Inter-calibration and validation of observations from ATMS and SAPHIR microwave sounders

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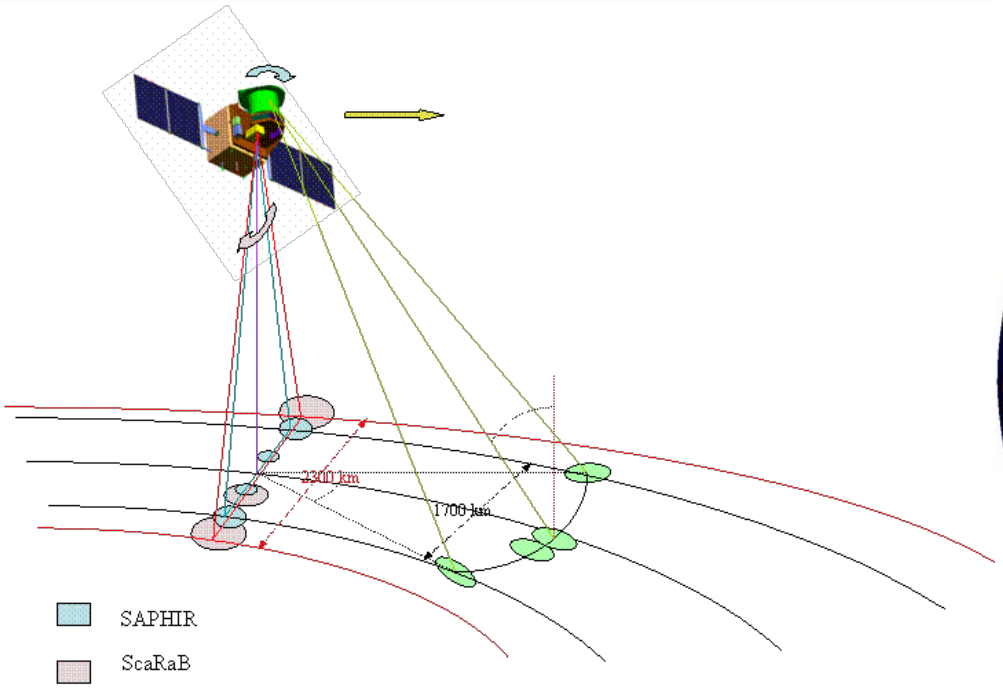
Outline

- ATMS and SAPHIR instruments
- Inter-calibrating SAPHIR and ATMS
- Validating SAPHIR and ATMS observations using radiosonde data
- Validating ATMS temperature sounding channels using GPS-RO profiles
- Conclusion

