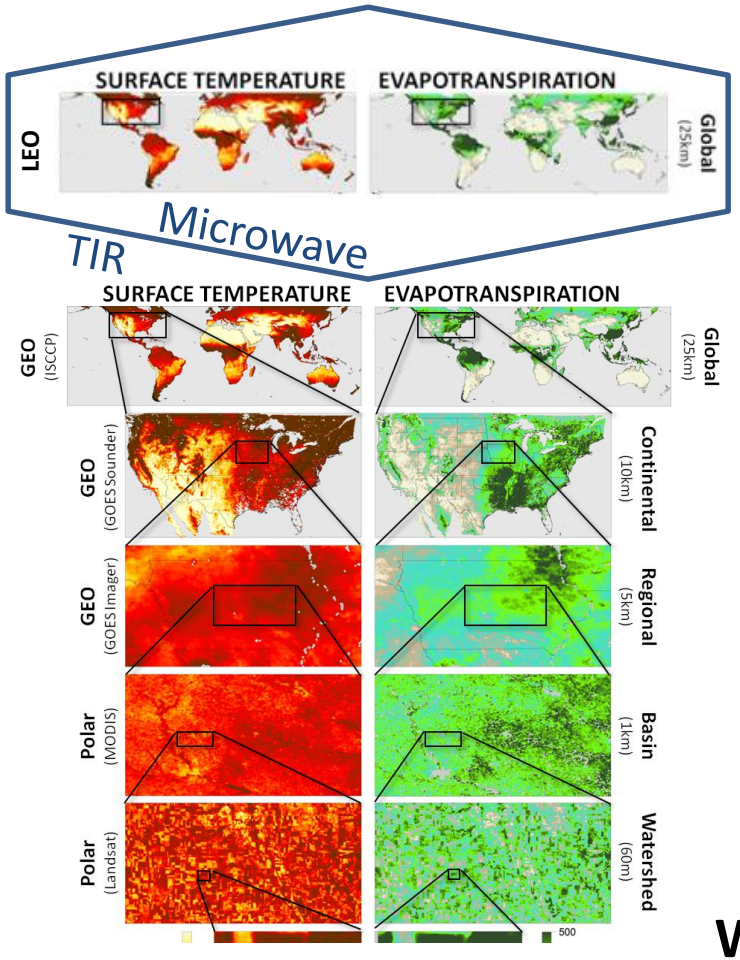

EXPLOITING HIGH TEMPORAL RESOLUTION DATA FROM TROPICS FOR MODELING SURFACE ENERGY FLUXES

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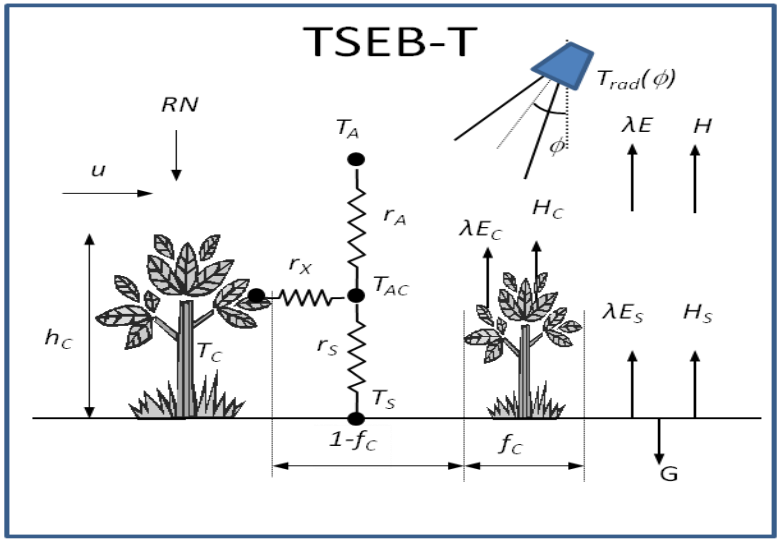
Context

- There is a need for observation-based methodologies to estimate evapotranspiration (ET) at diverse spatial domains.
- The ALEXI methodology (Atmosphere Land Exchange Inverse) is a thermal-based implementation of the two-source energy balance method: it provides one of the most direct estimates of actual ET.



