

Demonstration of the radiometric accuracy of IASI for climate monitoring using coincident data from the Advanced Along-Track Scanning Radiometer.

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Radiometrically for IASI, radiometric characterisation

- Monitors radiometric stability for IASI (long-term testing of instrument)
- Provides information on radiance accuracy for product derivation
- Allows IASI to provide radiance standard for intercomparisons of instruments: spectral dimension (GSICs)
- Allows IASI to provide the tie for other sensors with gaps in otherwise long-time series e.g. AATSR/SLSTR radiometers.

Scientifically, a long-term series of climate spectrally resolved radiances

- can be used directly to study the long term radiance change over decades
 - can be used to directly test radiation schemes in GCMs
- [accurate radiances are a geophysical product in themselves]

What is the AATSR instrument?

- **Dual view thermal and Vis/IR imaging radiometer on ENVISAT**
- Thermal emission channels similar to AVHRR, MODIS: **11, 12 and 3.7 μm** (nighttime)
- **Dual view** (nadir and 55° to nadir)
 - Along-track scanning, two views of same scene at different angles, for better atmospheric correction
- **Intrinsic on board calibration**
 - **2 accurate on-board black bodies** for IR calibration
 - VISCAL unit for visible channel calibration
- **1 km IFOV nominal at nadir**
- **500 km swath**
- **Long time series from 1991 (ATSR, ATSR-2, AATSR and SLSTR on Sentinel-3)**
- Low noise detectors cooled to 80 K by active Stirling Cycle Coolers.

