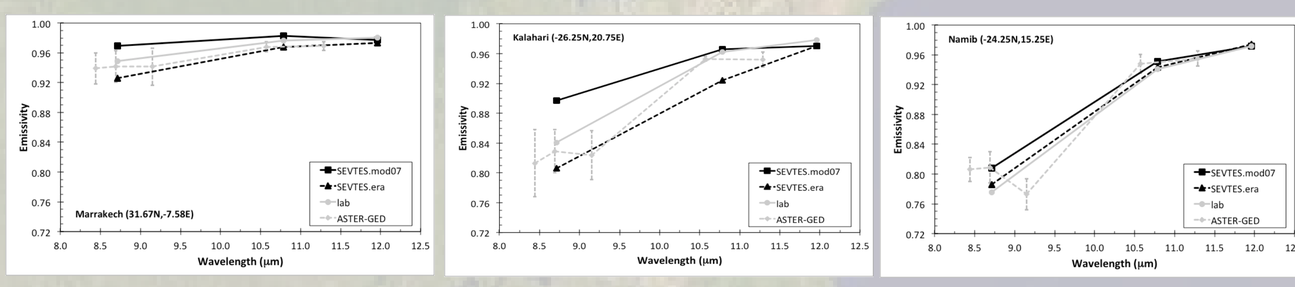
African test sites



SEVTES results: focus on emissivity

SEVTES results over Marrakech, Namib and Kalahari sites using MOD07 and ERA-Interim products for the atmospheric correction. SEVTES results are compared to laboratory measurements and to values extracted from the ASTER-GED.

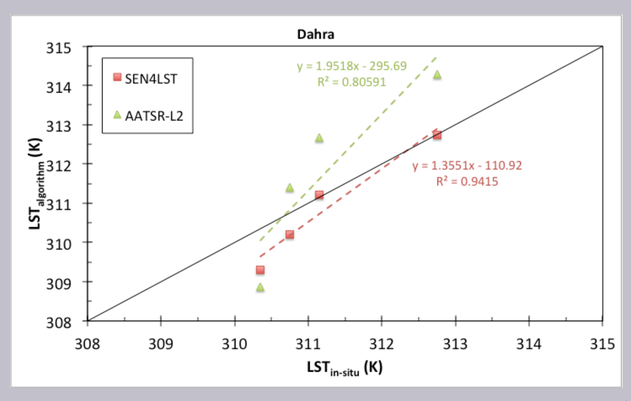


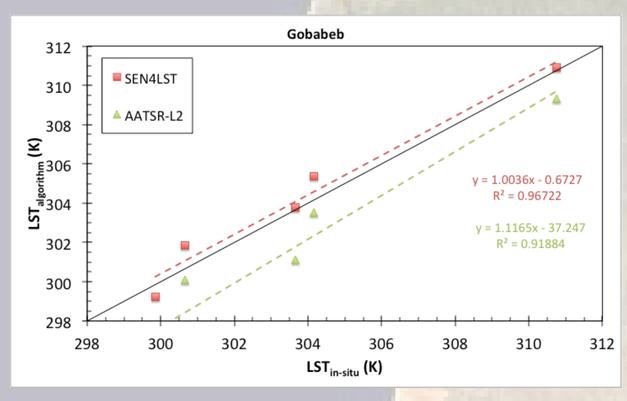


Spatial patterns of surface emissivity at band IR8.7 (SEVIRI) or band 29 (8.5mm, MODIS) over the Iberian Peninsula and North Africa (top) and Namib and Kalahari deserts (bottom). SEVTES retrievals are compared to LSA SAF, MOD11C1 v4.1 and v5 emissivity products.