Satellite Derived Inputs:

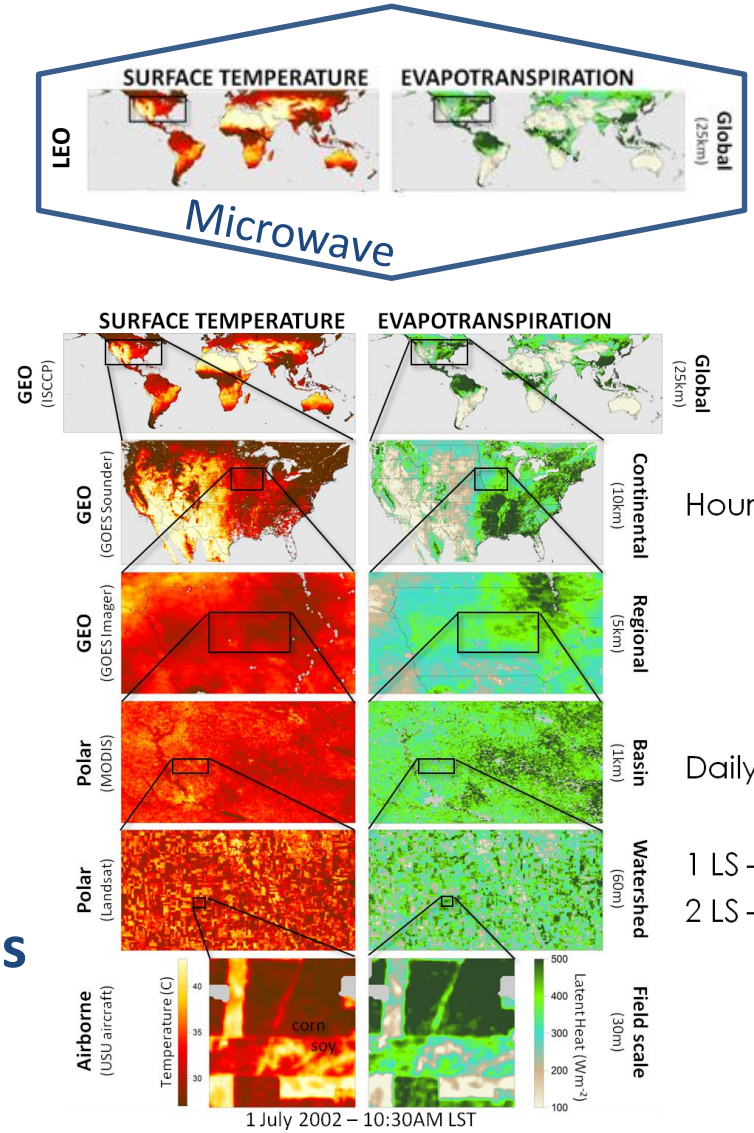
- Trad: Radiative Temperature
- RN: Net Radiation
- fc: vegetation cover fraction

Context

- ALEXI integrates measurements at multiple spatial scales depending on application:
  - *Field Scale*: crop water use
  - *Regional scale*: early indicator of agricultural drought
  - *Continental to global scales:* impacts of climate/land-use change.
- A key input is the morning rate of change in Land Surface Temperature (LST).

MW-LST: LST for clear and cloudy skies

- Using Thermal Infrared (TIR) based LST allows for field- to global scale applications.



Multi-scale ET maps using land-surface temperature from various TIR satellites

Methods
Land Surface Temperature from MW

- MW-LST: Ka-band (37 GHz) radiometer data from 8 satellites:

