

*A Preliminary Report to EUMETSAT and
the IPO for NPOESS*

**Initial Results from the Joint Airborne
IASI Validation Experiment (JAIVEx)**

Houston, Texas

12 April 2007 – 4 May 2007

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JAIVEx Objectives

- To validate and characterize the radiometric performance of IASI
- To validate the performance of different algorithms designed to retrieve temperature, humidity, ozone and carbon monoxide profiles from IASI spectral radiance measurements over land and ocean and under cloudy as well as clear sky conditions
- To gather a diverse set of IASI spectra with co-located airborne and in-situ observations to further the development of innovative techniques to assimilate IASI data into numerical weather prediction models, utilizing as many channels as possible, over land and ocean and under cloudy as well as clear sky conditions

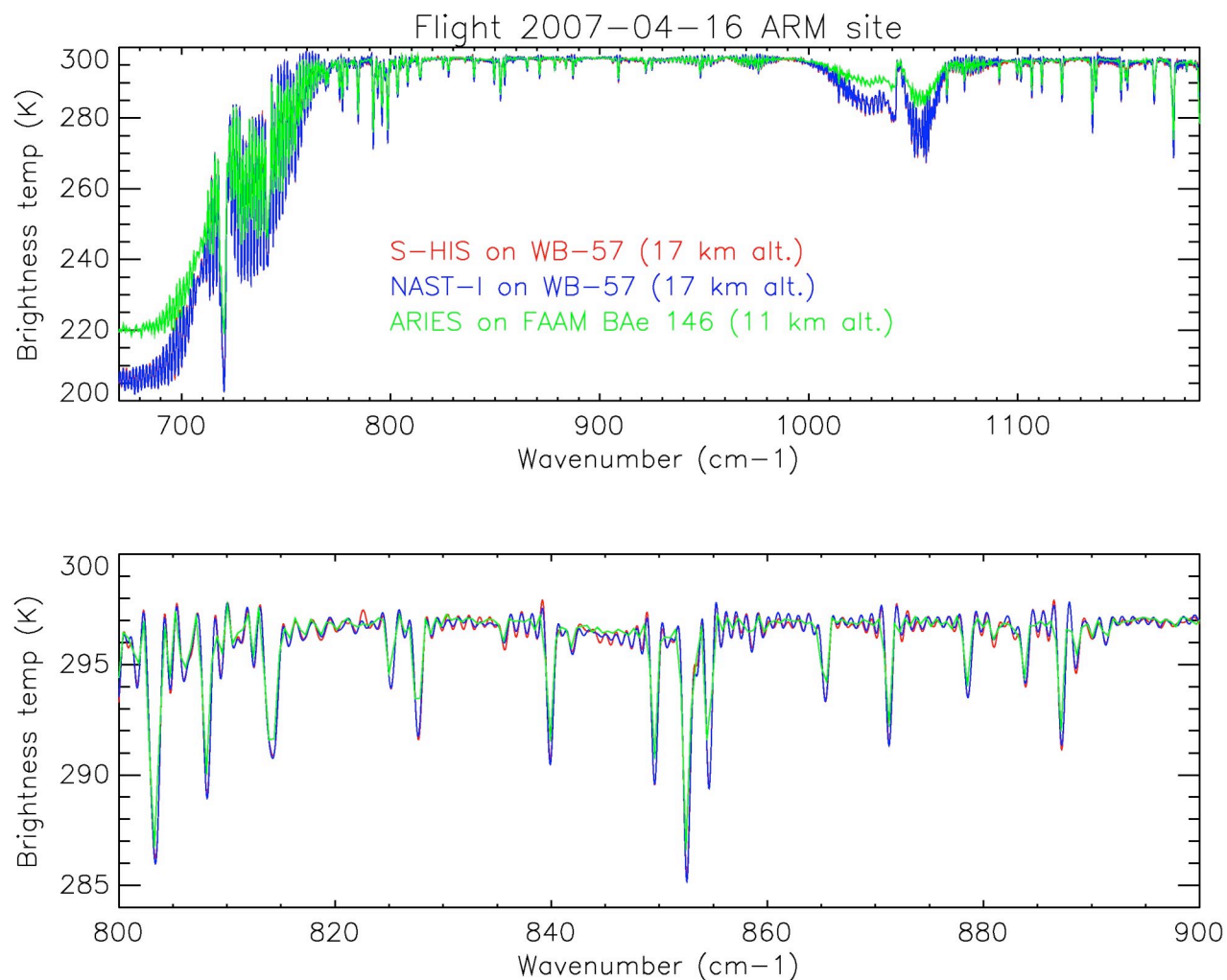
Two Airborne Platforms

- **The Facility for Airborne Atmospheric Measurement (FAAM) BAe 146-301** atmospheric research aircraft, jointly funded by the Met Office and the Natural Environment Research Council (NERC), flies in the troposphere measuring directly the surface emission characteristics and the state of the atmosphere, both with in-situ measurements from aircraft probes and by dropping sondes. Radiometric measurements with infrared instruments on MetOp (e.g., IASI) are being compared to measurements made with the airborne ARIES interferometer.
- **The NASA WB-57** is flying in the stratosphere to carry out high altitude radiometric observations with NAST-I and Scanning-HIS, both interferometers similar to IASI, and the NAST-M microwave radiometer. The US team is sponsored by the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Integrated Program Office (IPO) and NASA.

