Jason Radiometer Cross-calibration System Supporting the Altimeter CDR

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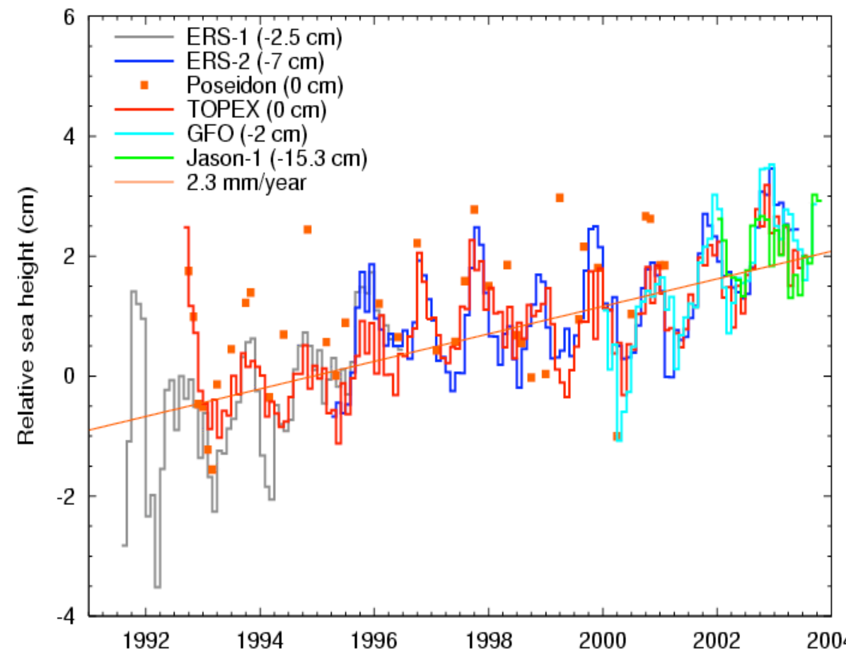
Background

- The Jason series of satellites measures global mean sea-level rise, for which the stability requirements is 1mm/yr.

- The Jason radiometer measures path delay due to water vapor (0~60 mm)

- Jason radiometers uses noise diodes for calibration, which was found unstable(e.g., 0.5 K or 1 K jump). The stability need to be monitored and the measurements require recalibration.



Miller ad Bayler, 2004 AMS meeting

2001 Jason1 →

2012 Jason3 →

1992 TOPEX 2005

2008 Jason2 →

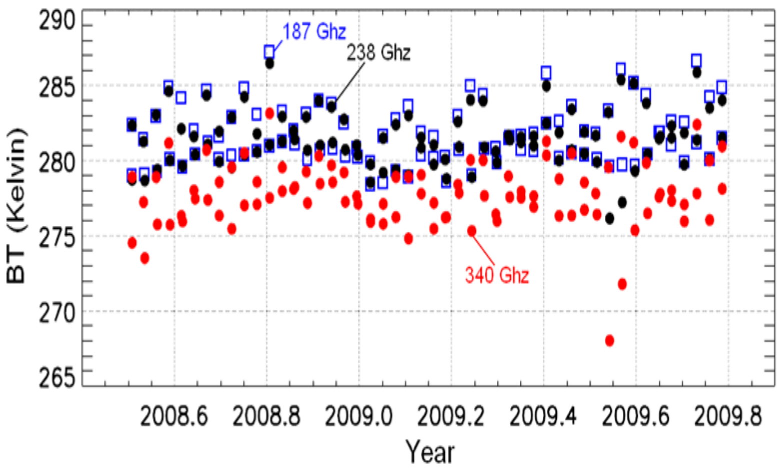
Ocean Surface Topography Missions – NASA/NOAA/CNES

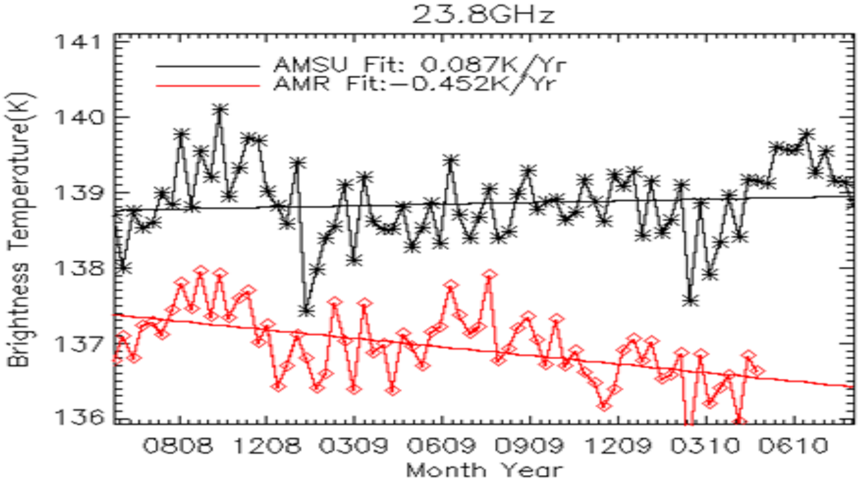
Previous Studies of Jason Radiometer Stability

