

Inter-calibration of Satellite Microwave Radiometer Brightness Temperatures from NOAA-N15 AMSU-B & DMSP-F14 SSM/T-2

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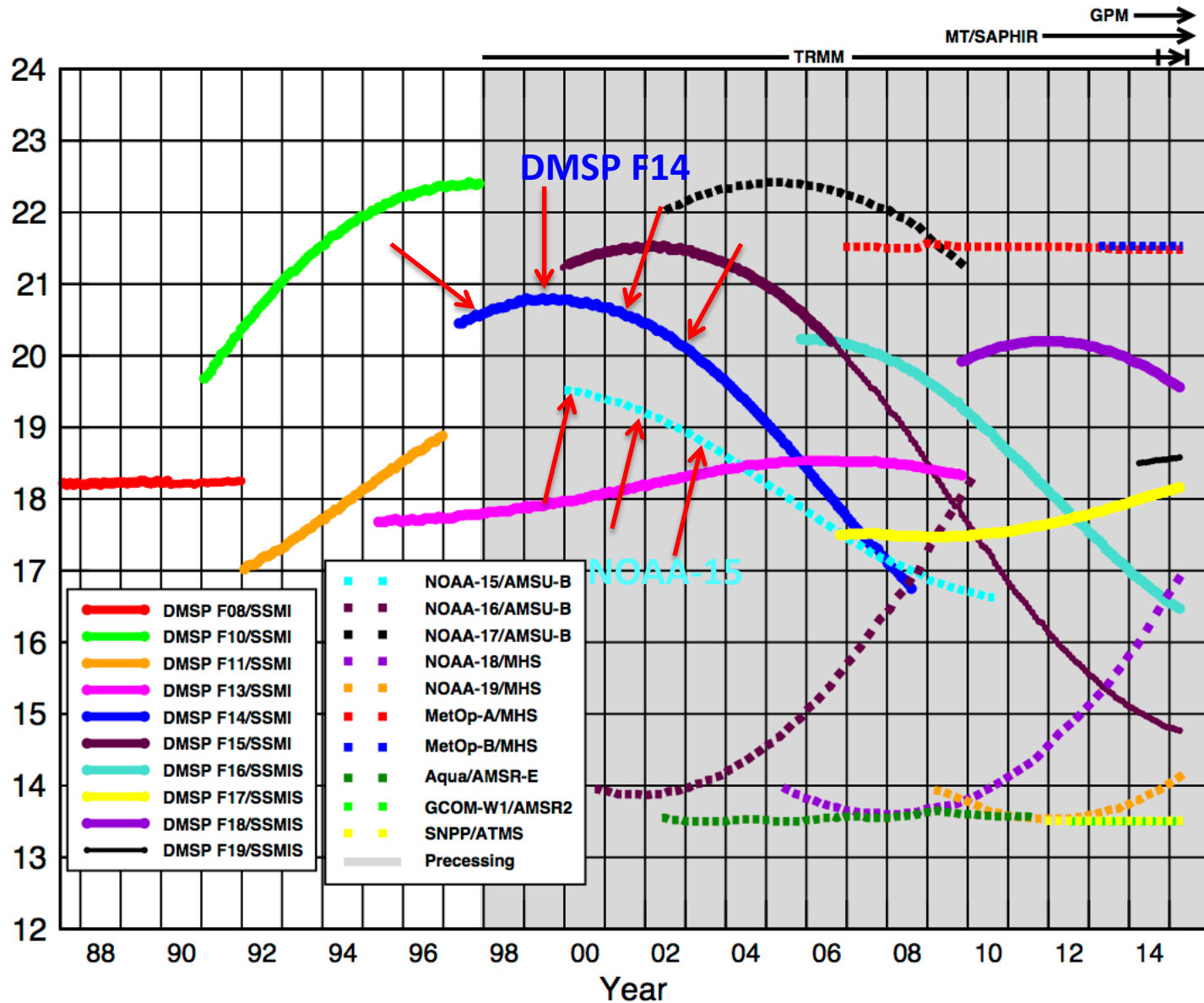
April 21, 2016