Intercomparison of Airborne Interferometers

- It is important to compare the radiometric performance of the airborne interferometers used to validate satellite observations
- Initial checks completed during flight over the ARM site with aircraft stacked vertically
- Future flights will be flown with both aircraft at same altitude

Intercomparison of Spectral Radiance from ARIES, NAST-I and S-HIS



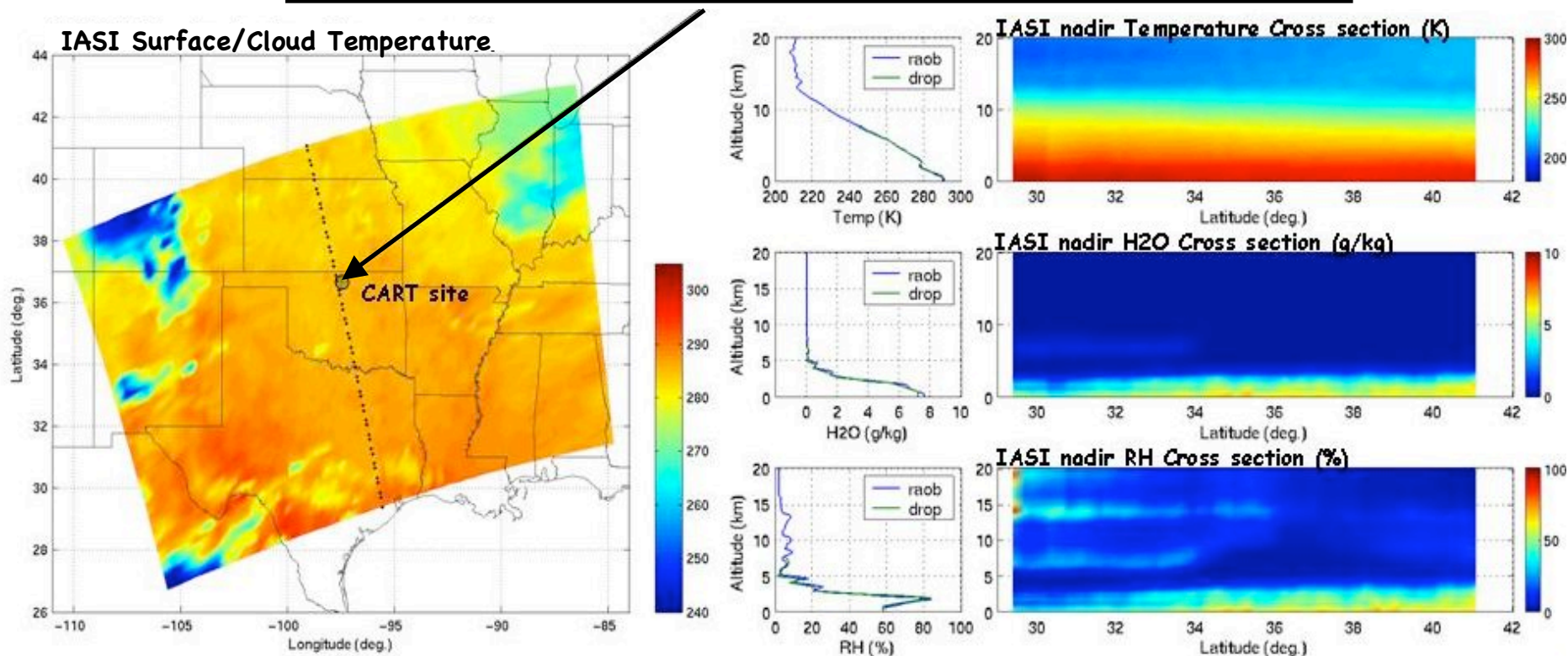
MetOp Measurement Summary

- Two flights have been flown:
 - 19th April 2007 – WB57, BAe146 and MetOp over the DoE ARM CART-site in Oklahoma, for totally cloud free conditions
 - 20th April 2007 – WB57, BAe146 and MetOp over the Gulf of Mexico, for scattered thin cirrus cloud conditions
- With the return of IASI to nominal operations, further flights are planned.

Quick-Looks (April 19, 2007- 0335 UTC)

