The EUMETSAT Satellite Applications Facility on Land Surface Analysis

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Acknowledgements: LSA SAF Team

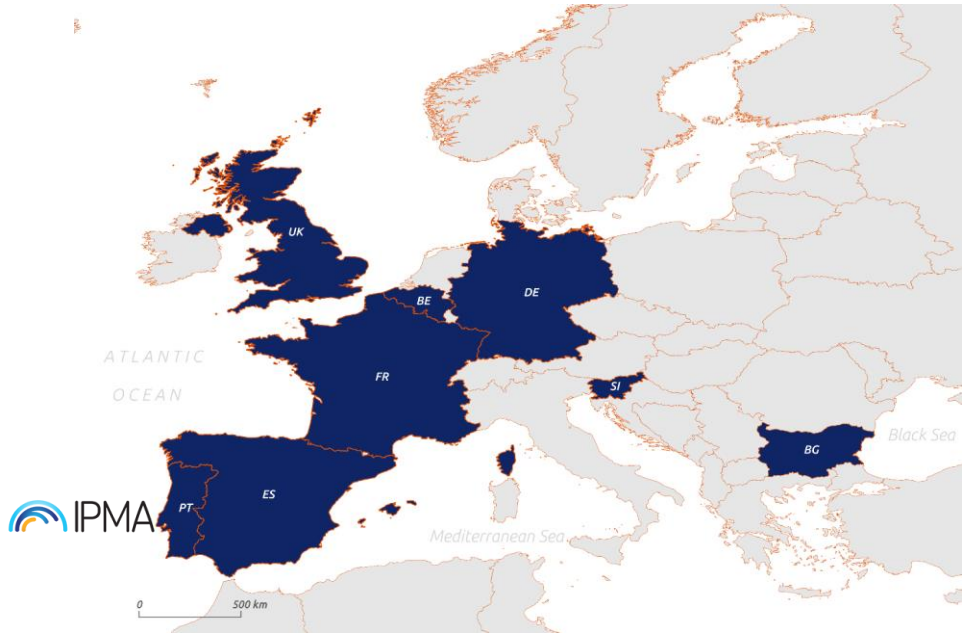
EUMETSAT LSA-SAF

EUMETSAT Satellite Applications Facility on Land Surface Analysis

- Decentralized Development of Satellite Algorithms and Products related **to Land Surfaces** & **Land-Atmosphere interactions**
  - ✓ primarily focusing EUMETSAT satellites – current and future missions

- Decentralized Service ensuring:
  - ✓ Near Real Time & Off-line **Production** and **Distribution** of Land Surface Variables
  - ✓ Product Documentation
  - ✓ User Support / Helpdesk
  - ✓ Promotion: Training; Workshops; Show Cases

10 Institutions/ 8 Countries

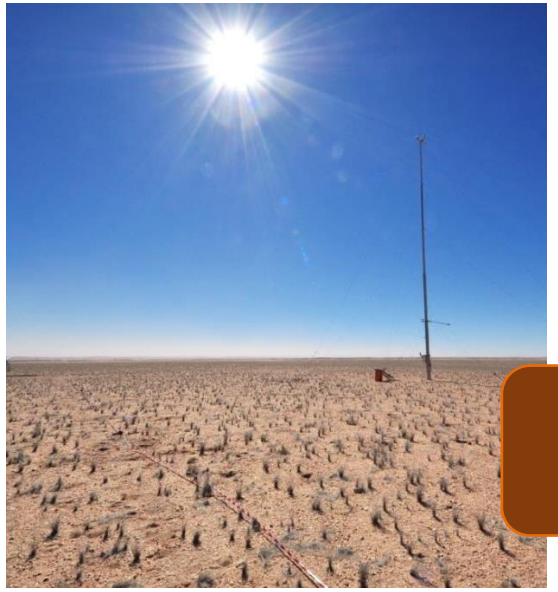


- ✓ Distributed Product Development & Validation
- ✓ Data Production, Archiving & Dissemination: IPMA, VITO

IPMA

EUMETSAT LSA-SAF: Products

- Evapotranspiration
- Turbulent Fluxes
- All Sky LST



Energy Balance

Radiation

Vegetation

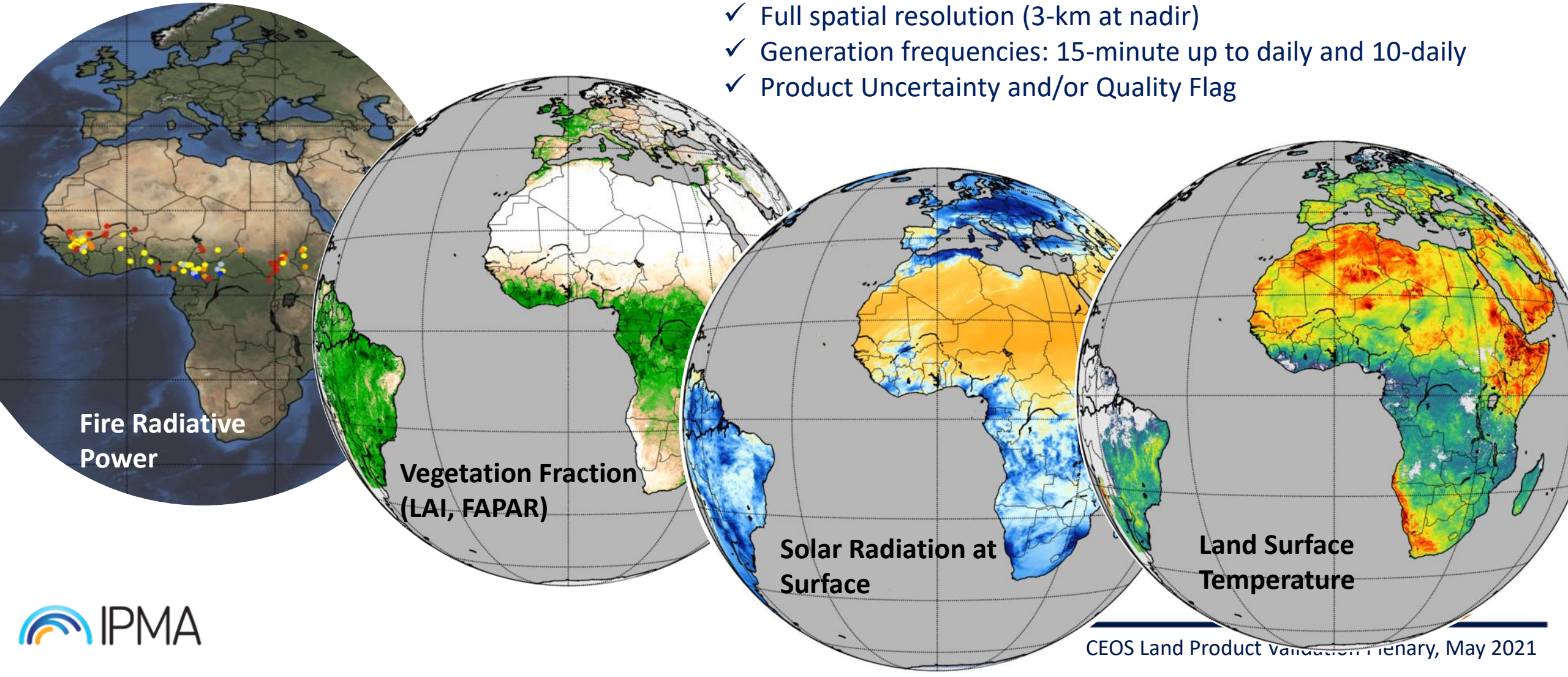
- **SW:** Albedo, Down-welling SW
- **LW:** LST, Emissivity, Down-welling LW

