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National Environmental Satellite, Data, and Information Service (NESDIS)

Monitoring Jason 2/AMR Stability using SNO Observations with AMSU on MetOp and NOAA satellites

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Background

- The Jason series of satellites provides continuous observation of sea surface height (SSH) over the globe.
- The stability requirement for measuring global mean sea level rise is 1mm/yr.
- Jason radiometer measures path delay due to water vapor, which contributes to a significant uncertainty in the measurements of sea surface height
- Janson1/JMR and Jason2/AMR uses noise diode and internal reference for calibration, and their long-term stability needs to be monitored

Objective

- A Jason Radiometer Stability Monitoring System is developed at NOAA/NESDIS/STAR

- This monitoring is performed through

  --- comparisons with other microwave radiometers at SNO locations, Jason2 AMR/Metop AMSU, Jason1 JMR/NOAA18 AMSU

  --- vicarious techniques (for comparison with SNO)

  coldest part of ocean (Ruf, 2000, IEEE Geosci., Scharroo and Schrama, 2004, Marine Geodesy)

  monitoring at selected sites including Corsica, Harvest Water Body ROI, Alcopoco, Amazon 1, Amazon 2, and Libya desert.

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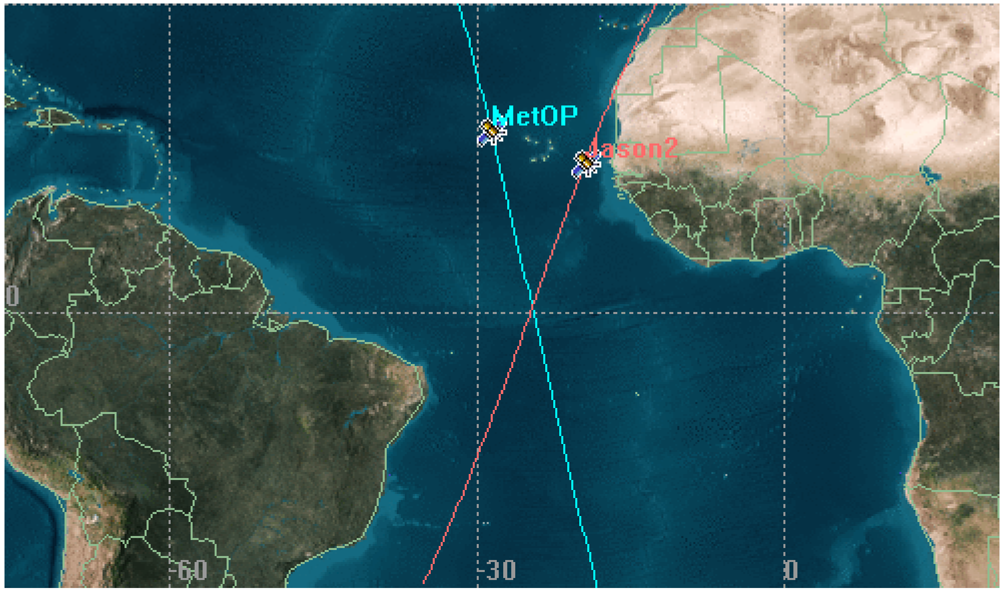
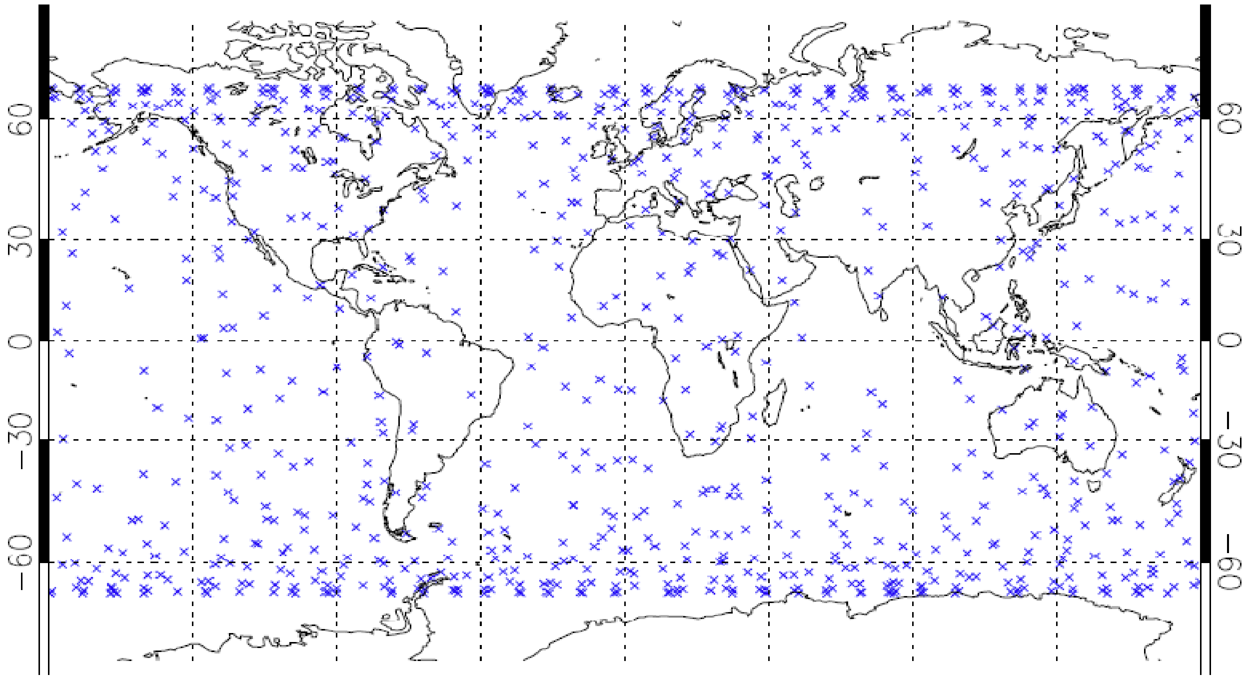
Simultaneous Nadir Overpass (SNO) between Jason 2 and MetOP

