

AMMA Land Surface Model Intercomparison Experiment coupled to the Community Microwave Emission Model: ALMIP-MEM



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ALMIP-MEM consists in an ensemble of simulations of C-band brightness temperatures (TB) over West Africa for 2006. Simulations have been performed for an incidence angle of 55 degrees and results are evaluated against C-band satellite data from the Advanced Microwave Scanning Radiometer on Earth Observing System (AMSR-E). The ensemble encompasses 96 simulations, for 8 Land Surface Models (LSMs) coupled to 12 configurations of the Community Microwave Emission Model (CMEM).

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Role of Soil Moisture in West Africa?

West Africa is a region known for its strong surface atmosphere interactions

One of the regions of strongest feedback of Soil Moisture on Precipitation.

SM, variable of interface

- Partition LE/H
- Vegetation phenology,
- Soil respiration,
- Biogeochemical cycle

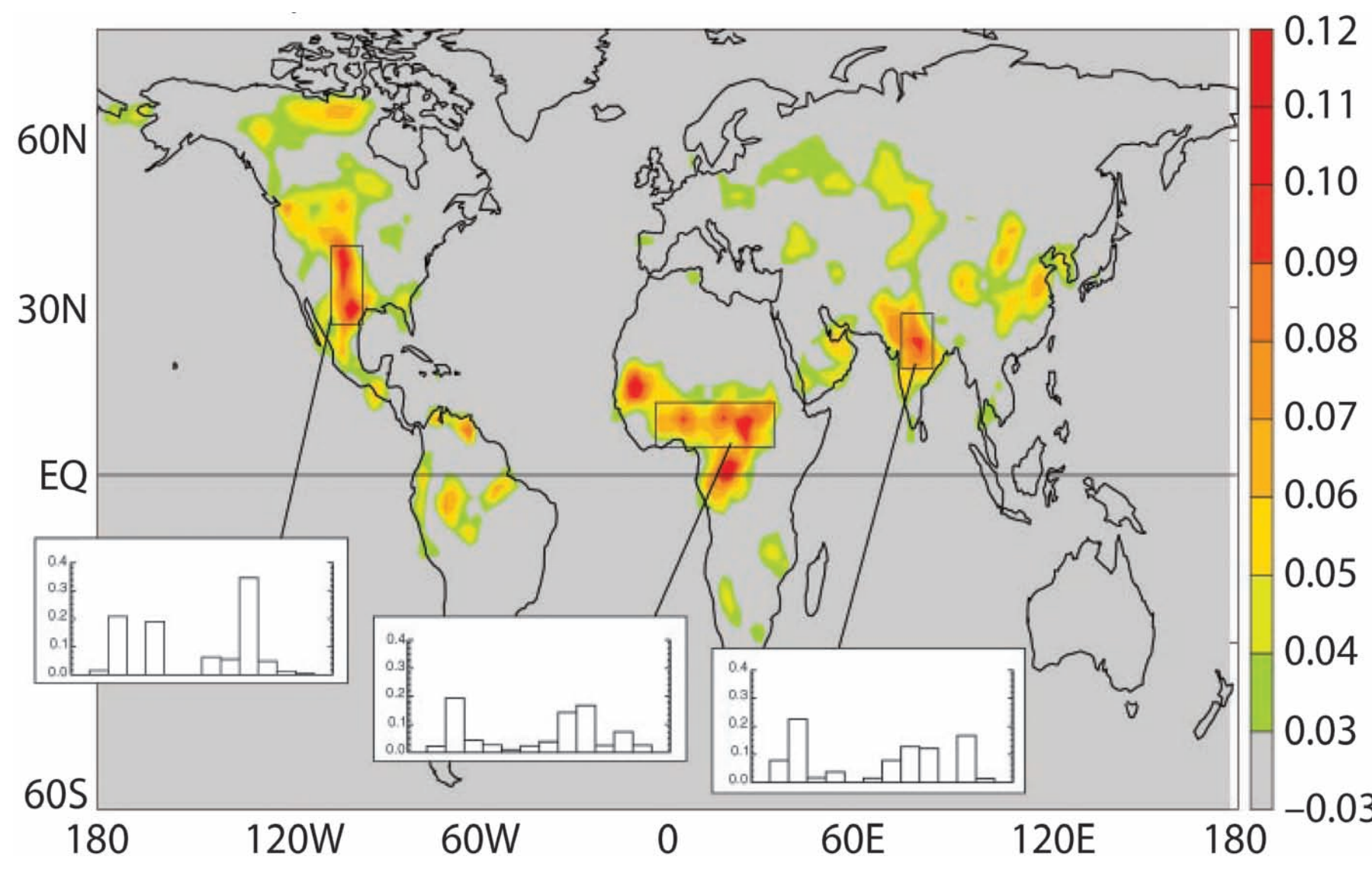


Figure 1 Land Atmosphere coupling strength (Koster et al., 2004)

CMEM – Community Microwave Emission Model

CMEM has been developed by ECMWF as the forward operator for low-frequency passive microwave brightness temperatures at 1 to 20 GHz.

The physics are based on a simplified solution of the vector radiative transfer equation, the tau-omega model. CMEM's modularity allows different parametrizations to be considered for the main components.

- ECMWF passive microwave low frequency forward operator.
- Based on the state-of-the-art in microwave emission modelling.
- Modular code: combines different parametrizations for computing surface and atmospheric emissions (figure 2).
- Flexible and modular Input/Output (grib,ascii, netcdf) and portable for any linux/unix systems.
- Specifically designed for L-band microwave emission for the future SMOS (Soil Moisture and Ocean Salinity, to be launched in 2009).
- Also applicable for a large range of Frequency: 1 GHz to 20 GHz (suitable RTTOV).

CMEM documentation and sources are available on:
http://www.ecmwf.int/research/ESA_projects/SMOS/cmcm/cmcm_index.html