- **State**: LAI, FAPAR, FVC, NDVI
- **Stress**: ET, ETRef
- **Wild-Fires:** FRP, Emissions, Risk

Meteosat Second Generation

Derived from SEVIRI/MSG: Available since 2004; up-dated in Near Real Time

- ✓ Full spatial resolution (3-km at nadir)
- ✓ Generation frequencies: 15-minute up to daily and 10-daily
- ✓ Product Uncertainty and/or Quality Flag



NRT Products: SEVIRI/MSG and AVHRR/Metop

Other LSA-SAF Products:

- ✓ Currently available in Near Real Time
- ✓ Back-processing of full satellites' data records to be completed in 2021.

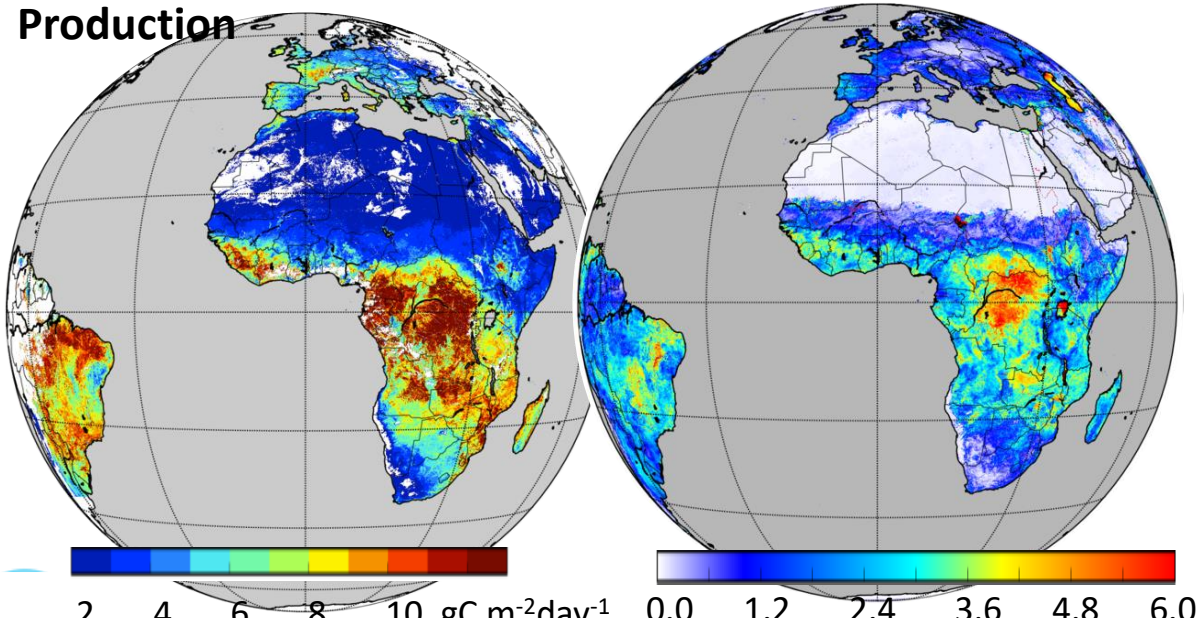
Vegetation: LAI, FAPAR, FCV

Albedo

Temperature

Gross Primary Production

Evapotranspiration



Product Validation (LSA-SAF Validation Reports)

Strategy

- comparisons with reference in-situ measurements – following LPV Protocols:
  - ✓Assessment of Product Accuracy and Precision (to be extended to product stability)
  - ✓Validation of estimations of Product Uncertainty

  Reference Stations: High quality measurements; Well-characterized site & surroundings; within Homogeneous areas

- comparisons with similar and relevant parameters retrieved from other sensors or provided by numerical models.
  - ✓Consistency assessment
  - ✓Includes **inter-comparison of LSA-SAF products** derived from different sensors platforms (e.g., SEVIRI/MSG **LST** *versus* and AVHRR/Metop **LST**).

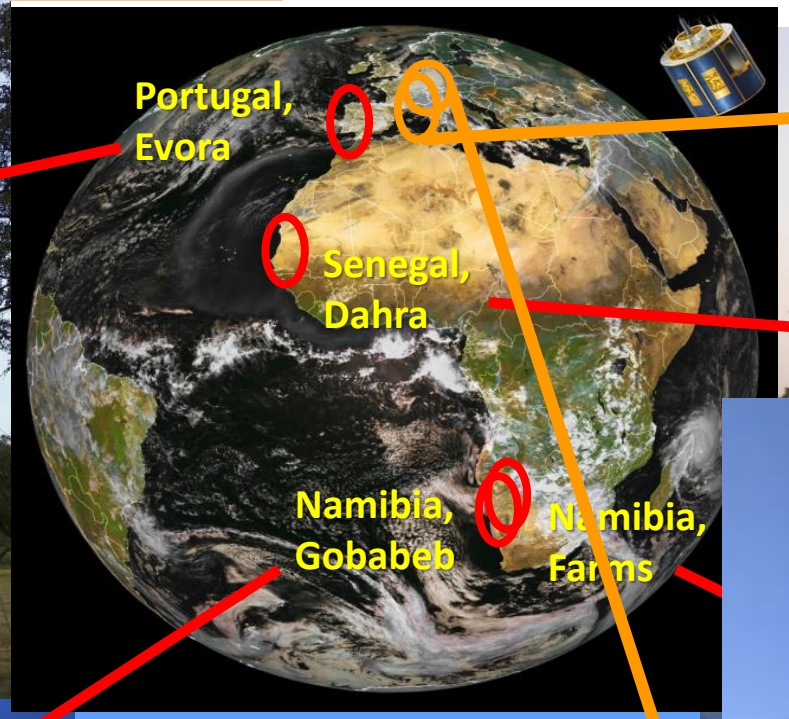
LST Validation Stations (Meteosat Disc)