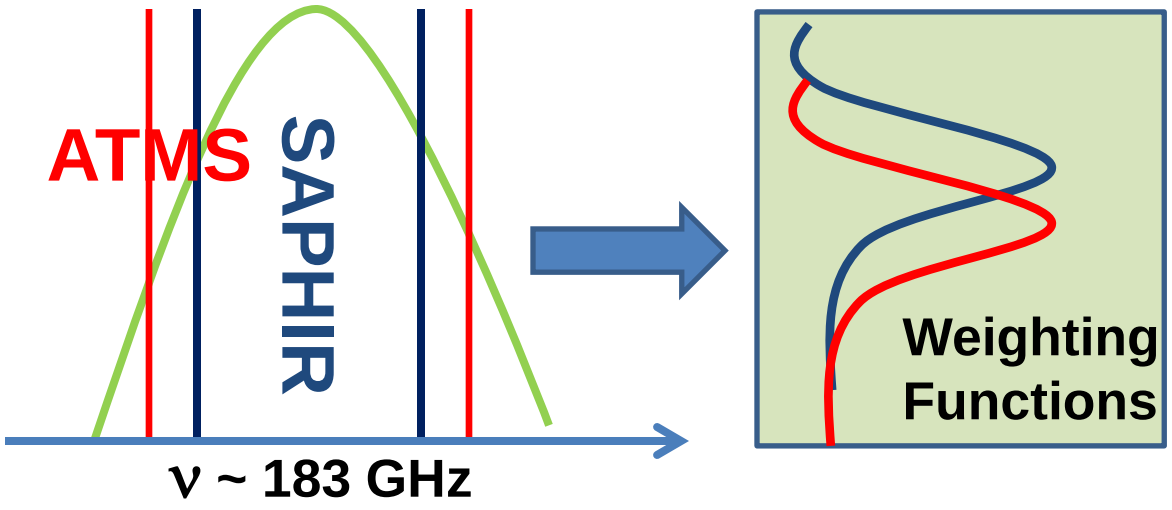
Megha-Tropiques

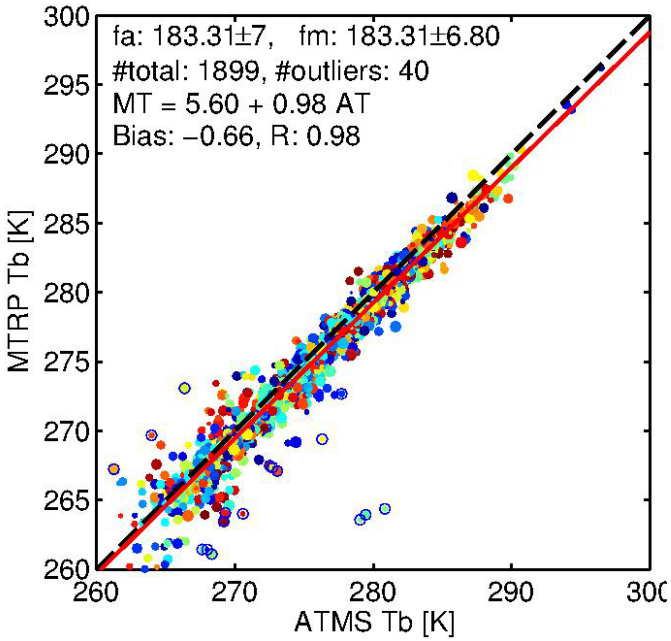


- A microwave imager (MADRAS) to study precipitation and cloud properties (SSM/I type, with an additional channel at 157 GHz).
- A microwave sounding instrument for the atmospheric water vapor (SAPHIR - 6 channels in the 183 GHz band).
- A radiometer for measuring outgoing radiative fluxes at the top of the atmosphere (ScaRaB).