--- Vicarious techniques

Coldest part of ocean and Amazon rain forest sites (Ruf, 2000, IEEE Geosci., Scharroo and Schrama, 2004, Marine Geodesy).

- Affected by seasonal and long-term changes of geophysical parameters, e.g., surface temperature, water vapor, wind speed.
- Uncertainty is large, or at least need to be complemented by other methods





- Jason2/AMR Amazon 2 Time Series
  - Channel 187GHz: 281.660 +/- 1.94231 (0.689%)
  - Channel 238GHz: 281.455 +/- 1.85729 (0.659%)
  - Channel 340GHz: 277.751 +/- 2.16540 (0.779%)

- Jason2/AMR and MetOp/AMSU Time Series over Coldest part of ocean for 23.8 GHz
  - Seasonal variations
  - Long-term trends, mixed results of geophysical parameter and calibration anomalies

Objectives of This Study

- Develop a system to monitor and cross-calibrate the Jason 1, 2, 3 Radiometers.

- The monitoring is performed through

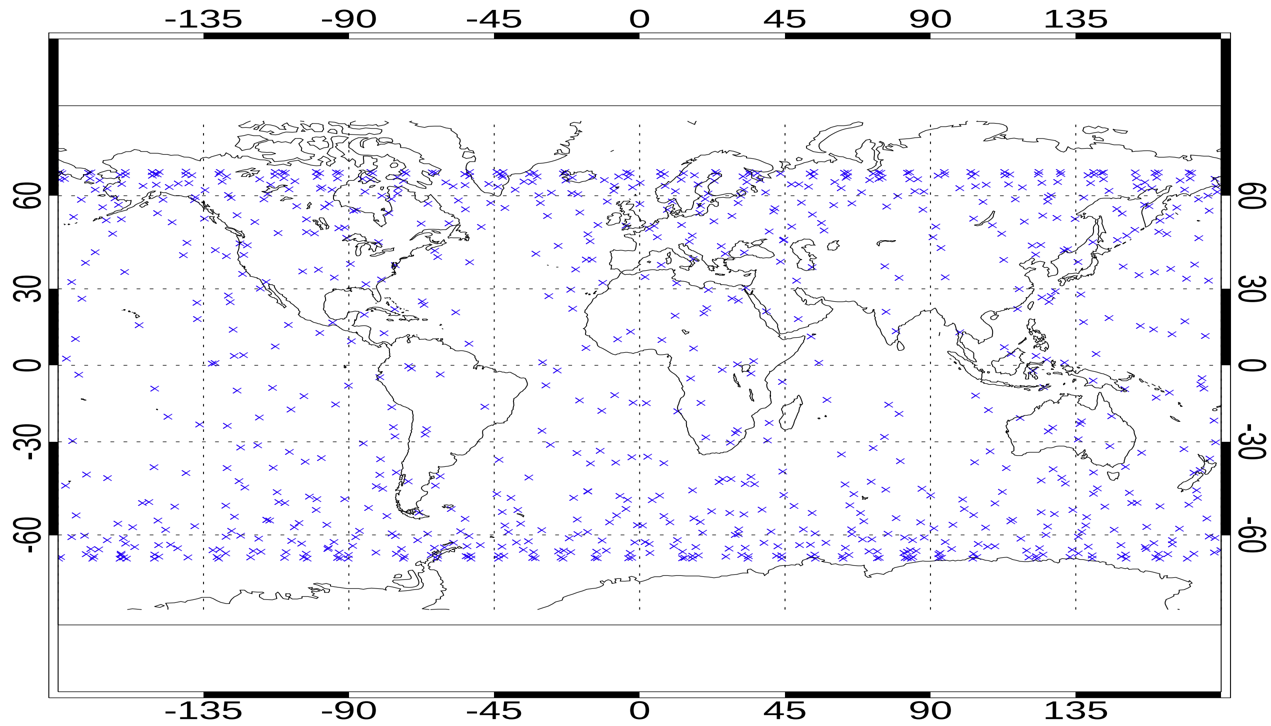
--- Comparisons with other microwave radiometers at SNO locations with similar channels, Metop/NOAA AMSU, DMSP SSMI
  - AMSU/SSMI is calibrated with Space-view, AMSU has nadir view.
  - Future AMSU/SSMI FCDR is available through CDRP
  - SNO happens globally between polar satellite and low-inclination satellites.

