



CONAE Microwave Radiometer (MWR) Counts to Tb Algorithm and On orbit Validation



Zoubair Ghazi¹, Andrea Santos-Garcia¹, María Marta Jacob² and Linwood Jones¹

¹Central Florida Remote Sensing Lab, Department of EECS, University of Central Florida. ²CONAE – Comisión Nacional de Actividades Espaciales

Abstract

The CFRSL, in collaboration with CONAE, have developed two improved algorithms (V6.0 & V7.0) to convert the radiometric counts to brightness temperature (Tb) for production of MWR level-1 science data. This poster presents a description of these algorithms and shows results for MWR Cal/Val activities during the past 15 months.

Mission Status

- MWR experience a power subsystem failure and ceased science operations on 04-18-14
- However, there exists 29 months of high quality brightness temperatures that are collocated with AQ and associated geophysical retrievals:
 - Wind Speed, Water Vapor, Rain Rate & Sea Ice Conc
- Improved MWR Counts-to-Tb algorithm V6.0 & V7.0 developed and validated
- Legacy data archive to be released by mid-2015

MWR History

- MWR on-orbit commissioning Aug 29th, 2011
 - Cal/Val campaign Sept, 2011 – Jan 2012
- Counts to Tb V5.0 - March 2012
 - Used 6 mo of MWR on-orbit collocation with WindSat
 - Ocean Tb's exhibited small and acceptable Tb biases
 - Anomalous Tb's near Land/water boundaries
- Counts to Tb V5.0S – April 2012
 - CONAE implements “Smear” correction algorithm
 - Discovery of small Tb non-linearity
- Counts to Tb V6.0 beta – September 2013
 - Corrects non-linearity and other problems with V5.0S
- V6.0 Validation & V7.0 beta – February 2014

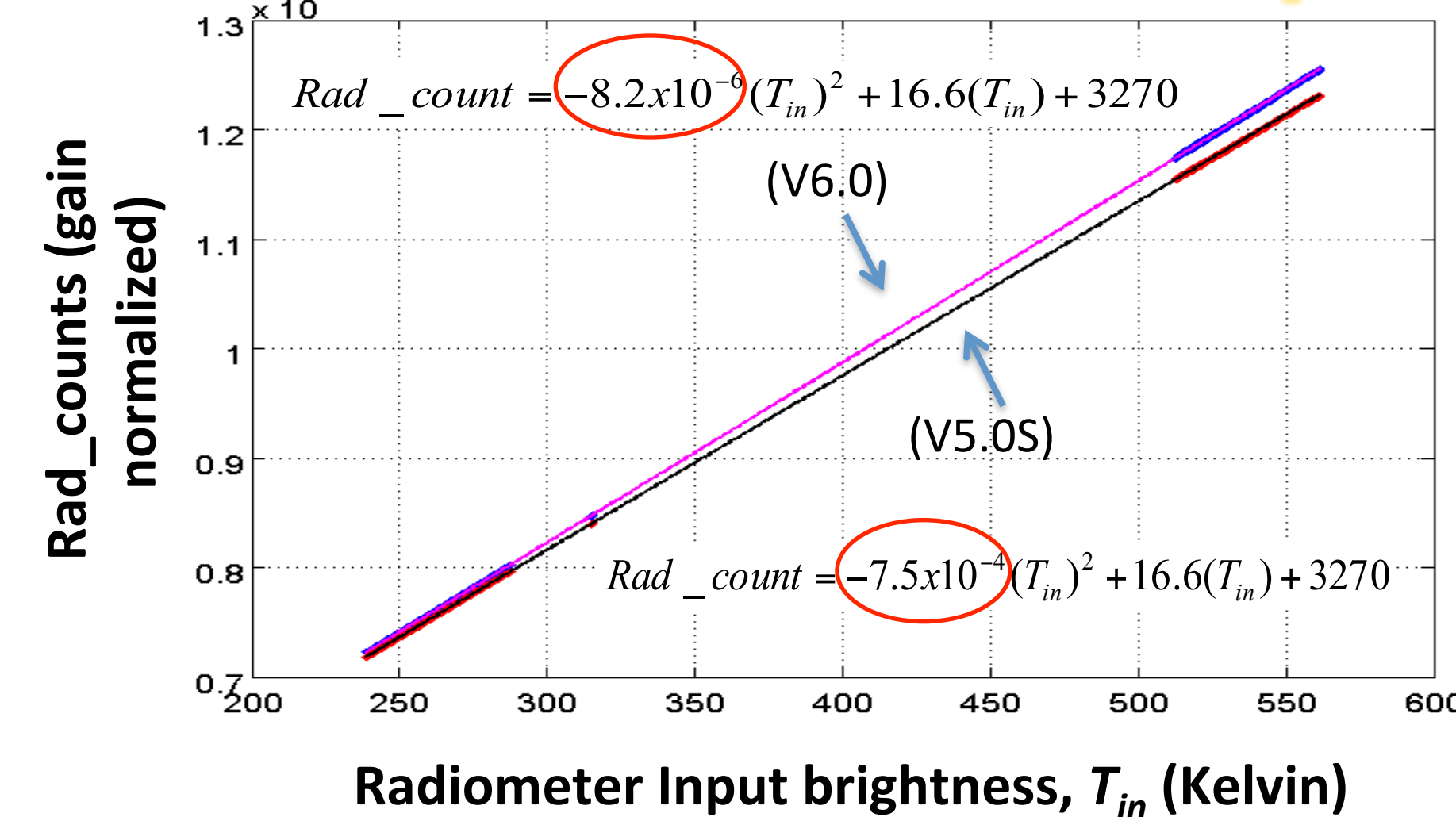
V6.0 Attributes

- Builds on V5.0S and incorporates:
 - System gain non-linearity correction
 - Reanalysis of pre-launch TV radiometric calibration test for improved Antenna Switch Matrix losses
 - Empirically derived coefficients to match on-orbit observations:
 - Inter-satellite cross calibration (XCAL) with WindSat
 - Deep space calibrations
 - Noise diode injected Tb
- Represents most rigorous MWR radiometric calibration available