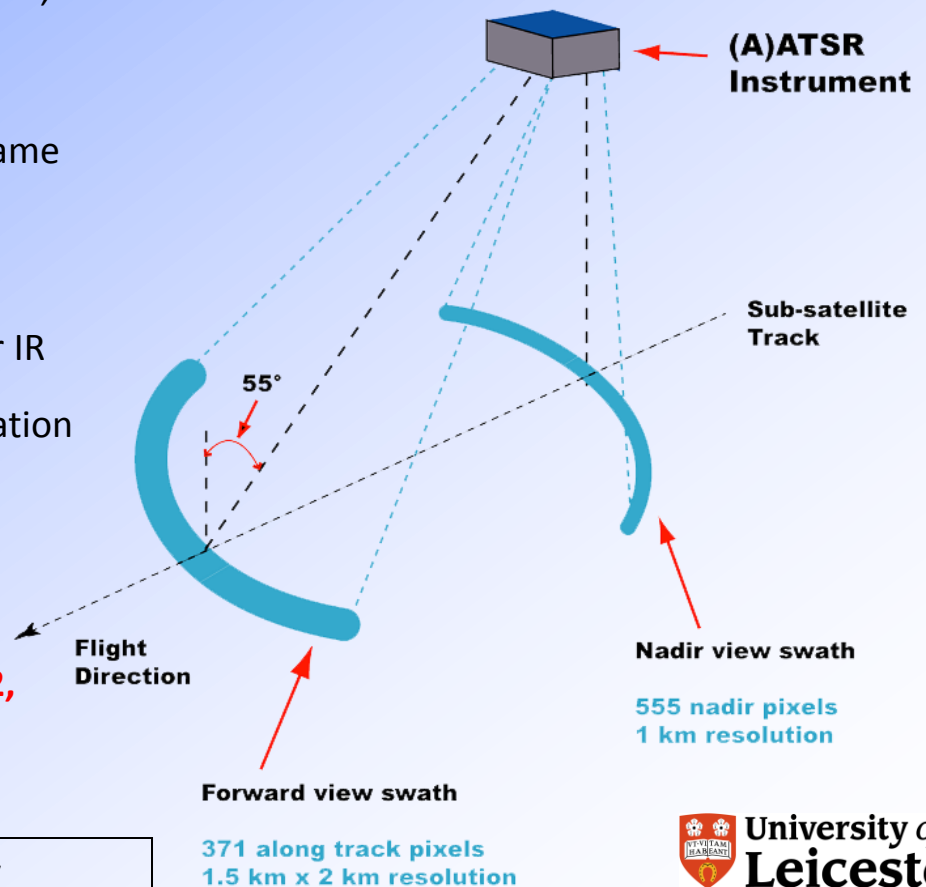
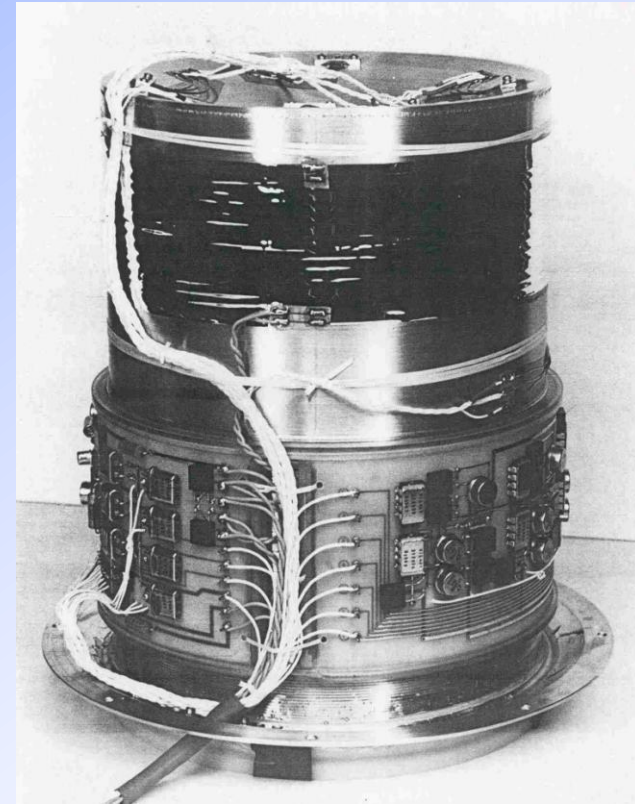
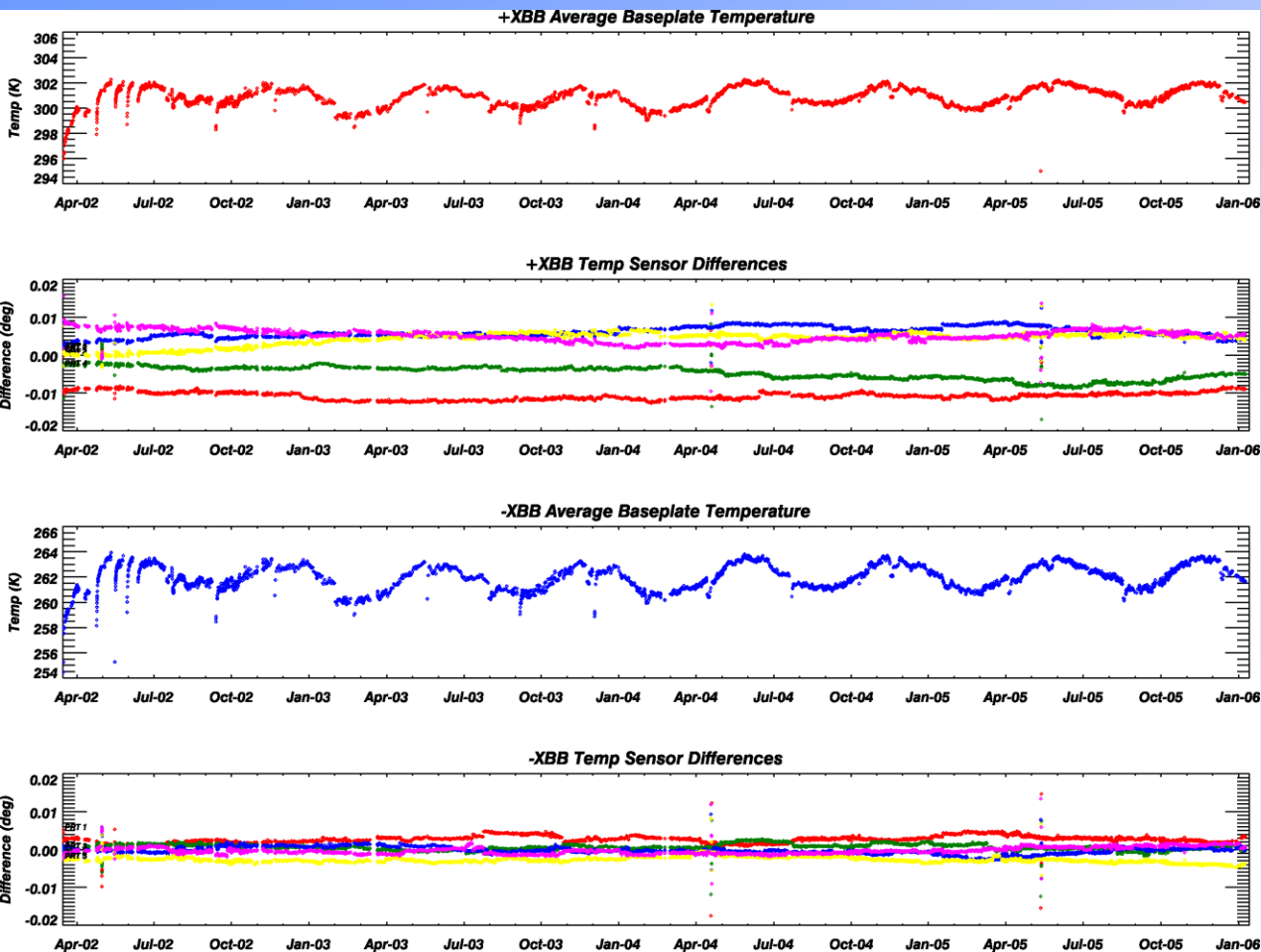