- Occurs regularly
- Frequency of occurrence depends on the simultaneity criteria
- With a 3 minute SNO criteria, this occurs once every 2-3 days
- Trade-off exists between simultaneity and number of samples



Example SNO between Jason-2 and MetOP on December 17, 2009

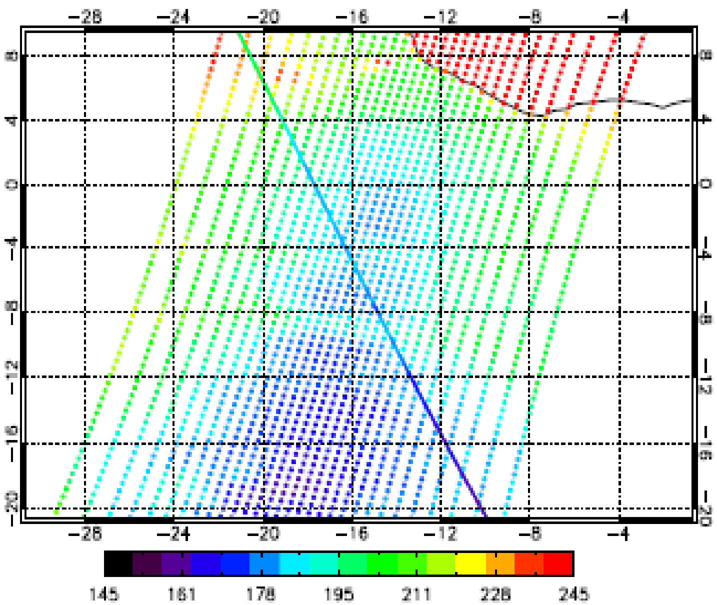
SNOs between Jason-2 and MetOP (~1 yr)

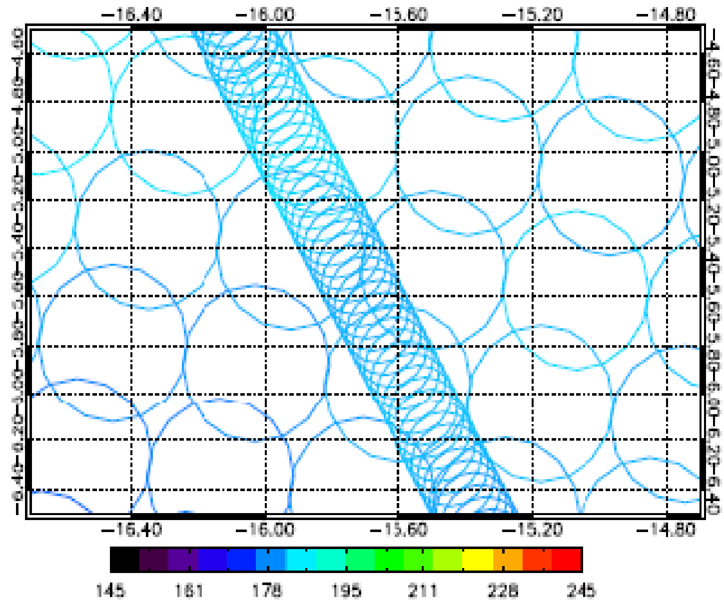


Metop/Jason-2 SNO events, 07/08 ~ 06/09

- More SNO events occur at high latitude than in the tropics
- Total 875 SNOs between 6/21/08 and 6/30/09 (5 min criteria)