Inter-calibrating SAPHIR and ATMS

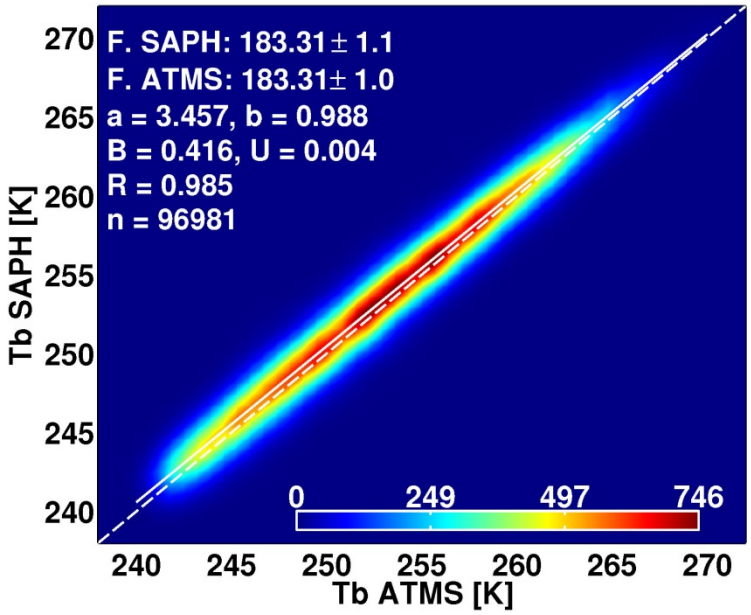
SAPHIR vs. ATMS

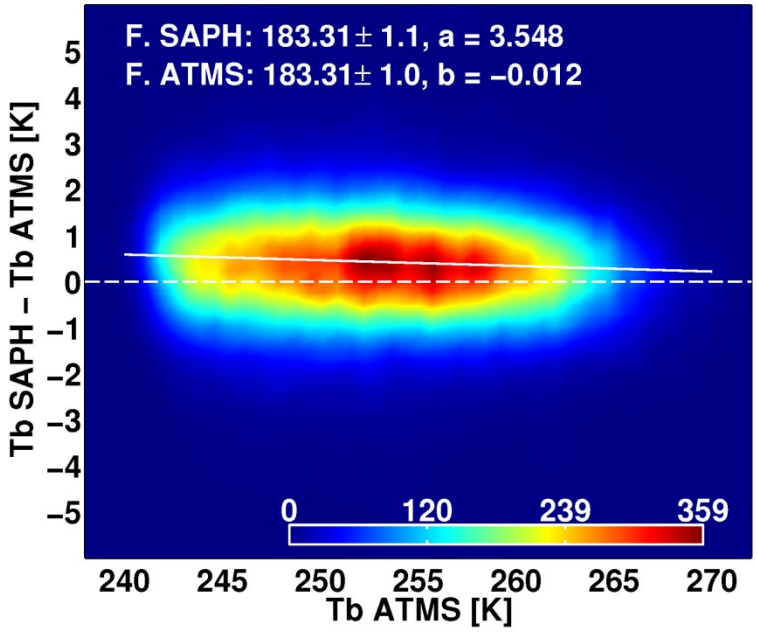


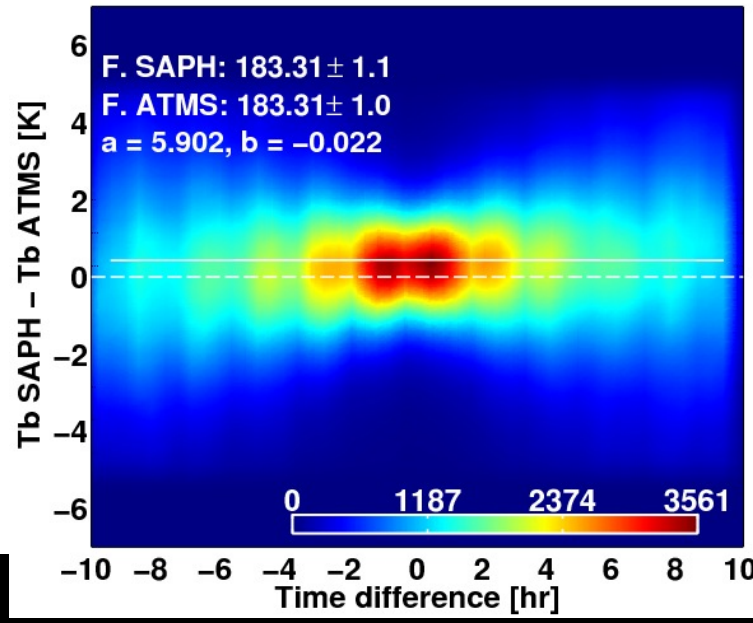


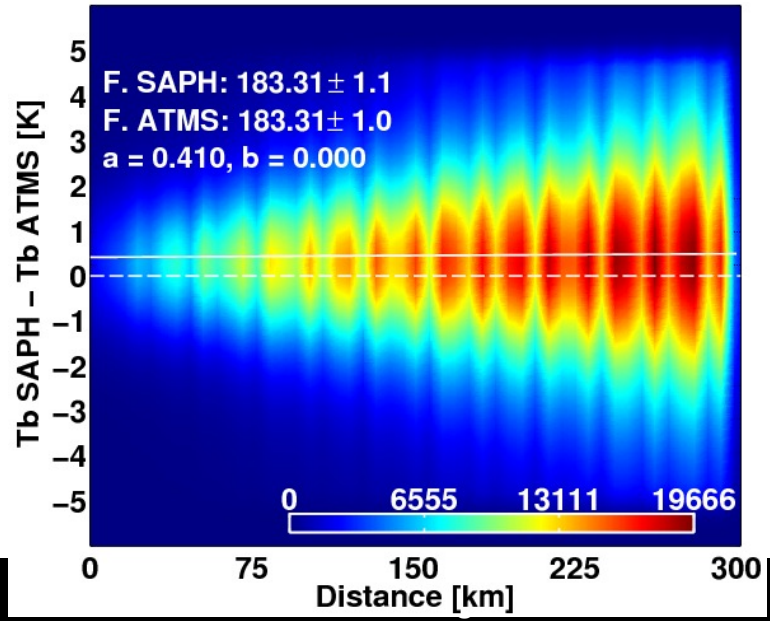
ATMS	SAPHIR	Bias (Obs)	Bias (Sim)	Obs - Sim
183±7.0	183±6.8	-0.68	-0.42	-0.26
183±4.5	183±4.2	-1.56	-0.91	-0.65
183±3.0	183±2.8	-1.23	-0.93	-0.30
183±1.0	183±1.1	+0.42	+0.90	-0.48