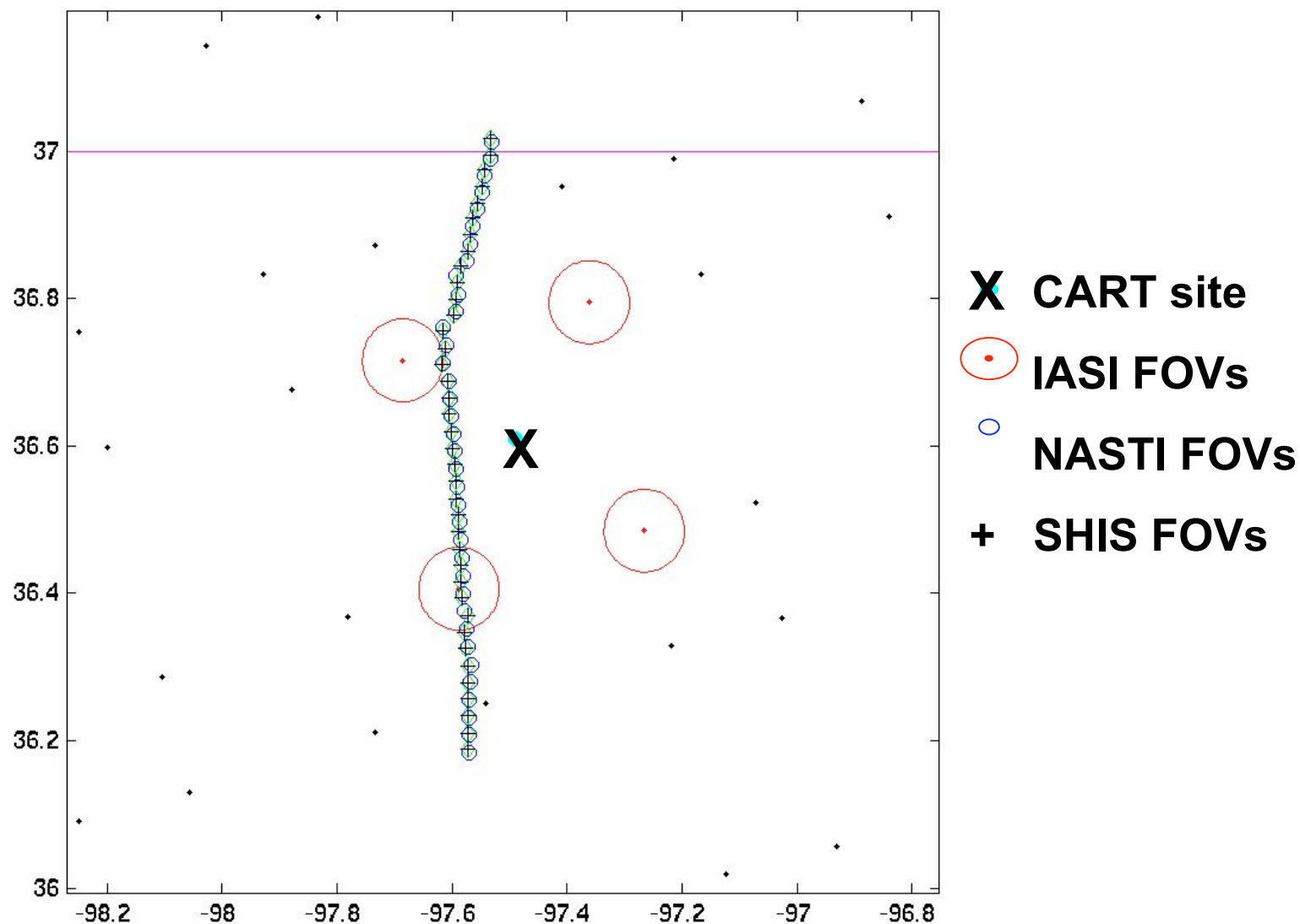
Joint IASI Validation Experiment (JAIVEx)

