Ultra High Spectral Resolution Satellite Remote Sounding - Results from Aircraft and Satellite Measurements

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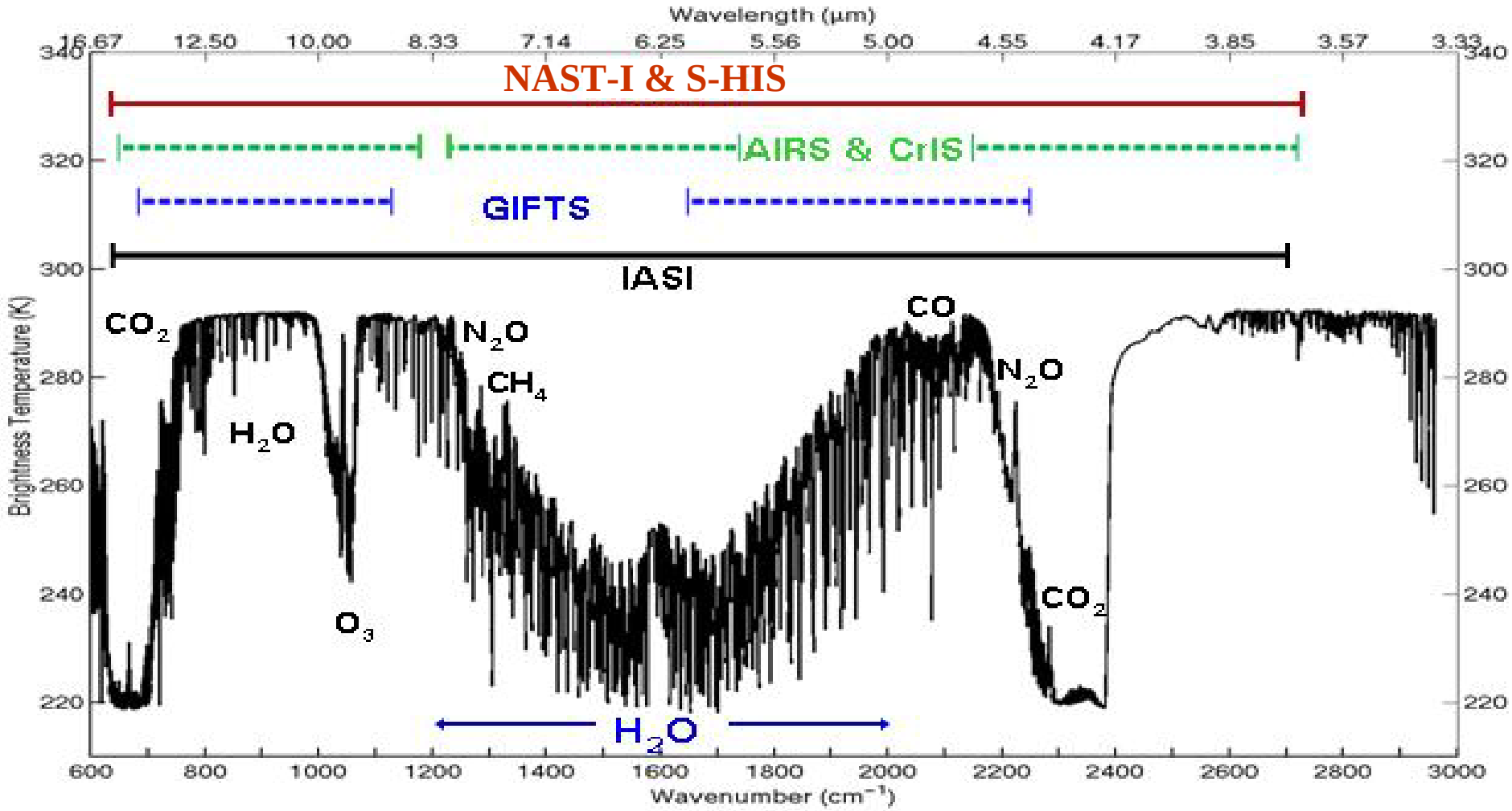
Ultraspectral Atmospheric Sounders



- **Broad Spectral Coverage**
- **High Spectral Resolution**
- **Thousands of Spectral Channels**
- **High Information Content**