V7.0 Attributes

- Builds on V6.0 and incorporates:
 - Normalization to WindSat radiometric calibration
 - Introduces a small time-variable Tb bias adjustment by antenna beam
 - Tb calibration consistent with XCAL standard
 - Based upon 5-day “Double Difference” XCAL for entire MWR time series
 - Used to produce MWR L-2 geophysical retrievals
- Recommended Tb data product for AQ science users

V6.0 Corrects for V5.0S non-linear Radiometer Transfer Function 37GHz V-pol



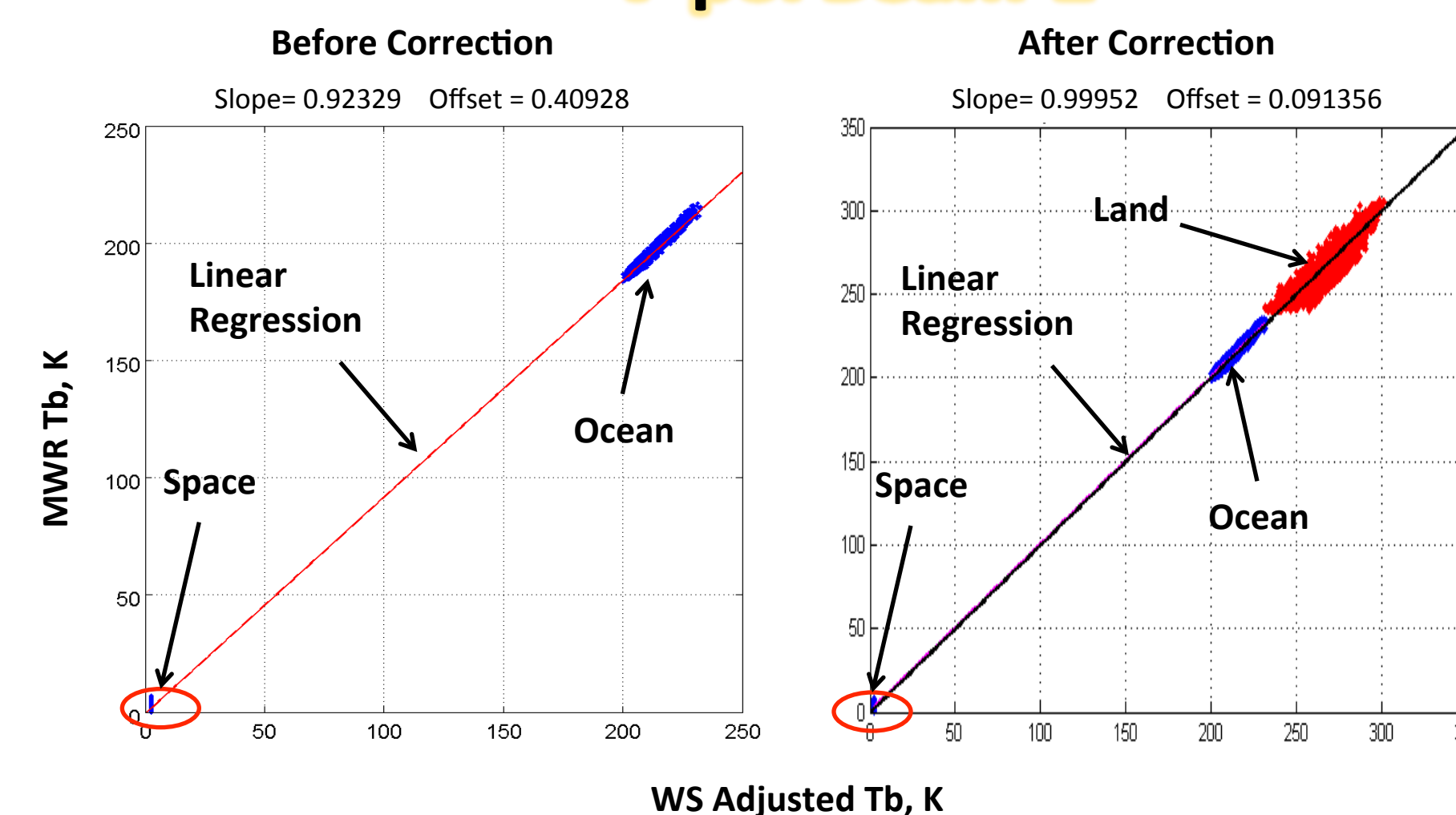
Inter-satellite Radiometric Calibration (XCAL) Post Launch Analysis

- Ant Pattern Correction and Tb bias correction were applied by inter-satellite XCAL
 - MWR = target & WindSat = reference
 - WindSat is documented to be a very well calibrated instrument
- MWR and WindSat have different incident angles, therefore, Tbs were adjusted using theoretical radiative transfer model values for both satellites (MWR_{sim} and WS_{sim})