Spatial Sampling Characteristics of AMR and AMSU-A



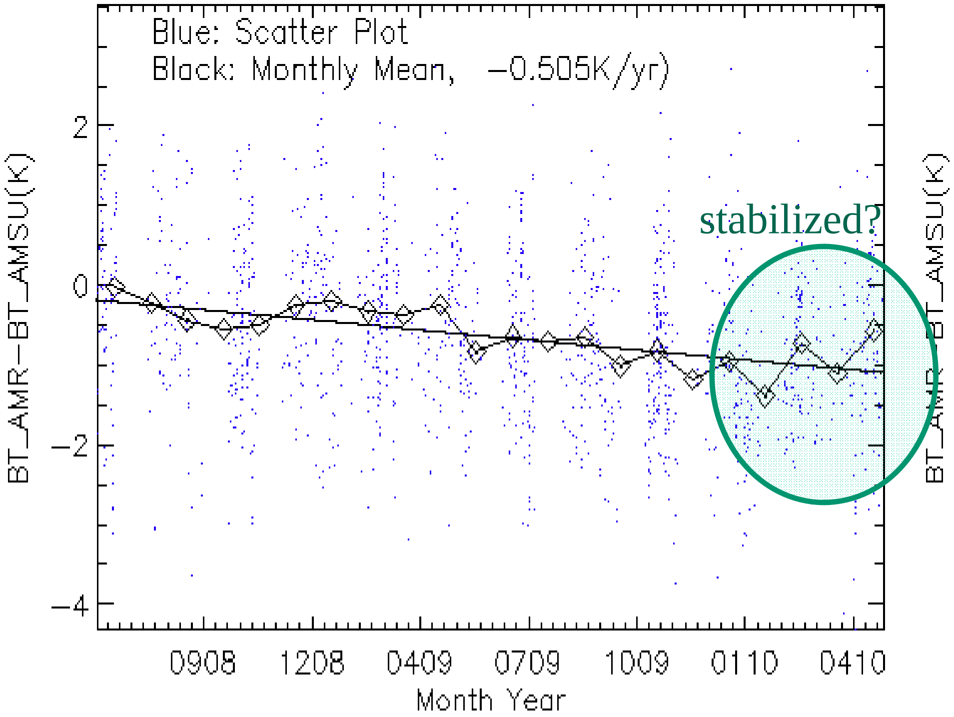


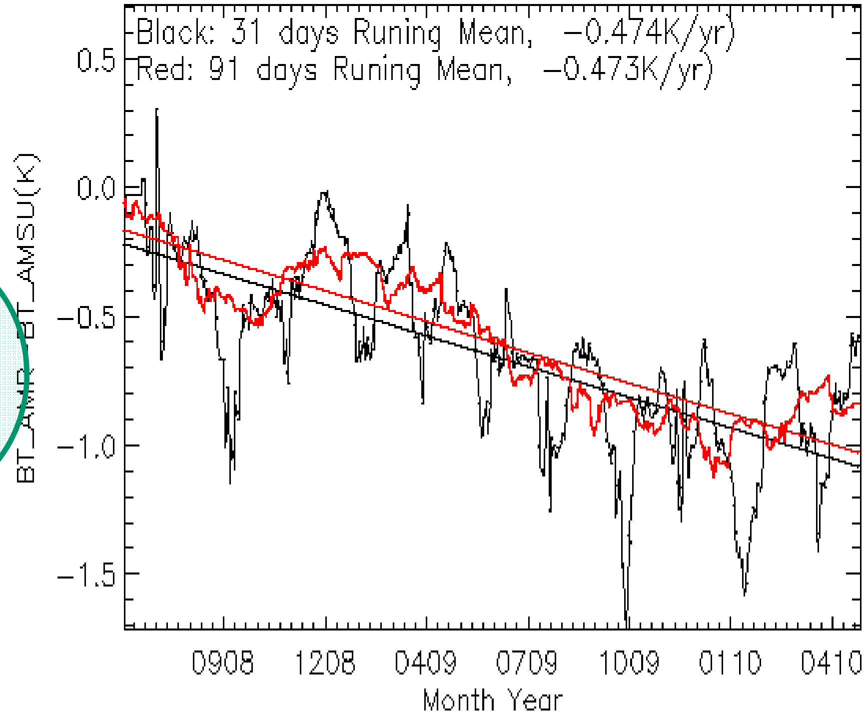
- AMR: Nadir view only, 26 km resolution, with significant oversampling alongtrack, JMR 50km resolution
- AMSU-A: Cross-track scan, 50km resolution, only nadir-view pixels are useful

AMR/JMR and AMSU-A Channel Comparisons

- Three AMR channels: 18.7, 23.8, and 34GHz
  - Partially calibrated using noise diodes and internal references
- Fifteen AMSU-A Channels from 23.8 ~ 89 GHz
  - Fully calibrated using blackbody and spaceview, known to be very stable and good for climate studies
- Only the 23.8 GHz channel exactly matches in frequency between AMR/JMR and AMSU-A, AMR/JMR's 34GHz channel is similar with AMSU-A's 31 GHz

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





- Three statistical methods are applied: monthly mean, cumulative mean, and running mean
- A 0.5K/yr drop in the AMR measurements relative to MetOp/AMSU is detected.