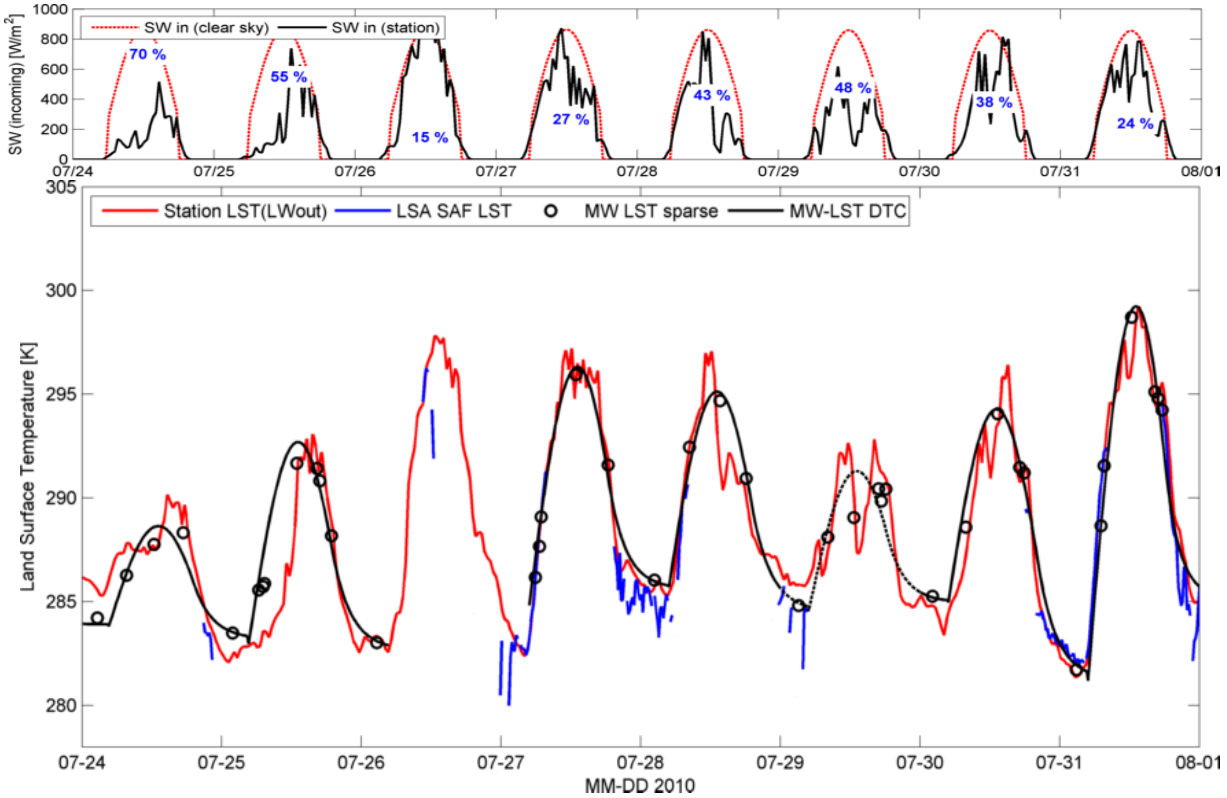
Radiometer	Platform	Overpass	Years
AMSR-E	Aqua	1:30 AM/PM	2002-2011
AMSR2	GCOM- W	1:30 AM/PM	2012-Present
SSM/I, SSMIS	DMSP F13-F18	7-9 AM/PM	2002-2011
WindSat	Coriolis	6 AM/PM	2003-Present
TMI	TRMM	Variable	1997-Present

→ Overall 5-10 observations per day

– All satellites inter-calibrated with TMI as transfer reference

- TIR-LST for calibration:
  LSA-SAF LST product, as based on thermal infrared radiometer on geostationary MSG -9, upscaled to 0.25 degree resolution

Methods
Land Surface Temperature from MW



- In situ data: LST (from long wave radiation), weighted average
- TIR-LST: sampling poor due to clouds
- MW-LST: sampling during clear and cloud-covered periods
- MW-LST: diurnal fit to sparse data