OK CART-Site Used for IASI Validation

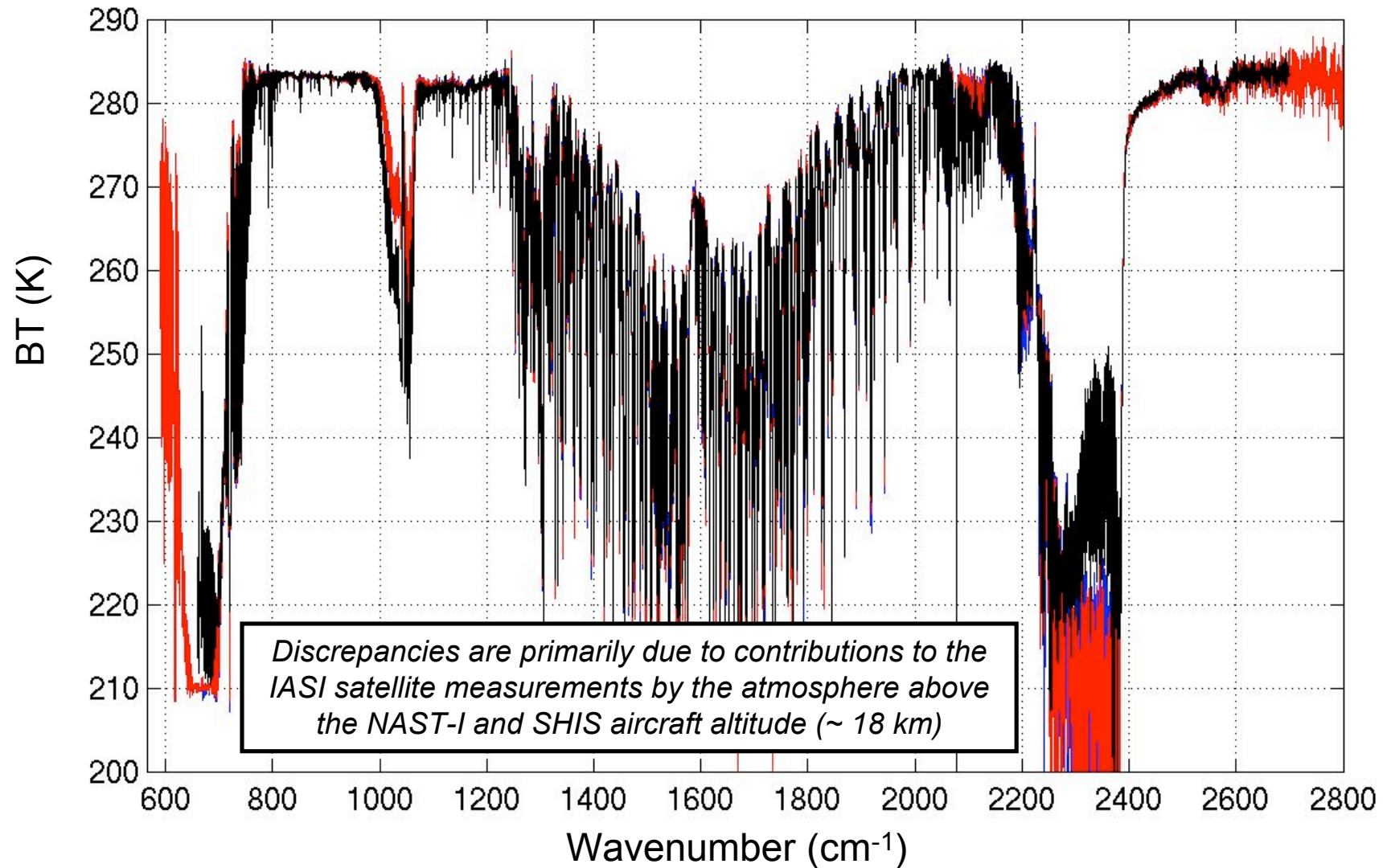


Radiance Validation:

Near-Nadir IASI and Nadir SHIS and NAST-I FOVs
Selected for Comparison



IASI, NAST-I, and SHIS Mean Spectra



(IASI L1C and NAST-I spectra processed to match SHIS spectral resolution)

