

Land Surface Microwave Emissivity: Modeling and Validation to Support Global Precipitation Mission

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

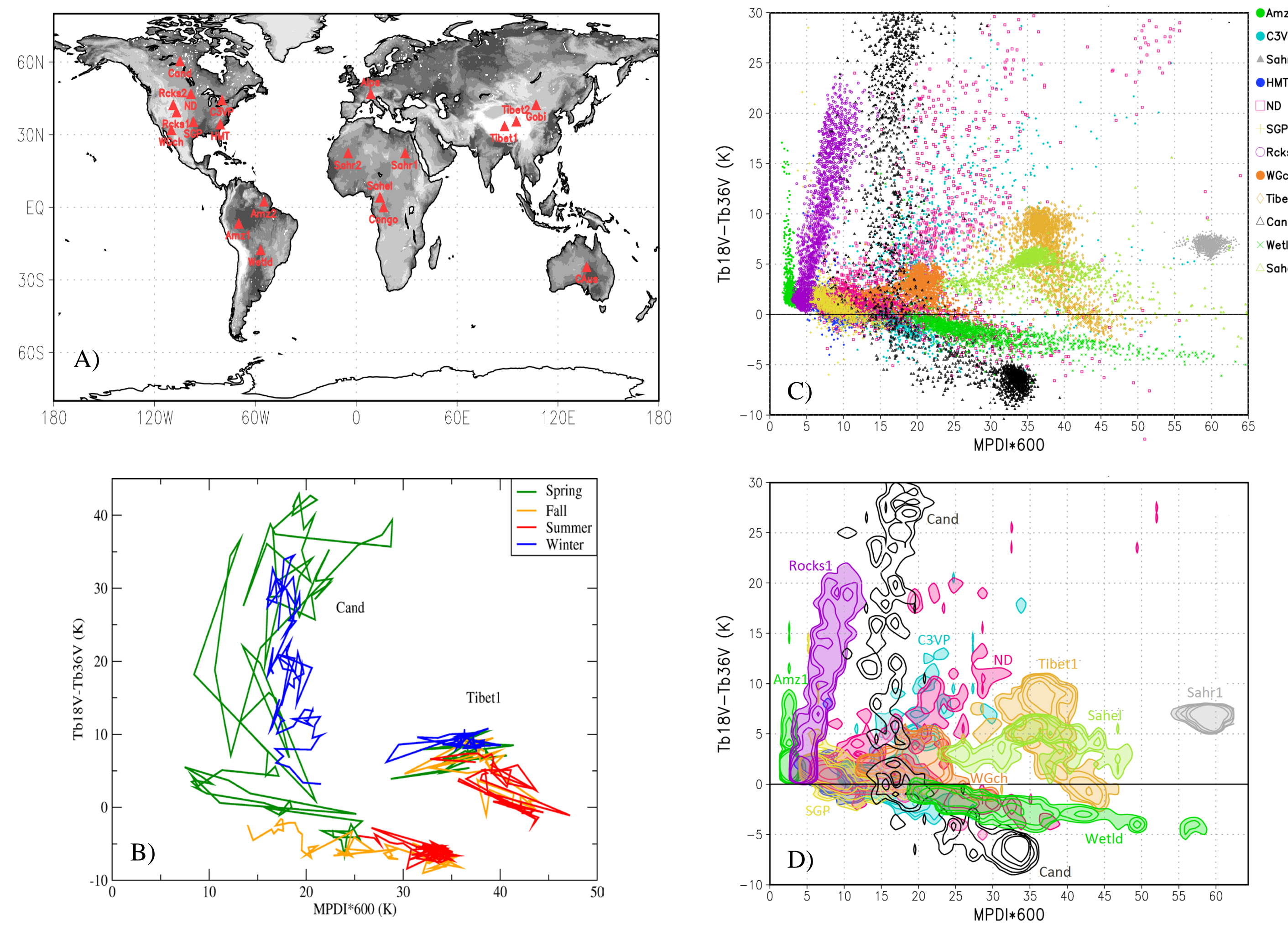


Figure 1. Dynamical regimes in the MPDI-vs.-(Tb18V-Tb36V) phase space for 12 diverse land surface types.