--- Comparisons between Jason microwave radiometers at SNO locations
  - Remove inter-satellite discrepancy

--- Vicarious techniques
  - Compare Jason radiometers and AMSU/SSMI at coldest part of the ocean to separate calibration anomaly from natural changes

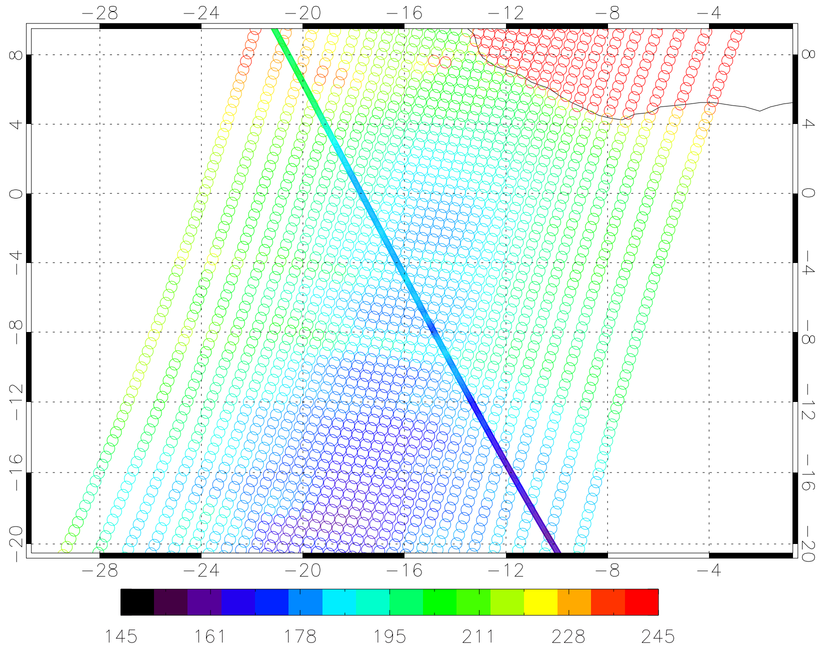
- The system will be expanded based on the Jason 2 AMR stability monitoring system developed

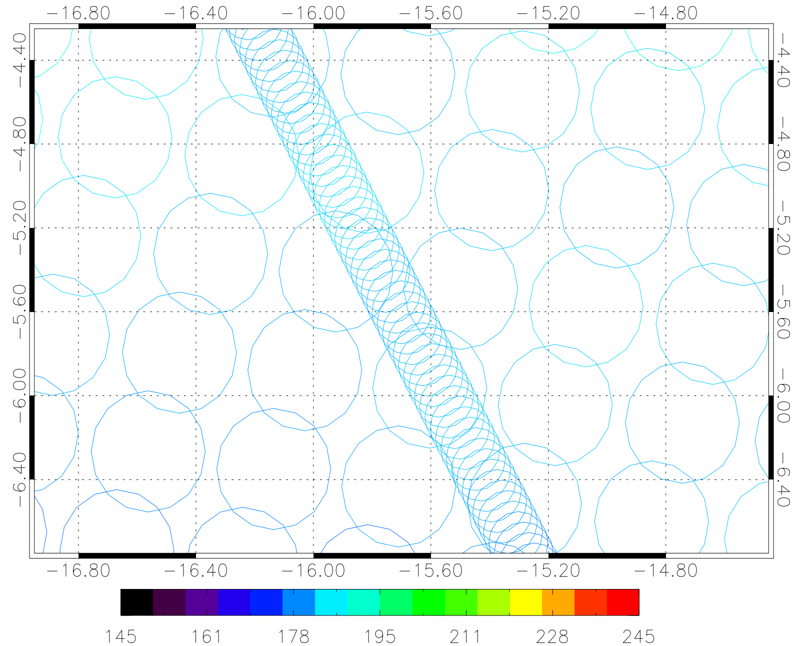
SNOs between Jason and MetOp



- Total 875 Metop/Jason 2 SNOs between 6/21/08 and 6/30/09 (5 min criteria)
- Happens globally, more SNO events occur at high latitude than in the tropics
- Allows monitoring globally and over full scene temperature range