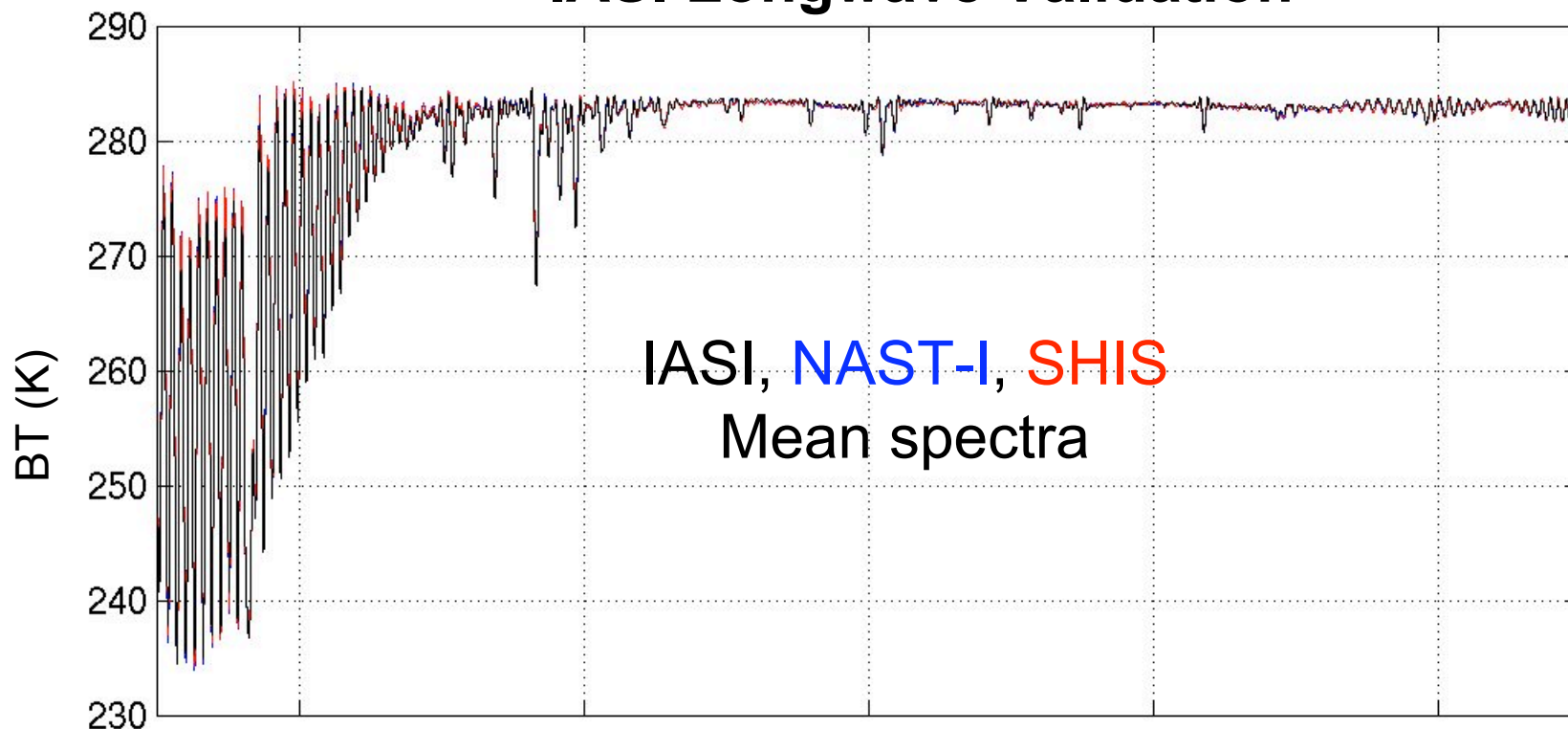
Radiometric Performance of IASI

- The double difference technique is used to evaluate the radiometric performance
 - Line-by-line simulations of the radiance spectra, measured by the aircraft and satellite instruments, are computed using temperature and humidity profiles observed using soundings at the time of the aircraft and satellite measurements.
 - The difference between IASI minus simulation and NAST-I (or S-HIS) minus simulation is then computed.
 - This technique allows the radiometric performance to be evaluated taking in to account the different altitudes and viewing geometry of the satellite and aircraft observations.

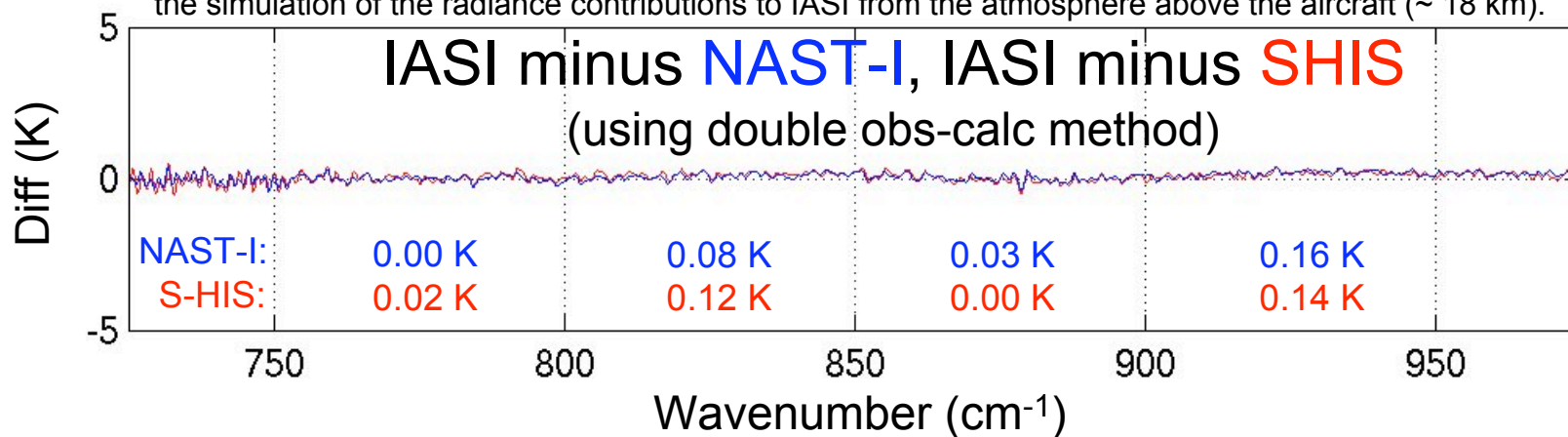
IASI Performance

- The IASI spectra are split in to three spectral regions
- IASI and NAST-I are processed to match S-HIS spectral resolution
- In the following three figures, the double differences between IASI and NAST-I and between IASI and S-HIS are shown in the lower panel. The mean differences for 50 cm⁻¹ bins are also shown as numbers in the lowest panel.

