

Utilizing the rapid revisit of TROPICS observation for improved surface characterization for terrestrial application

By

Saswati Datta

Data and Image Processing Consultants, LLC

Overview

- Background – GPM related research
- Advantage of using TROPICS data
- Application

Current Research: Prototype Tool developed using GMI to support the GPM XCAL Activity

Objective of existing tool: Identify dry/arid pixel for intercalibration.

Used brightness temperature diurnal amplitude and Second Stokes parameter to develop the tool.

Assumptions:

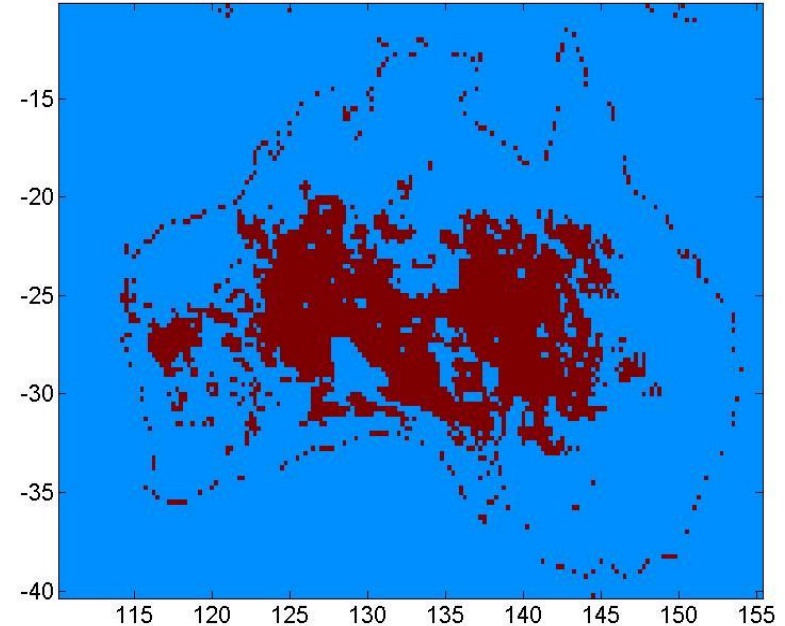
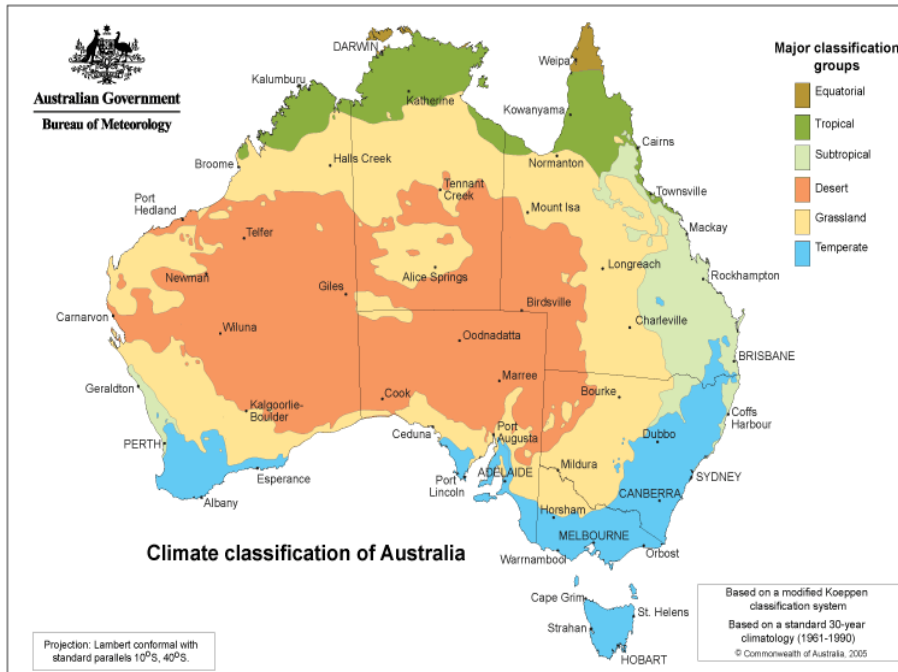
- 1) Diurnal amplitude maximum over arid pixels; and
- 2) $(T_V - T_H)$ about 25-40 K depending on the channel frequency.