- 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

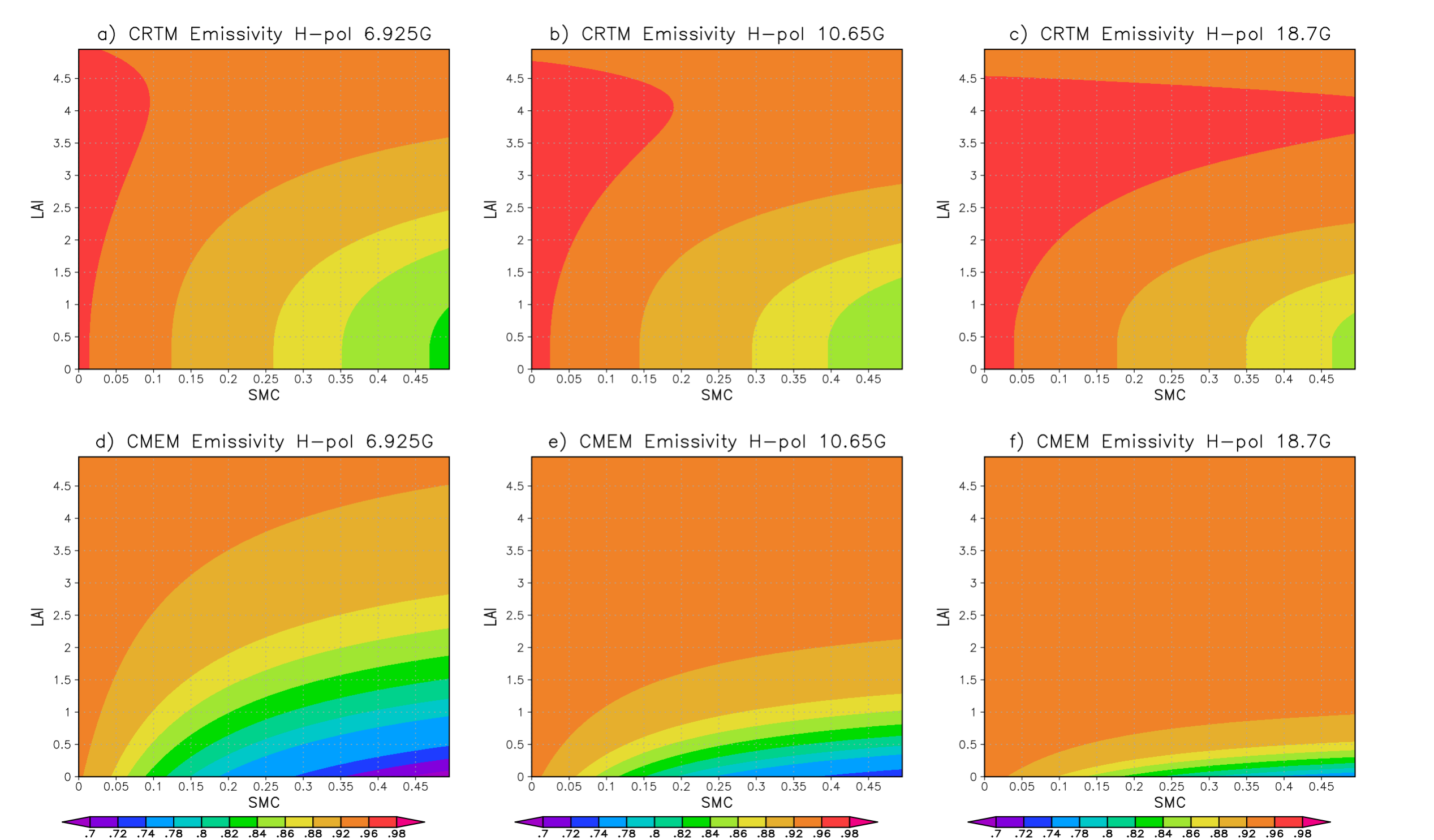


Figure 2. Sensitivity study of CRTM (top) and CMEM (bottom) with the SMC-LAI phase diagram for the emissivities of the three lower AMSR-E frequencies (from left to right, 6.925, 10.65 and 18.7 GHz). The values of other equivalent input variables for both models are: soil temperature: 300° K; skin temperature: 300° K; sand fraction: 20%; and clay fraction: 80%.