EUMETSAT LSA SAF

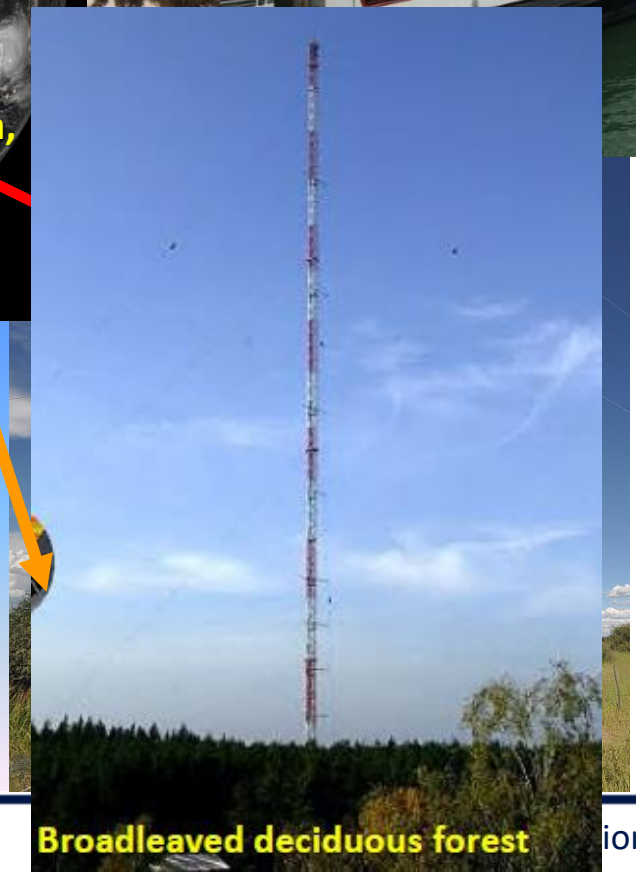
KIT Validation Sites

KIT Karlsruher Institut für Technologie

F. Göttsche et al.



- Large, **homogeneous** sites
- Well **characterised**
- Different climates & biomes
- **Dedicated** to LST validation



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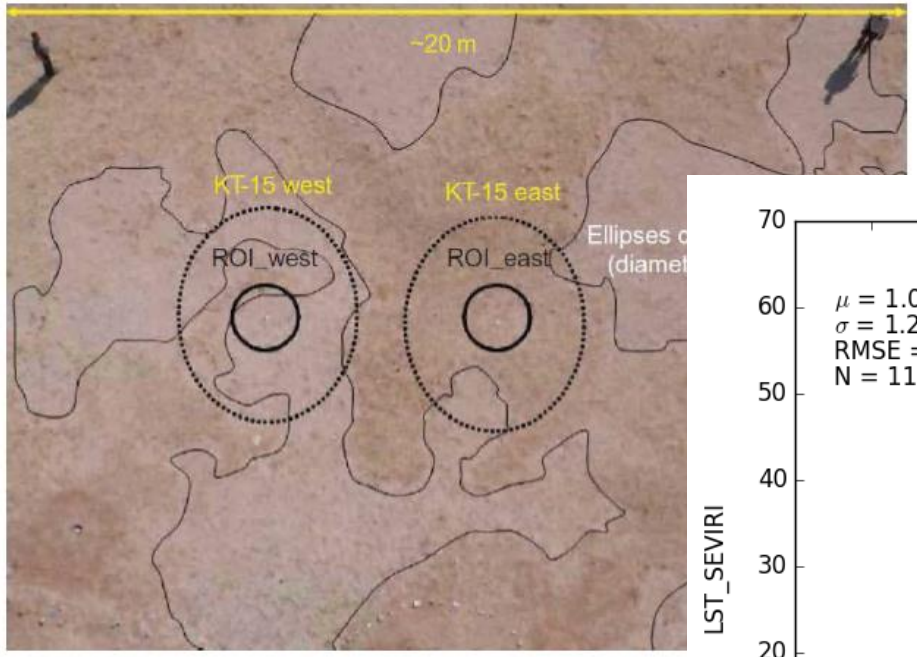
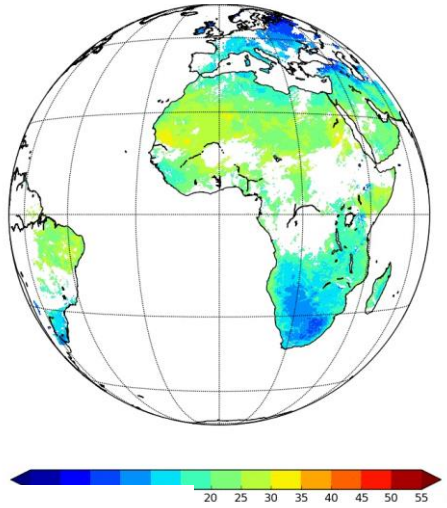
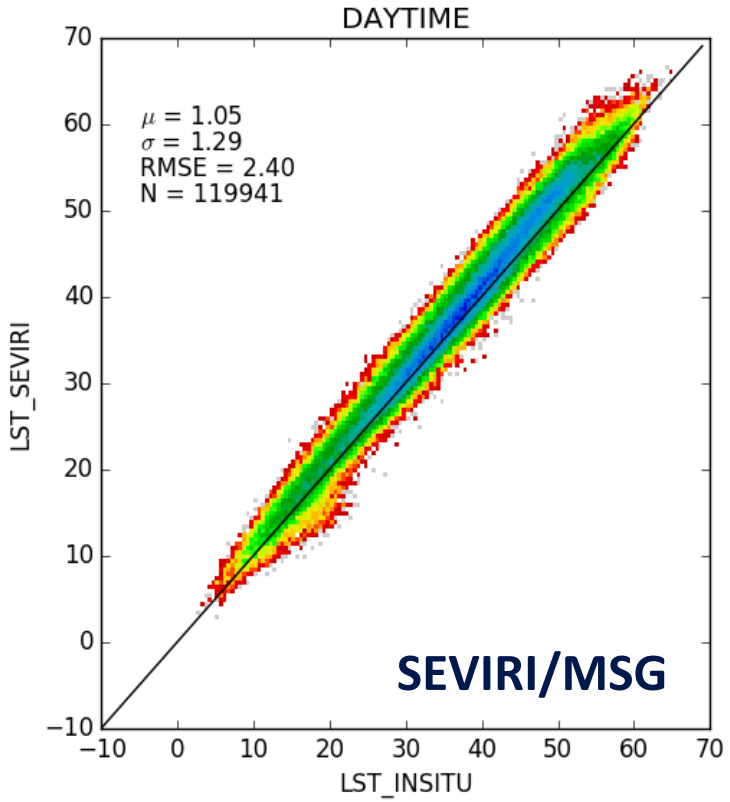
LST Validation – Gobabeb (Desert Site)