Today's Ultraspectral Resolution IR Sounding Capability

AIRS

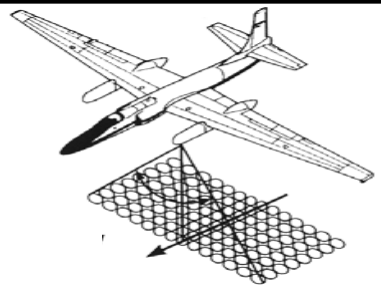
ER-2

NAST/SHIS

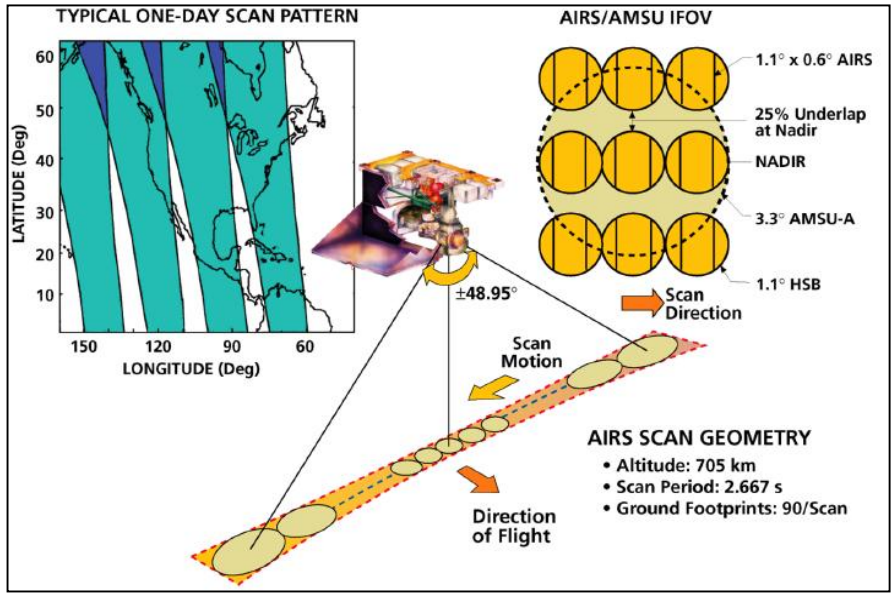
Proteus

NAST and AIRS Characteristics

Spatial Resolution
130m/km flight alt.
(2.6 km from 20km)
Swath Width
2 km /km flight alt.
(40 km from 20 km)



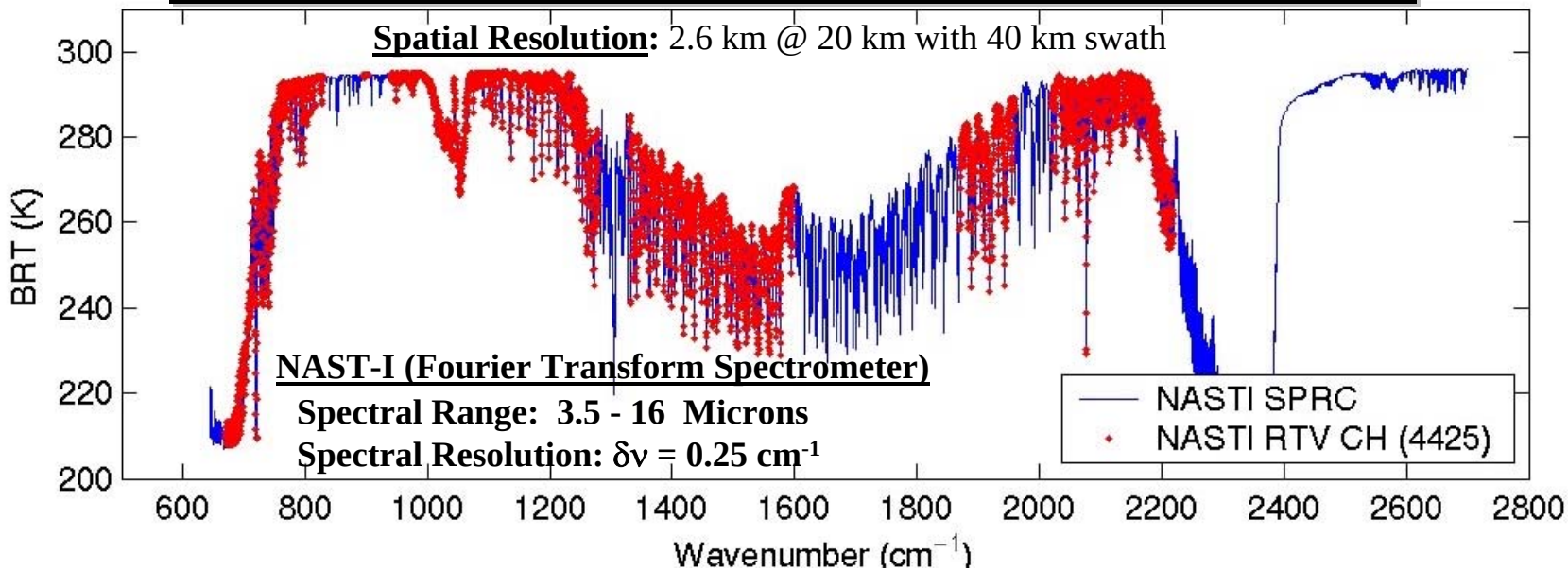
- **Instrument Characteristics**
  - infrared Michelson interferometer (~9000 spectral channels) 3.5 – 16 microns @ 0.25 cm^{-1}
- **Aircraft Accommodation**
  - ER-2 Super pod & Proteus Underbelly pod
- **Radiative Measurement Capability**
  - calibrated radiances with < 0.5 K absolute accuracy, < 0.2 K precision