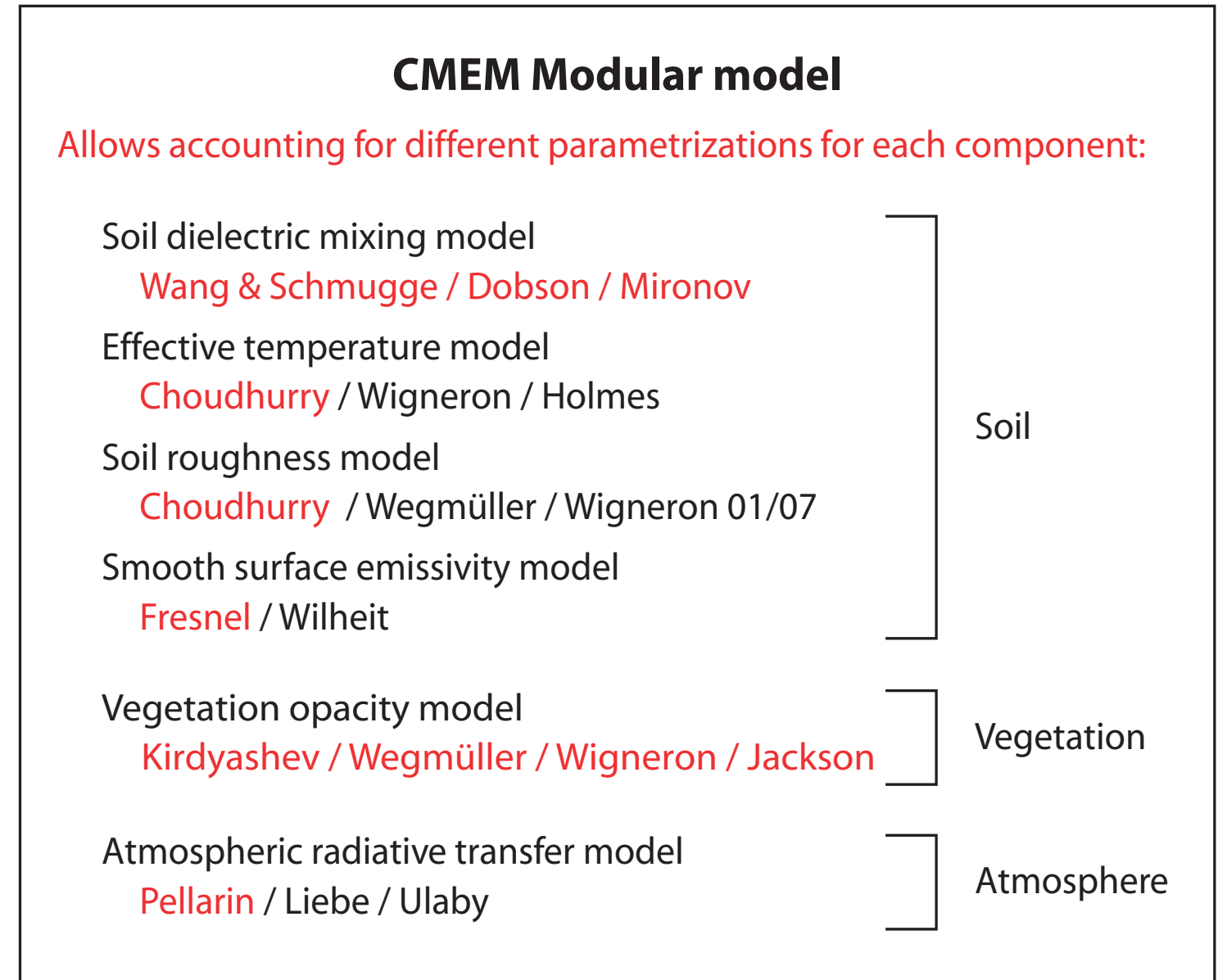


Figure 2 CMEM modular structure. Options in red are evaluated in ALMIP-MEM.

Field Validation



Models

- ALMIP soil moisture and temperature (8 LSMs)
- ALMIP-MEM TB at C-band (8 LSMs, CMEM configuration 10 of Table 1)

Observations

- In situ Soil Moisture & Temperature (Agoufou, 15.3N,1.5W)
- AMSR-E brightness temperatures over this pixel