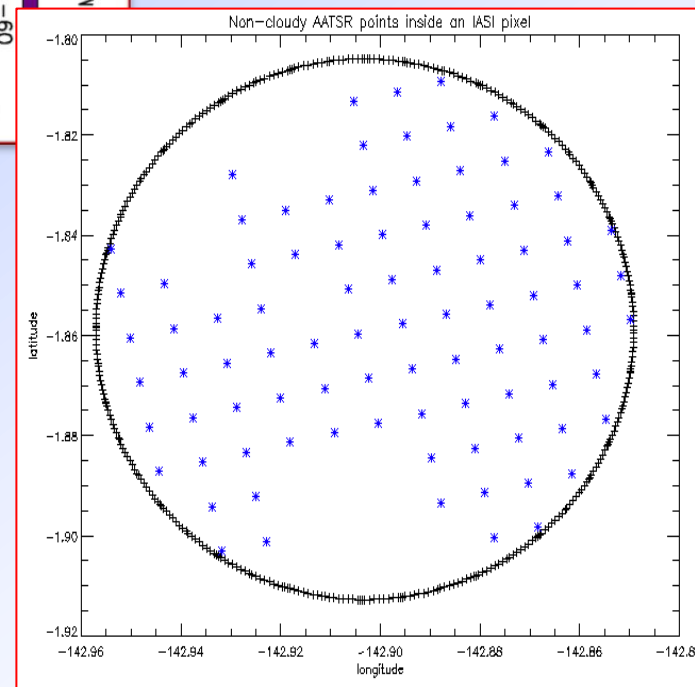
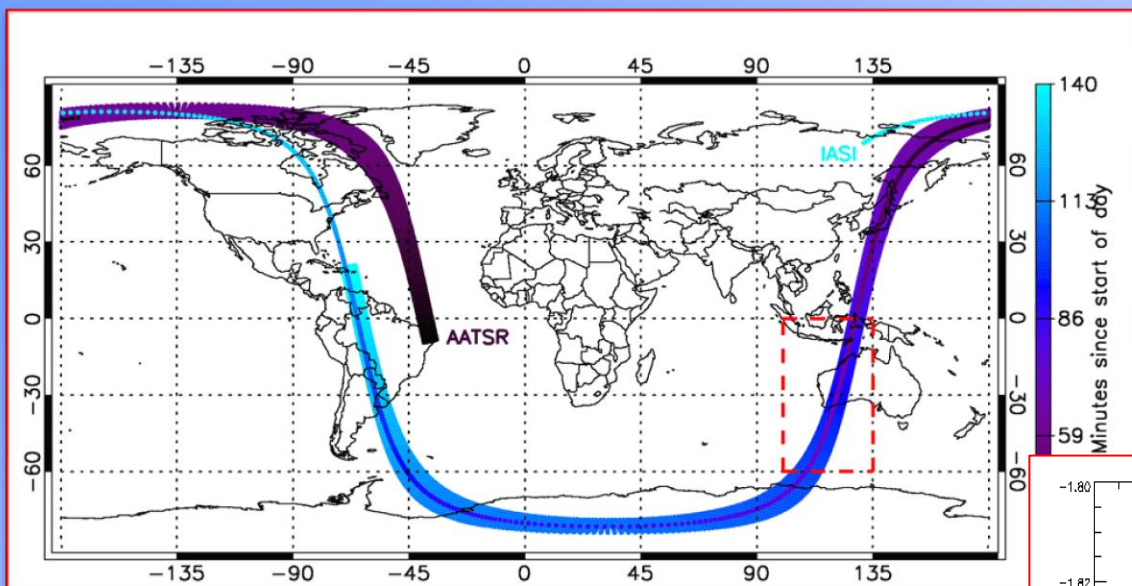
Image courtesy of Rutherford Appleton Laboratory