Characteristics of AMSU-B & SSM/T-2

Attribute	Instrument					
	AMSU-B			SSM/T-2		
Design Goal	Calculation of vertical water vapor profiles from the Earth's surface to about a 200-millibar pressure altitude (12 km or 7.5 mi) ¹			Global monitoring of the concentration of water vapor in the atmosphere under all sky conditions by taking advantage of the reduced sensitivity of the microwave region to cloud attenuation ²		
Platform	NOAA 15, 16, 17			DMSP F11, 12, 14, 15; Block 5D-2		
Orbit	Sun-synchronous			Sun-synchronous		
Period (min)	102			101		
Altitude (km)	833 +/- 19 or 870 +/- 19			830		
Measurement Frequencies ³ (GHz) & Nadir Resolution (distance, km and angle, deg)	89.0 ± 0.9	48 & 16	1.1	91 ± 1.25	100	6.2
	150.0 ± 0.9	16	1.1	150 ± 1.25	60	3.7
	183.31 ± 1.00	16	1.1	183.31 ± 1.00	50	3.0
	183.31 ± 3.00	16	1.1	183.31 ± 3.00	50	3.0
	183.31 ± 7.00	16	1.1	183.31 ± 7.00	50	3.0
Imaging System	Cross-track Scanner			Cross-track Scanner		
Scan Angle (deg)	± 48.95			± 40.5		
Scan (sec)	8/3			8		
Steps	90			28		
Polarization (at nadir)	Rotates with Scan			Rotates with Scan		
Swath Width (km)	2300			1500		

Equator-Crossing Times (Local)



Ascending passes (F08 descending); satellites depicted above graph precess throughout the day.
 Image by Eric Nelkin (SSAI), 19 May 2015, NASA/Goddard Space Flight Center, Greenbelt, MD.

Datasets & Inter-calibration Methods

- **Datasets**

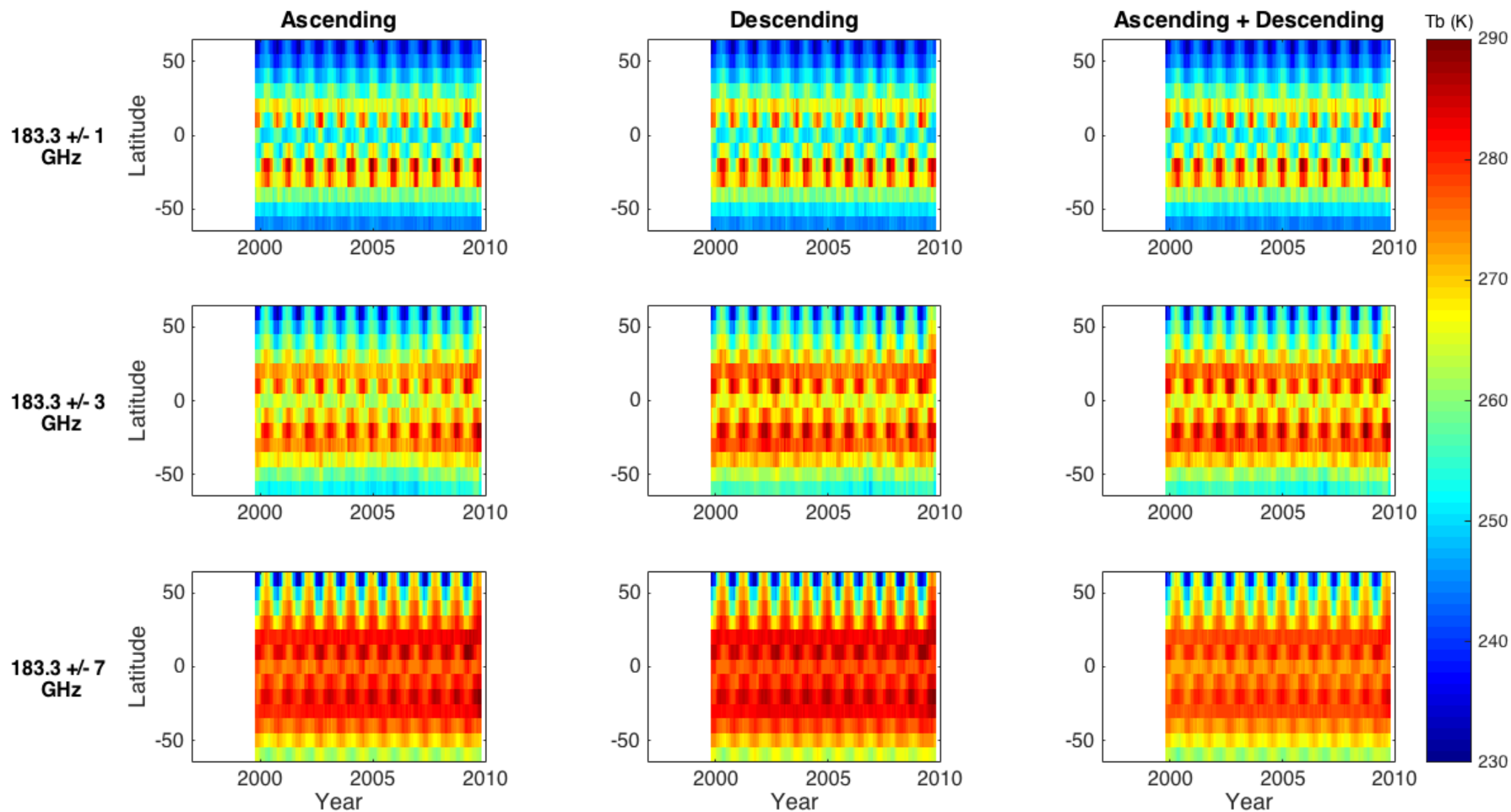
- AMSU-B: NOAA-15, 2000-2010 (CICS-MD/STAR)
- SSM/T-2: DMSP-F14, 1997-2006 (J. Luo)