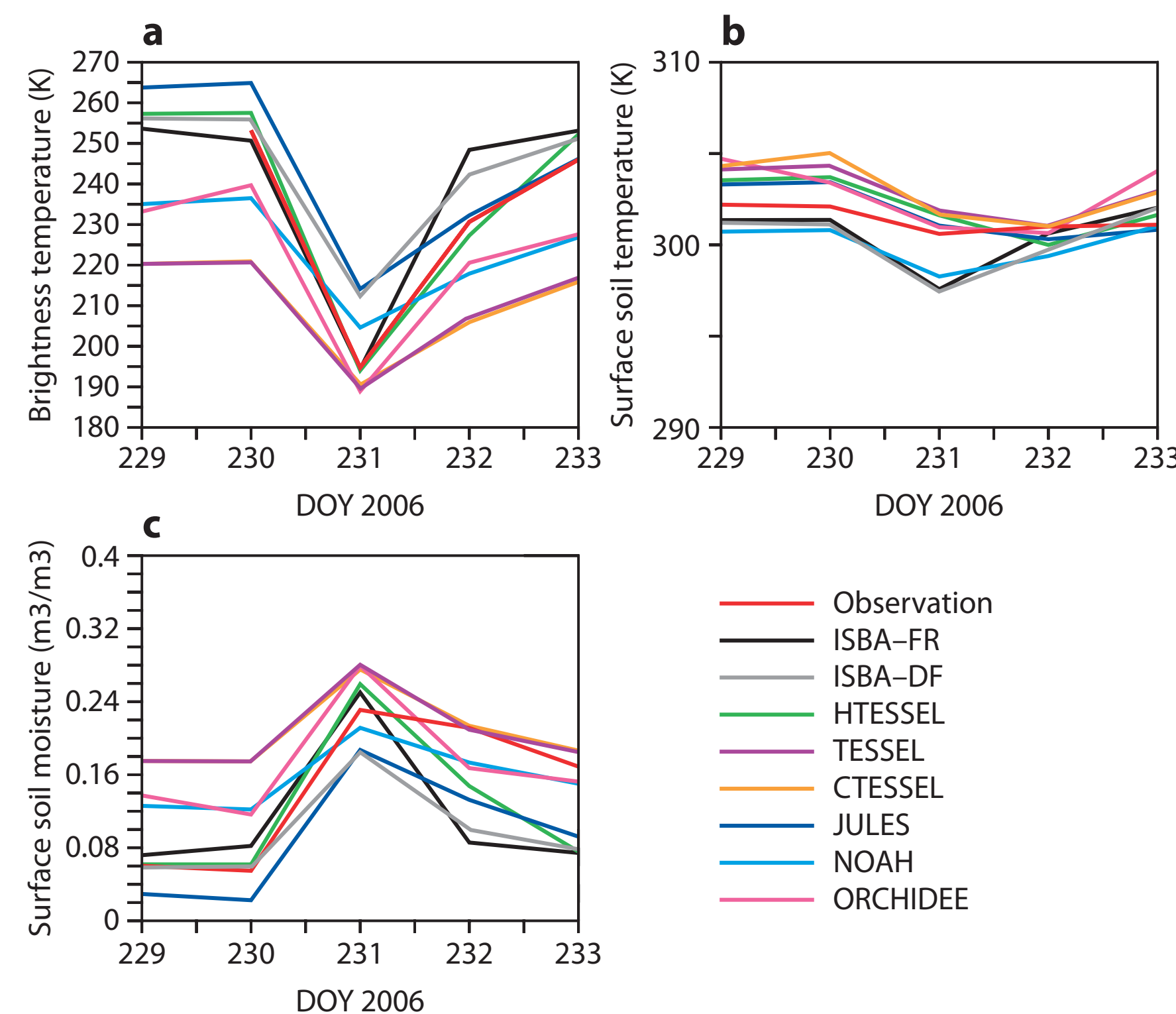


Figure 3 (de Rosnay et al., 2009-a b)

AMMA Land Surface Model Intercomparison Project, Microwave Emission Model

Context

SMOS / AMMA (African Monsoon Multidisciplinary Analysis)

ALMIP (AMMA Land Surface Model Intercomparison Project, Boone et al., 2009)

Concept

- Combined 8 LSMs (ISBA-FR, ISBA-DF, HTESSEL, TESSEL, CTESSEL, JULES, NOAH, ORCHIDEE) and 12 microwave models (MWM) inter-comparison
- Simulation of C-Band Brightness Temperature (TB) for 2006 over West Africa
- Evaluation against AMSR-E (C-band)

Objectives

- Sensitivity of simulated TB to the LSM and MWM parametrizations
- Identify key parametrizations for the CMEM forward operator