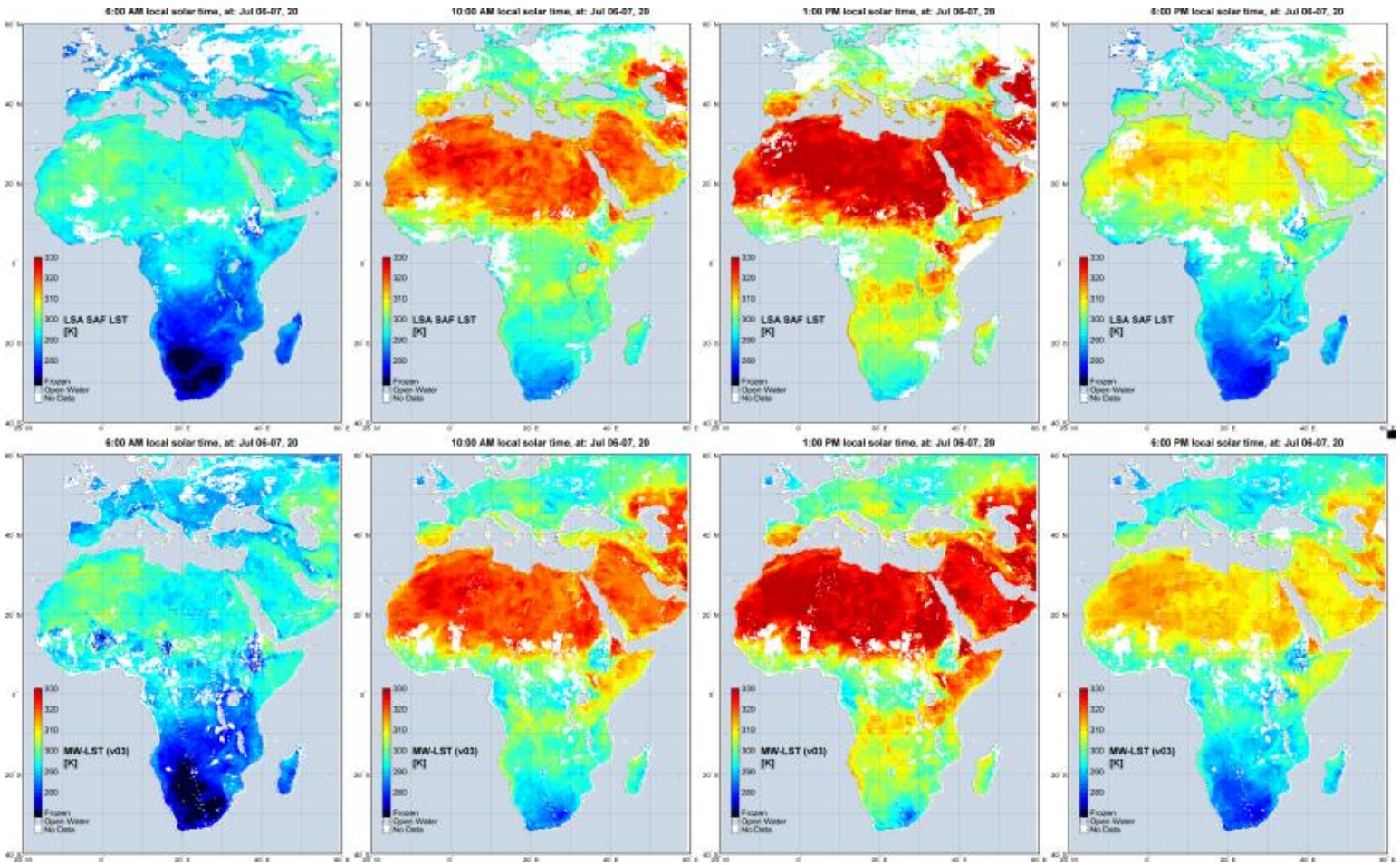
Land Surface Temperature
Every 15 minutes, 0.25 degree resolution

2-day composites

6AM 10AM 1PM 6PM

TIR
LSA SAF LST
MSG-9
(geostationary)