SAPHIR vs. ATMS



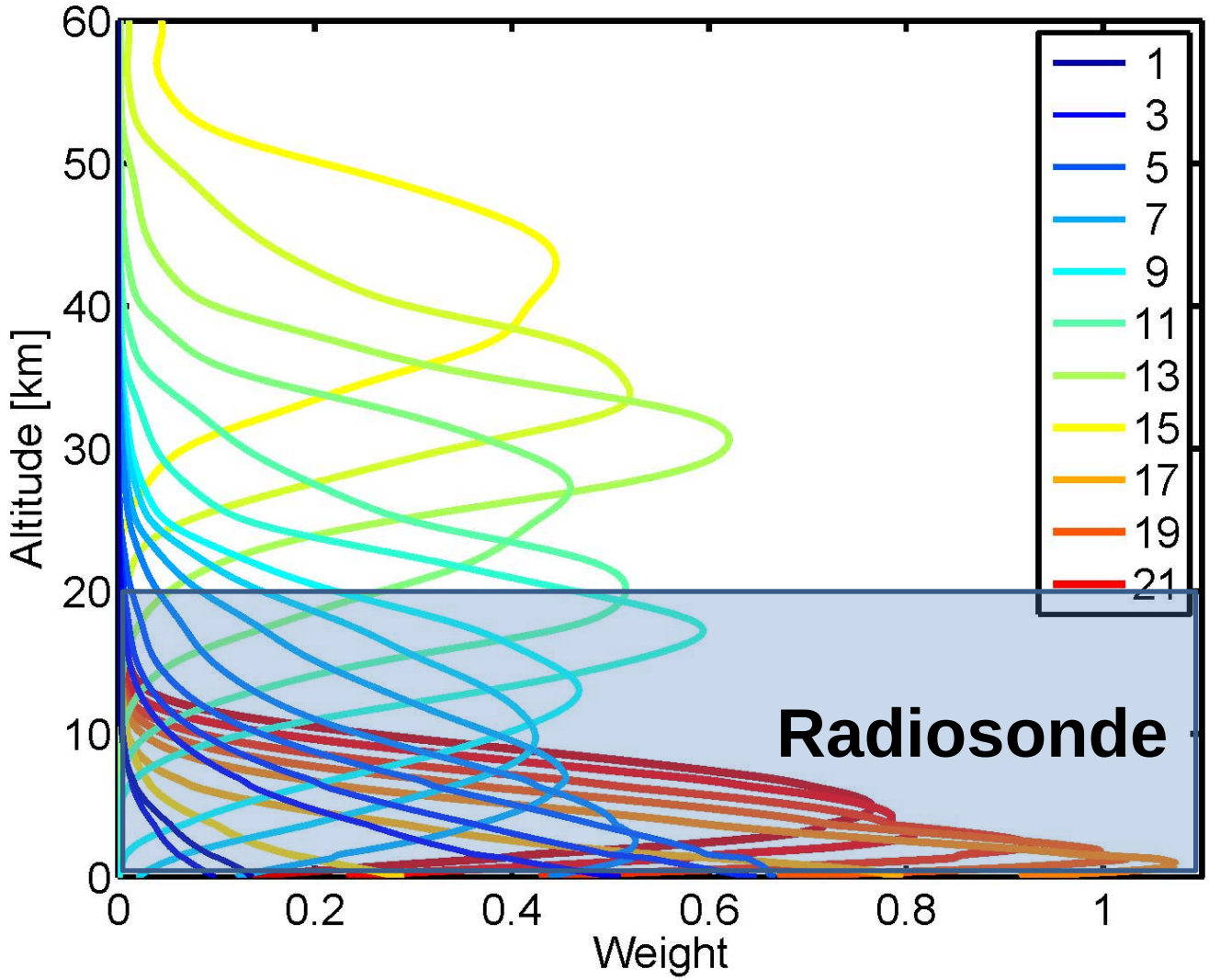




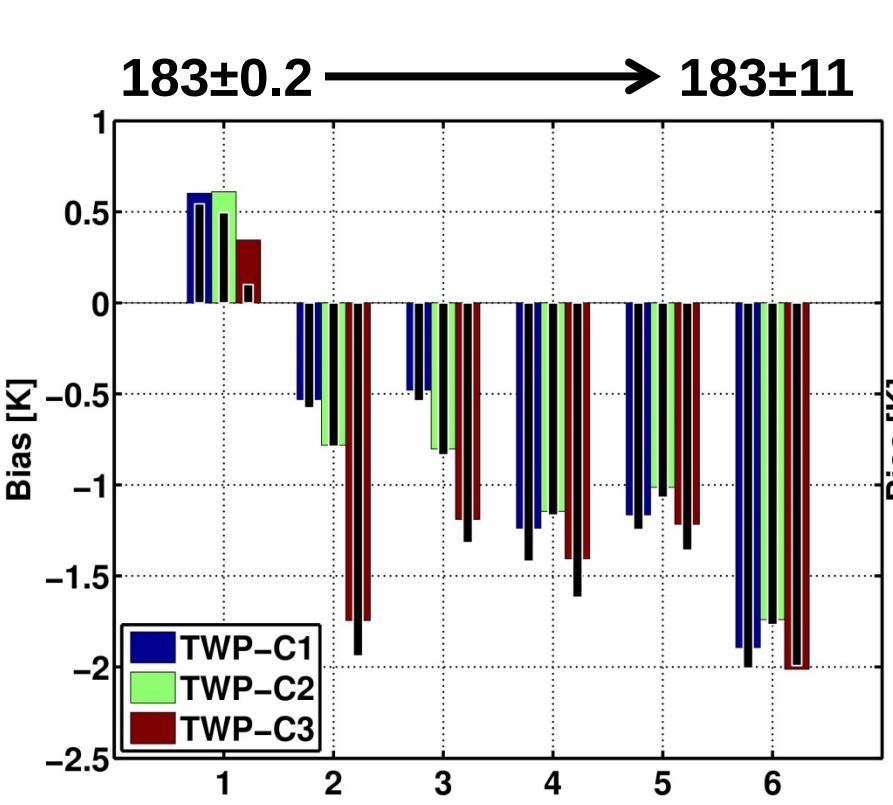


Validating using radiosonde data

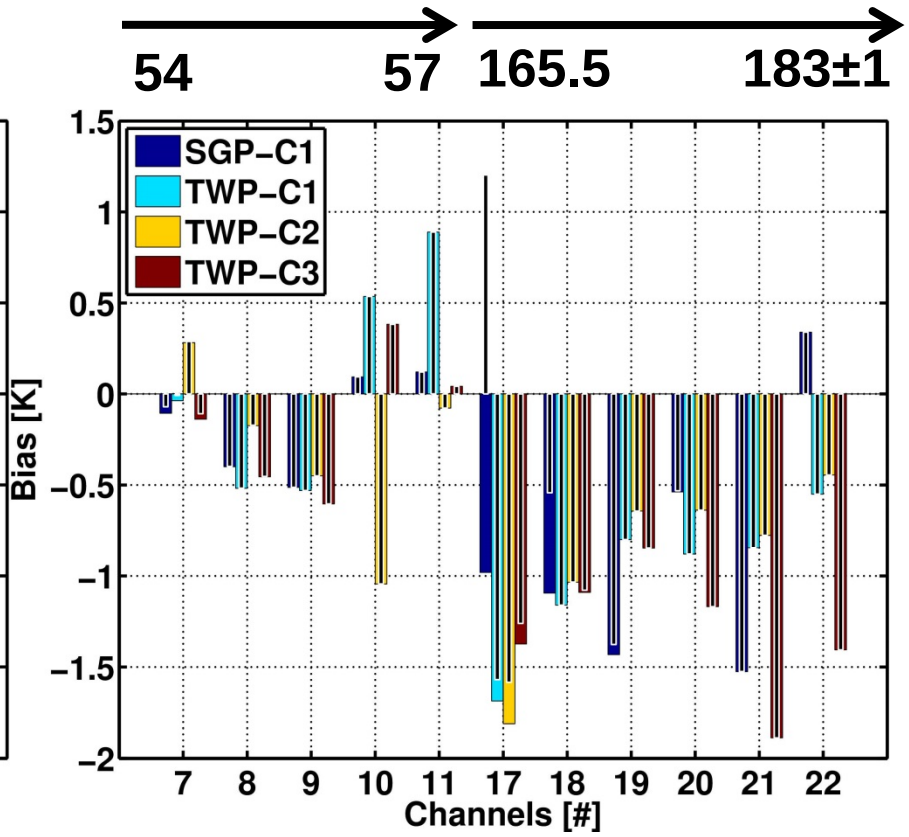
ATMS Weighting Functions



Validating Using ARM Data