- **Methods**

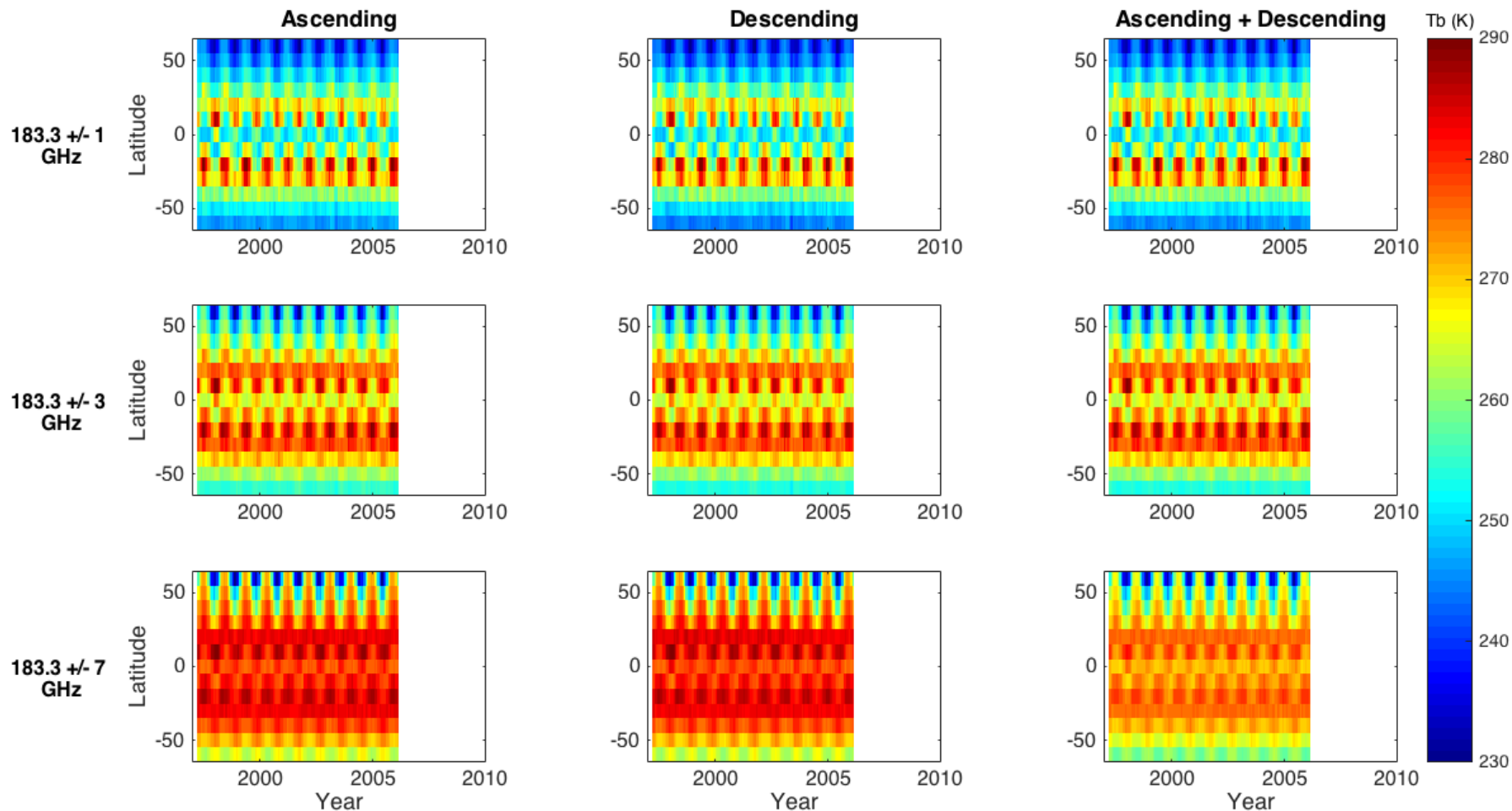
- Zonal averages
- Natural targets (tropical ocean)
- Simultaneous nadir overpasses (SNOs)