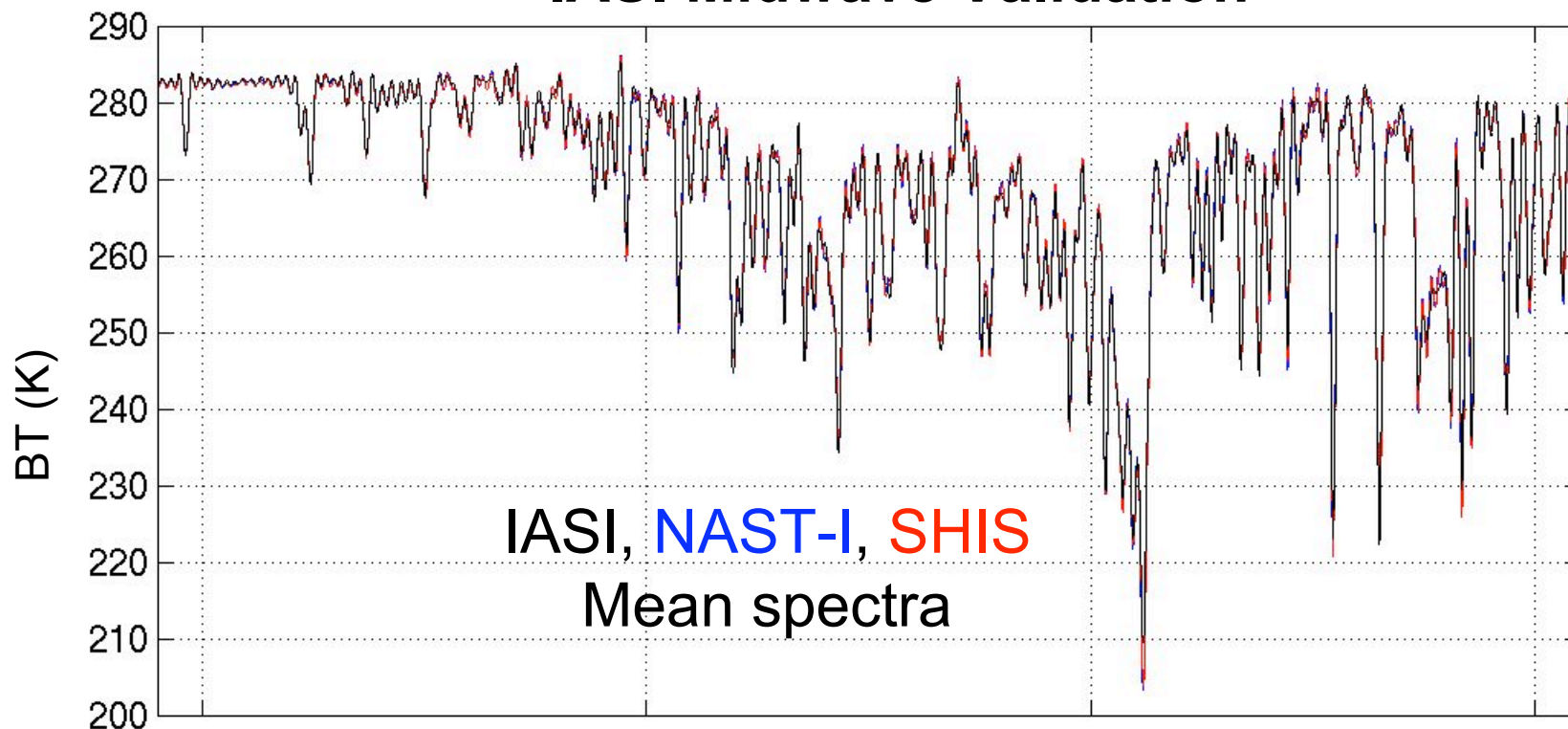
IASI Longwave Validation



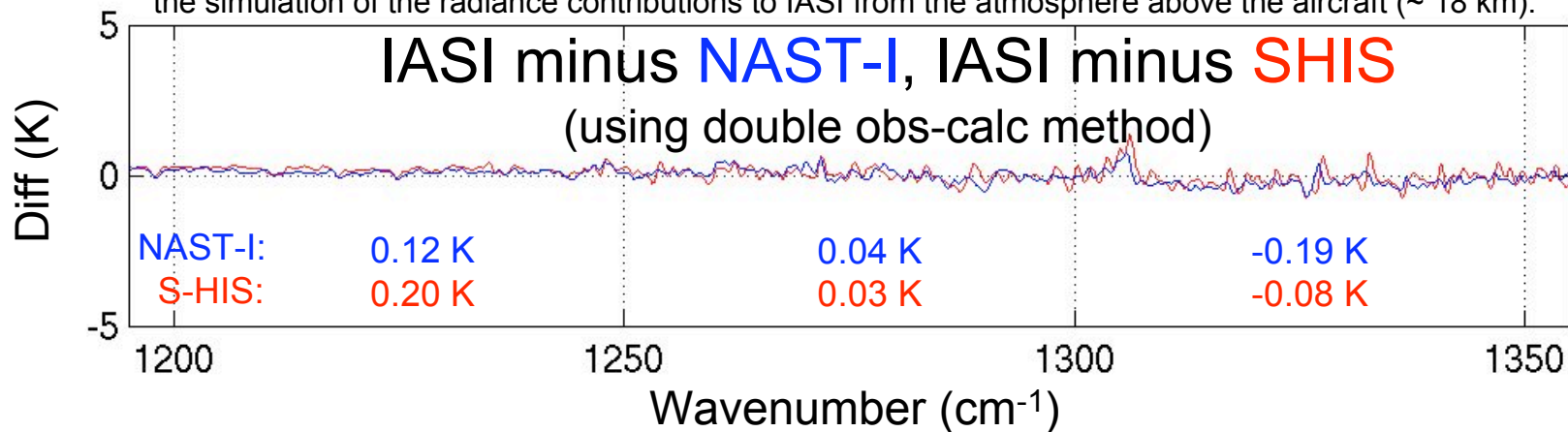
* Correlated IASI differences with NAST-I and SHIS, shown in the plot below, can result from errors in the simulation of the radiance contributions to IASI from the atmosphere above the aircraft (~ 18 km).



