

# Continental scale monitoring of (sub-)daily evapotranspiration enhanced by the assimilation of geostationary data

N. Ghilain, A. Arboleda, F. Gellens-Meulenberghs



Royal Meteorological Institute of Belgium  
nicolas.ghilain@meteo.be



## Summary

- The EUMETSAT LSA-SAF evapotranspiration products (LSA-SAF ET) based on Meteosat Second Generation have been operationally produced in near-real time for approximately 6 years.
- From both user's experience and own LSA-SAF validation, we have worked towards correcting some deficiencies in semi-arid environments and adding more features.
- A new prototype is ready. It relies on more satellite data, and will additionally deliver the surface heat fluxes.

### The operational LSA-SAF evapotranspiration products v1 rely on:

- a model (parameterization from LSM, no modelling of soil moisture)
- radiation components from Meteosat Second Generation (Geo-satellite)
- ECMWF forecasts and ECOCLIMAP land cover database

→ Aim at continuous monitoring in near-real time at 3-5 km resolution.

**GEO Radiation**

Users request more precision in semi-arid areas.

Strategy adopted: - revise model parameterization

- **assimilate more satellite data**

→ Benefit: more observation-based (less dependency to forecasts)

### Leaf Area Index & Fraction of Vegetation Cover are assimilated daily.

Strategy: (implementation in a pre-processing module)

- optimal interpolation with a 5-years climatology
- sub-pixel decomposition (vegetation class) by linear least square
- Back-up: LAI of nearest homogeneous pixels

Benefits: detection of short-term local fluctuations and inter-annual variability.



Accuracy is improved over Southern regions of Europe:

- better distribution between soil and vegetation,
- better variability of LAI linked to soil water stress.

Note: tests with a beta prototype LSA-SAF ET + VGT

### Snow Cover is assimilated daily.

- Surface albedo is modified (as it is underestimated by satellite)
- Latent heat of sublimation used over snow cover
- Partial snow cover assumes 50% of covered area, distributed proportionally over the different vegetation types.



### Soil moisture is assimilated daily (in selected regions).

GEO soil moisture ? Based on 15 min land surface temperatures (LST) daily variation.

Daily surface soil moisture index at continental scale for clear sky days validated with measurements (ISMN, FLUXNET): reliable over Sahel and south of Europe. It detects irrigated areas and wetlands.

A screening is required: - not competitive for temperate Europe, equatorial Africa,

- Problems over mountains, and during high aerosol loads.
- Persistent cloudy days.

Extra information used: GTOPO, MACC aerosol, KG-revised climate map.

→ Combination of ECMWF and GEO soil moisture.