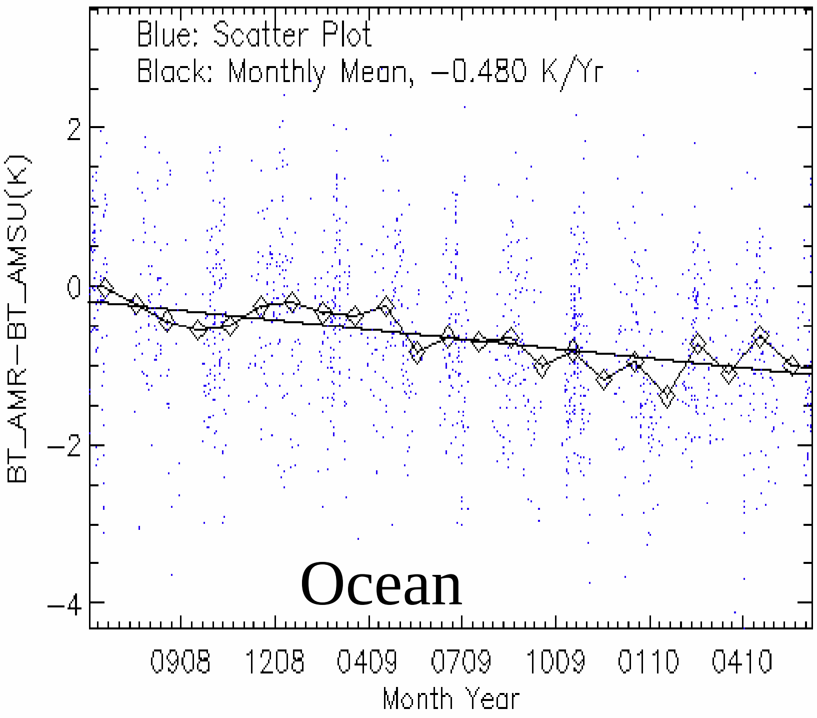
Spatial Sampling Characteristics of AMR and AMSU-A

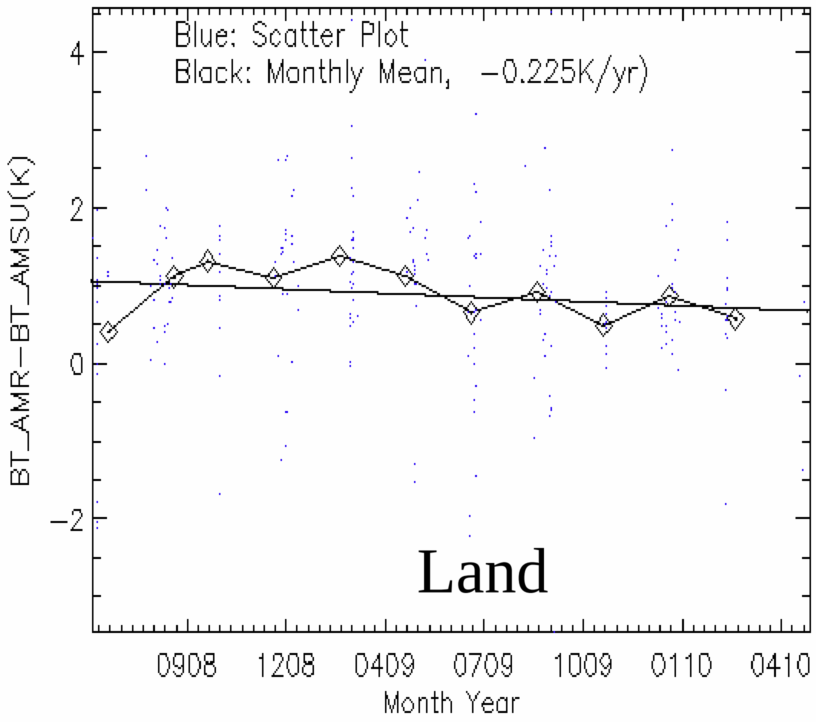




- AMR: Nadir view only, 26 km resolution, with significant oversampling alongtrack, JMR 50km resolution
- AMSU-A: Cross-track scan, 50km resolution, only nadir-view pixels are useful