BB Temperature Sensor Stability

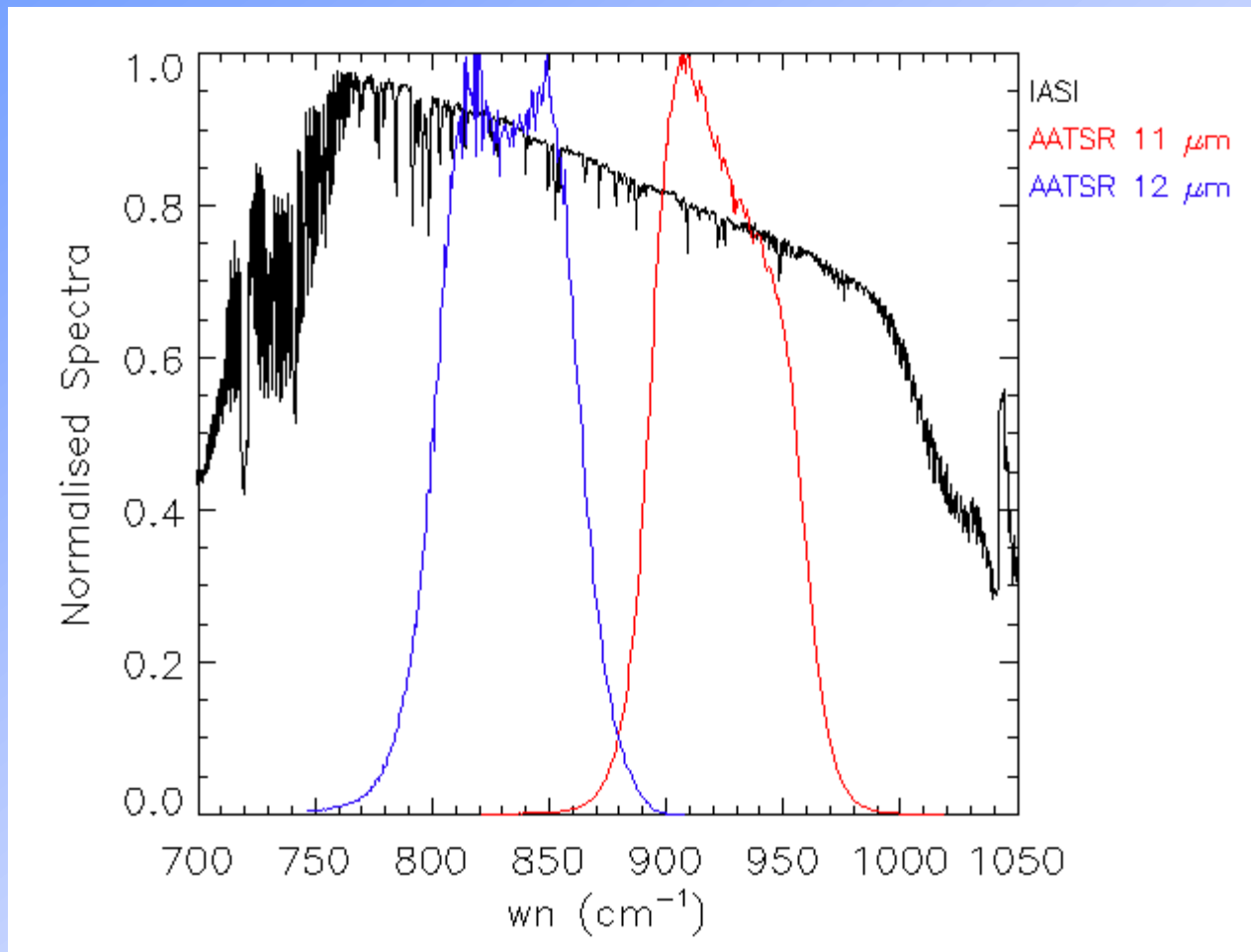


Average temperature errors from two blackbody crossover tests < 20 mK
Pre-launch cal to within 30 mK (Smith et al, 2001)

IASI vs. AATSR: orbits



IASI vs. AATSR spectral response



Compute IASI equivalent BTs for the AATSR filter functions

Filters ACP paper

Illingworth, Remedios and Parker, ACP, 2009

1. Data only over ocean
2. Time difference between IASI and AASTR is less than 20 minutes
3. Only accept data for which there is a difference between the 2 viewing angles of LT 1°
4. Only select date for which there are no outliers of AATSR BT within each IASI pixel, i.e. if any of the AATSR BTs within each IASI pixel lie **more than 3σ away from the mode**, then this pixel is **rejected**. This filter is a first check of **homogeneity** of the AATSR BTs within each IASI pixel.
5. Once the comparison has been done for the clear data, the standard deviation of the AATSR pixels within each of the clear IASI pixels is used as a filter to ensure homogeneity within each of the cloudy IASI pixels.