3. How to model microwave emissivity?

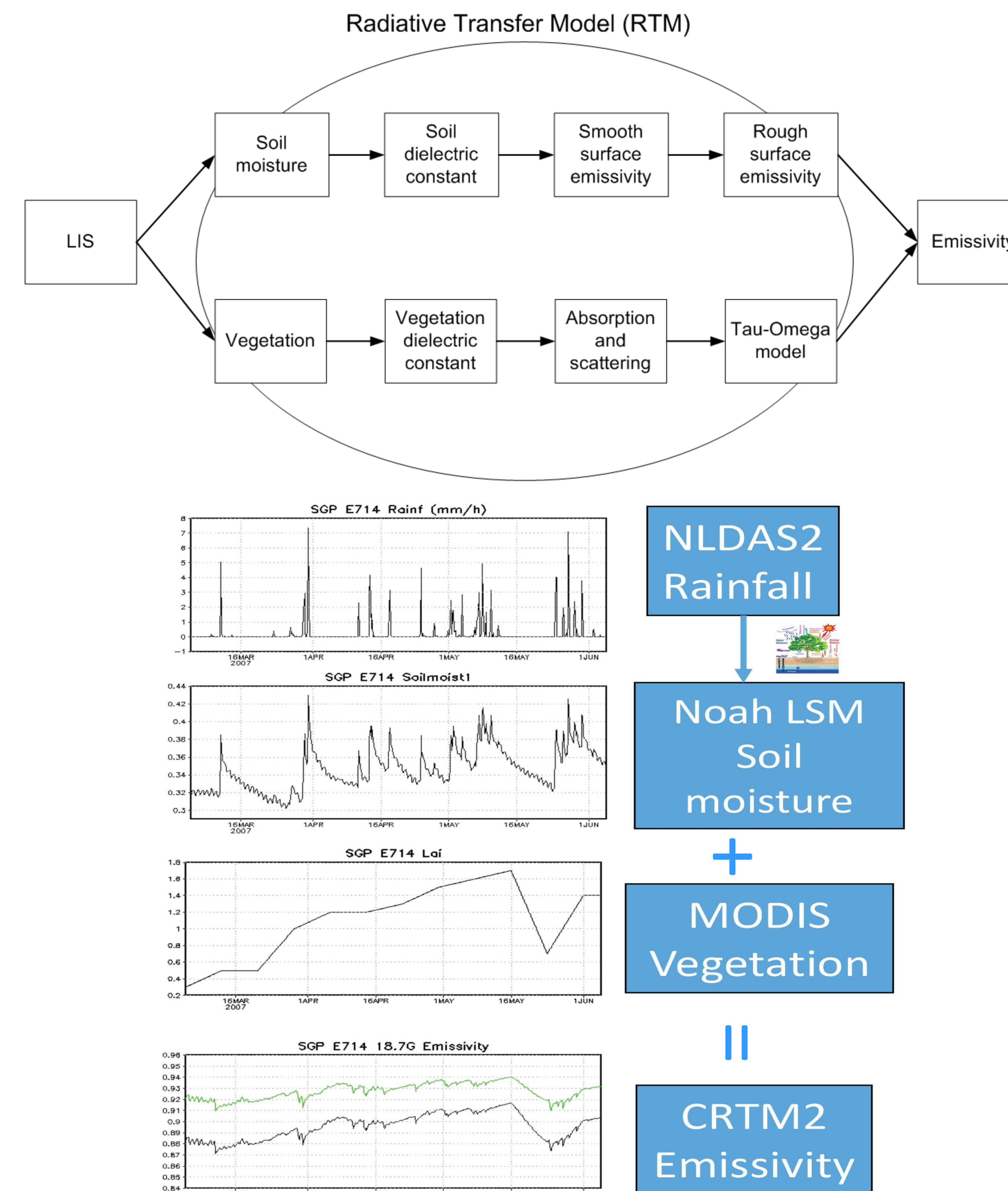


Figure 3. The NASA Land Information System (LIS) provides input (soil moisture, vegetation, etc.) to the radiative transfer models (RTMs), which in turn, compute the microwave emissivity at given frequencies, with a mixture of physical and empirical formulations.