Results

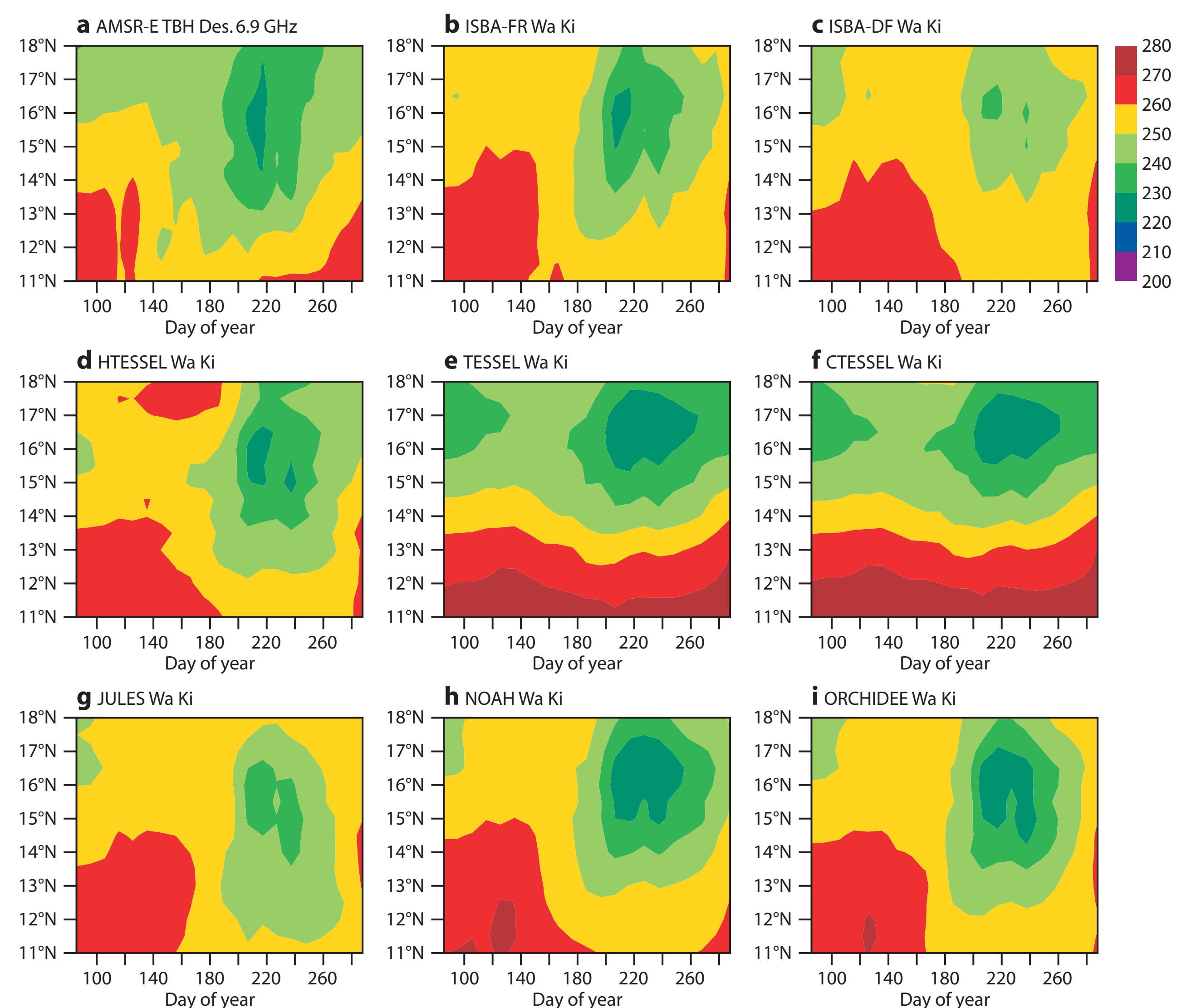