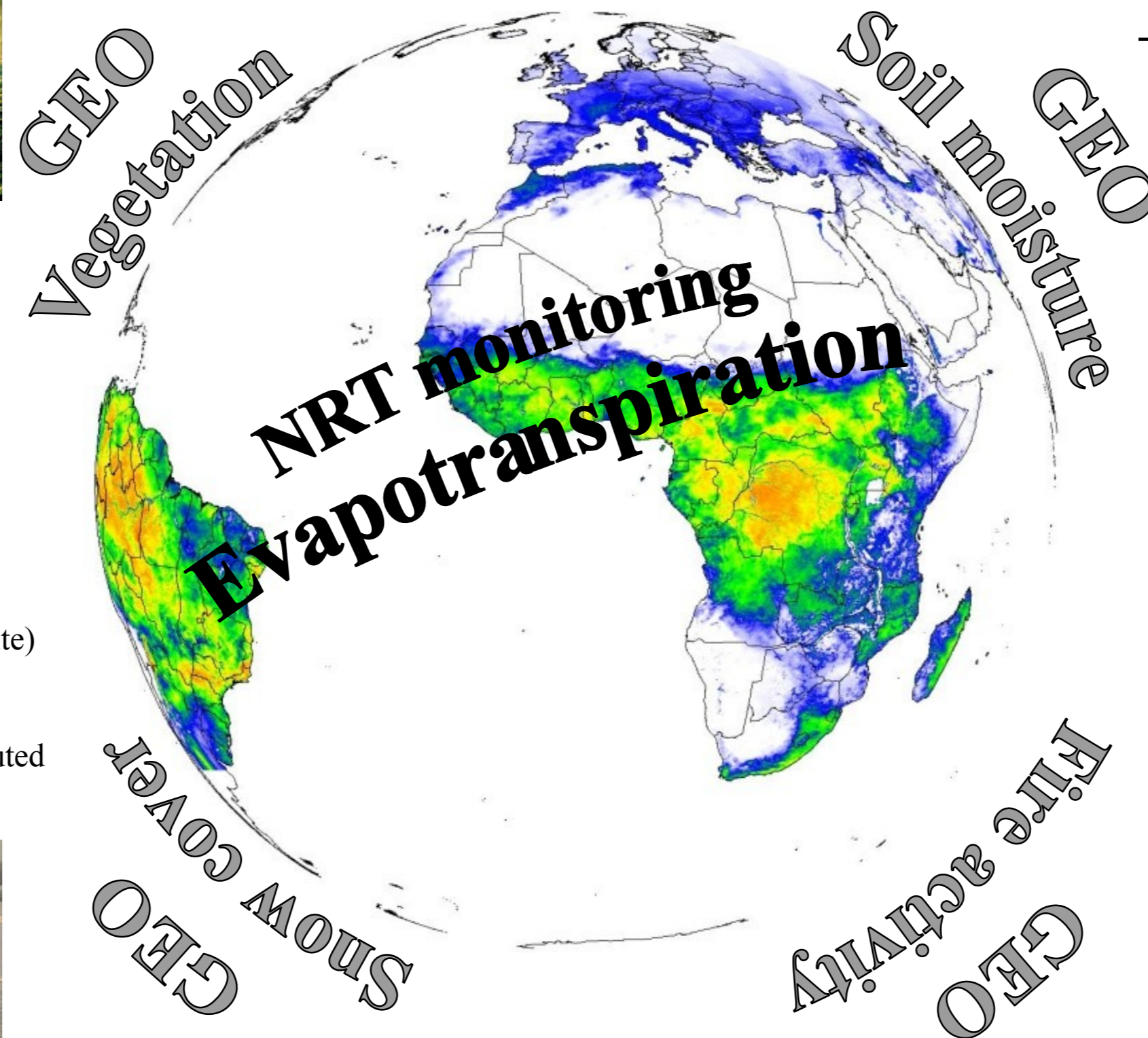
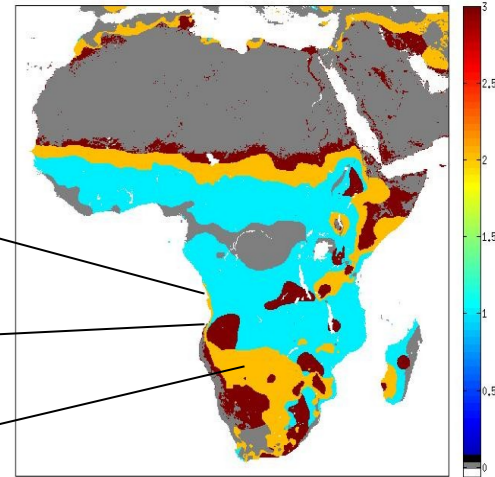


Mask applied to select the SM input.

Only ECMWF (IFS or H-SAF)