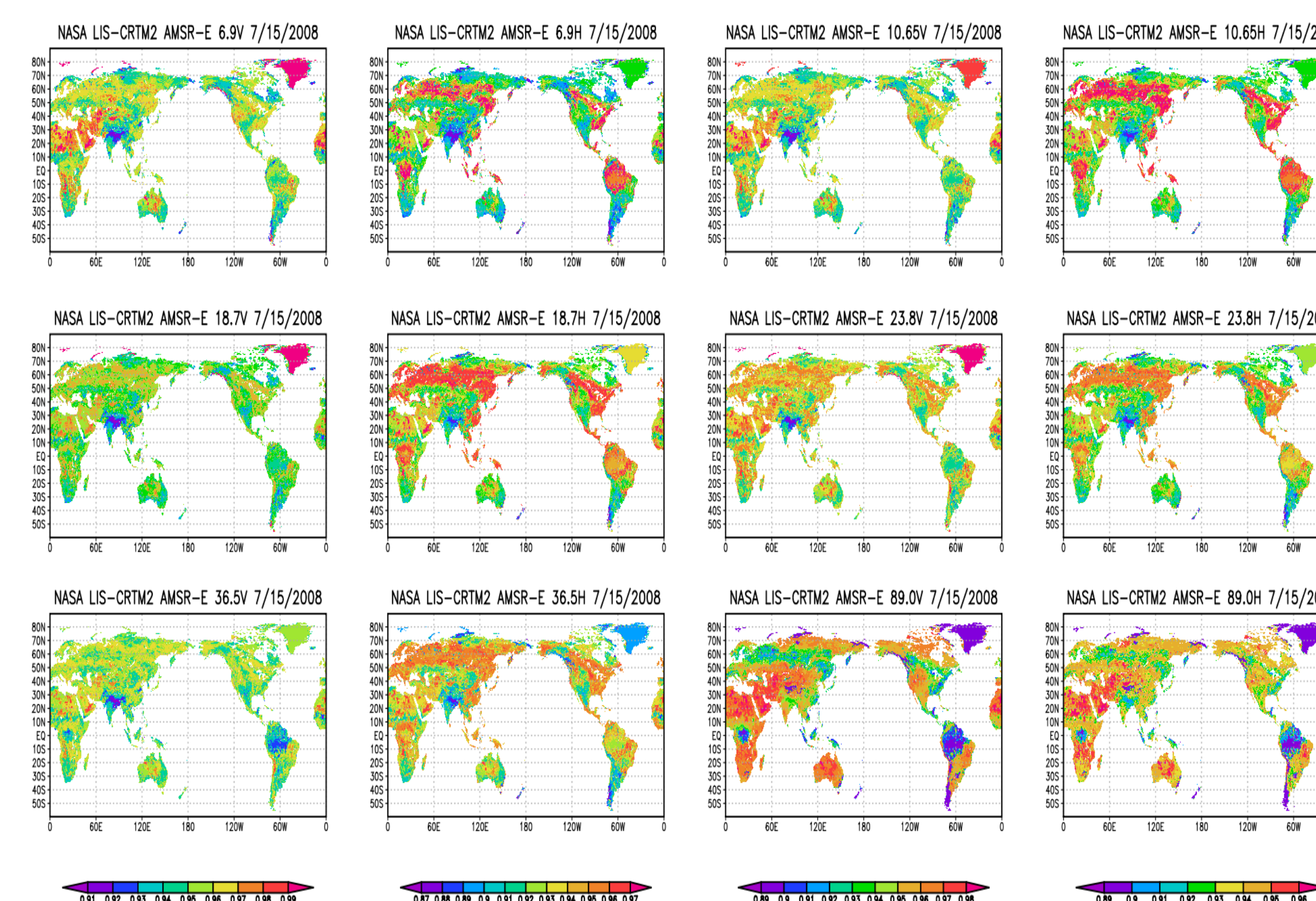


Figure 4. Global simulations of microwave emissivities at AMSR-E frequencies, for Jul. 15, 2008, produced by LIS-CRTM2 coupled runs. Detailed model configuration and data can be found at <http://lis.gsfc.nasa.gov/PMML/>.