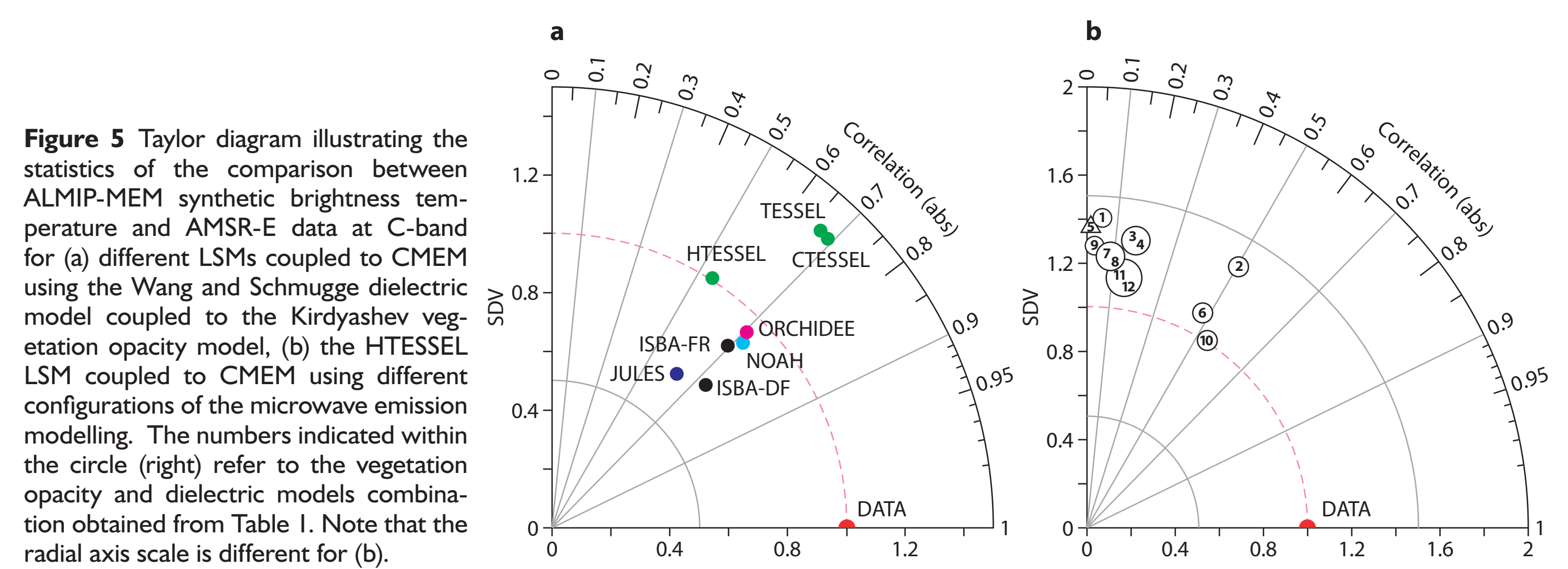