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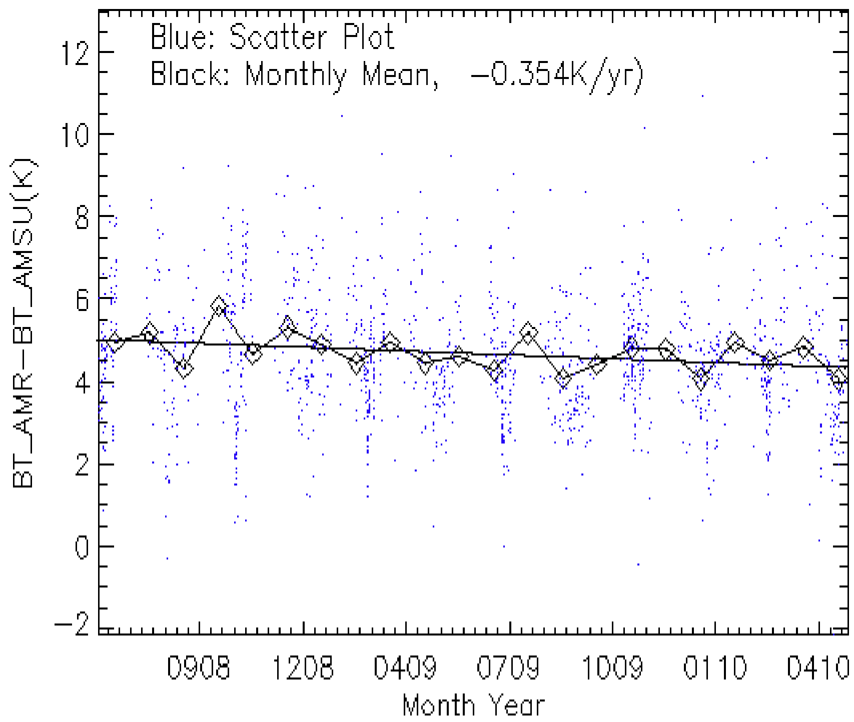
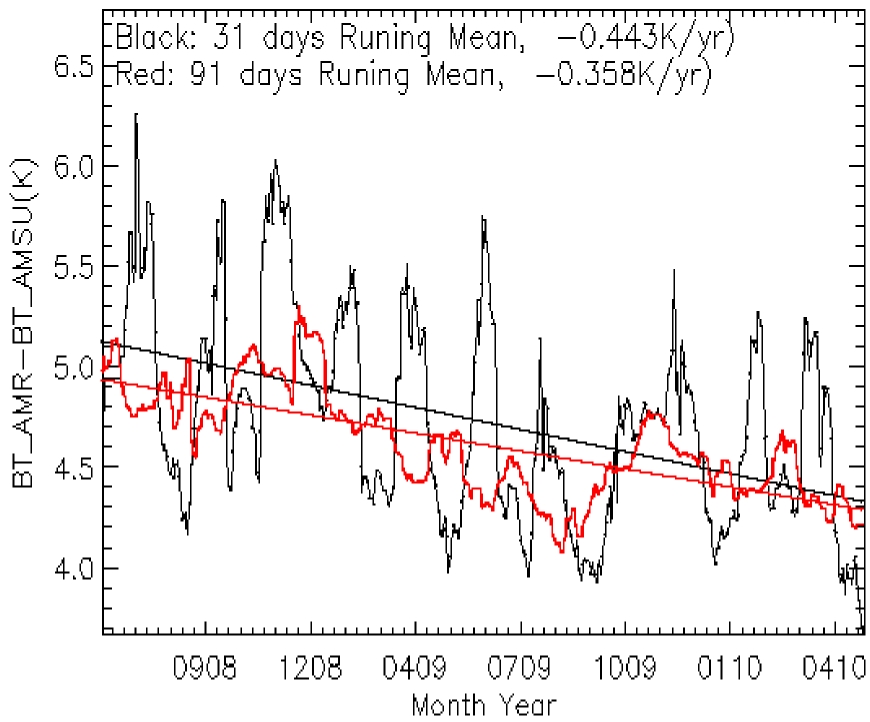
SNO Analysis between Jason 2/AMR and MetOp/AMSU for the 34/31 GHz Channel





- Noisier than that for the 23.8 Ghz channel due to frequency differences between AMSU and AMR
- A 0.35K/yr drop in the AMR measurements relative to MetOp/AMSU is detected