Zonal Averages

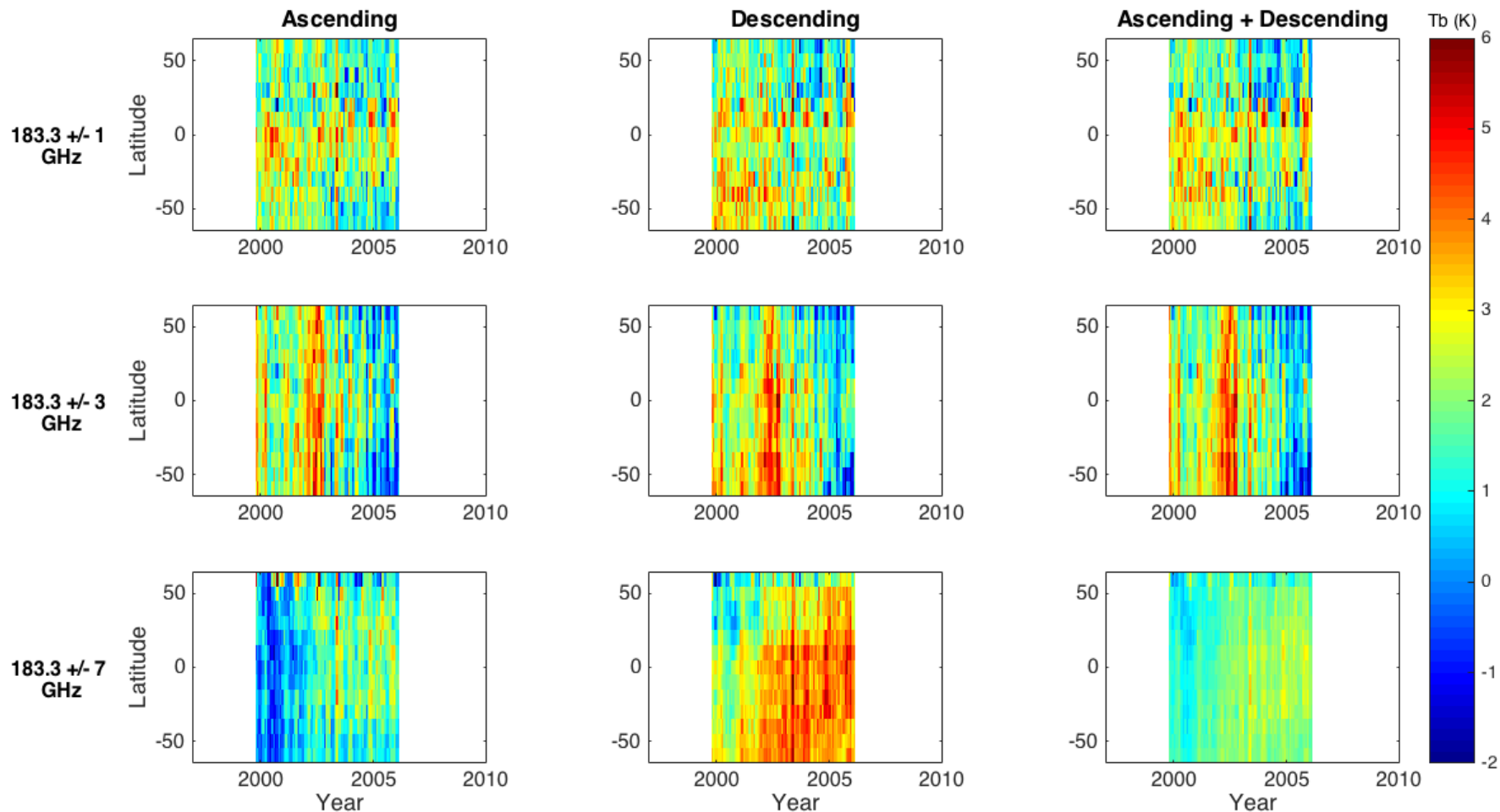
- Monthly zonal-averaged brightness temperatures of 10° wide latitude bands.
- Restricted data bet. 60NS and values between 100 and 300 K.
- Near-nadir measurements only (averaged footprints).
- Used both land and ocean data.
- Deep Convective Clouds Criteria (30NS)
 1. Cold Clouds (Staelin and Chen, 2000)
 - TB 183 +/- 1 GHz < 235 K
 1. Deep Convective Clouds (Hong et al. 2004)
 - $\Delta T_{17} = [(183 \pm 1) - (183 \pm 7)]$
 - $\Delta T_{13} = [(183 \pm 1) - (183 \pm 3)]$
 - $\Delta T_{37} = [(183 \pm 3) - (183 \pm 7)]$
 - $\Delta T_{17} \geq 0$, $\Delta T_{13} \geq 0$, and $\Delta T_{37} \geq 0$ K
- Area weighting using cosine of latitude.