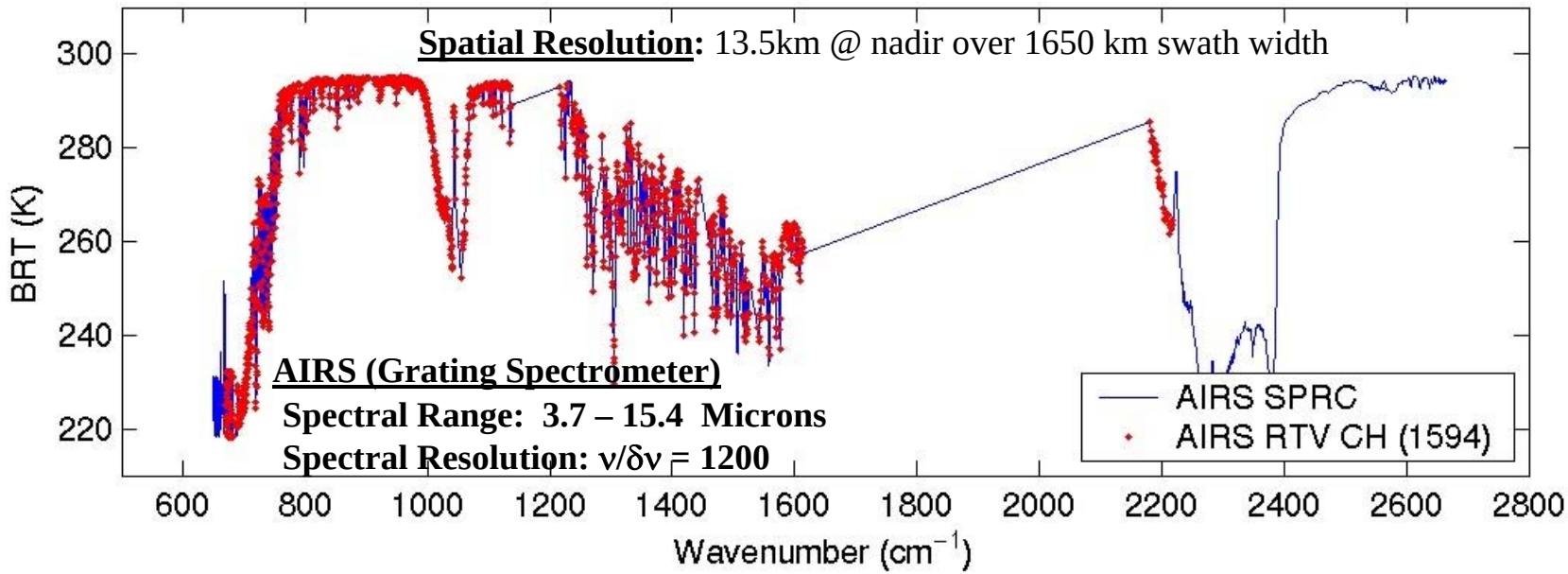
- The *NPOESS-I Aircraft Sounder Testbed – Interferometer* (NAST-I) consists of a 9000 spectral channel infrared interferometer (600-2850 cm^{-1}) with a spectral resolution of 0.25 cm^{-1}. NAST-I spatially scan and provide a ground resolution of about 2.6 km and a swath width of approximately 40 km, from an aircraft altitude of 20 km.