Only LST

ECMWF & LST



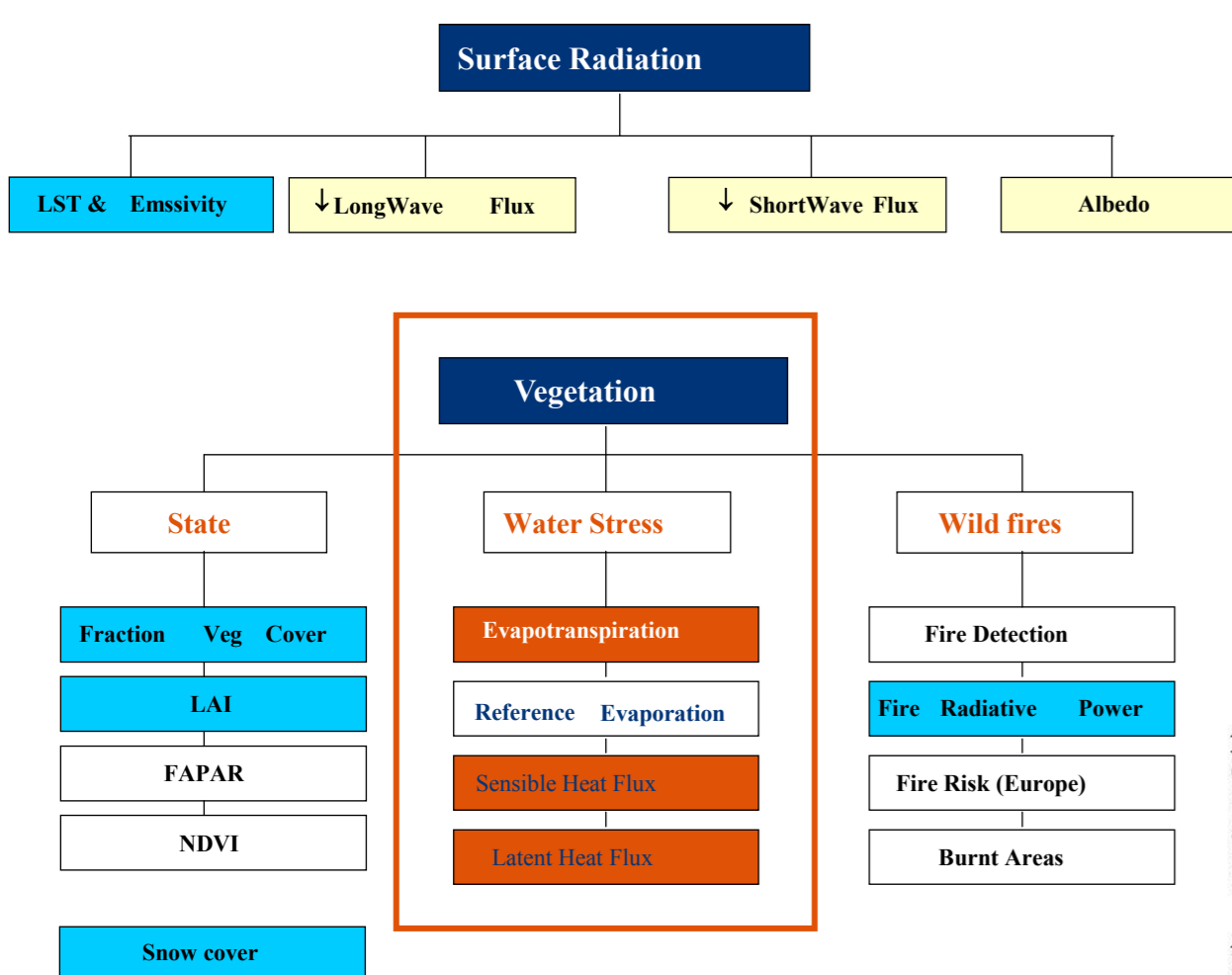
### Fire radiative power is used every 30 minutes.

Strategy:

- Screen LST data (unreliable)
- Modelling of latent heat released by fire activity.