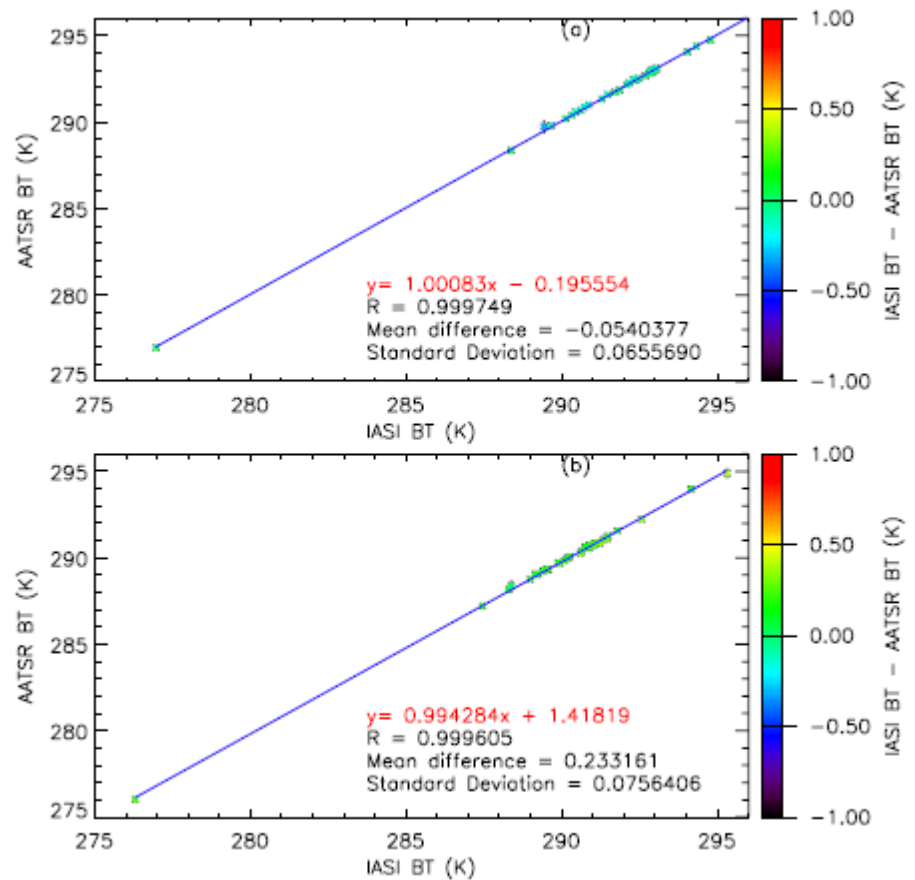
1st September 2007

41 **clear** pixels

AATSR-IASI

11 μm difference = -0.05 K

12 μm difference = 0.23 K



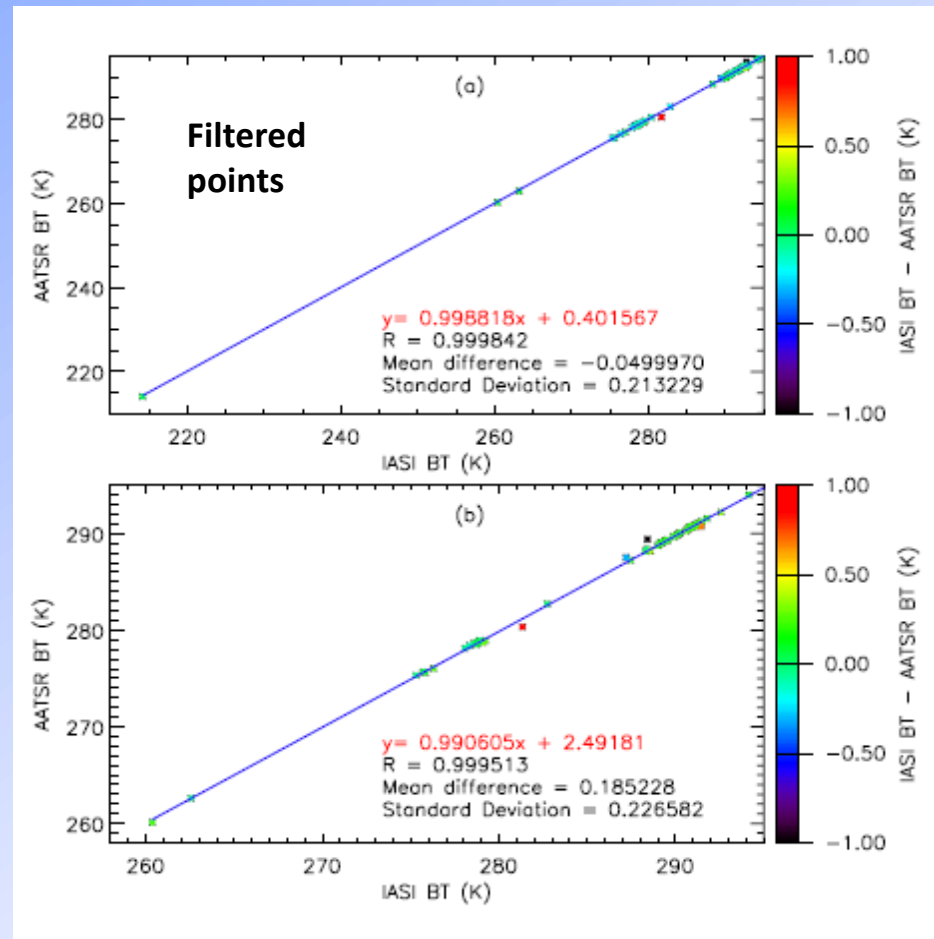
1st September 2007

41 **clear** and 25 **fully cloudy** pixels;