SNO Analysis between Jason 2/AMR and MetOp/AMSU for the 23.8 GHz Channel

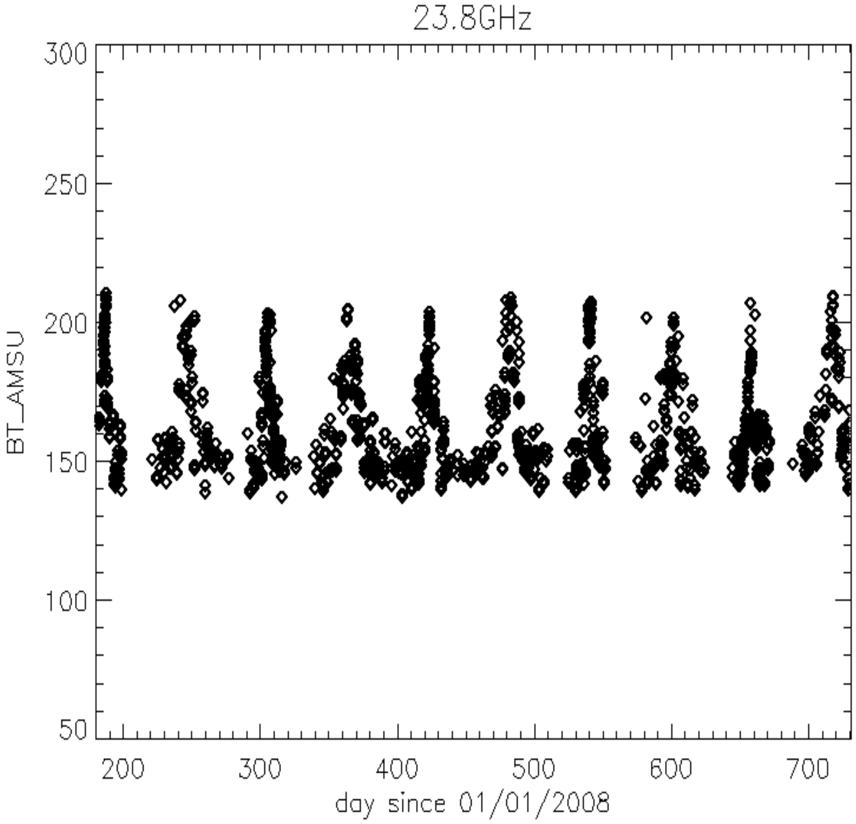


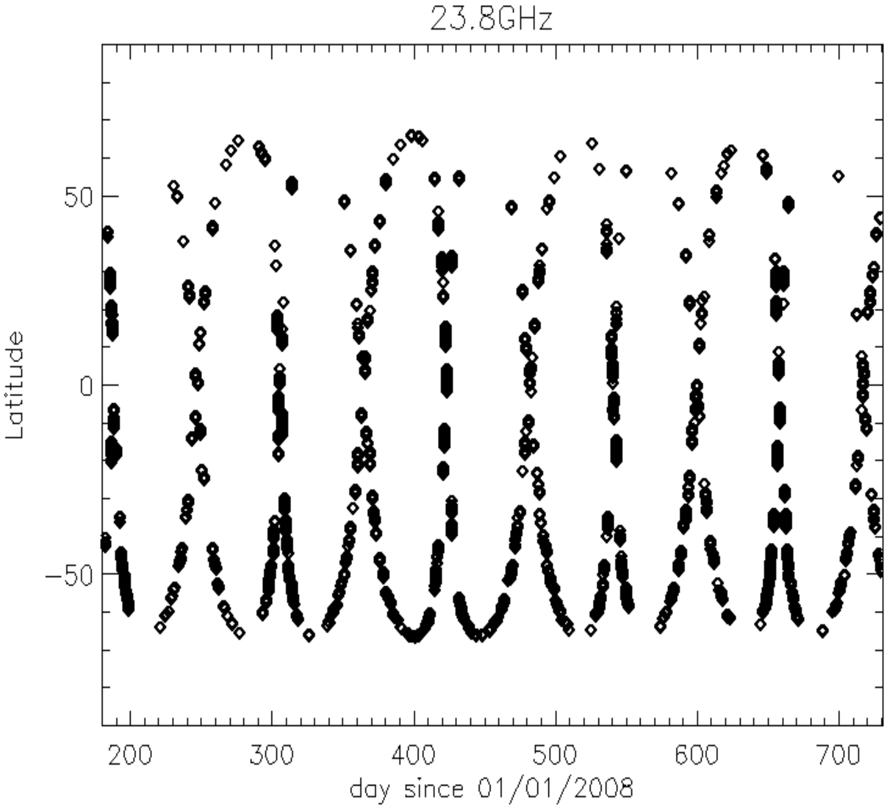


- Over ocean, a 0.48K/yr drop in the AMR measurements relative to MetOp/AMSU is detected until the beginning of 2010, translate to -2.49mm/hr as path delay.