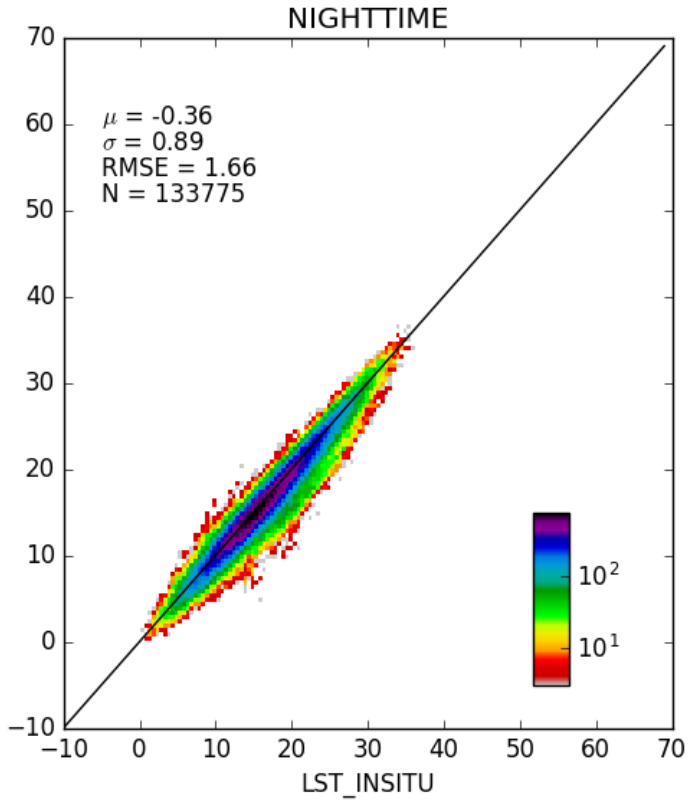
- ✓ Site run by KIT – KT15 radiometers measuring sfc & sky Tb.
- ✓ Highly Homogeneous site – mostly gravel and dissecated grass.
- ✓ Very wide temperature amplitudes – at daily and annual time scales.



15-minute LST



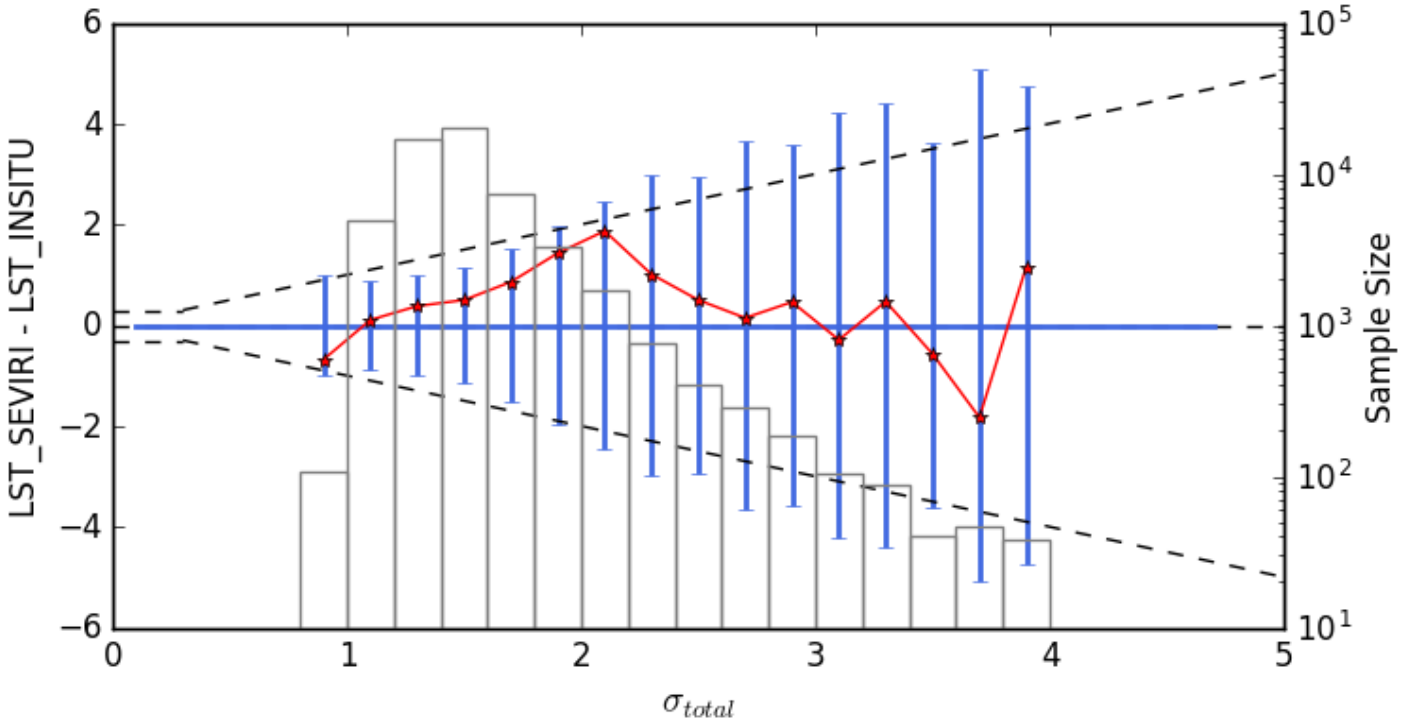


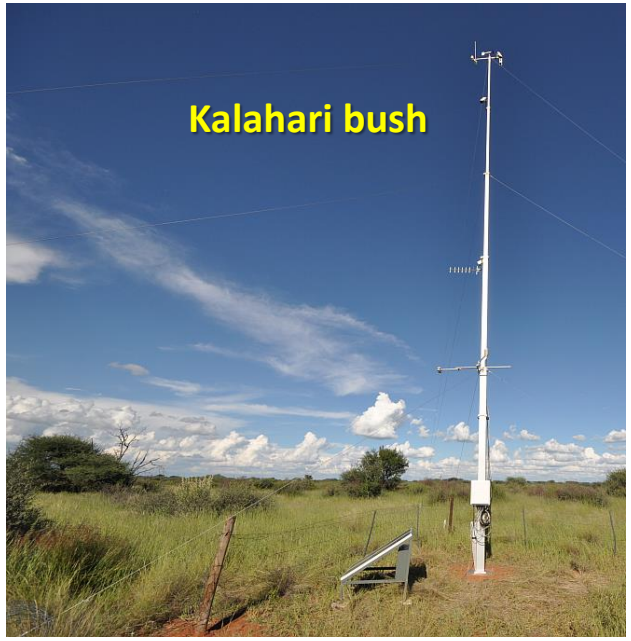


LST Uncertainty Validation – Heimat (Kalahari)

Blue bars: Standard deviation of LST_SEVIRI- LST_InSitu versus bins of σ_{total}

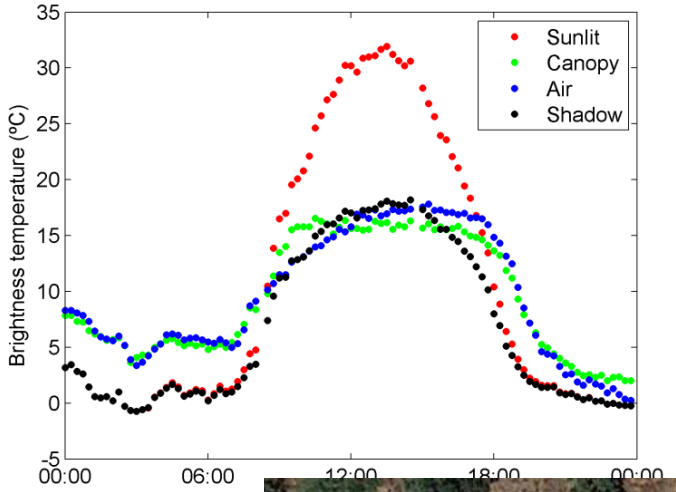
$$\sigma_{total} = \sqrt{\sigma_{sat}^2 + \sigma_{insitu}^2 + \sigma_{time}^2 + \sigma_{space}^2 + 2\sigma_{\varepsilon}^2 \frac{\partial LST_{ins}}{\partial \varepsilon} \frac{\partial LST_{sat}}{\partial \varepsilon}}$$