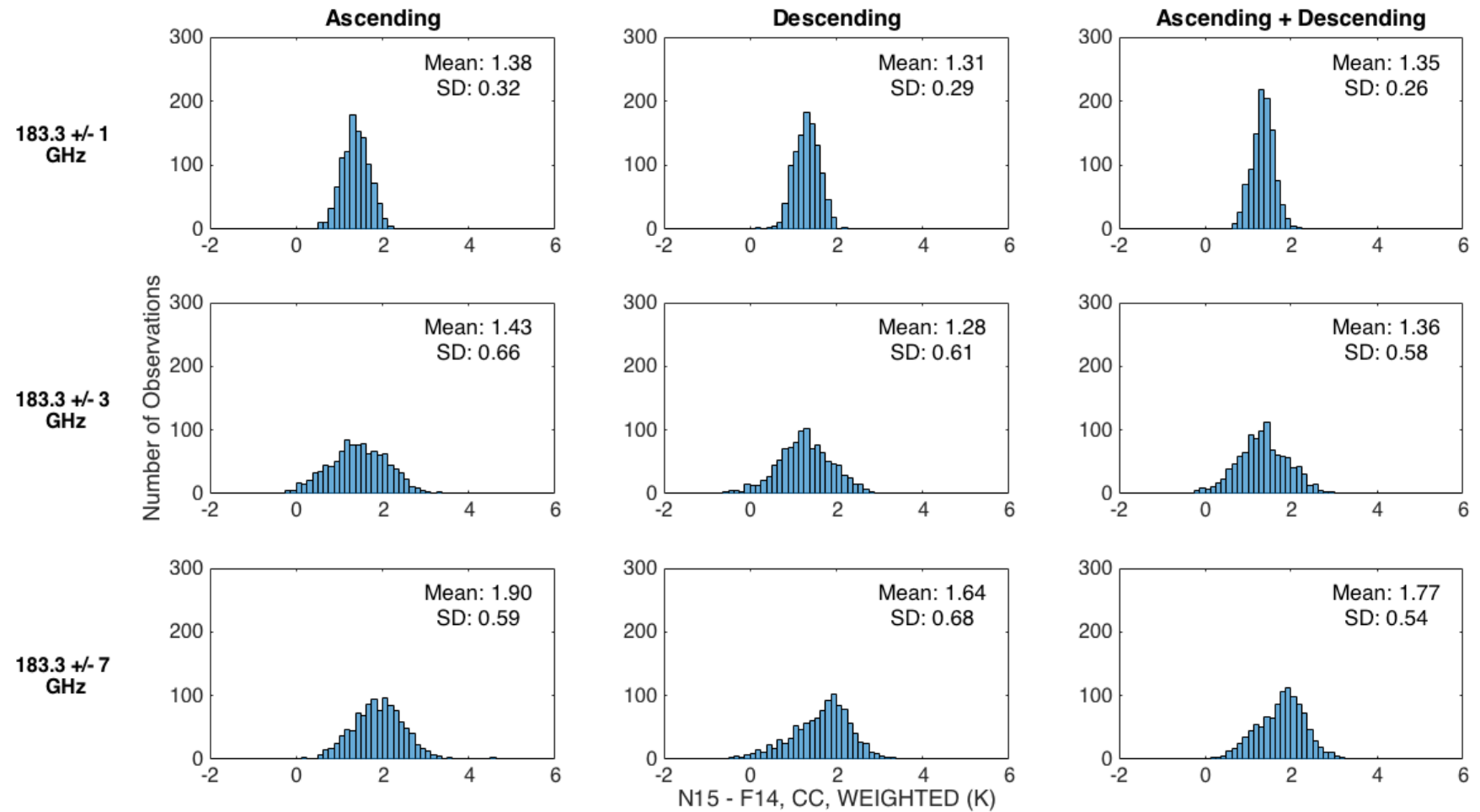
N15, ZONAL AVERAGES, WEIGHTED, CLOUD CLEARED₆



F14, ZONAL AVERAGES, WEIGHTED, CLOUD CLEARED₇



N15 - F14



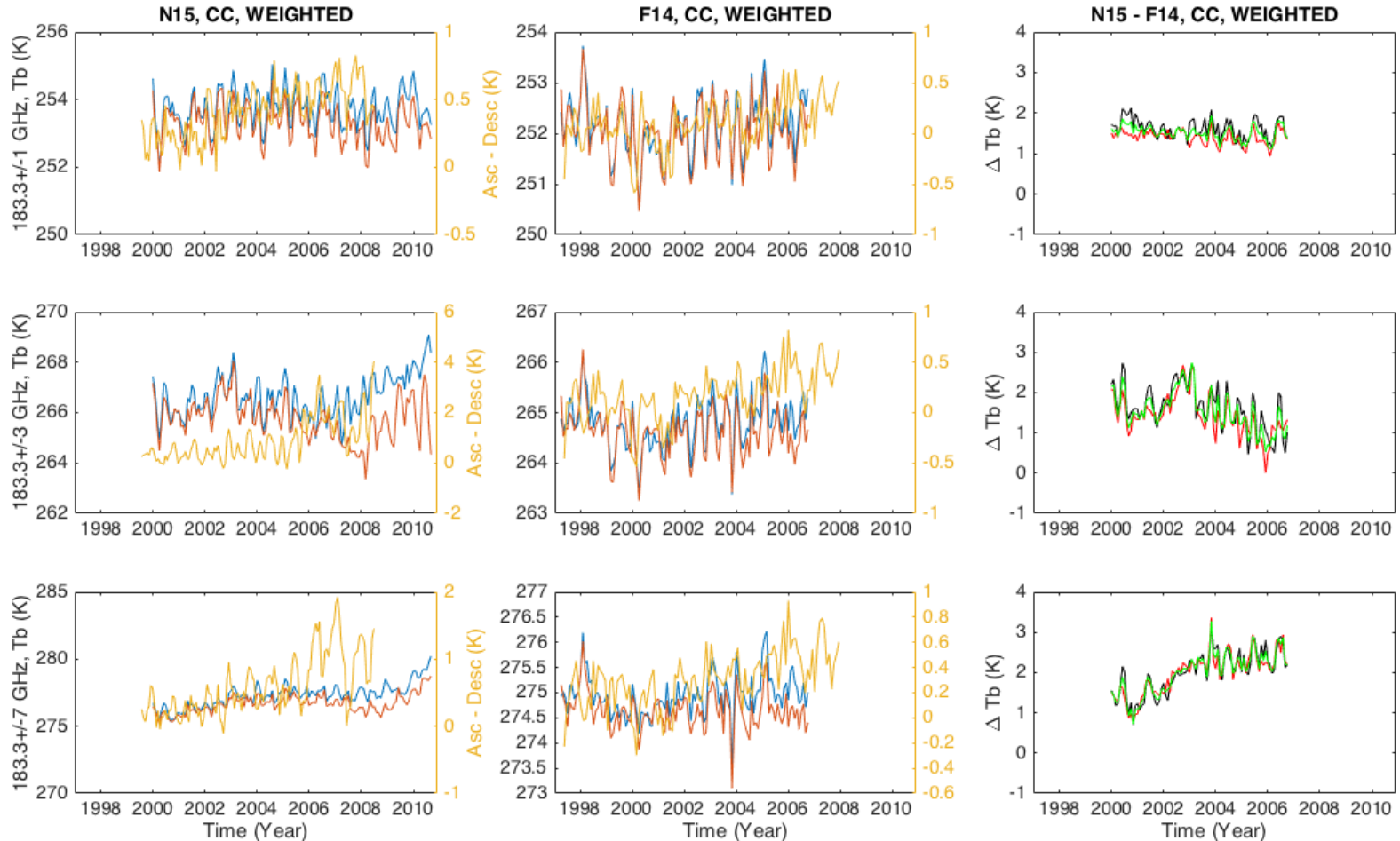
N15 - F14, MEAN AND STANDARD DEVIATION

Natural Targets (Tropical Oceans)

- Monthly mean brightness temperatures.
- Restricted data bet. 20NS and values between 100 and 300 K.
- Near-nadir measurements only (averaged footprints).
- Ocean data only, applied landmask.
- Deep Convective Clouds Criteria (30NS)
 1. Cold Clouds (Staelin and Chen, 2000)
 - $TB_{183} \pm 1 \text{ GHz} < 235 \text{ K}$
 1. Deep Convective Clouds (Hong et al. 2004)
 - $\Delta T_{17} = [(183 \pm 1) - (183 \pm 7)]$
 - $\Delta T_{13} = [(183 \pm 1) - (183 \pm 3)]$
 - $\Delta T_{37} = [(183 \pm 3) - (183 \pm 7)]$
 - $\Delta T_{17} \geq 0, \Delta T_{13} \geq 0, \text{ and } \Delta T_{37} \geq 0 \text{ K}$
- Area weighting using cosine of latitude.

Monthly mean near-nadir brightness temperature for ascending (blue) and descending (red) passes and their differences (yellow; ascending minus descending) of (middle) SSM/T-2 and (left) NOAA 15 from over tropical oceans (20°S–20°N). Right panels show intersatellite differences (N15–F14) for ascending passes (black), descending passes (red), and both combined (green).

- Seasonal cycle less pronounced
- Asc – Desc show neither large differences nor seasonal dependence.
- N15-F14, for 183.3 +/-1 GHz channel, shows small intersatellite bias compared to the other 2 channels.



Summary

1. Zonal averages: AMSU-B is generally warmer than SSM/T-2 by
 - 1.35 ± 0.26 K for 183.3 ± 1 GHz
 - 1.36 ± 0.58 K for 183.3 ± 3 GHz
 - 1.77 ± 0.54 K for 183.3 ± 7 GHz
2. Natural targets (tropical oceans): intersatellite bias is small for 183.3 ± 1 GHz channel but increases for 183.3 ± 3 GHz and 183.3 ± 7 GHz.
3. SNO method in progress.