4. Emissivity model validation

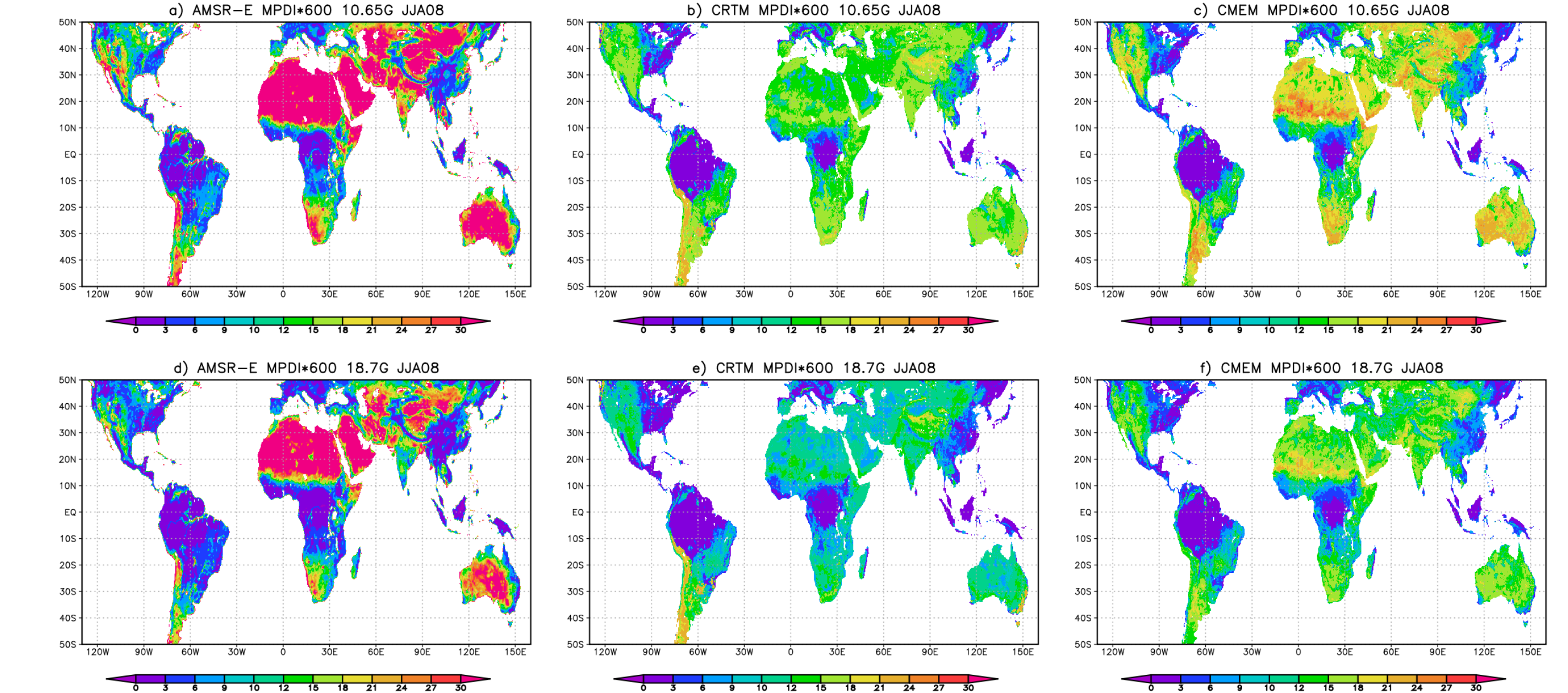


Figure 5. Comparison of seasonal mean of MPDI for the boreal summer (JJA) of 2008, between AMSR-E Tb-based MPDI (first column), CRTM (second column) and CMEM (third column), for 10.65 (top row) and 18.7 GHz (bottom row).