- Over land, the trend is smaller, however, the available SNO events are limited.

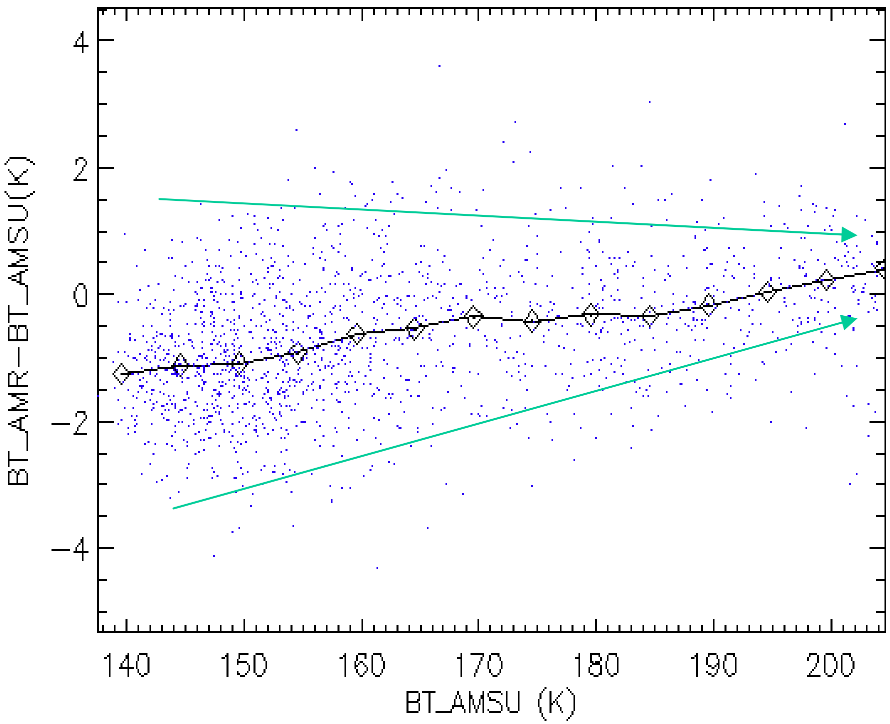
Bias Trend Not Correlated with BT Trend and SNO Latitude Time Series

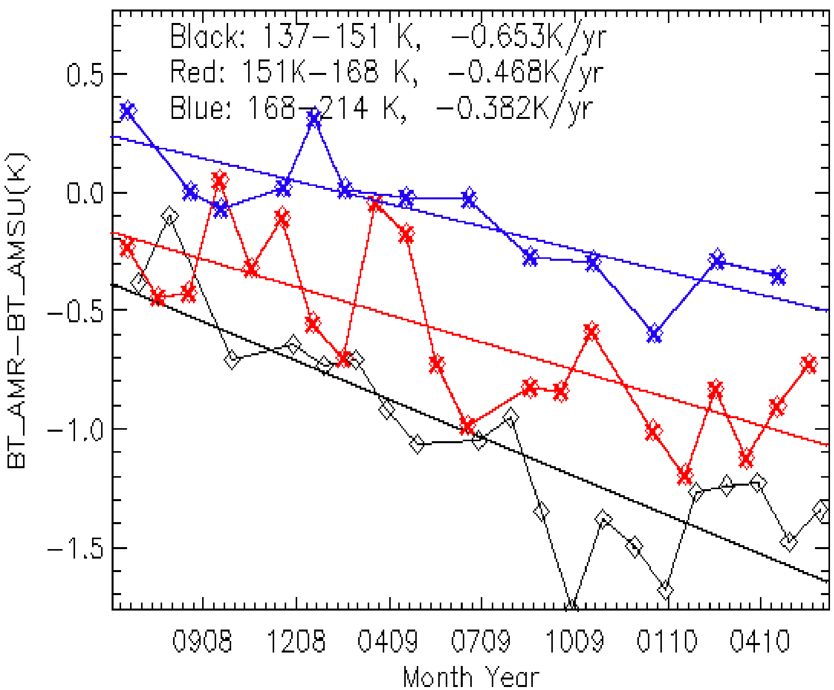




- There is no appreciable trend for the scene BT and latitude of SNO locations.
- The AMR bias trend relative to AMSU is mainly caused by calibration drift.