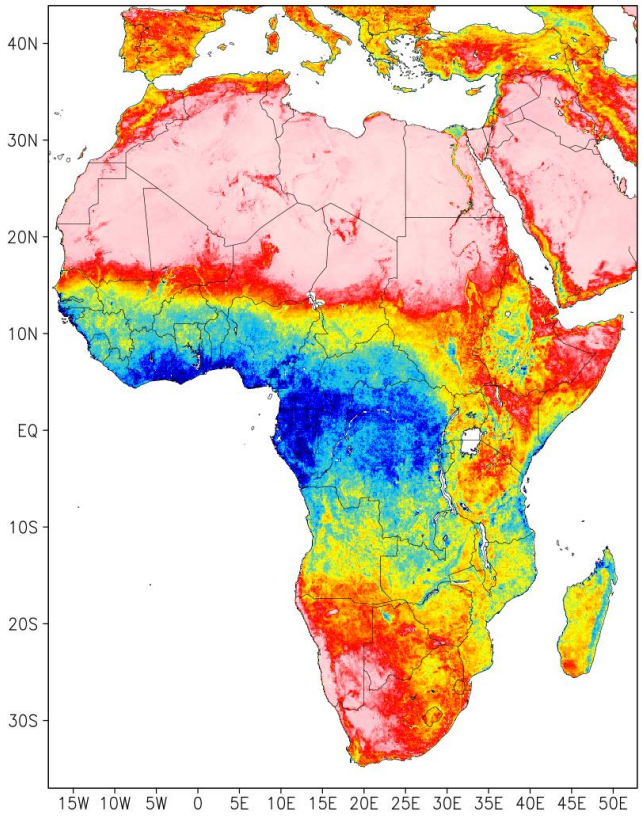
MW LST
Combination of
Low orbiting
Satellites

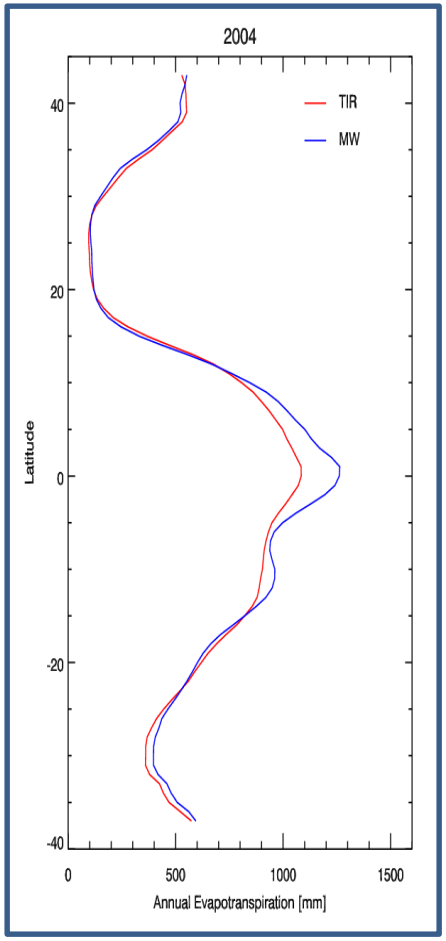


Experiment with MW-LST in ALEXI

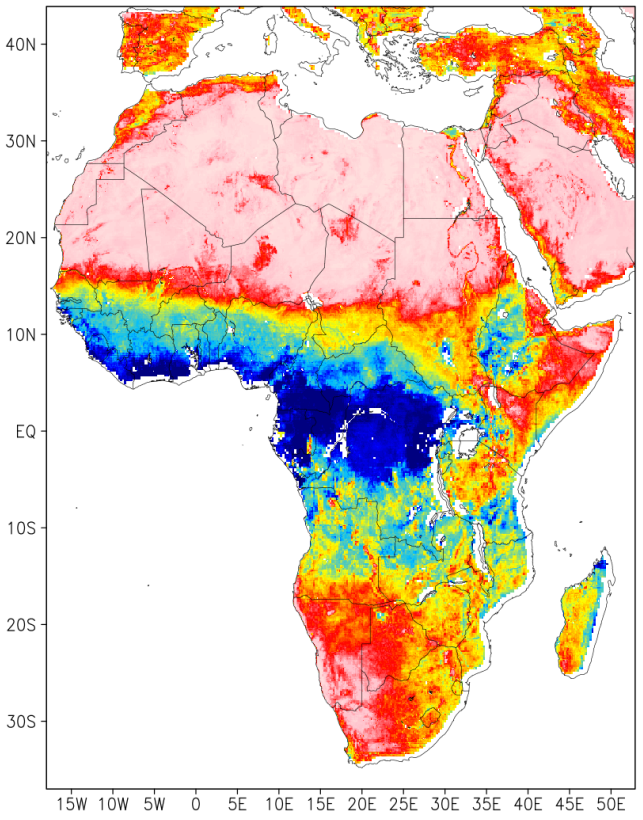
Cumulative - Clear Sky - Evapotranspiration (mm)
2004