- The *Aqua AIRS* instrument is a ~2500 spectral channel cooled grating spectrometer with a spectral resolving power of ~ 1200 (0.5 – 2 cm^{-1} spectral resolution) operating within the spectral range 650 – 2700 cm^{-1}. The spatial resolution of the AIRS is about 15 km, at nadir, and its cross track scan providing a swath width of approximately 1400 km.

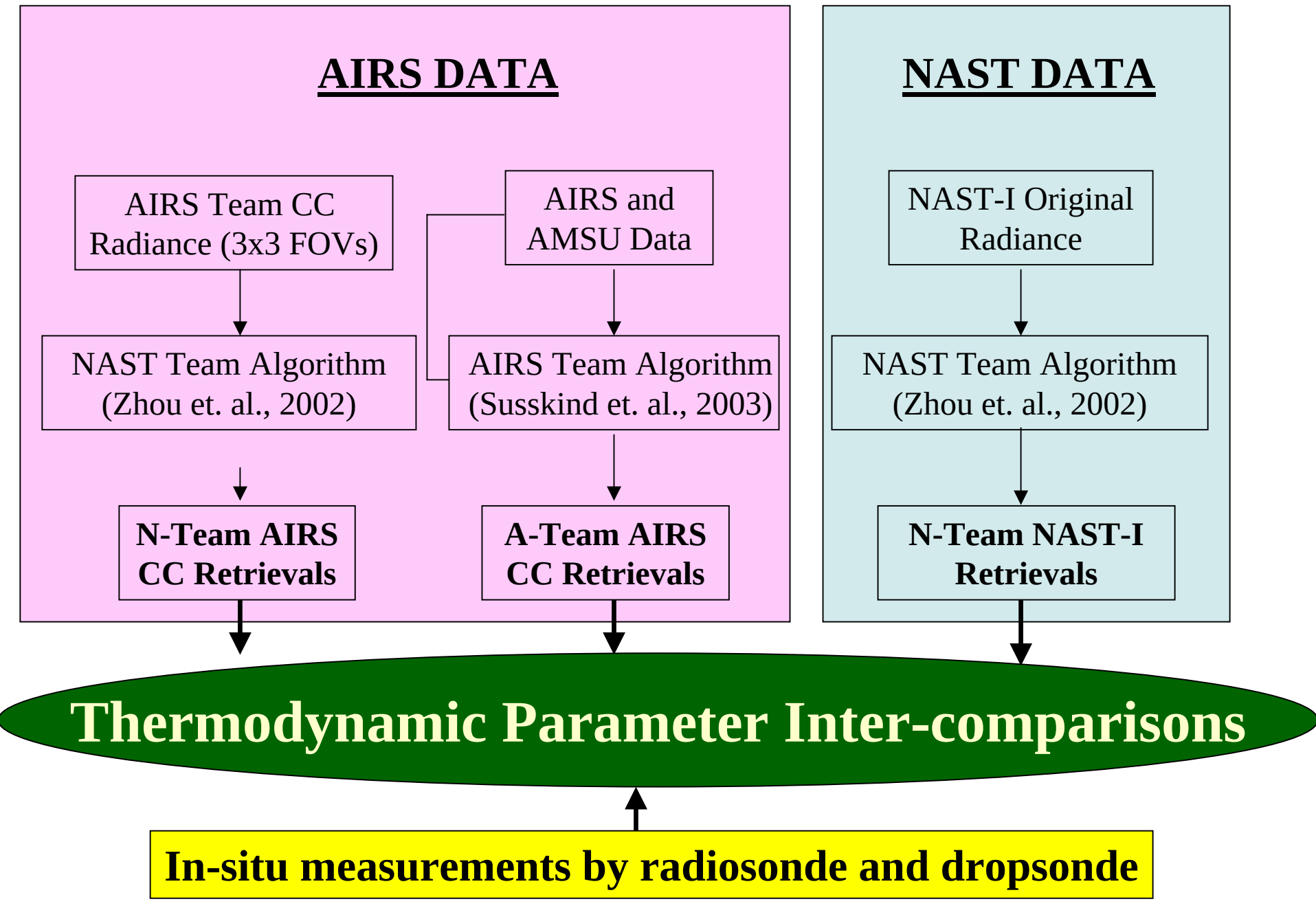
NAST-I & AIRS Spectral Characteristics



Quasi-continuous Measurements Over Broad Spectral Regions Enable High Vertical Resolution