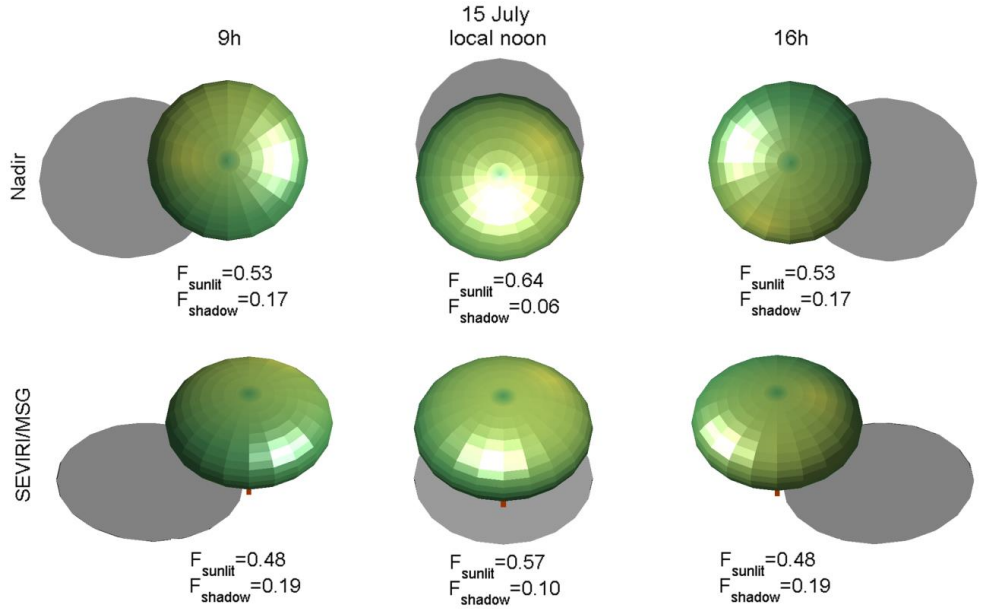




Evora – Validation Station

Radiometric temperatures in a summer day





Geometric model of generic trees & canopies

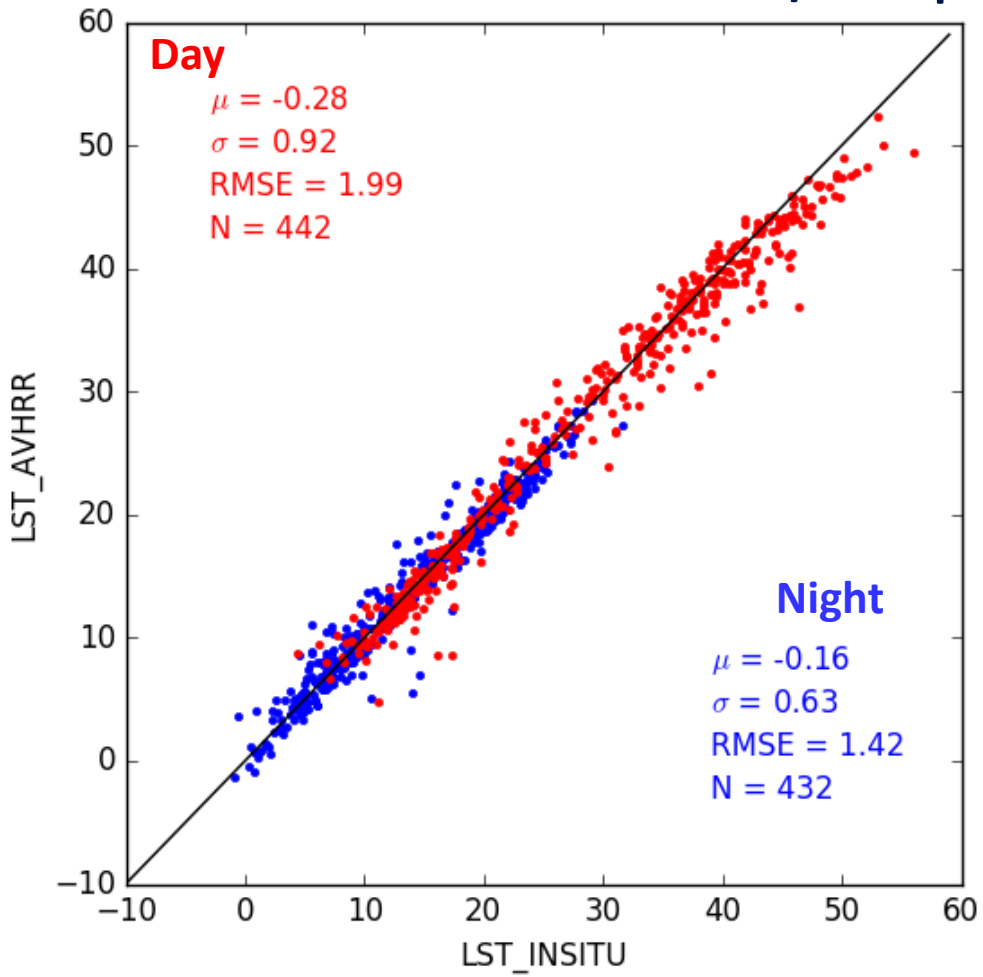
+

Boolean model to account overlapping of shades/canopies

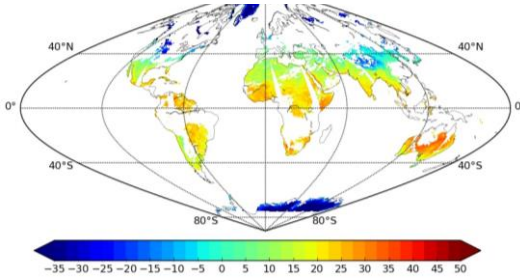
- ✓ Allows up-scaling in-situ measurements to any viewing & illumination geometries
- ✓ To our knowledge: the only station providing regular information on LST directional effects