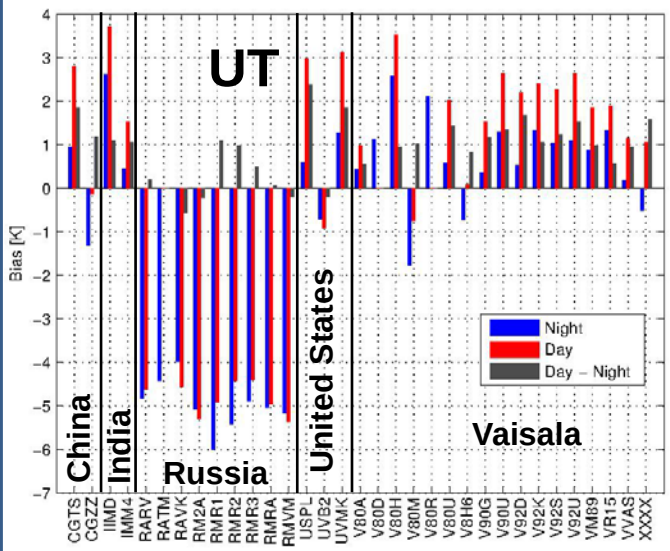


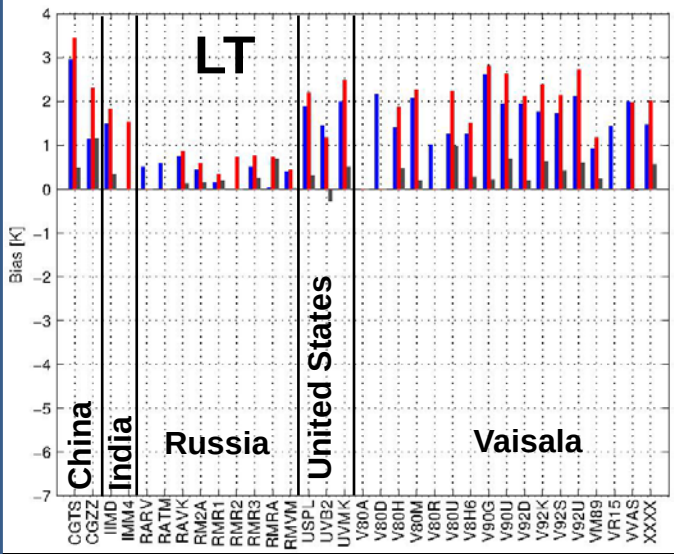
SAPHIR vs ARM

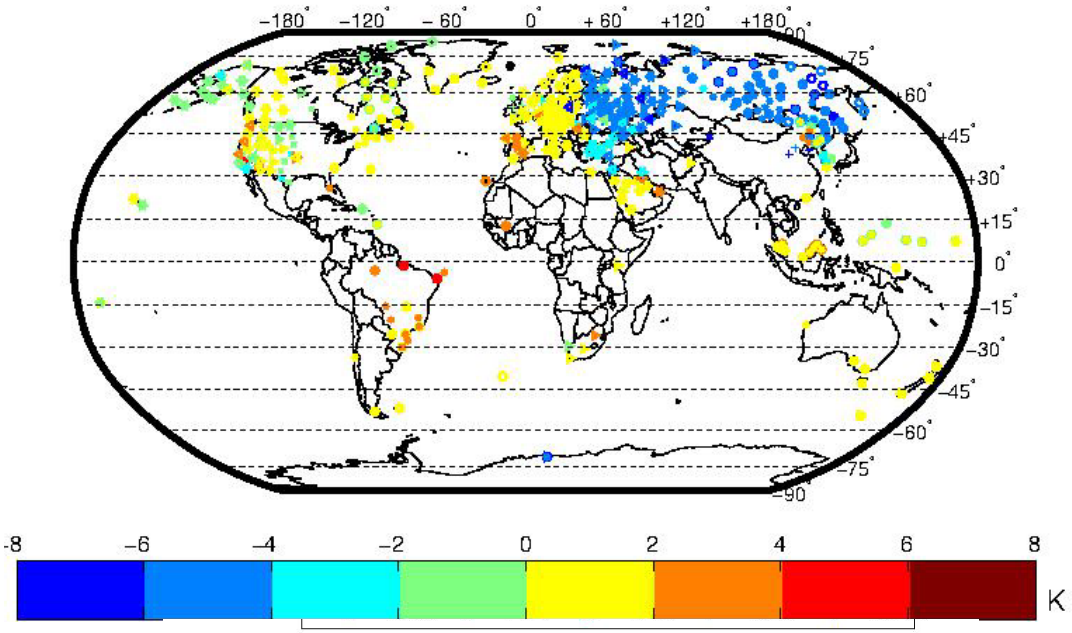


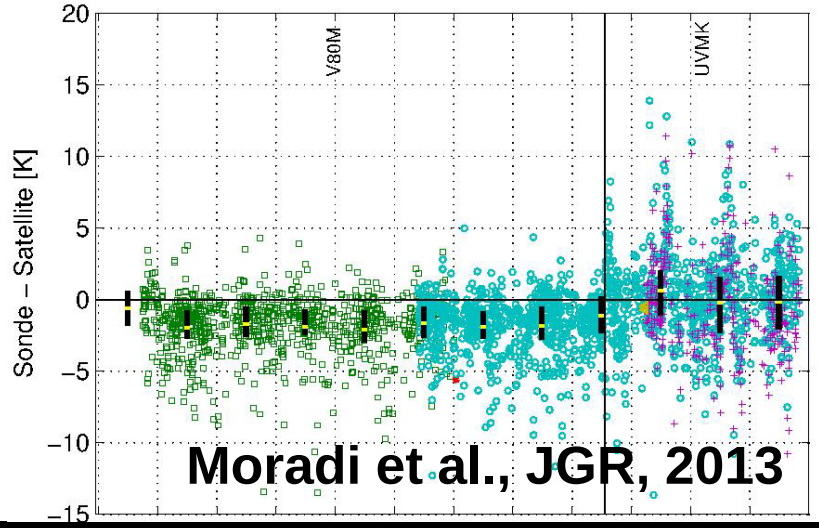
ATMS vs ARM

Error in IGRA humidity profiles