## LSA-SAF products portfolio



Products and documents available on <http://landsaf.ipma.pt>

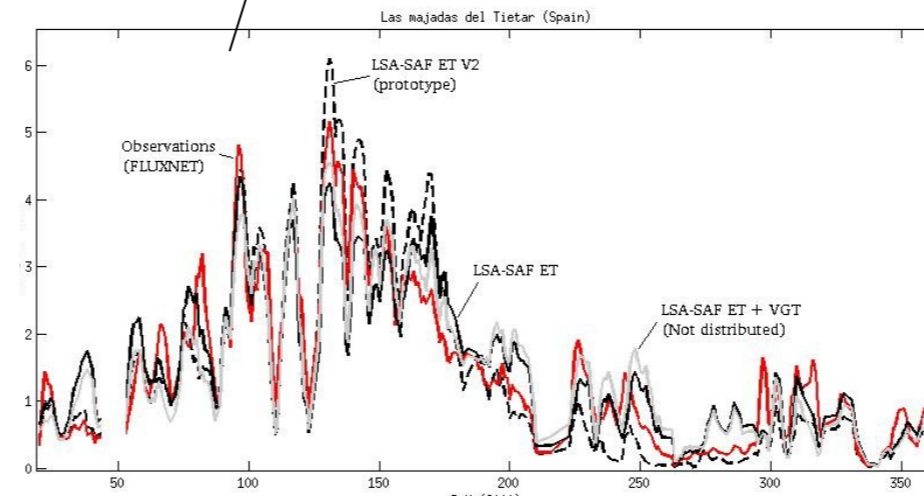
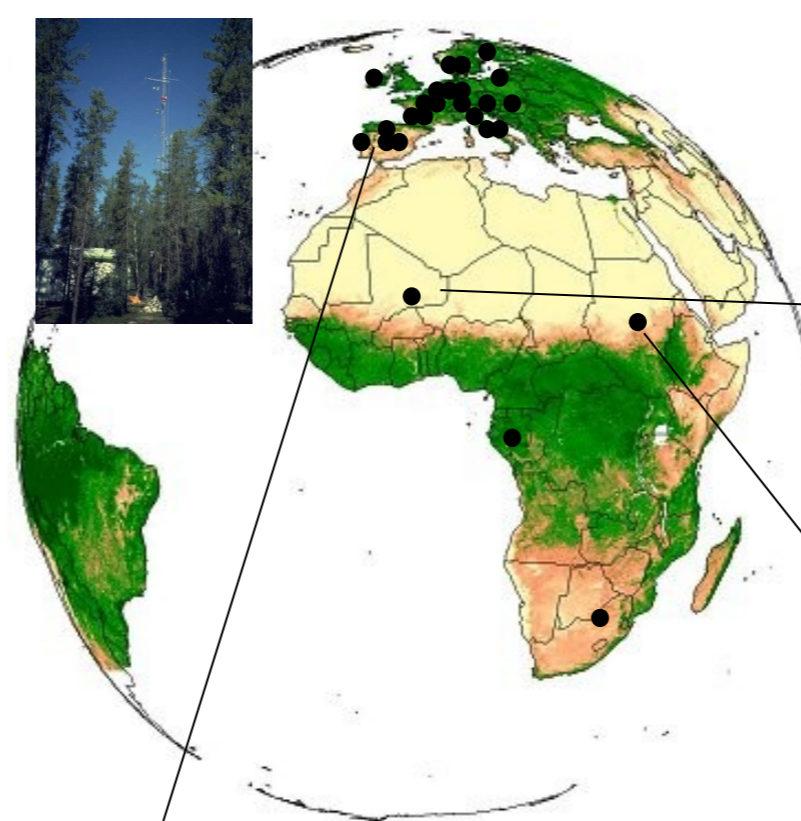
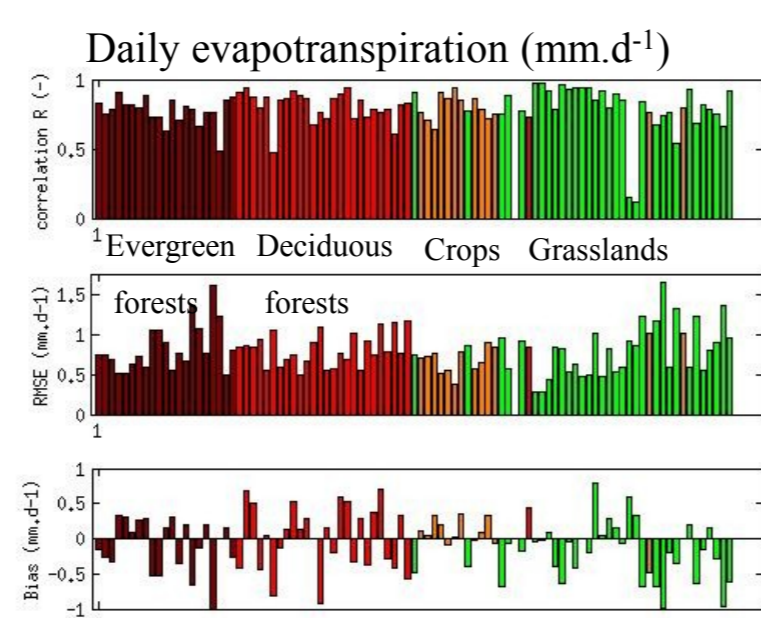
## LSA-SAF ET v2 prototype in-situ validation