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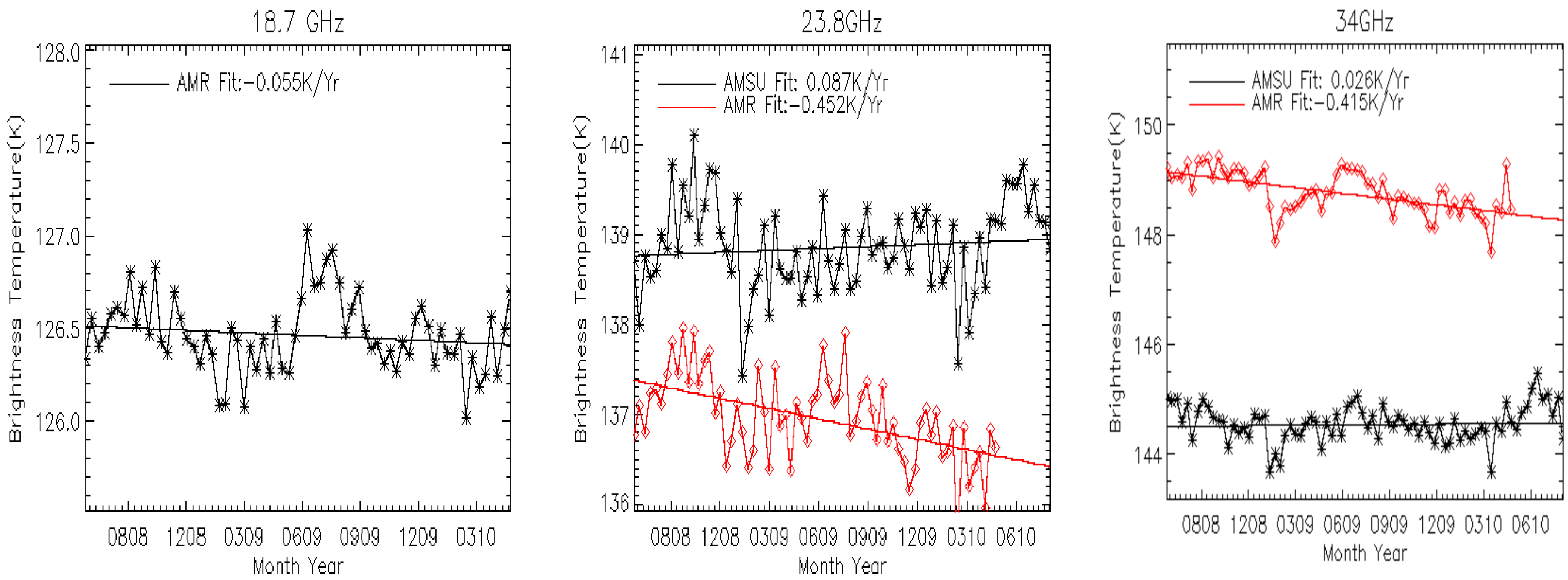
Coldest Part of the Ocean BT Analysis for Jason 2 AMR/Metop AMSU



- 18.7 GHz is stable; 23.8 GHz -0.45 K/yr; 34 GHz -0.41 K/yr drop
- Somewhat consistent with SNO analysis

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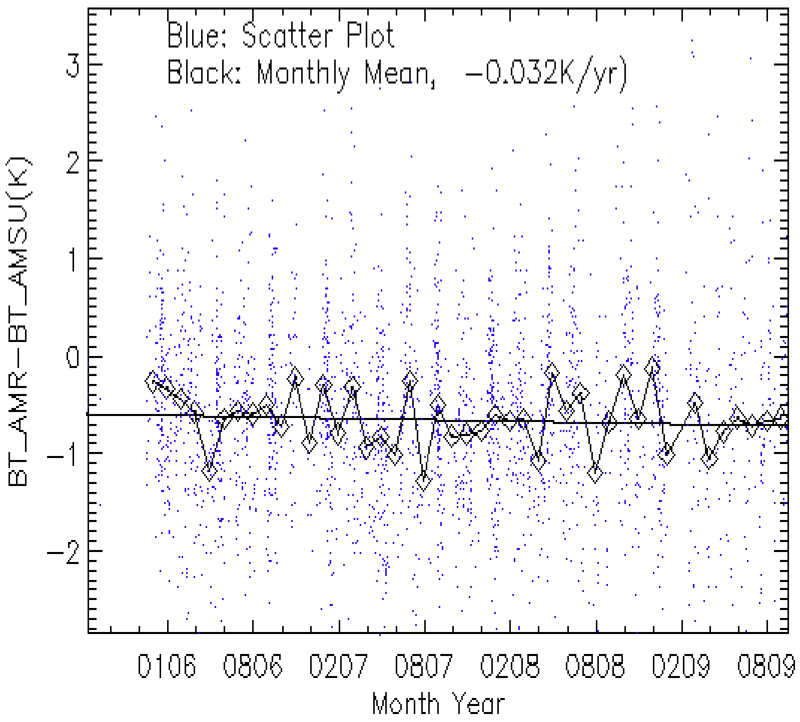
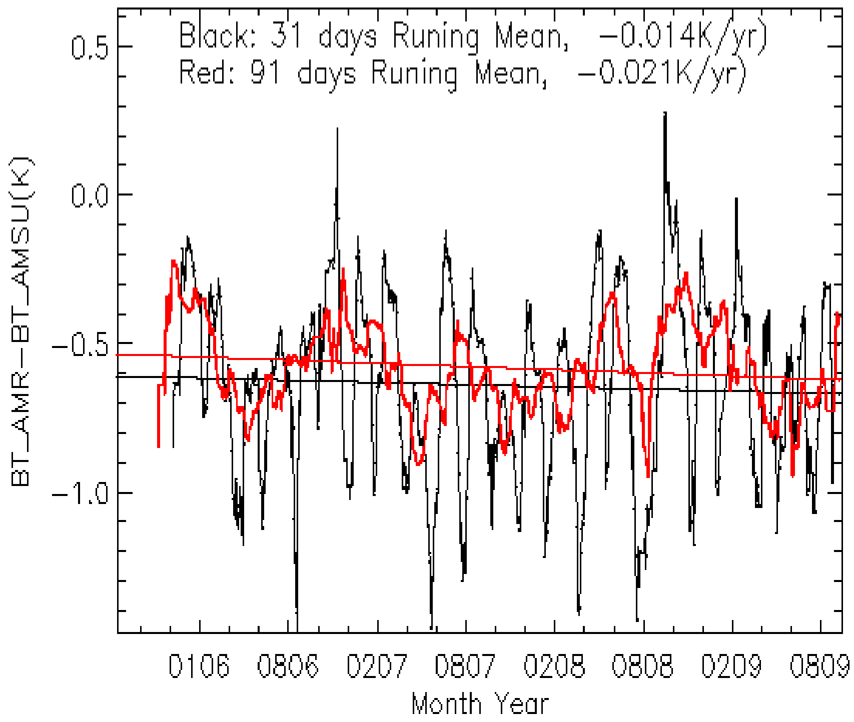
SNO Analysis between Jason 1/JMR and NOAA18/AMSU for the 23.8 GHz Channel