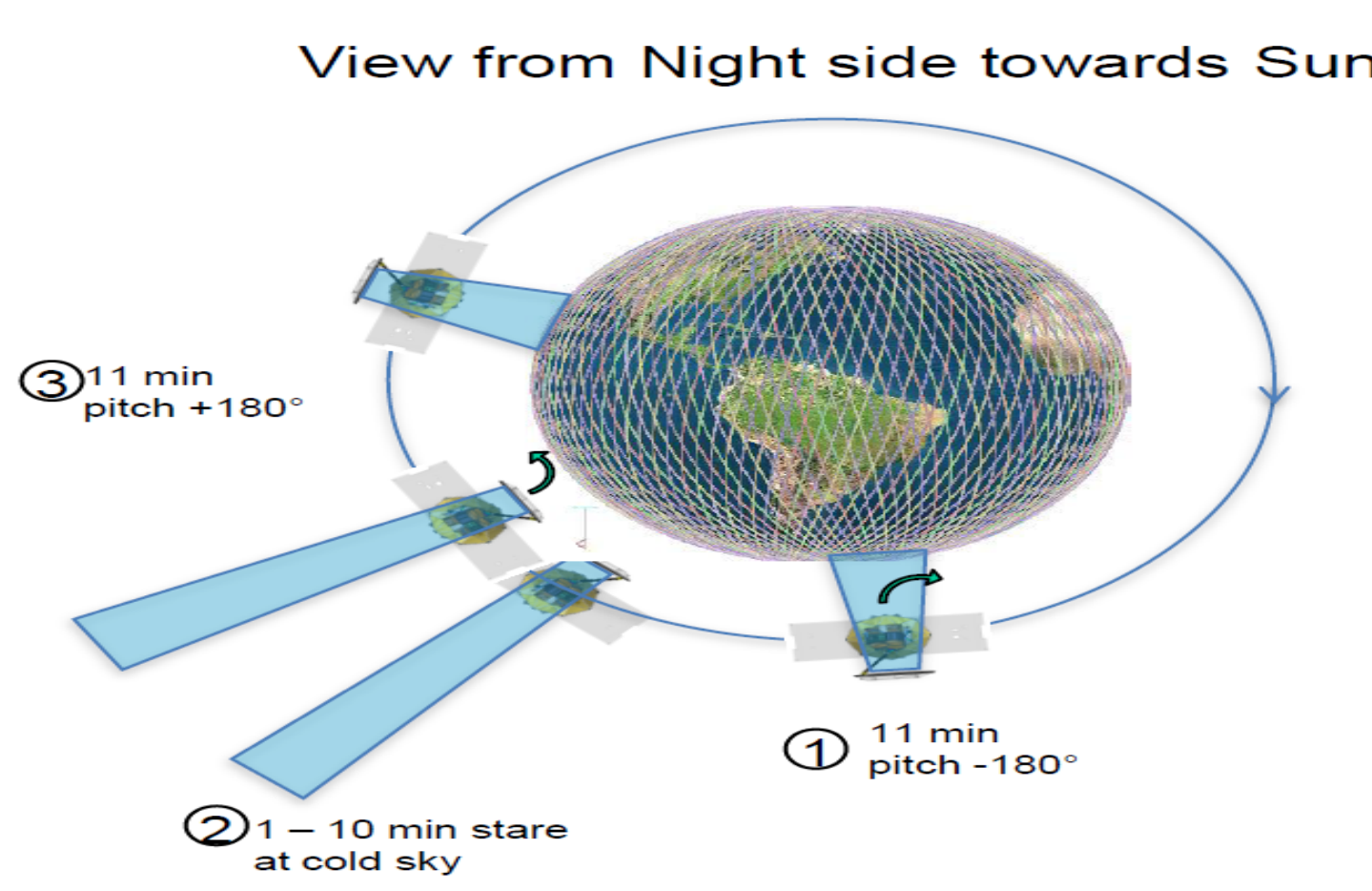
$$WS_{adj} = WS_{obs} + (MWR_{sim} - WS_{sim})$$
- Double Difference Technique