IASI-AATSR:

11 μm difference = -0.05 K

12 μm difference = 0.19 K

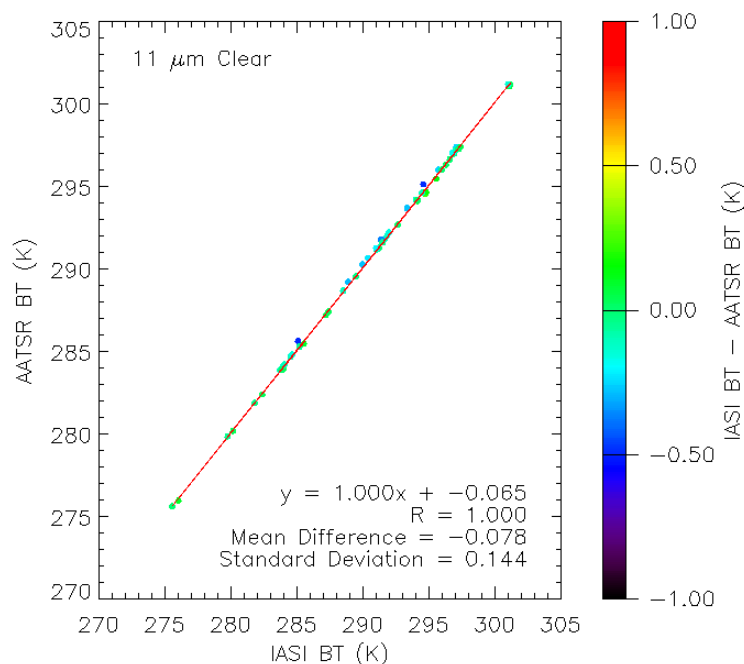


Filters: new analysis (preliminary)

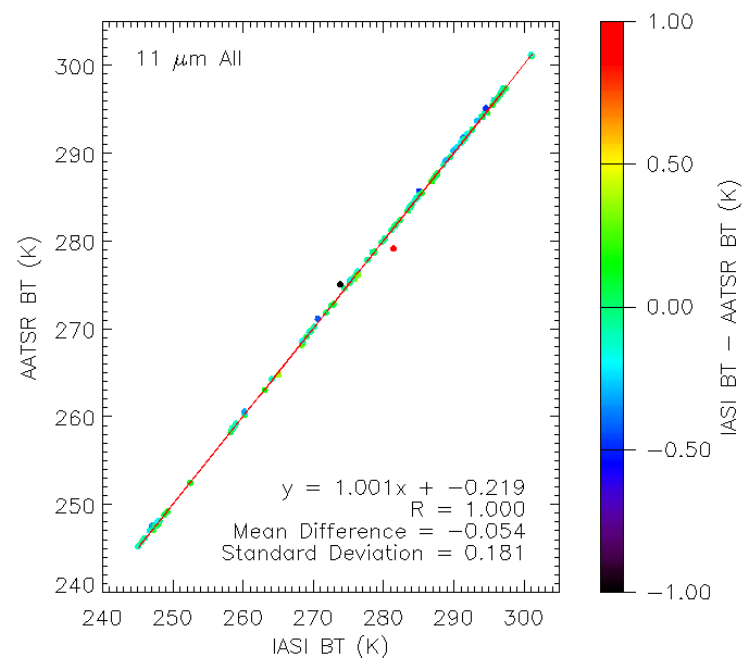
1. Data only over oceans
2. Only accept data where the time difference between the two instruments is **less than 30 minutes**. This is a change from the original work, and results in more global data, but also more statistical anomalies, as cloud may have had the chance to form during this time.
3. Only accept data for which **the IASI and AATSR viewing angle is $\leq 10^\circ$** , and for where there is a **difference** between the 2 viewing angles of $\leq 1^\circ$ (Consistent with Wang et al. (2009))
4. Only select data for which there are no outliers of AATSR BT within each IASI pixel, i.e. if any of the AATSR BTs within each IASI pixel lie more than 3σ away from the mode, then this pixel is rejected. This filter is a first check of homogeneity of the AATSR BTs within each IASI pixel.
5. Once the comparison has been done for the clear data, the standard deviation of the AATSR pixels within each of the clear IASI pixels is used as a filter to ensure homogeneity within each of the cloudy IASI pixels.
6. "All": clear and cloudy where $IASI-AATSR < 1K$ (arbitrary)