- JMR 23.8GHz is stable (final GDR).

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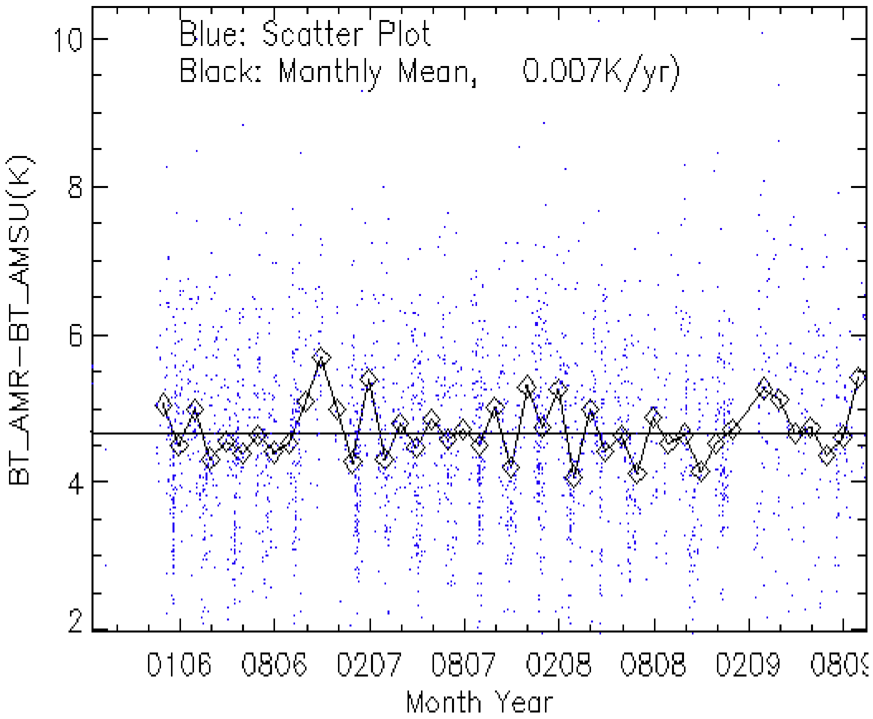
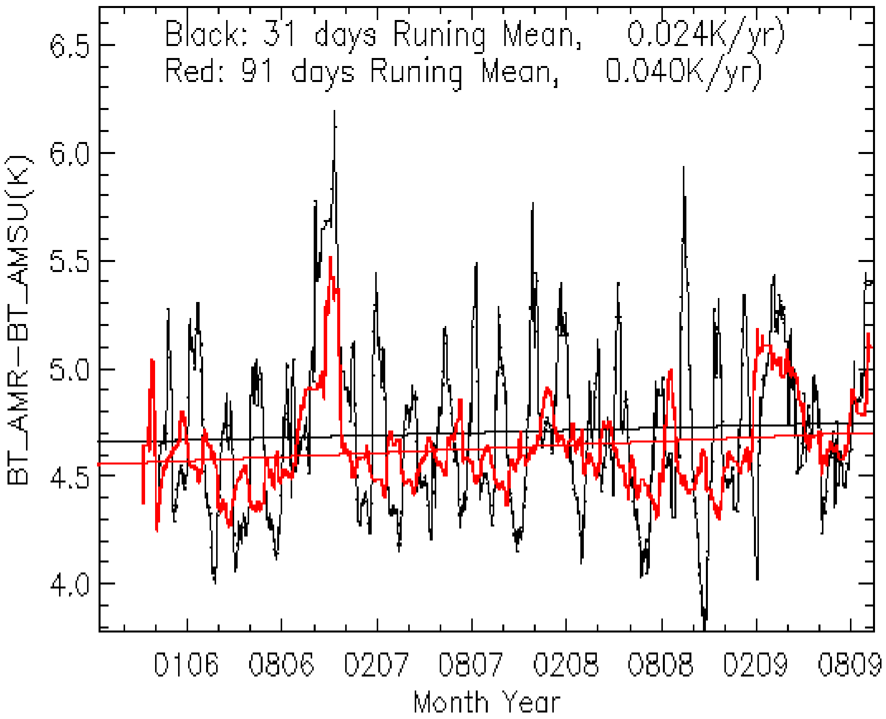
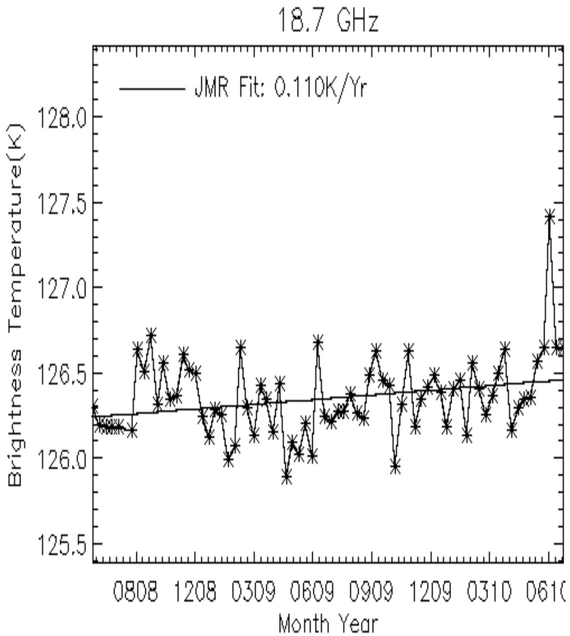
SNO Analysis between Jason 1/JMR and NOAA-18/AMSU for the 34/31 GHz Channel