Figure 4 Time-latitude diagram of the horizontally polarised brightness temperature observed by AMSR-E and simulated by ALMIP-MEM for EXP2. For each ALMIP-MEM simulation a bias correction was applied, specifically computed for each LSM when comparing simulated and observed brightness temperature.



Vegetation optical depth	Dielectric constant		
	Dobson et al. 1985	Mironov et al. 2004	Wang and Schmugge 1980
Jackson and O'Neill 1990	1	5	9
Kiryashev et al. 1979	2	6	10
Wegmüller et al. 1995	3	7	11
Wigneron et al. 2007	4	8	12

Table 1 CMEM parametrizations used for ALMIP MEM

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Conclusion

- Based on LSM community experience in inter-comparison (PILPS, GSWP2), but focus on West Africa and extended to compare different combinations of LSMs and radiative transfer models
- 1st inter-comparison exercise of land surface MW emission models
- Coupled LSM-CMEM models capture convective system occurrence in Sahel, as well as latitude-time feature of TB
- Sensitivity of simulated TB to MW models as important as that to LSMs
- Robustness of the Kiryashev opacity model to simulate TB in best agreement with AMSR-E measurements, for any LSM.
- Consistence between Skylab (Drusch et al., 2009) and ALMIP-MEM (de Rosnay et al., 2009), although different configurations (angle, frequency, LSM, scale) are considered
- High importance of MW modelling approach for SMOS monitoring and assimilation study