TIR-ALEXI

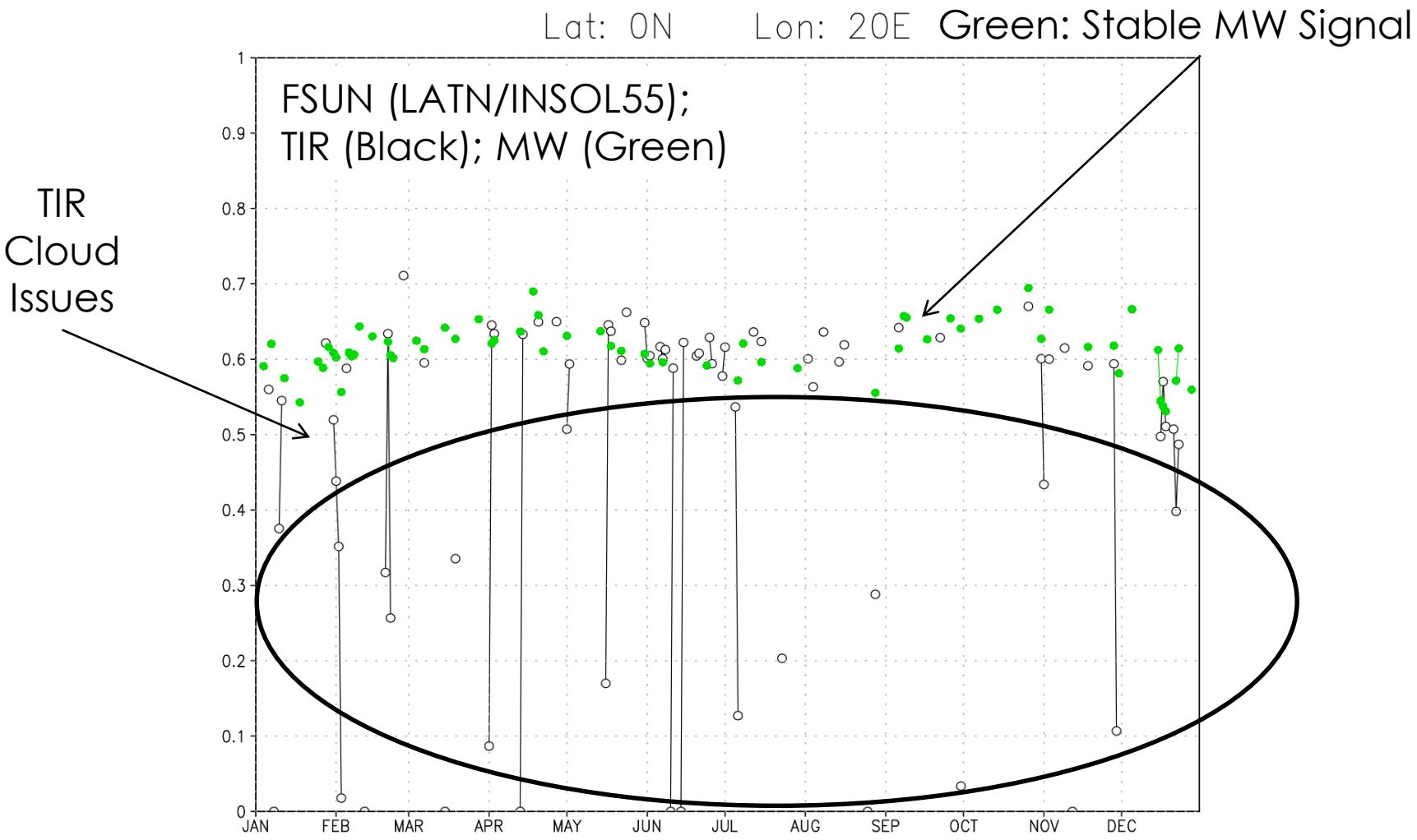




MW-ALEXI



Experiment with MW-LST in ALEXI
Time series example for Congo



Potential Synergy with TROPICS

- The improvements to temporal sampling from TROPICS will provide a unique opportunity to provide the diurnal details in LST that have not been possible with the current constellation of MW sensors.