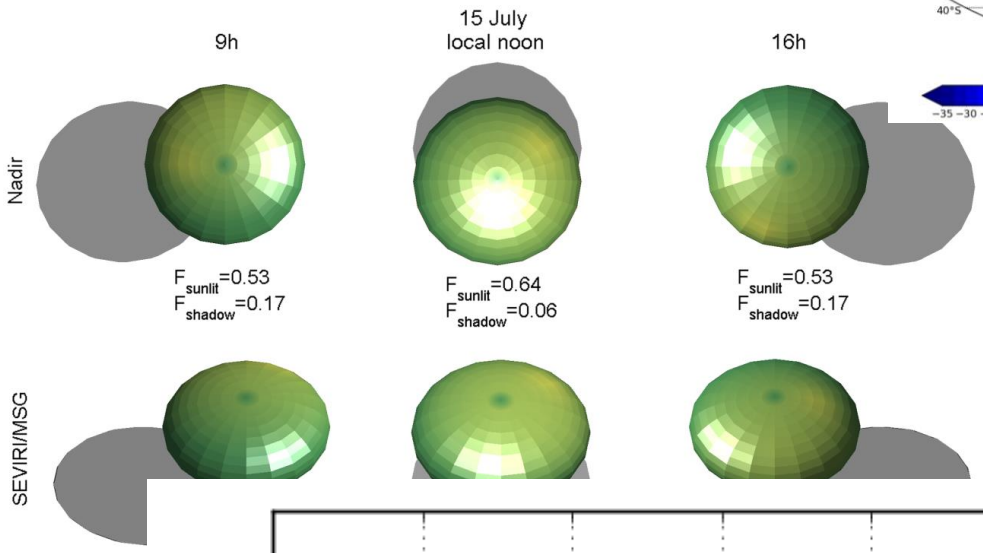
LST Validation – Evora (South Portugal)

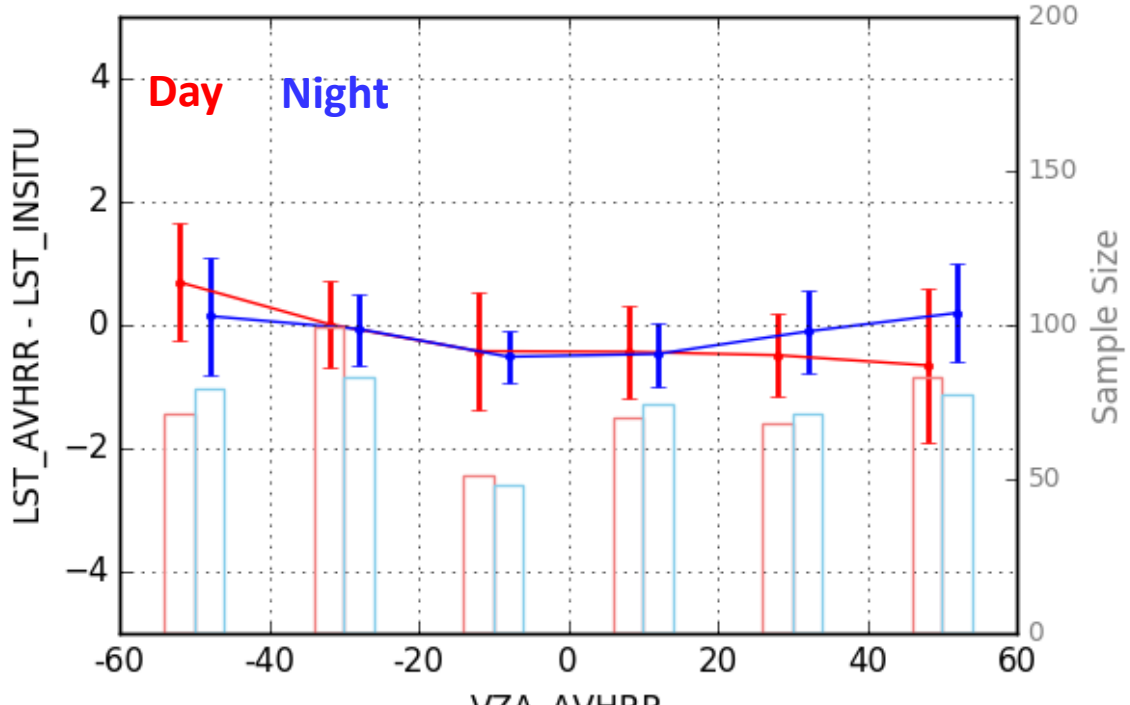
AVHRR/Metop



Twice-Daily LST







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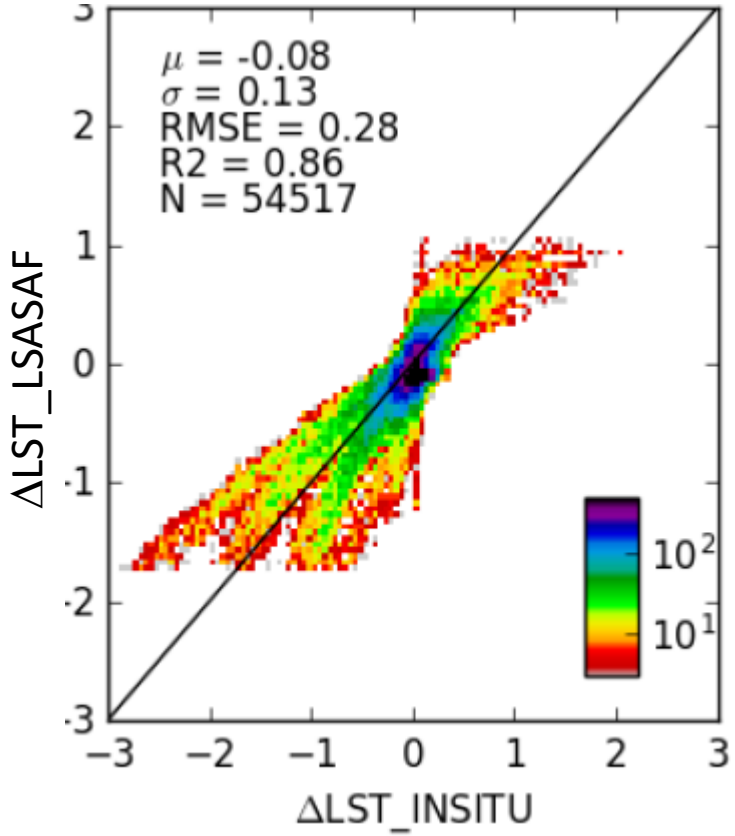
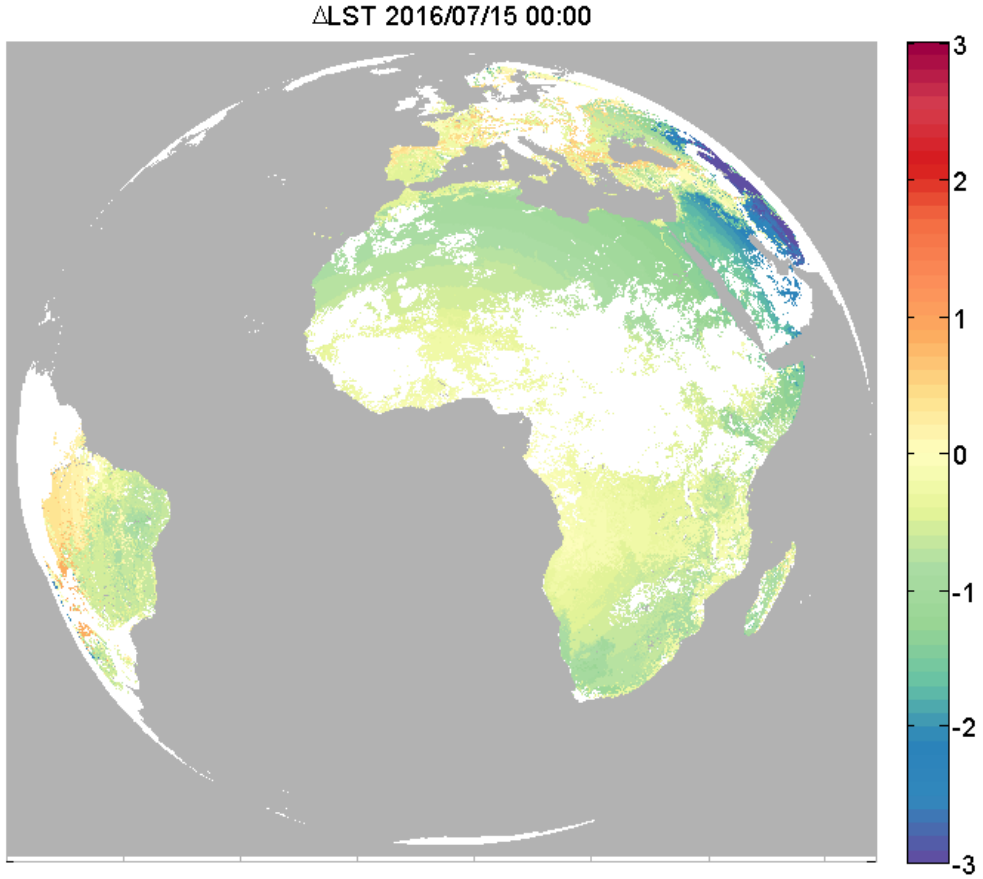
2021