$$DD = MWR_{obs} - WS_{adj}$$

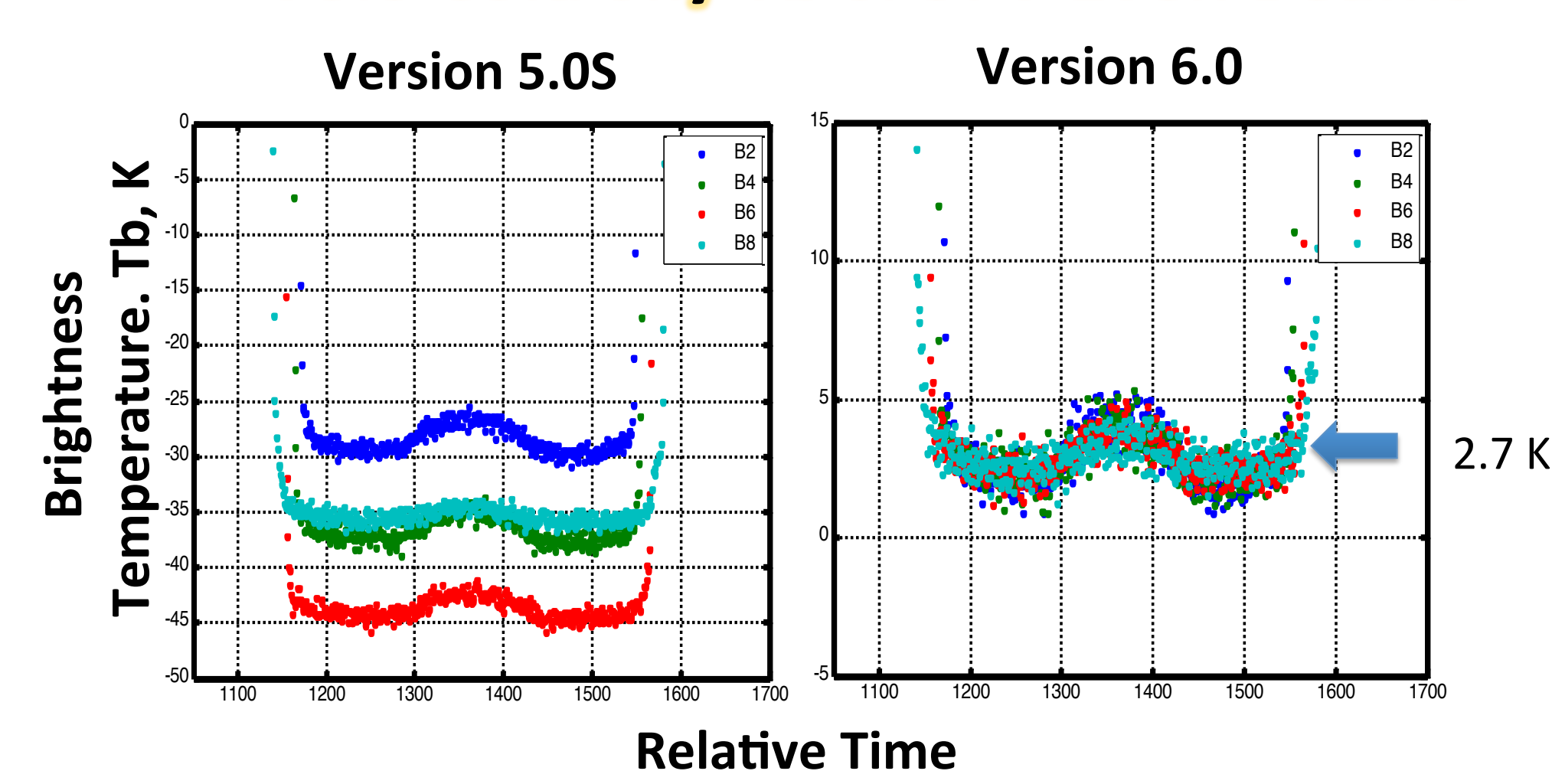
Example V6.0 Antenna Pattern Correction 37GHz V-pol Beam-1