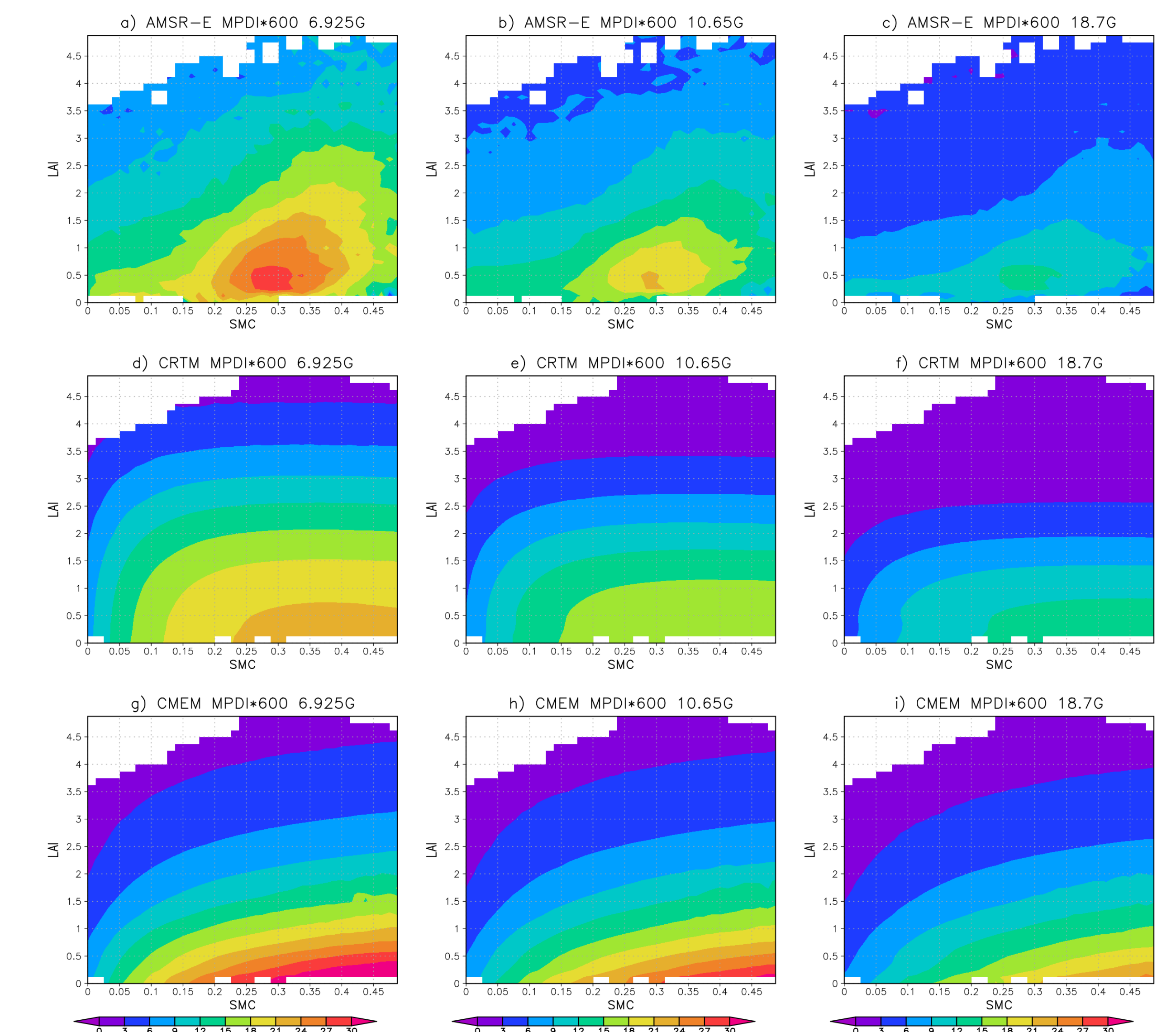


Figure 6. Comparison of SMC-LAI regime diagrams for MPDI computed from AMSR-E (top row), CRTM (center row) and CMEM (bottom row) over SGP, for AMSR-E's three lower frequencies (from left to right: 6.925, 10.65 and 18.7 GHz), for five years (July 2004 through June 2009).