LST Directional Effects Validation – Evora

New Layer added to SEVIRI LST:

- Estimated difference to LST retrieved from a Reference View **(Nadir)**



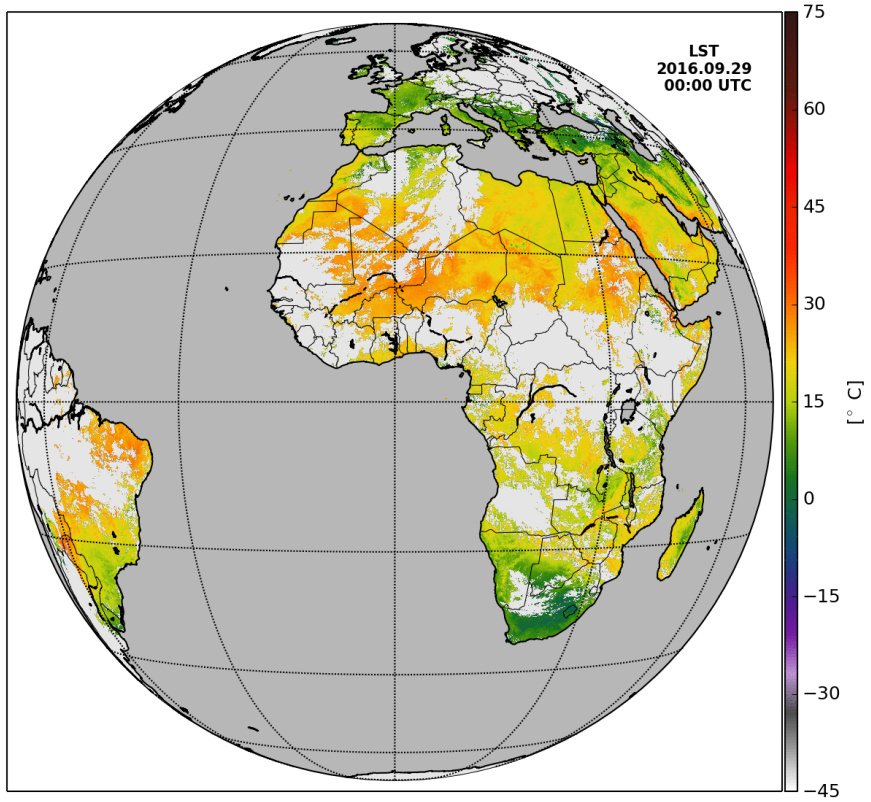


All-Sky LST

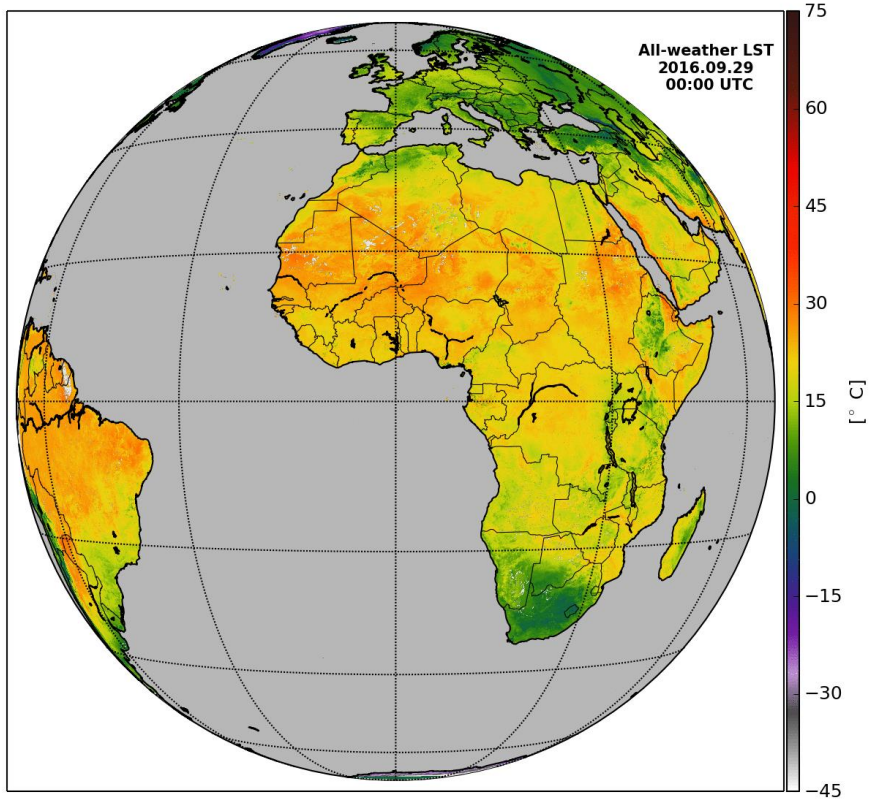
Simple merge between SEVIRI Level 2 (Clear Sky) LST and Surface Temperature resolving the Energy Balance over each pixel