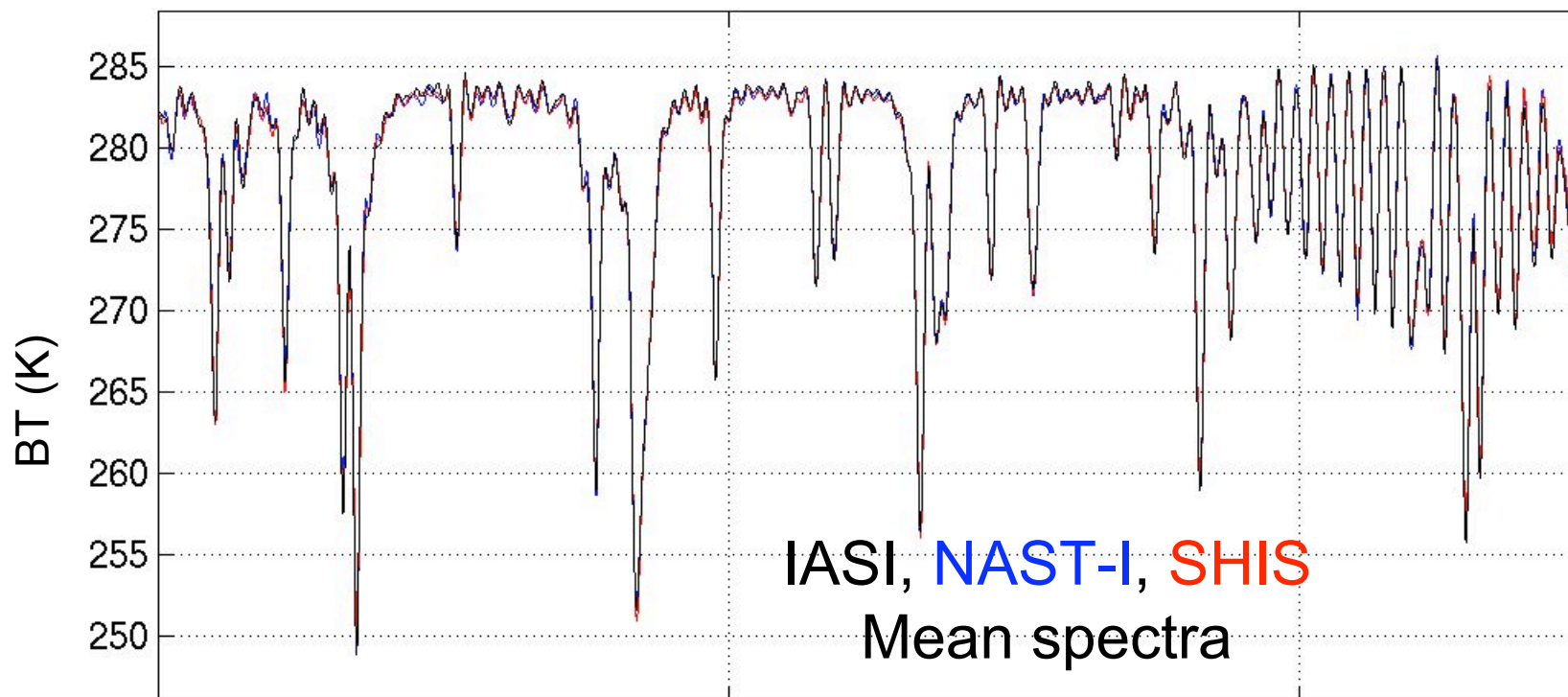
IASI Midwave Validation



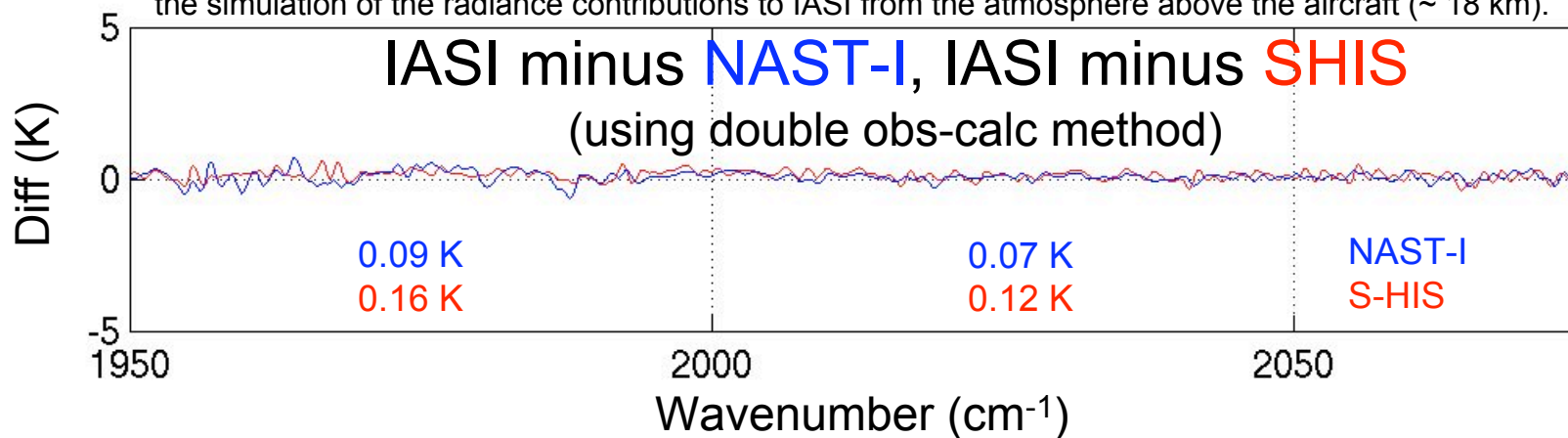
* Correlated IASI differences with NAST-I and SHIS, shown in the plot below, can result from errors in the simulation of the radiance contributions to IASI from the atmosphere above the aircraft (~ 18 km).



IASI Shortwave Validation



* Correlated IASI differences with NAST-I and SHIS, shown in the plot below, can result from errors in the simulation of the radiance contributions to IASI from the atmosphere above the aircraft (~ 18 km).