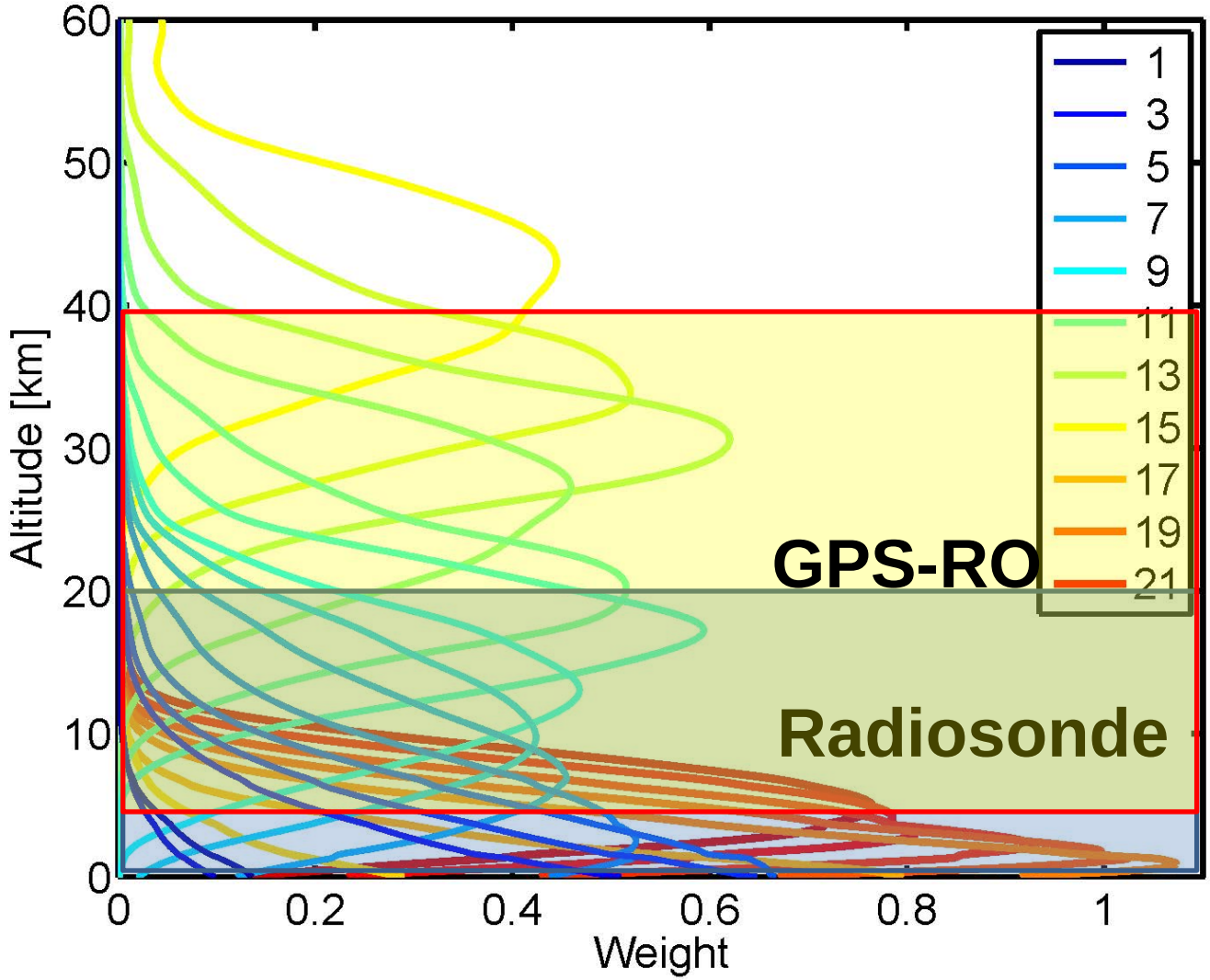




Moradi et al., JGR, 2013

Validating using GPS-RO data

ATMS Weighting Functions



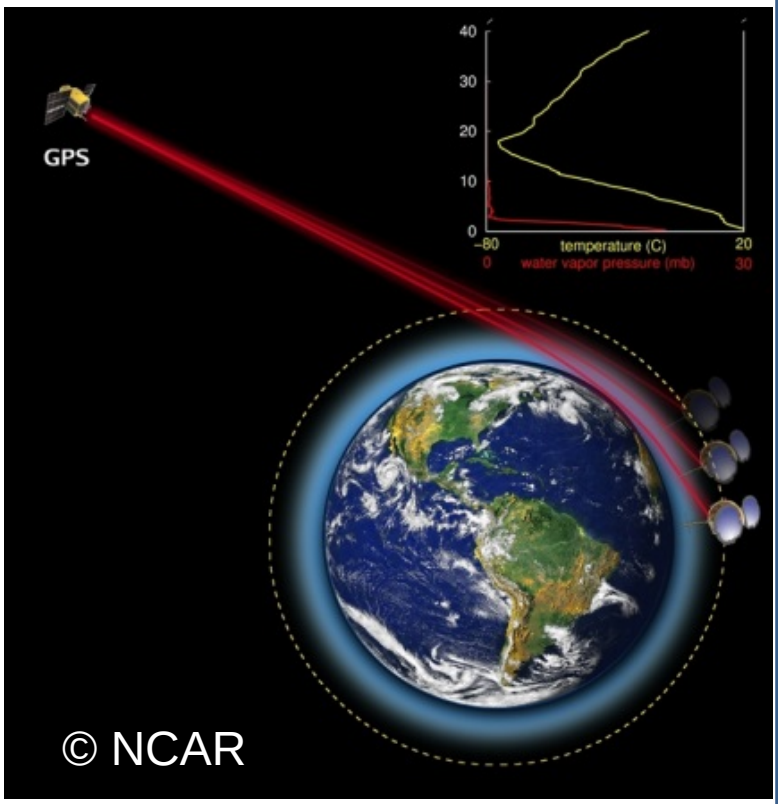
GPS Radio Occultation Data

- Radio signals transmitted by Global Positioning