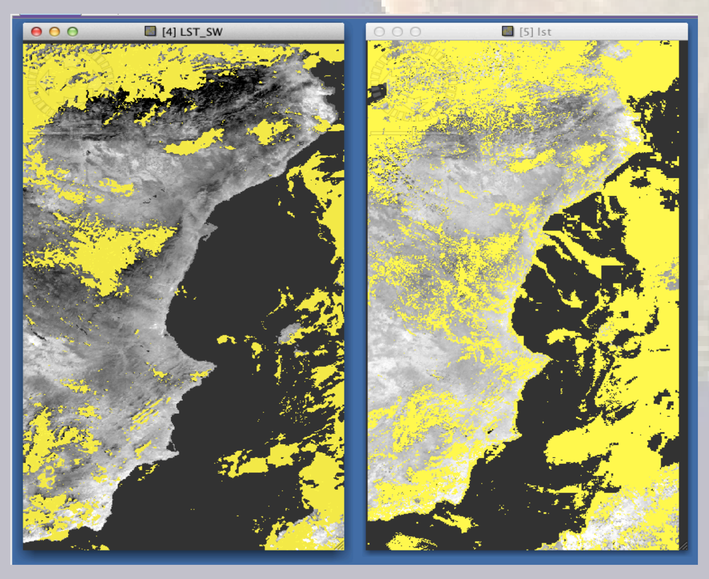
SEN4LST results: focus on synergy LST

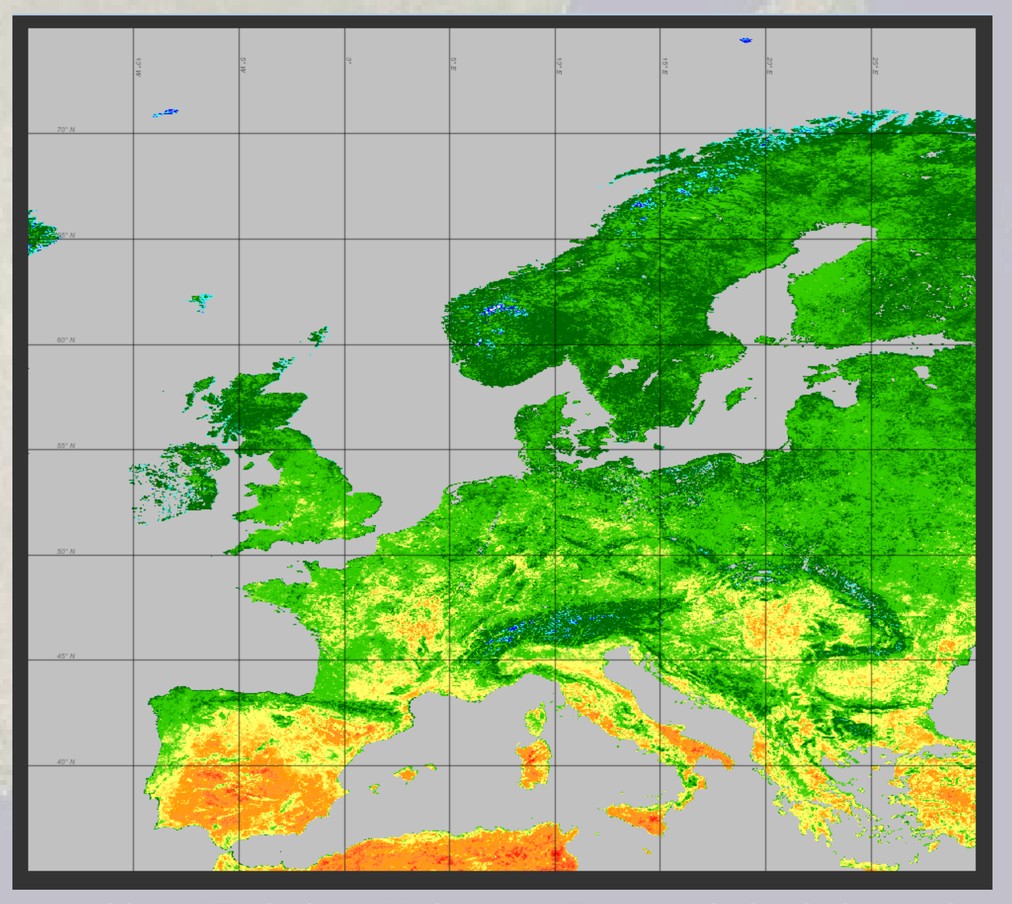
LST obtained from the SEN4LST algorithm and the AATSR level-2 standard LST product versus the LST measured in situ over the test sites (January and August, 2011). RMSE for the SEN4LST (AATSR-L2) algorithm is 0.6 K (1.5 K) and 0.9 K (2.4 K) over Dahra and Gobabeb, respectively.





Cloud masks (yellow) for the SEN4LST product (left) and the standard AATSR-L2 product (right)





Monthly LST (July 2003) over Europe derived from the SEN4LST algorithm.

CONCLUSIONS

✓ SEVTES allows the retrieval of multispectral emissivity at sub-daily temporal resolution and thus provides a valuable information about surface emissivity dynamics. SEVTES retrievals improve classification-based products over arid and semiarid areas.

✓ SEN4LST algorithm improves LST estimations of the AATSR level-2 standard product. Synergy with MERIS allows a better discrimination of clouds.