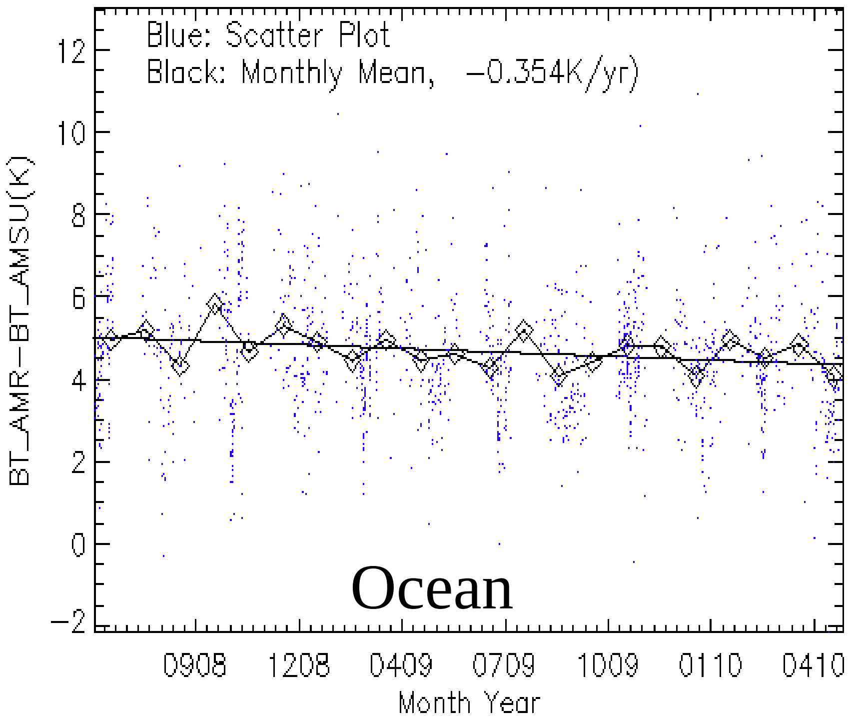
Temperature Dependence of AMR Bias over Ocean

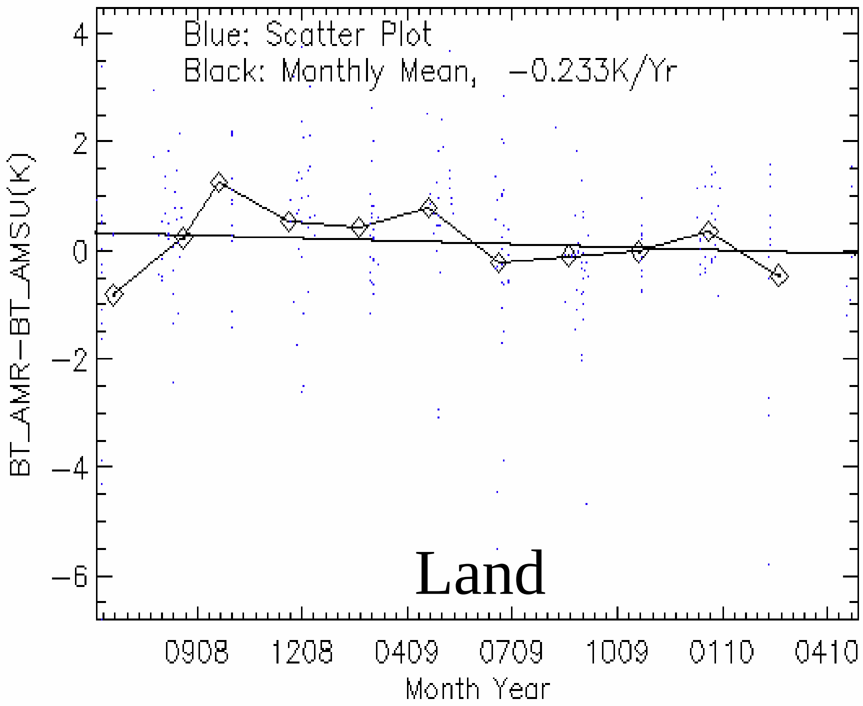




- AMR bias is larger and more variable at cold end (may be due to the lack of space-view?).
- The AMR bias trend is large at cold end and decreases toward warm end.