System (GPS) satellites are received by a receiver on a LEO satellite

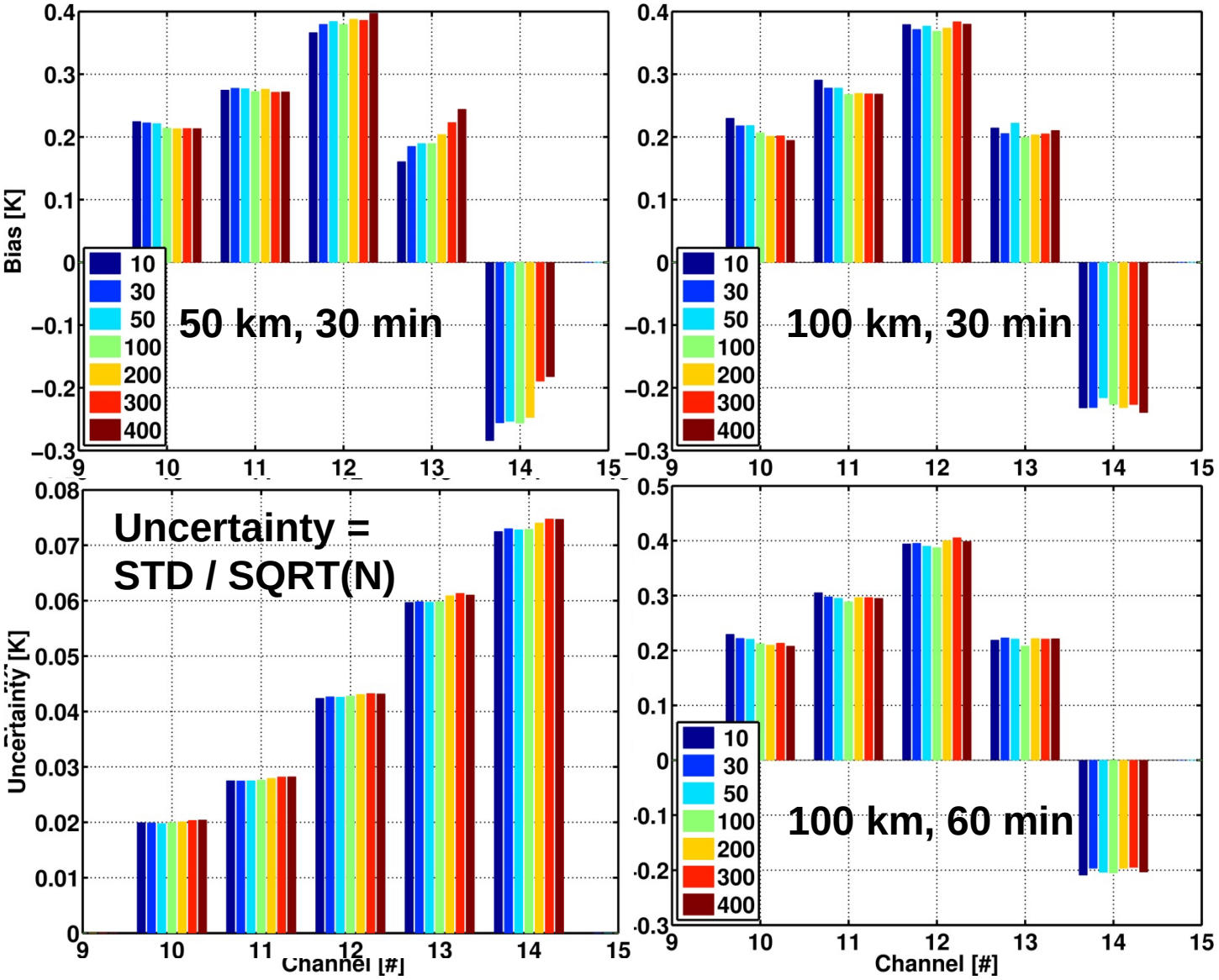
- Temperature and water vapor profiles are derived from bending angles using a-priori profiles and inversion techniques