Both diurnal amplitude and second Stokes parameter should also demonstrate minimal seasonal and spatial variability.

For details :

Datta S., W. L. Jones and R. Chen, 2018: Identifying Desert Regions for Intercalibration of Satellite Microwave Radiometers, accepted for publication in future issue of IEEE JSTAR, DOI:10.1109/JSTARS2018.2796184

Mask qualitative validation

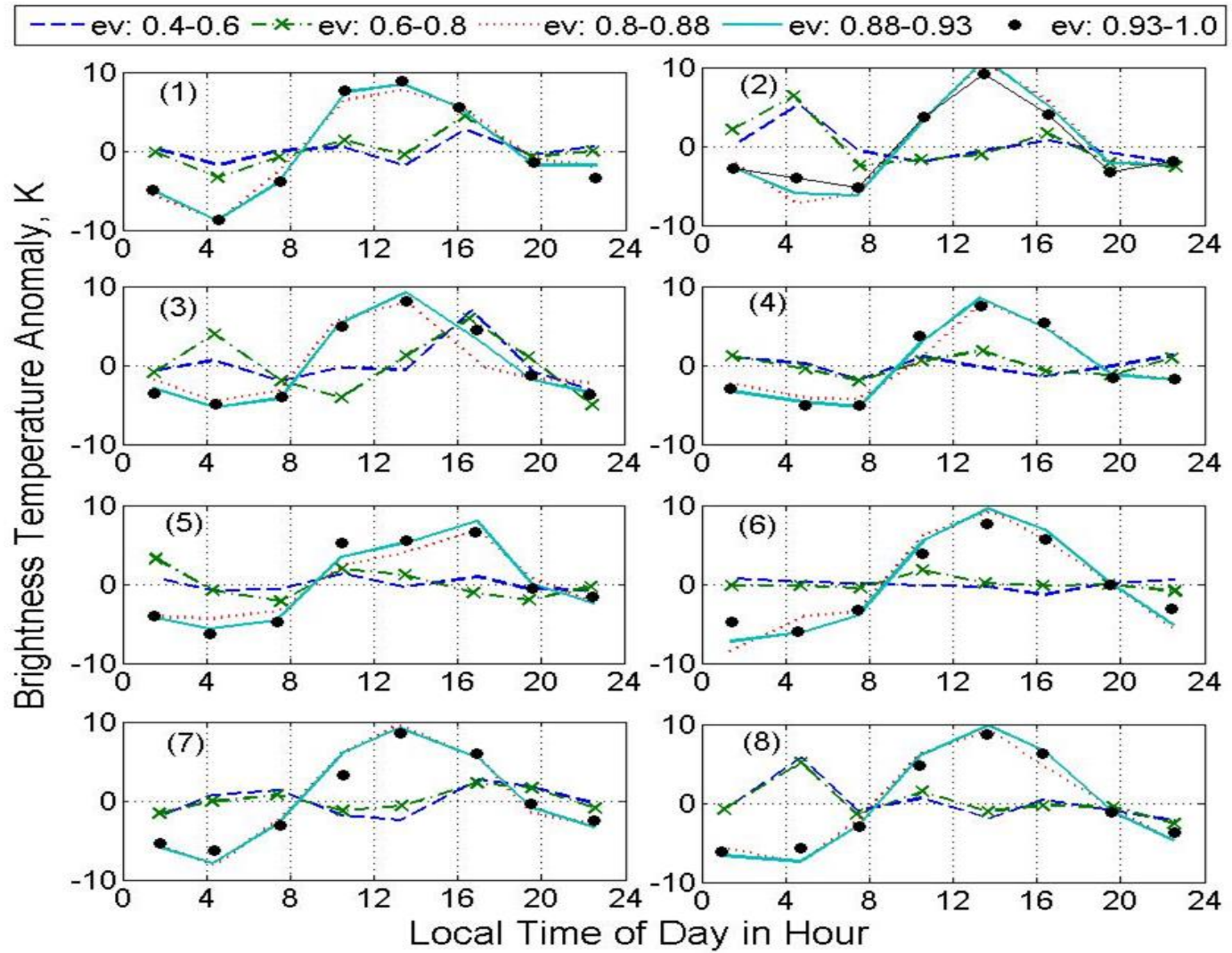


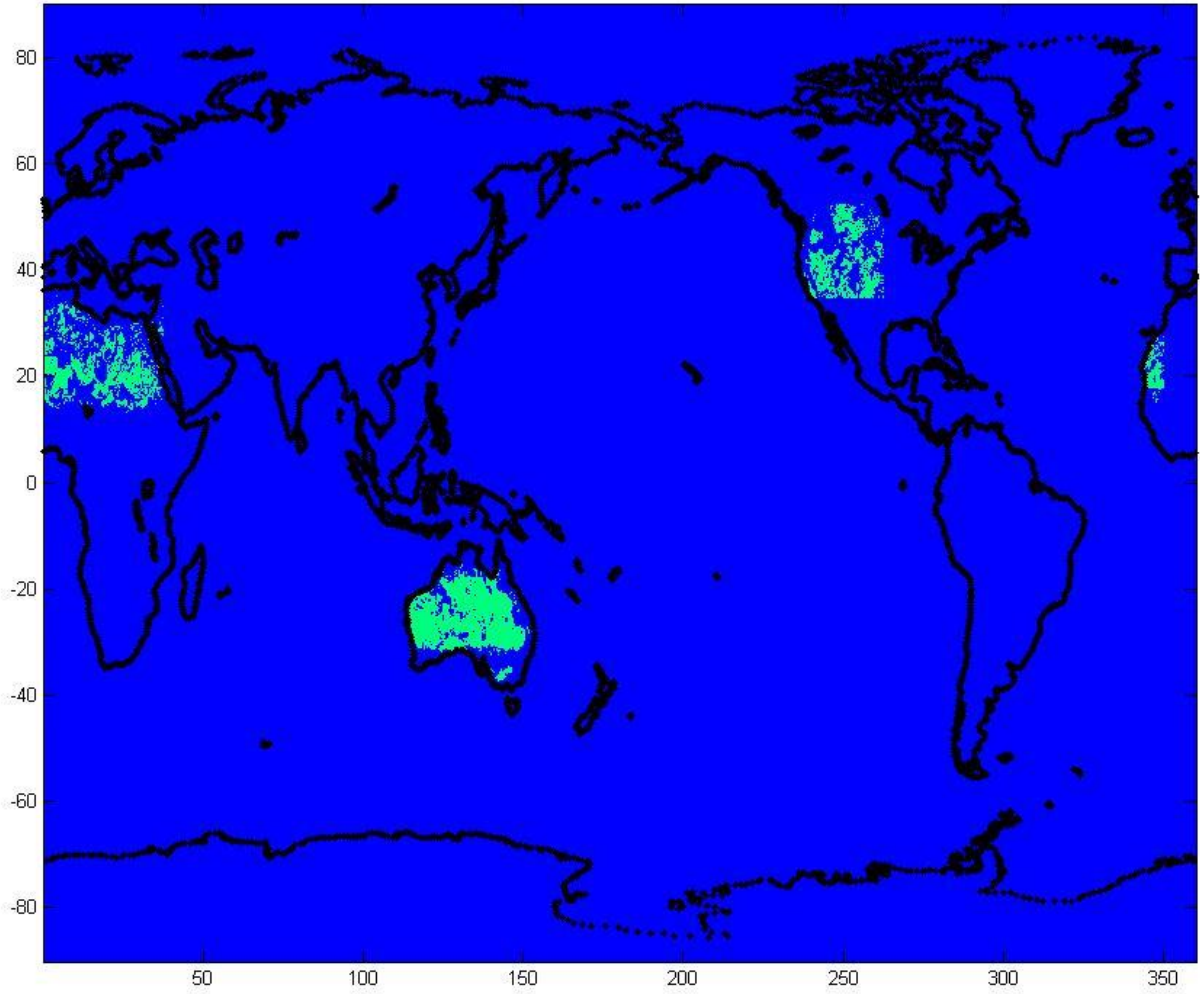
- SHOWMask tool did a very good job in identifying the desert region in continental Australia.
- The tool is able to identify even embedded small grasslands in the desert.