1st September 2007

11 μ m Clear



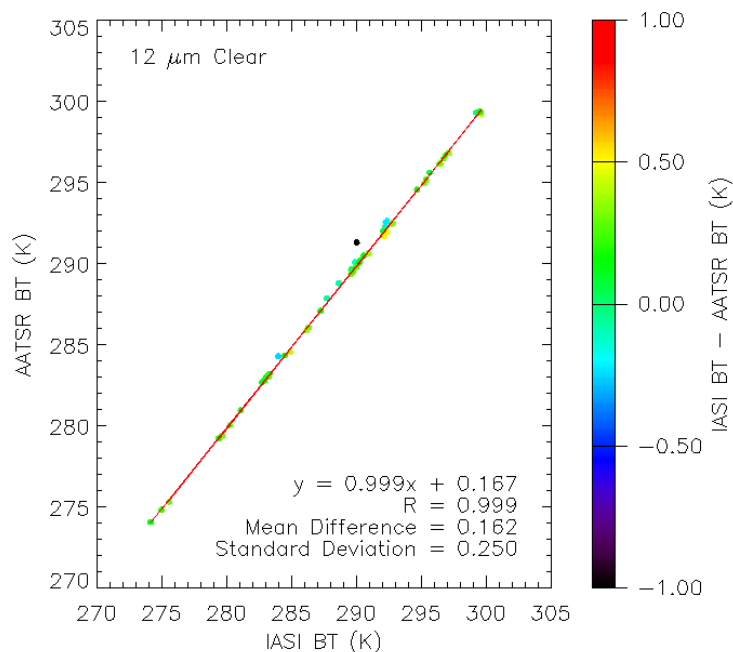
11 μ m Clear & Cloudy



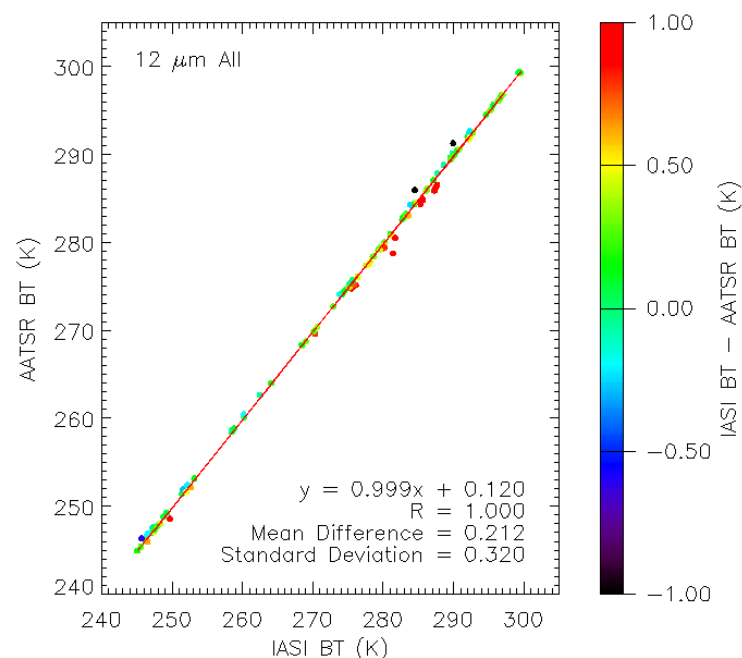
IASI-AATSR 11 μ m: clear = -0.08 K; all = -0.05 K (<1 K diff)
 clear = -0.08 K; all = -0.04 K (no 1 K filter)

1st September 2007

12 μ m Clear



12 μ m Clear & Cloudy



IASI-AATSR 12 μ m: clear = +0.16 K; all = +0.21 K (<1 K diff)
 clear = +0.16 K; all = +0.28 K (no 1 K filter)

Clear
sky

Date	"Best" 11 μm (clear)	"Best" 12 μm (clear)
13/08/2007	-0.06	+0.16
01/09/2007	-0.08 (-0.05)	+0.16 (0.23)
05/03/2008	-0.10	+0.14

Cloudy
sky

Date	"Best" 11 μm (all)	"Best" 12 μm (all)
13/08/2007	-0.06	+0.27
01/09/2007	-0.05 (-0.05)	+0.21 (0.19)
05/03/2008	-0.14	+0.15

Ref: Illingworth, Remedios and Parker, ACP, 2009

N.B. Cloudy data alone can show higher differences up to 0.4 K



Preliminary results:

- Radiometric intercomparison consistently better than 0.3 K
- Intercomparison at 11 μm < approx. 0.1 K
- Intercomparison at 12 μm < approx. 0.3 K
- More variability at 12 μm
- Cloudy data needs further investigation.