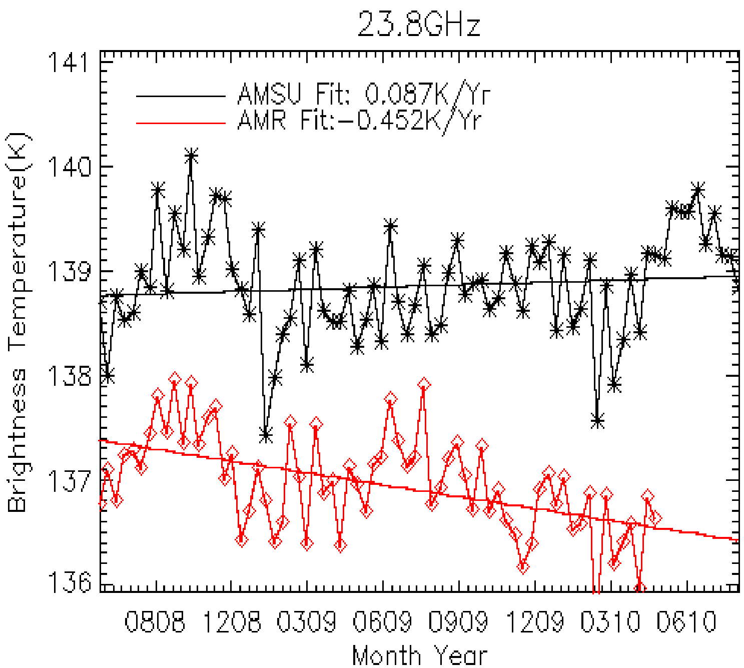
SNO Analysis between Jason 2/AMR and MetOp/AMSU for the 34/31 GHz Channel

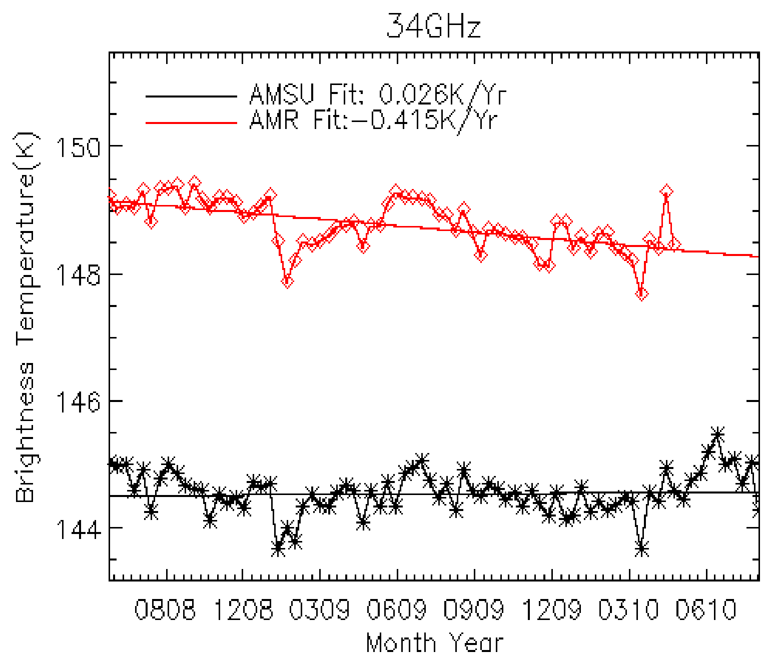




- Noise due to differences in channel frequency and surface emissivity/reflectance
- Similar AMR trend are found over land and ocean
- Future study to reduce the impact of channel frequency differences using models

Coldest BT Analysis for Jason 2 AMR/ Metop AMSU





- Seasonal variation at 23.8 Ghz channel because of water vapor changes
- Relative to AMSU, AMR drift -0.54 K/yr for 23.8 GHz, and -0.44 K/yr for 34 GHz
- Same trend with SNO analysis, though the exact values are different.

Summary

- A microwave radiometer cross-calibration system is proposed to support the Jason altimeter CDR.

- Preliminary results suggest the proposed system can calibrate Jason radiometers with high accuracy, over land and ocean, and covers full scene BT range.

- Future work includes SNO analysis for all related satellites and channels to complete the system

- Future AMSU/SSMI FCDR will be used for cross-calibrating Jason radiometers to further reduce uncertainties and establish consistency.