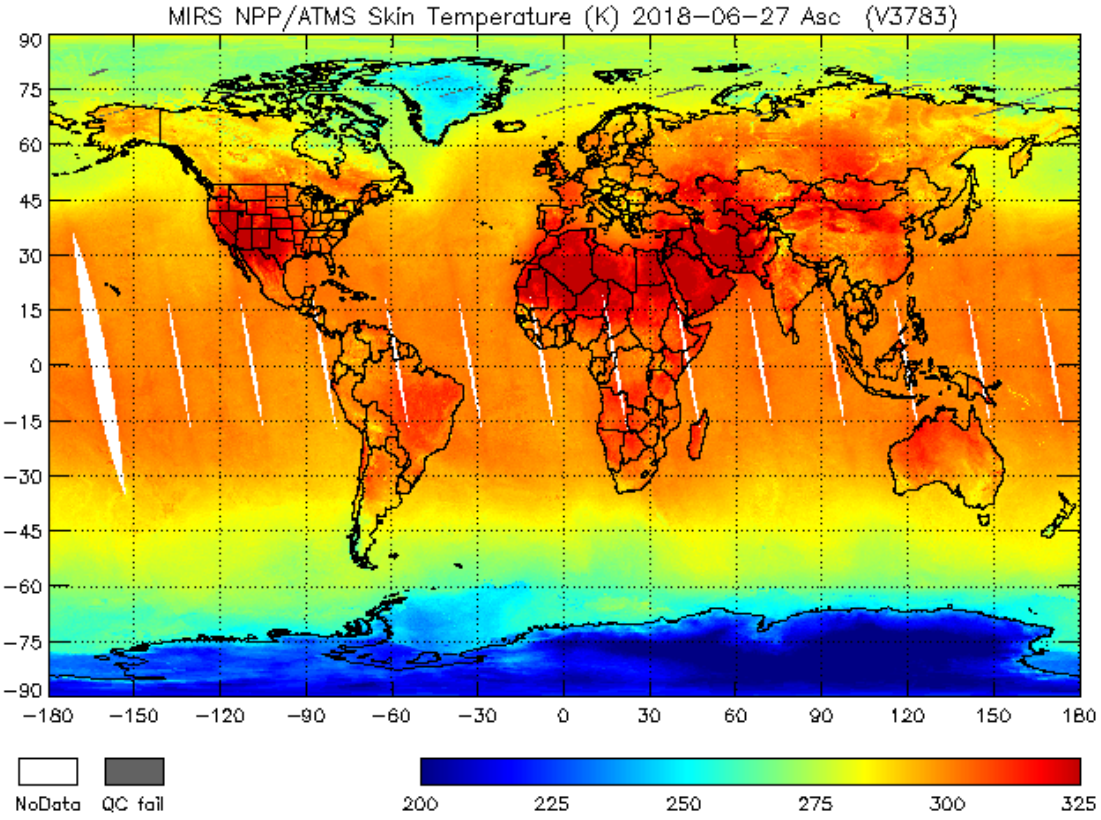
- *Caveat: TROPICS doesn't have Ka-band (37 GHz) observations so while we can directly apply TROPICS observations to our current MW LST retrieval algorithm there are potentially several ways that TROPICS data can be integrated into our surface energy balance applications….*

Potential Synergy with TROPICS

Using Data Assimilation to "retrieve" Skin Temperature:

- **Microwave Integrated Retrieval System (MIRS) - Algorithm Description**

The Microwave Integrated Retrieval System (MIRS) is an iterative, physically-based retrieval algorithm (1DVAR), whose principle is to minimize a two-source penalty function. This cost function is composed of; (1) the departure of the simulated radiances from the actual measurements and (2) the departure of the retrieved parameters from their respective backgrounds.



Potential Synergy with TROPICS

Using 90 GHz Tb Time Series to Improve Specification of Diurnal LST from 37 GHz:

- As seen below there are times where the temporal fit of diurnal LST is based on only a few sparse observations from MW.

- There is a potential to use the high temporal resolution observations from TROPICS at higher MW wavelengths to develop relationships to improve the diurnal fit used in our retrieval of LST from 37 GHz observations.