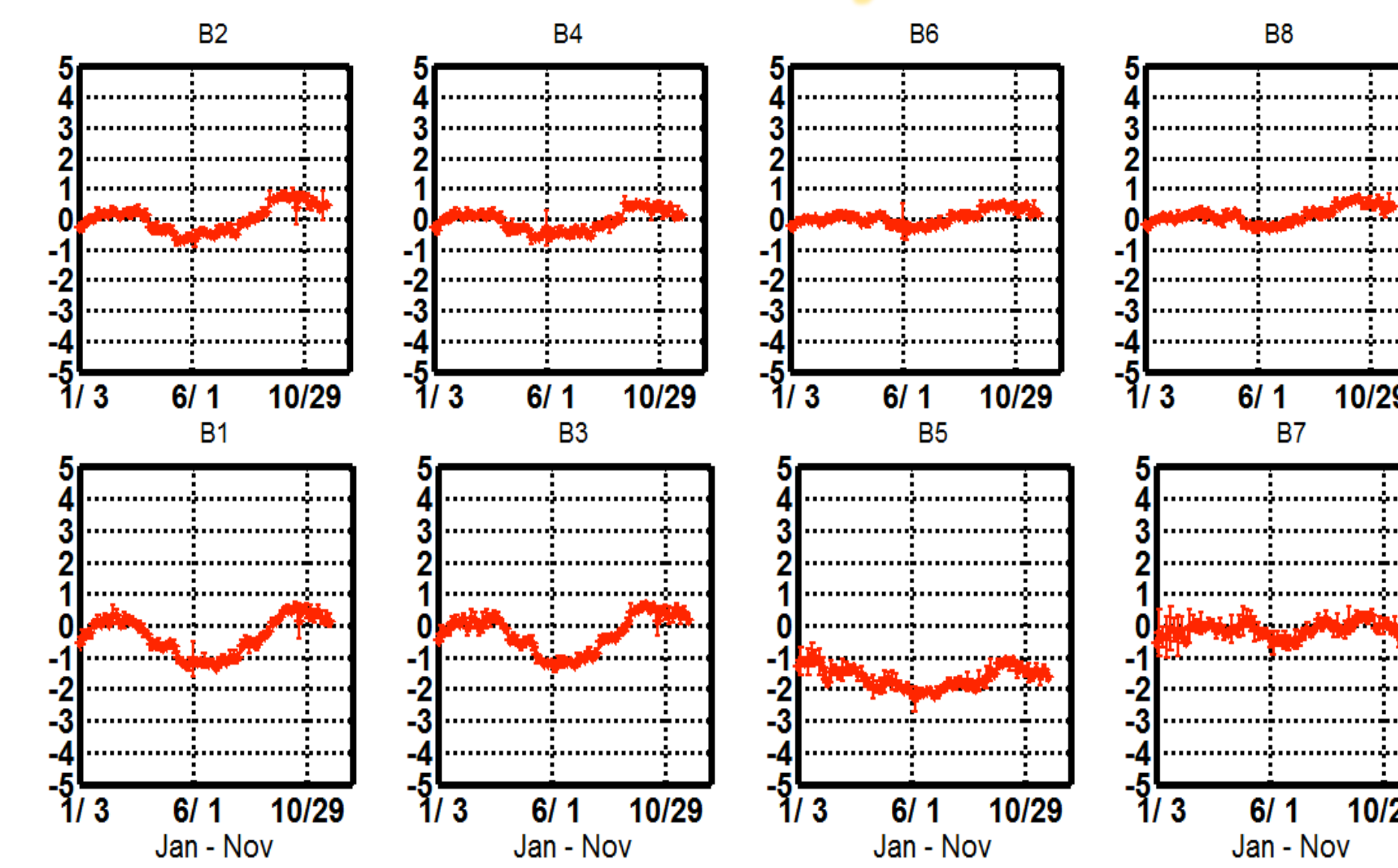
Deep Space Calibration cause MWR Antenna Beams to view Homogeneous Scene = 2.7 K