✓ 30 min / 3 km (sub-satellite point)

SEVIRI level 2 LST



SEVIRI level 2 + level 4 LST



All-Sky SEVIRI/MSG LST

All-Weather LST

$$Rn_i = H_i + LE_i + G_i$$

Energy balance per tile ⇨ Averaged per pixel:

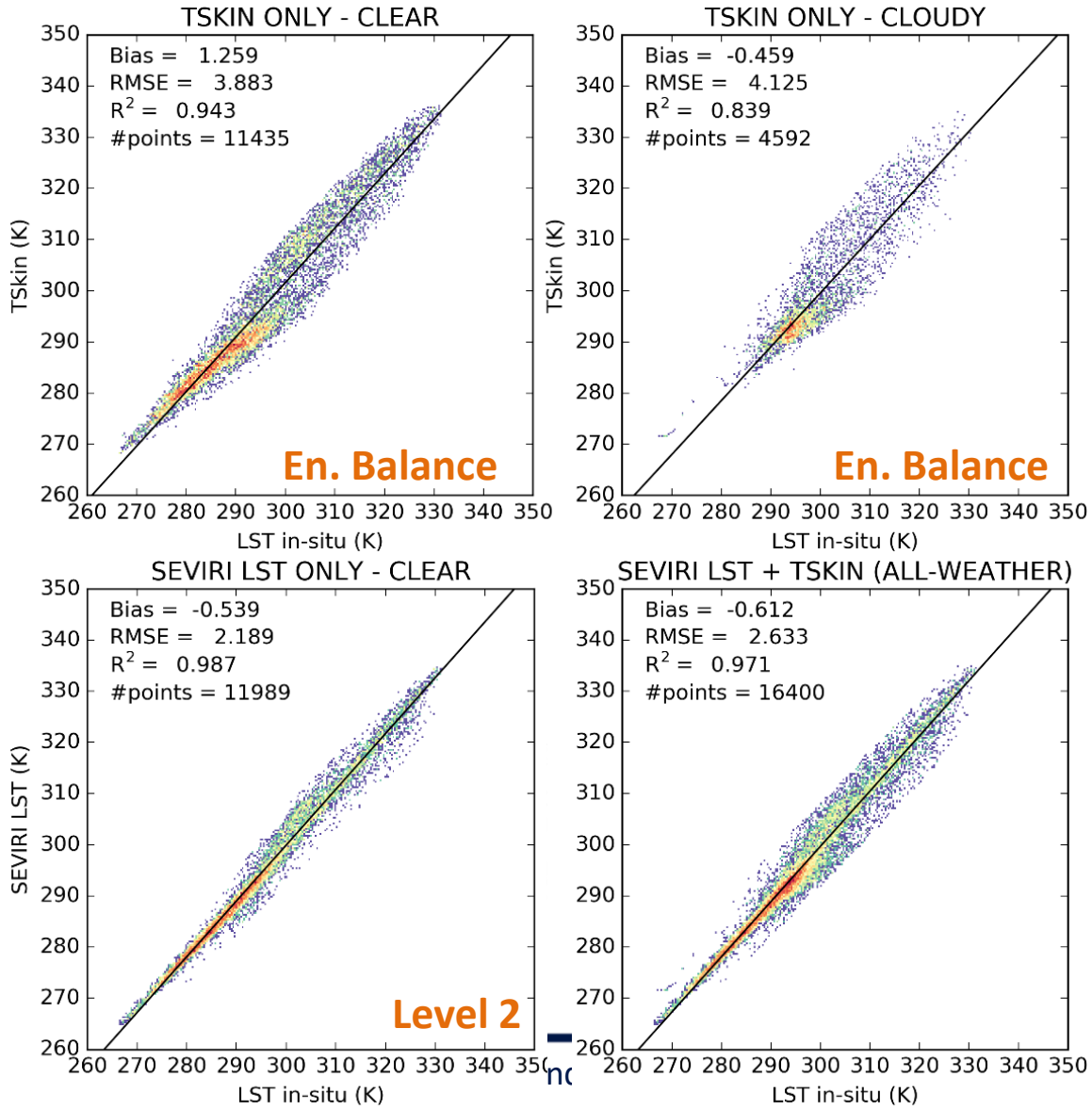
- ✓ Actual Evapotranspiration
- ✓ Sensible Heat Flux
- ✓ Latent Heat Flux

➢ **Surface Skin Temperature** is the unknown

Wish List:

- Validate Radiation Budget & Energy Balance components at super-sites

Kalahari (KIT site)

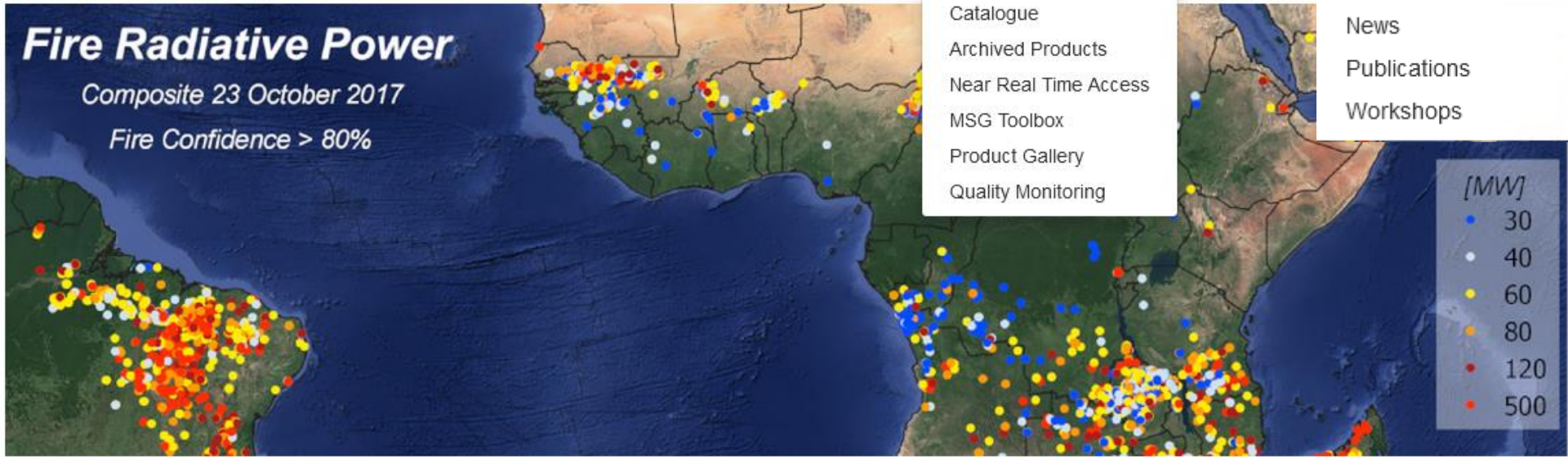


EUMETSAT LSA SAF

http://lsa-saf.eumetsat.int

Publications

Product Validation Reports



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