Dynamic Emissivity Estimates to Support Physical Precipitation Retrievals for GPM

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Outline

Land surface microwave emissivity …

1. How dynamic?
2. What land surface variables control it?
3. How to model it?
4. How well do the models perform?

1. Observational study of the dynamical behaviors of land surface microwave emissions

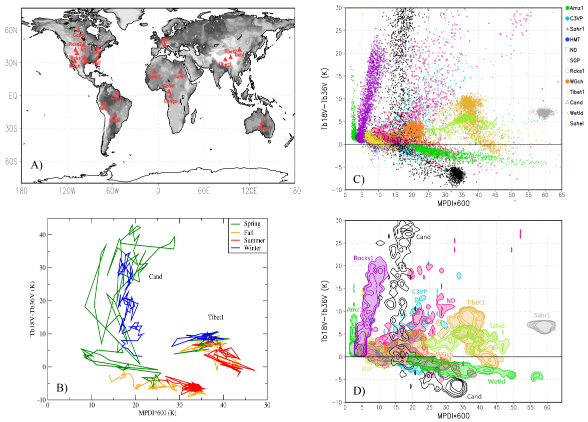

Figure 1. Dynamical regimes in the MPDI-vs.-(Tb18V-Tb36V) phase space for 12 diverse land surface types.

A) Locations of the study sites;

B) The seasonal evolutions of two sample sites for a one-year period (Dec. 2009—Nov. 2010).

C) The regime for the sites as constructed from 7-year AMSR-E descending-pass (nighttime) record.

D) The corresponding density plot.

MPDI is defined as:

$$MPDI = \frac{Tb_v - Tb_h}{Tb_v + Tb_h}$$

with Tb values at 10.65 GHz.

2. Emissivities are driven by many land surface variables

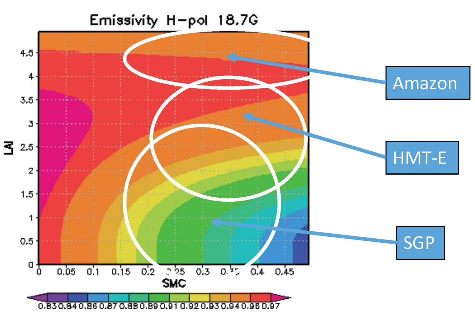

Figure 2. Over many flat, snow-free land surfaces, the emissivity is largely determined by the vegetation water content, which can be surrogated by LAI, and soil moisture (SMC). Thus the emissivity dynamics are controlled by the regional differences in SMC and LAI.

3. How to model microwave emissivity?

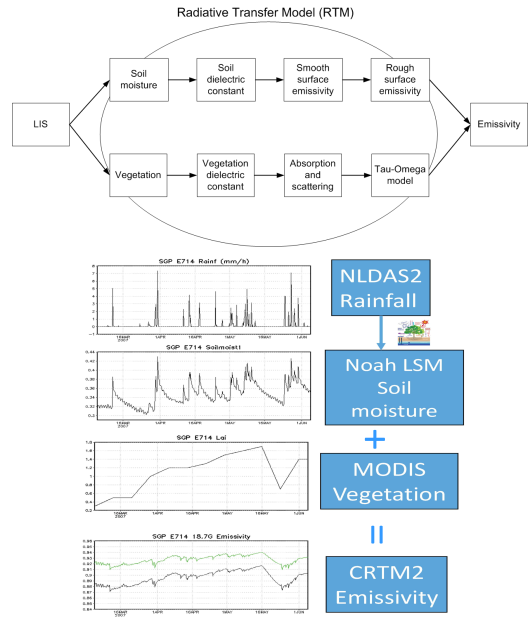

Figure 3. The NASA Land Information System (LIS) provides input (soil moisture, vegetation, etc.) to the radiative transfer models (RTMs), which in turn, compute the microwave emissivity at given frequencies, with a mixture of physical and empirical formulations.

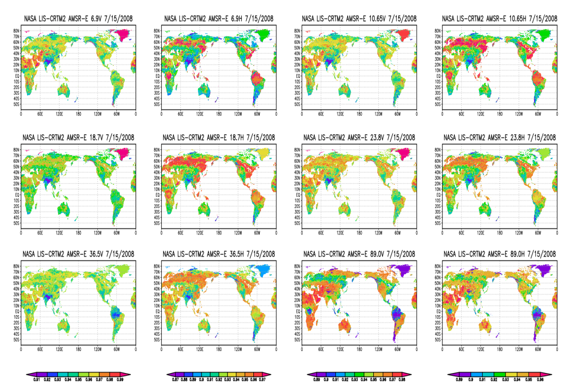

Figure 4. Global simulations of microwave emissivities at AMSR-E frequencies, for Jul. 15, 2008, produced by LIS-CRTM2 coupled runs. Detailed model configuration and data can be found at http://lis.gsfc.nasa.gov/PMM/le/.

4. Emissivity model validation

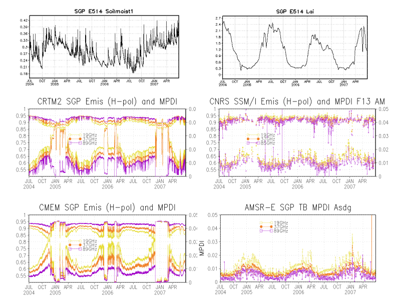

Figure 5. Qualitatively, LIS coupled with either CRTM2 or CMEM3 produced similar emissivity responses to land surface states. But there are quantitative differences, indicating the model parameters need to be calibrated. This is ongoing at GSFC.

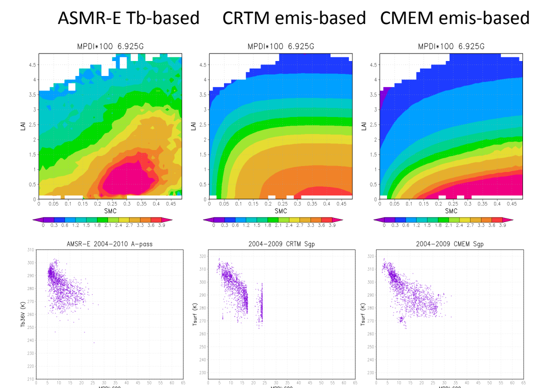

Figure 6. Both the regime diagram shown in Fig. 2 and the phase diagram in Fig. 1C can be used as powerful model validation tools to reveal structural differences between the models themselves and observations.

References

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