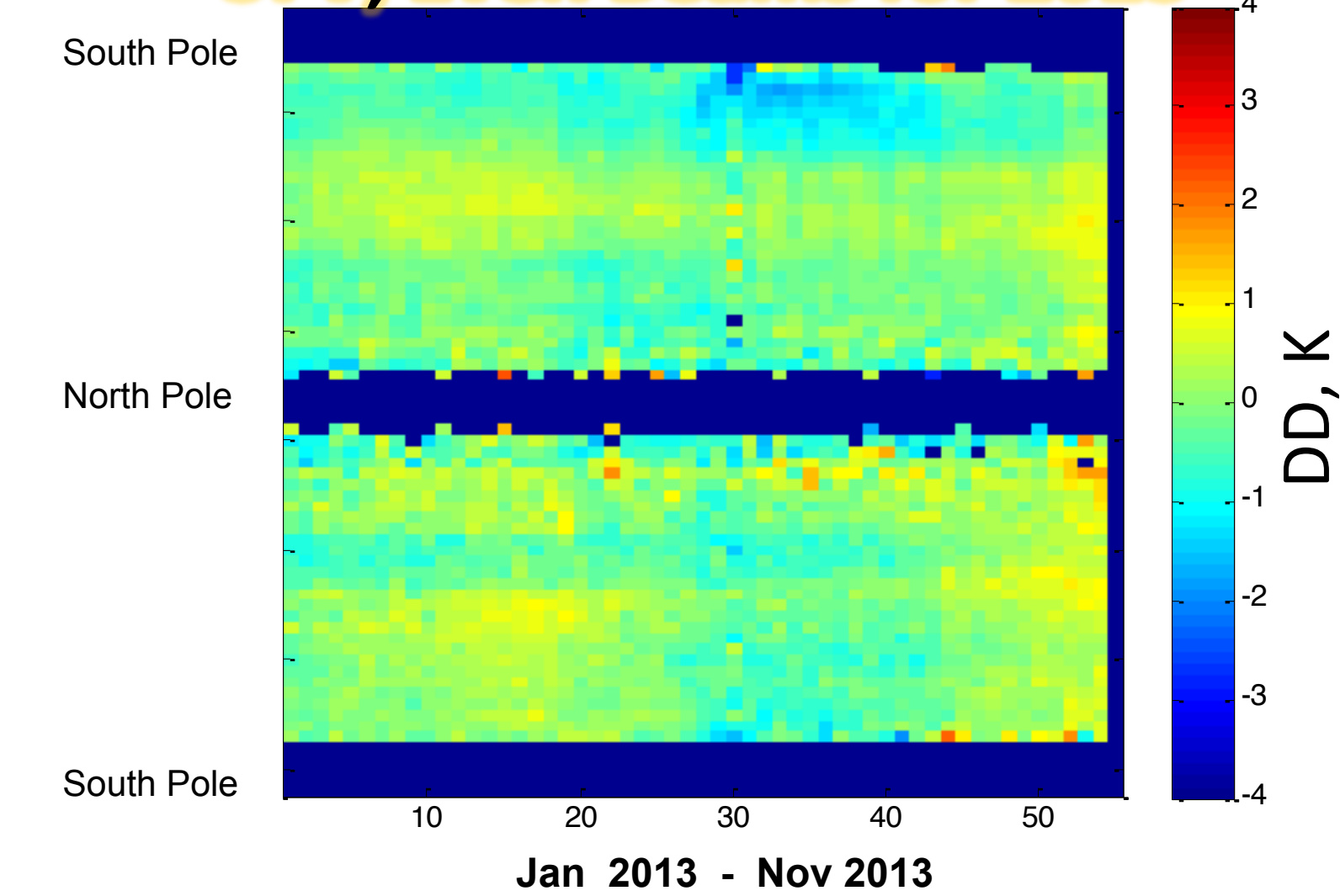
V6.0 Cold Sky Tb's: 37V Even Beams



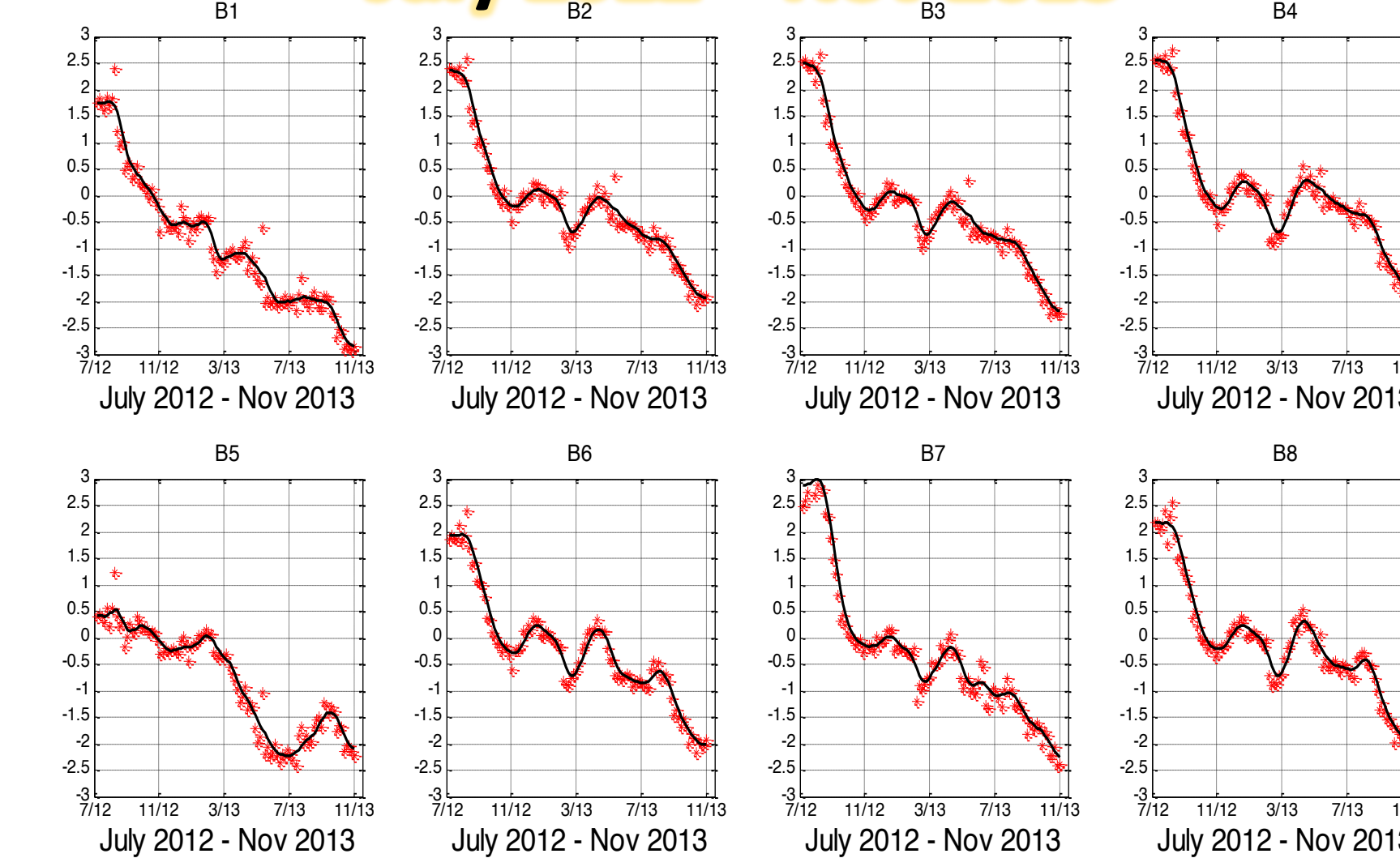
V6.0 XCAL Double Difference Biases: 37V 8 Beams, 2013