Key to Estimating Diurnal Variation

- Non sun-synchronous orbit of GMI
 - 83 day precessing orbit with 65° inclination
 - About 17 minute displacement in local overpass time over consecutive ascending or descending overpass
 - About 12 hours separation between ascending and descending pass near equator
 - Combining ascending and descending observations over 42 day period, it is possible to capture the full diurnal cycle

Example Tb diurnal anomaly for GMI 10 V channel for year 2015





Advantage of TROPICS rapid revisit

- TROPICS **rapid revisit time of 30 -60 minutes** with six cubesat constellation in 3 orbital planes, presents an **unique opportunity** to produce more dynamic surface classification map.
- As noted in our prototype analysis, not only the amplitude but the shape of the diurnal profile carries important information. So a 3 parameter unsupervised K-mean clustering can produce surface type classification without using any external ancillary data.
 - TROPICS cubesats will have passive microwave spectrometers that are cross track scanners – so there will be quasi polarized observation on both sides of nadir, which will be even more useful as per understanding impact of polarization difference on surface radiative state.
- The plan is to use the 90 GHz channel.
- Further, using an effective temperature formalism, we can easily estimate the surface emissivity at 90 GHz, as

$$\epsilon_{surf}^p(\nu) = \frac{T_B^p(t, \nu)}{T_{eff}^p(t, \nu)}$$

Where

$$T_{eff}^p(t, \nu) = T_{day}^{LST}(t_0) + \frac{\Delta T_B^p(\nu)}{\Delta t} (t - t_0)$$

Application

- Microwave **Precipitation retrieval over land** is challenging due to
 - Poor contrast
 - Heterogeneous surface type, soil type, texture, extent of vegetation cover, vegetation type, proper physical temperature of the soil layer etc.
 - Precip. retrieval is particularly sensitive to understanding accurate dielectric state of the surface.
 - Which depends on proper surface class
- Using microwave brightness temperature observation only it is possible to obtain dynamic surface classification
 - The diurnal pattern can be used to estimate effective surface temperature thereby improving the estimate of dynamic surface emissivity
 - Improved precipitation rate retrieval over land.
- Other Application:
 - Surface hydrology: Recession of flood water, change detection and tracking – due to the rapid refresh of TROPICS data, there will be opportunity to quick change detection of surface radiative state using the effective temperature formalism and also from the time series of the dynamic surface classification – even a 3 hour latency will be enough for mitigation and emergency management efforts following a sudden flooding.
 - Tracking areas that are losing vegetation or getting relatively arid will help in agricultural and land use planning.
 - Nesting GPM/TRMM based classification with TROPICS classification for validation and sub grid scale surface characterization – Insurance damage assessment- forensic meteorology application

Questions??

- Please contact: Saswati Datta

(919) 599 2033

sdatta@dniconsultants.com

Thank you for your attention.