Comparison for 96 sites-years

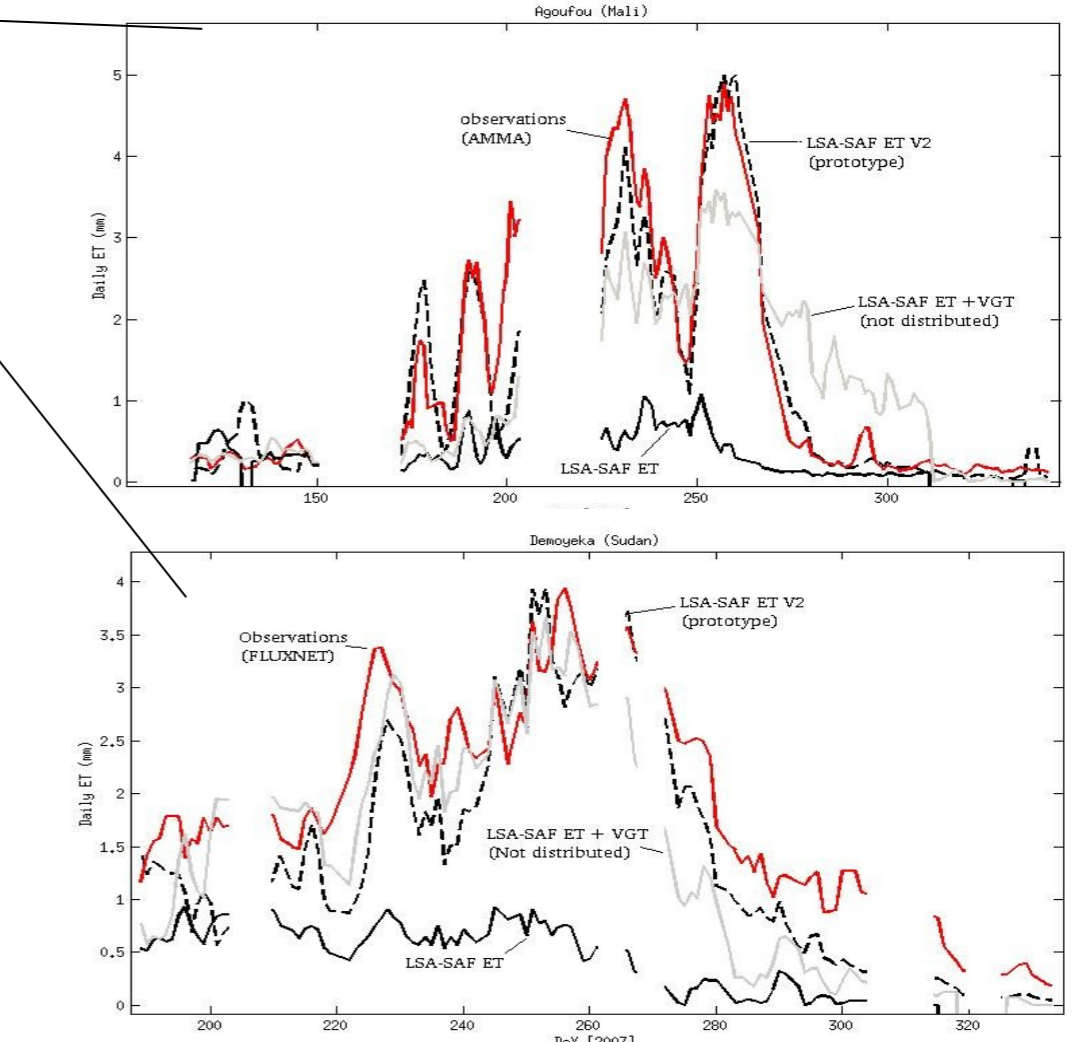
- 30 min and daily
- ET, LE, H, Rnet
- Forests, crops, grass, shrublands, savannahs

Cross-validation:

LSA-SAF ET surface temperature vs LSA-SAF LST.



The combined use of vegetation variables and soil moisture from LST considerably improves the model performances over arid and semi-arid regions of Africa.



## Discussion

LSA-SAF ET v2 is expected to deliver ET (30 min, 1 day), H and LE (30 min) in LSA-SAF in 2016 with MSG and in 2019 with MTG. The methodology seems applicable to other geostationary satellites and could provide global coverage. Opportunities from LEO satellites could provide useful additional information (eg soil moisture from MetOp/ASCAT, vegetation from Proba-V/Sentinel, land surface temperature from Sentinel).