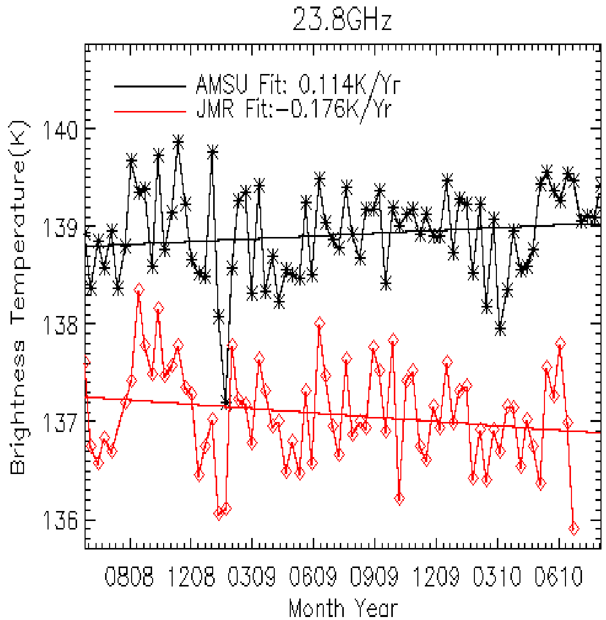


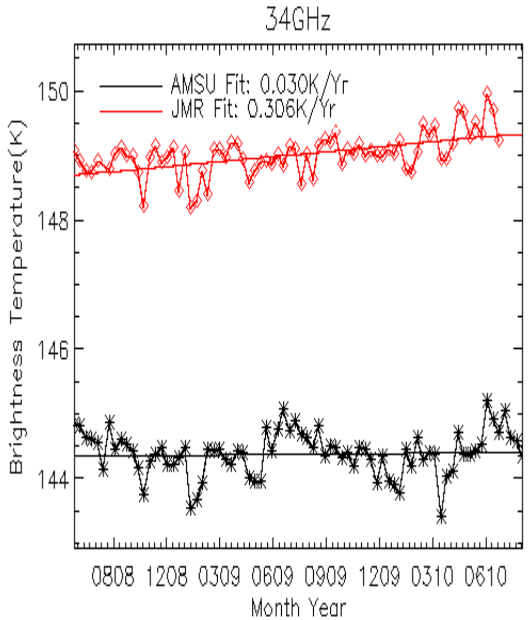


- JMR 34GHz is stable (final GDR).