IASI Performance Summary

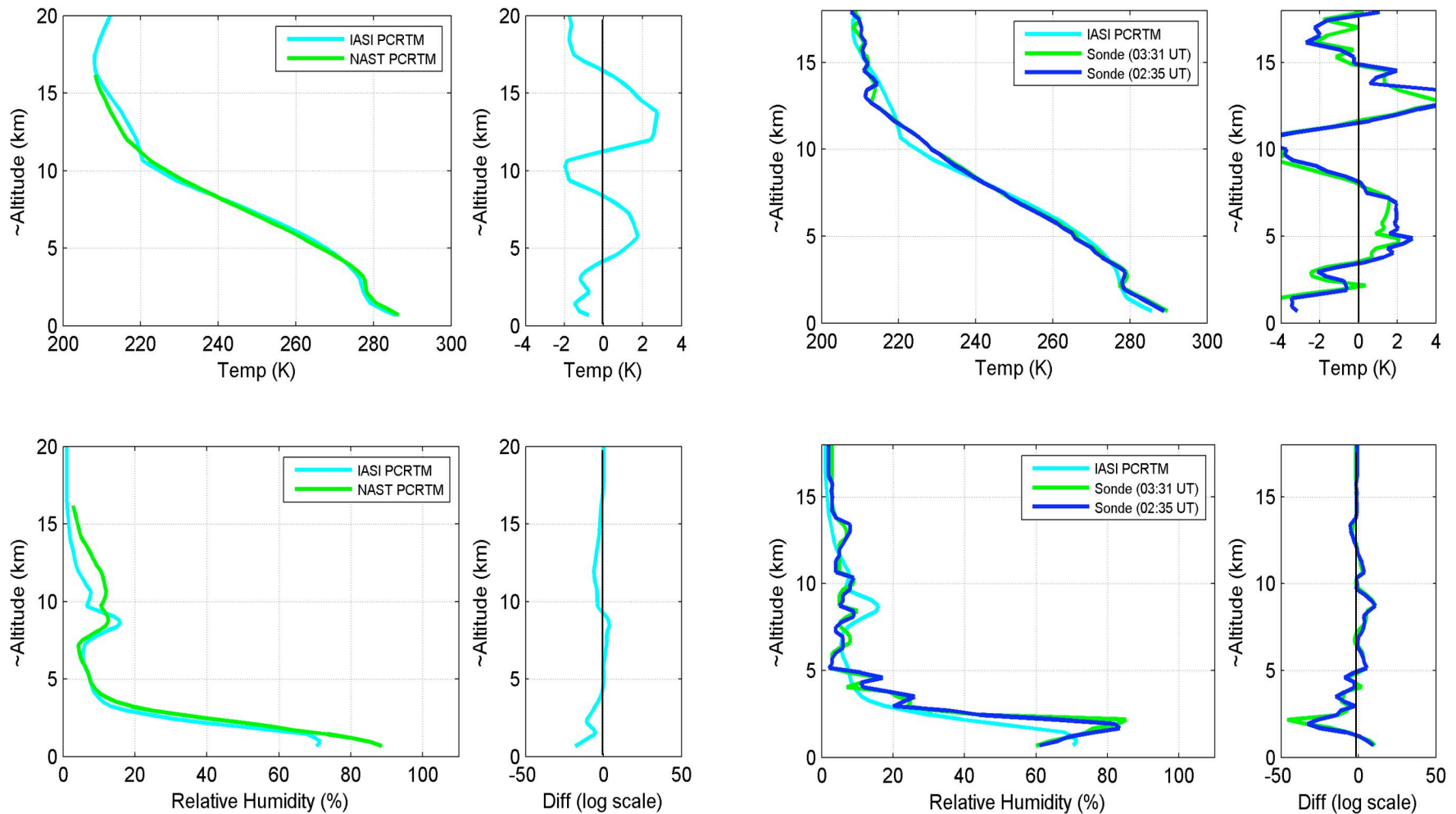
- The radiometric agreement between IASI, NAST-I and S-HIS is stunning with many spectral regions showing agreement better than 0.1K !
- This is extremely good news to potential users of IASI data, and a credit to the producers of the IASI instrument and the providers of the associated data processing algorithms and software.

Profile Retrieval Validation

- Some initial retrievals of temperature and humidity profiles have been made using IASI, NAST-I, and S-HIS radiance measurements and compared with radiosondes and dropsondes.
- The results are very encouraging. The retrieval algorithms will be optimized over the coming months.

Example Retrieval Validation:

CART-Site April 19, 2007 (~ 03:35 UTC)



Summary

- Initial results from JAIVEx are extremely good showing the radiometric performance of IASI to be excellent.
- Initial profile retrieval results are encouraging.
- Further flights are planned over the coming week to compare IASI with AIRS on the same day and to further evaluate the performance of IASI.
- Note that all results presented here are preliminary
- The JAIVEx data set clearly demonstrates the potential for validation of satellite instruments using coordinated airborne measurements and it will be a useful resource for research into hyperspectral remote sensing.
- The IASI data will be processed to simulate CrIS spectral radiance measurements in order to enable CrIS retrieval algorithms, and associated software, to be tested in support of the NPOESS program.