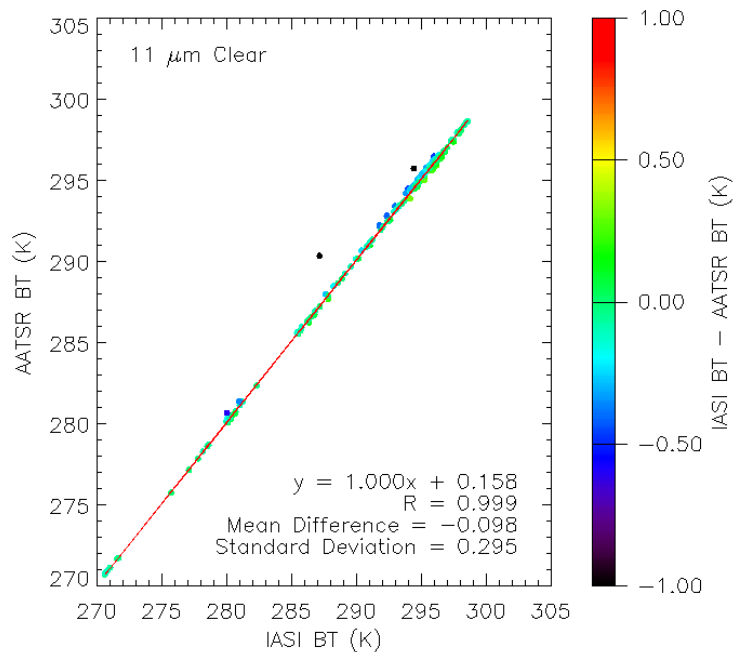
Outlook:

- Improved understanding of results and “global” methodology
- IASI (spectra) and AATSR (radiometric) good foundation for GSICS intercomparison project
- Important to maintain consistency of IASI calibration and intercomparison of successive IASI instruments – and also for FTS on MTG Sounder platform
- Clearly important to have very well known spectral response functions for radiometers.
- Suggests provenance for NASA CLARREO mission.

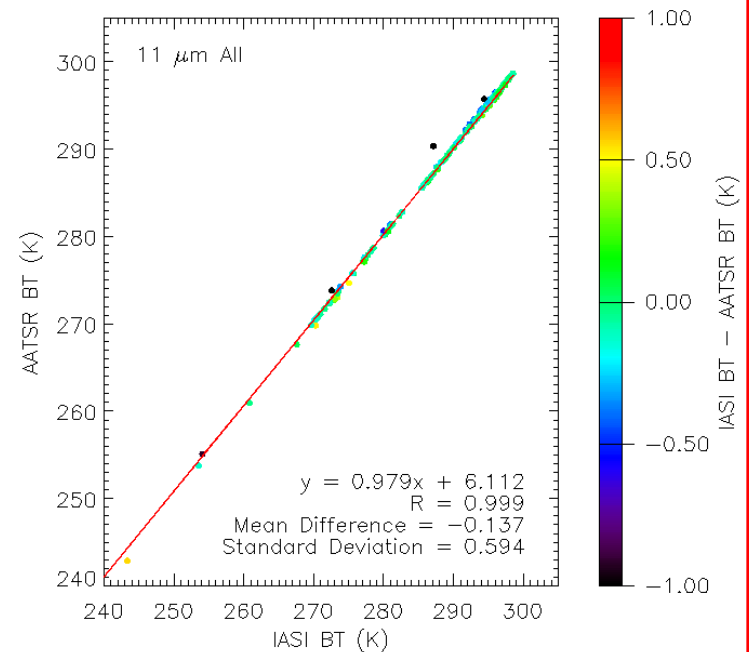
Thank you for
Listening

5th March 2008

11 μ m Clear

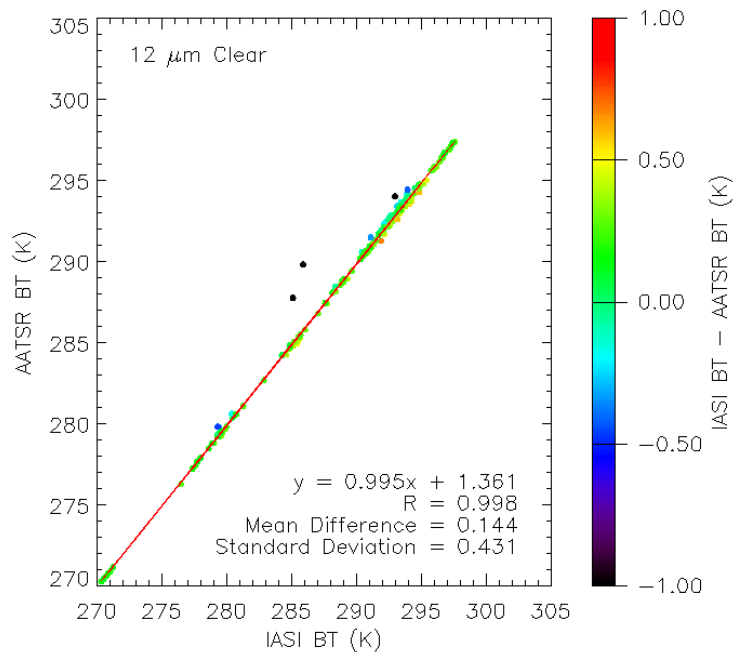


11 μ m Clear & Cloudy



5th March 2008

12 μ m Clear



12 μ m Clear & Cloudy