Coldest Part of the Ocean BT Analysis for Jason 1 JMR/ NOAA-18 AMSU



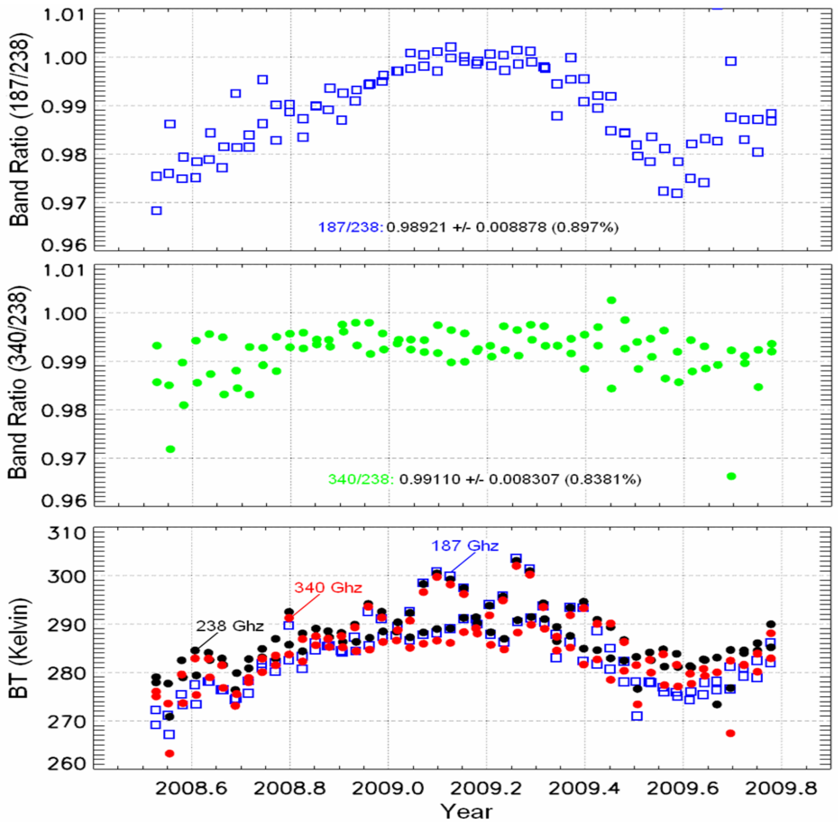


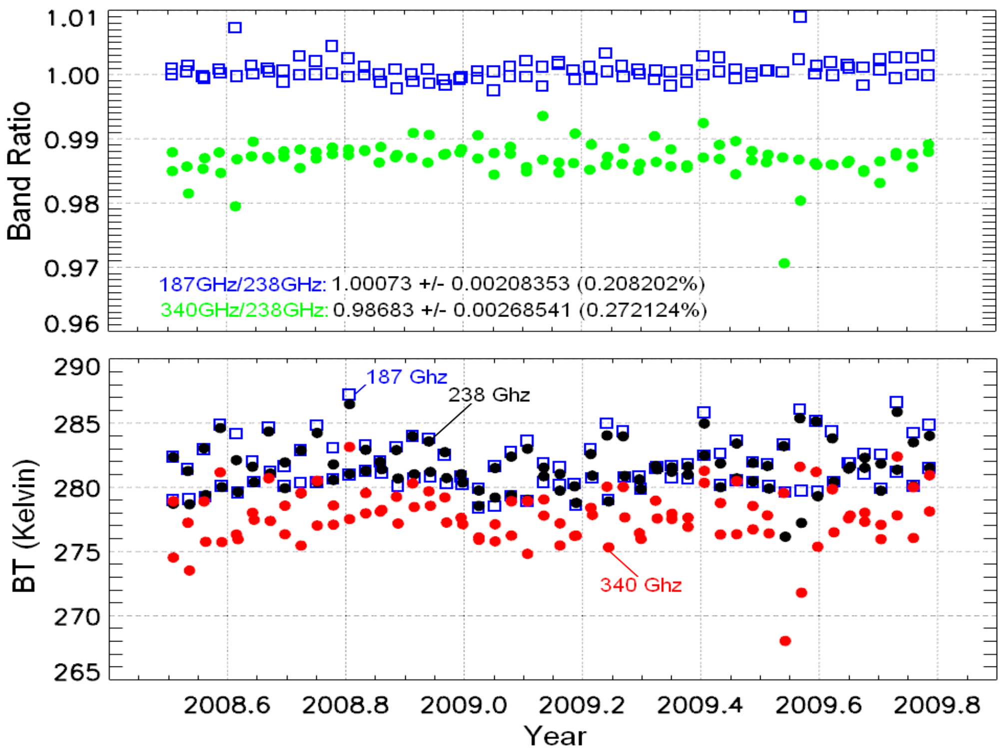


•18.7 GHz 0.11 K/yr; 23.8 GHz -0.18K/yr; 34 GHz 0.36 K/yr

•Some differences with SNO analysis

Monitoring at Vicarious Sites





- Amazon 1 Time Series
  - Channel 187GHz: 283.488 +/- 7.73414 (2.728%)
  - Channel 238GHz: 286.548 +/- 5.95696 (2.078%)
  - Channel 340GHz: 284.029 +/- 7.49680 (2.639%)

- 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%)

Summary

- A system has been developed at NOAA to monitor the stability of the Jason radiometers using the SNO method
- A relative drift between Jason 2/AMR and MetOp/AMSU at 23.8 GHz is observed at a rate of ~0.5 K per year initially and stabilized since April 2010
- Analysis using several methods confirmed the bias trend
- Vicarious calibration is also performed, but the results are too noisy to see the trend
- Future work will include more analysis on JMR/AMR SNOs, and additional work on the 18.7 GHz channel.