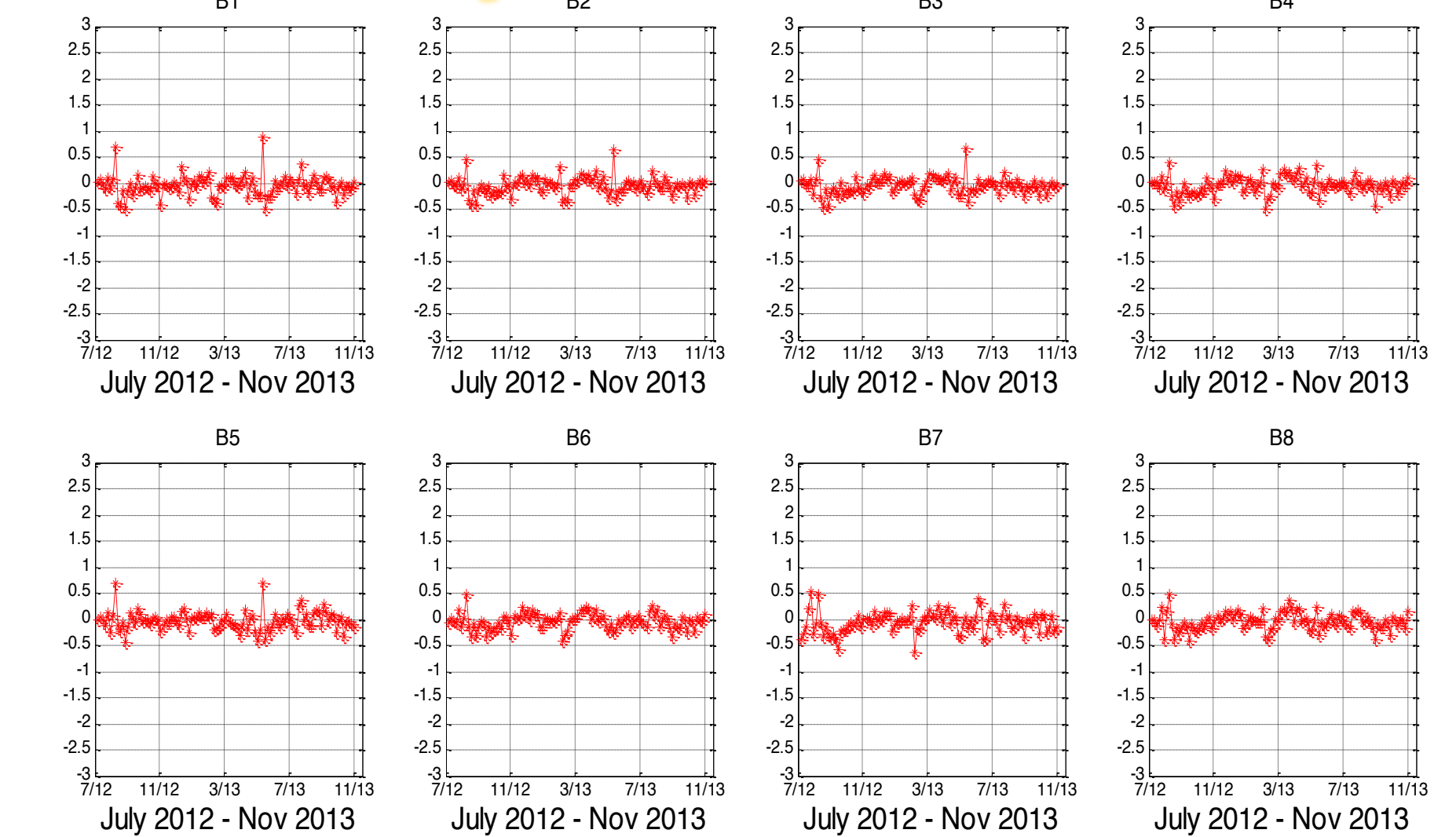
V6.0 Five days Average in 5° Lat Zones 37V, Even Beams for 2013



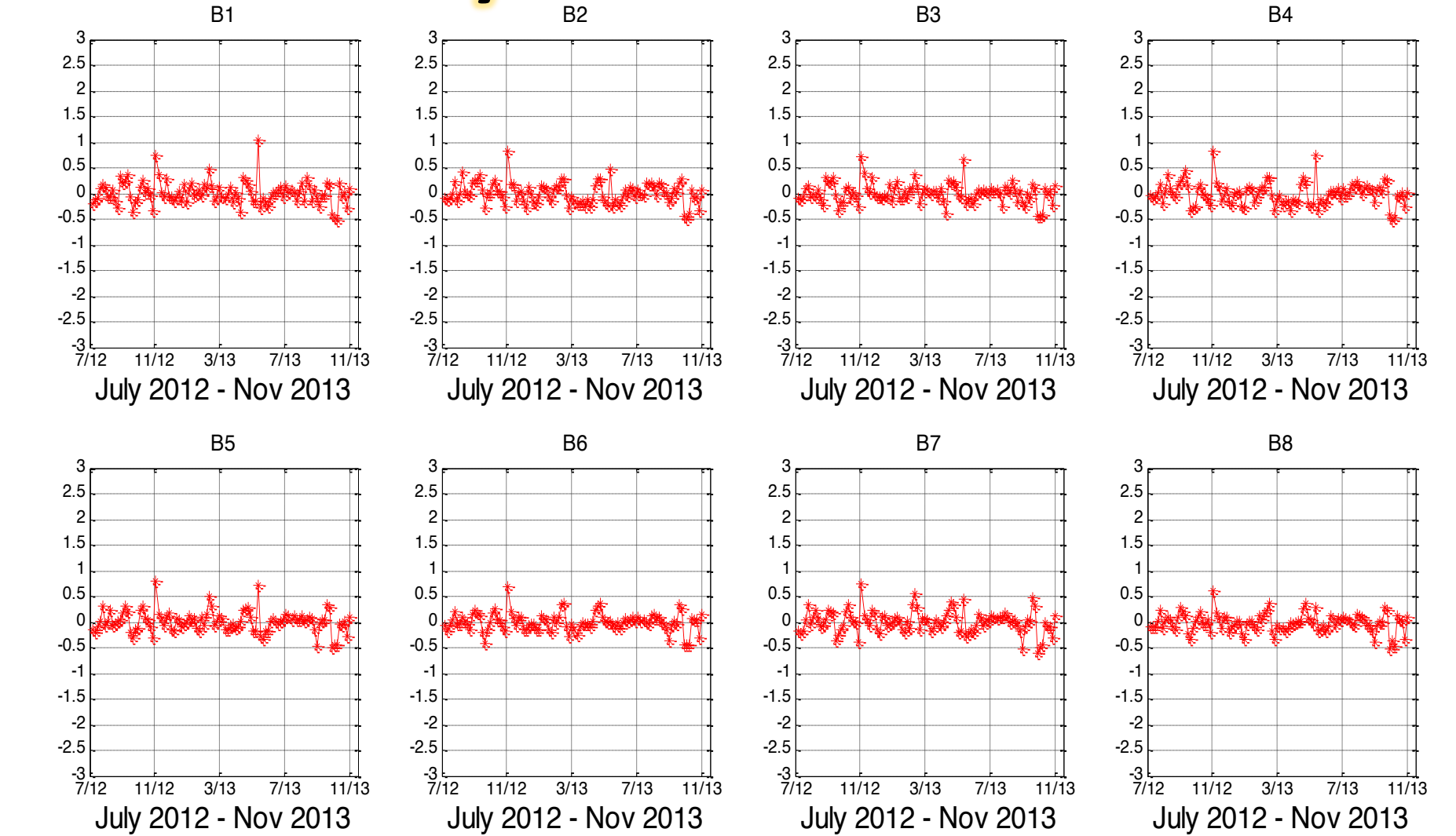
V6.0 23H, DD biases (MWR-WS) July 2012 – Nov 2013