- Raw GPS-RO data (time delay) have very high accuracy in the upper troposphere and lower stratosphere (500 hPa to 40 km) but different

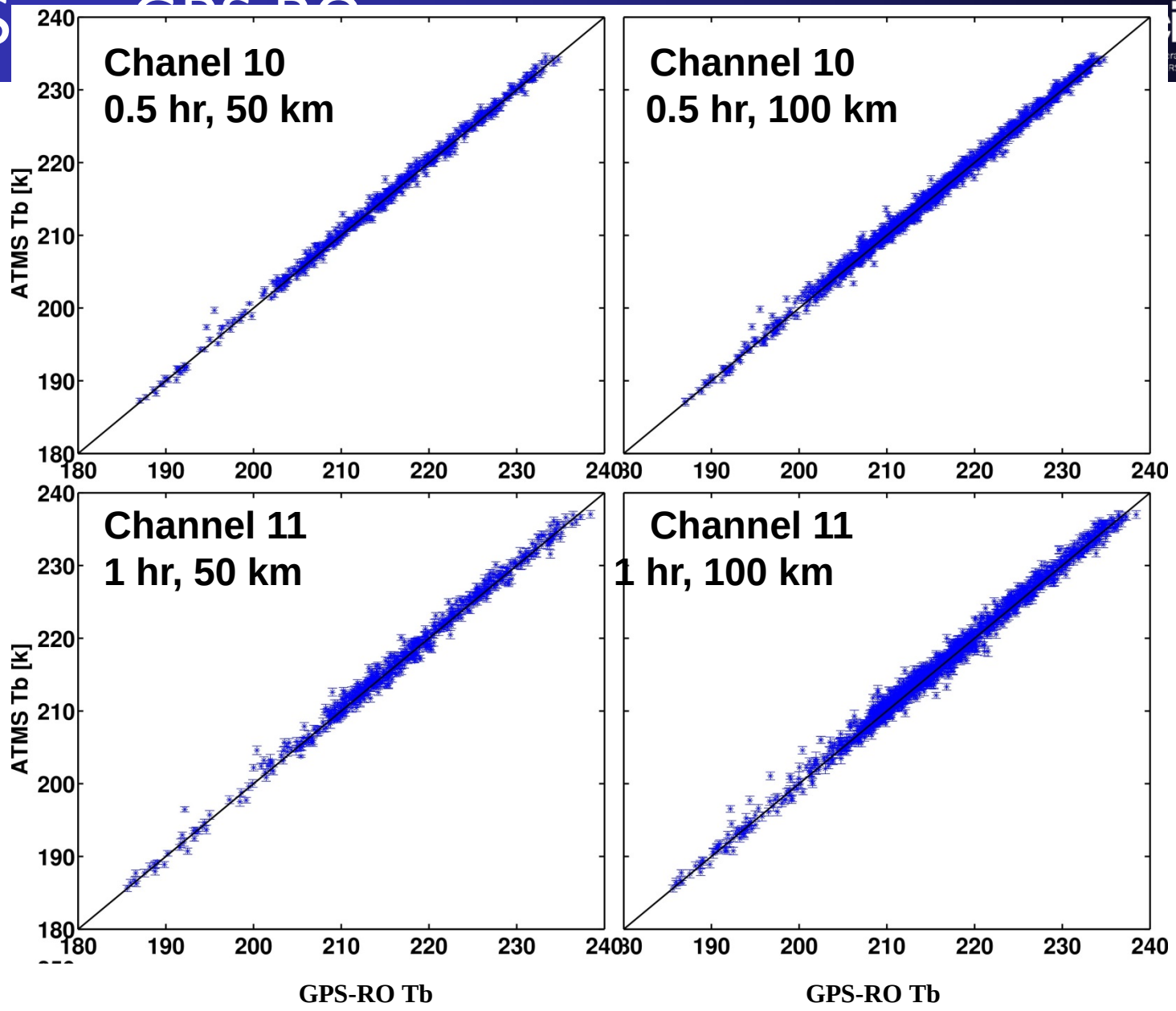
- errors and uncertainties are introduced during inversion to the atmospheric state variables



ATMS vs. GPS RO



ATMS GPS-RO


Chanel 10
0.5 hr, 50 km
Channel 10
0.5 hr, 100 km
Channel 11
1 hr, 50 km
Channel 11
1 hr, 100 km
ATMS Tb [k]
ATMS Tb [k]
GPS-RO Tb
GPS-RO Tb
180
190
200
210
220
230
240

Conclusions

- **SAPHIR and ATMS observations show very good consistency**
- **SAPHIR provides a great opportunity for inter-calibrating MW WV channels on POES satellites or to transfer the calibration among the POES satellites**
- **There is still a lack of reference datasets for validating MW satellite observations**
- **Radiosonde data can only be used to evaluate the overall bias in the WV channels and cannot precisely detect the magnitude of the bias**
- **GPS-RO data provide a good opportunity for validating observations from upper troposphere and lower stratosphere but the difference between GPS-RO and satellite observations cannot be translated as absolute bias in the satellite data**
- **The window channels cannot still be validated because of uncertainty in the surface emissivity**

Thanks for your attention

Sunrise in Northern Sweden
after a two-month long polar-night

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