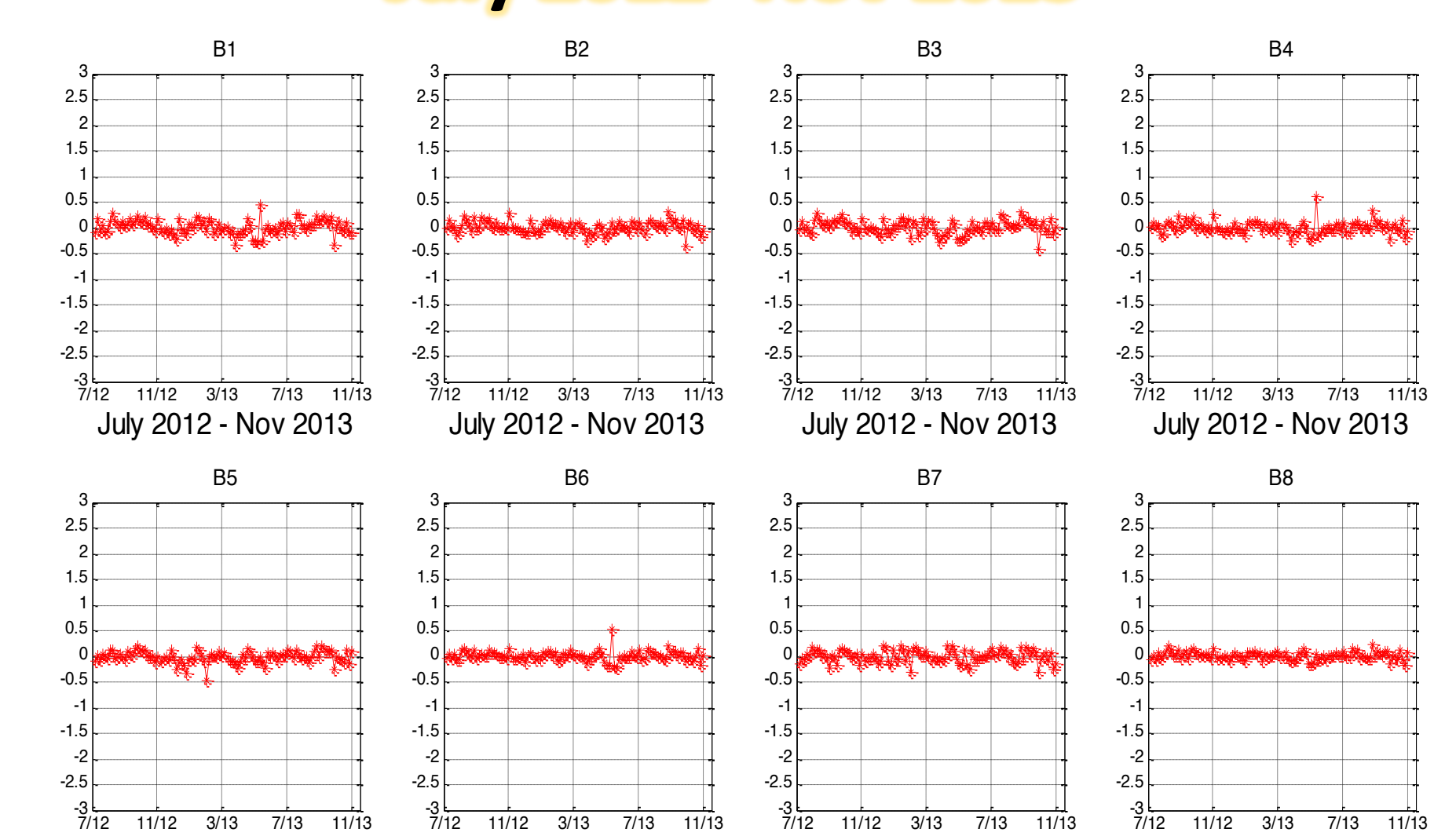
V7.0 DD Adjusted to WindSat 23H July 2012- Nov 2013



V7.0 DD Adjusted to WindSat 37H July 2012- Nov 2013



V7.0 DD Adjusted to WindSat 37V July 2012- Nov 2013



Conclusion

- Improved MWR counts to Tb algorithms V6.0 & V7.0 developed
- V6.0 is the best radiometric calibration available using MWR pre- & post-launch CAL/Val datasets V7.0 is adjusted to match WindSat radiometric standard
 - Near-zero inter-beam Tb biases that are stable ($\pm 0.1 - 0.2$ K) over the entire data time series
- Beta versions of V6.0 & V7.0 available on PODAAC
- Final archive Tb datasets will be available mid-2015