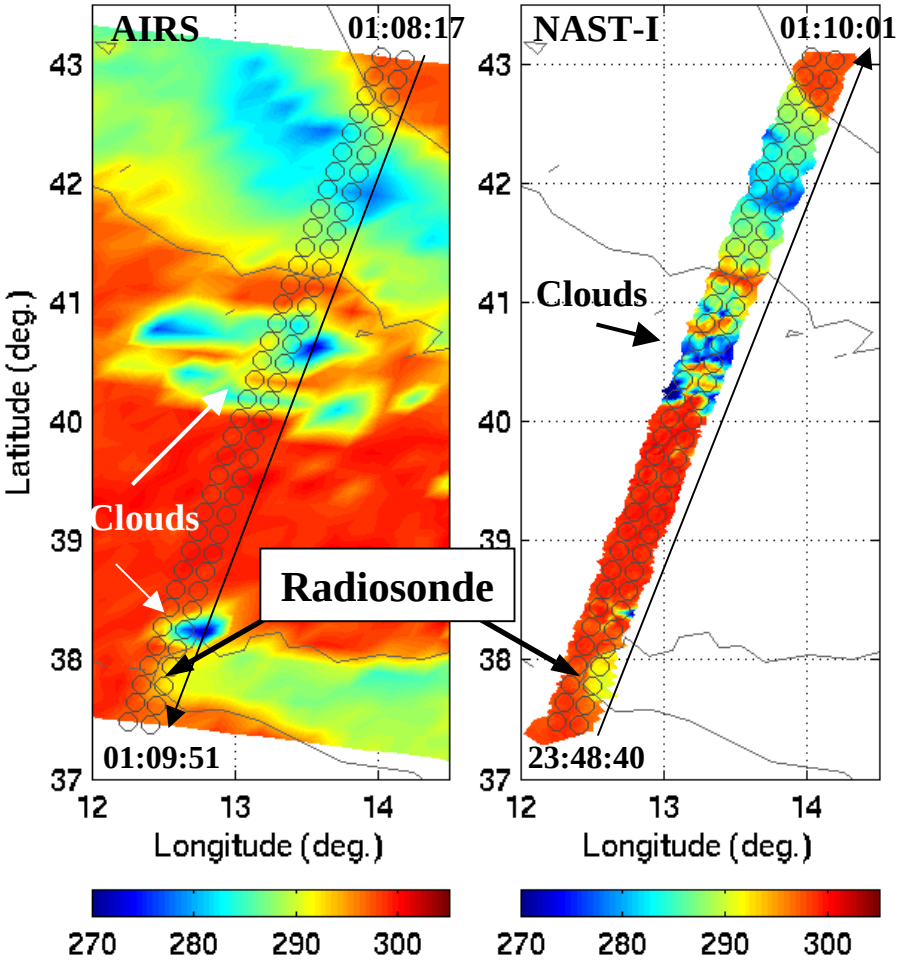
Data and Algorithms Used for Inter-Comparisons

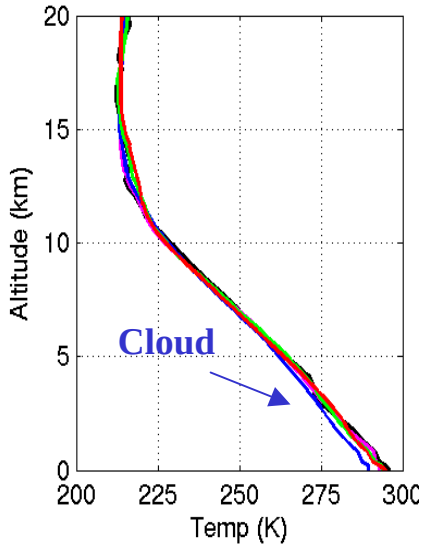


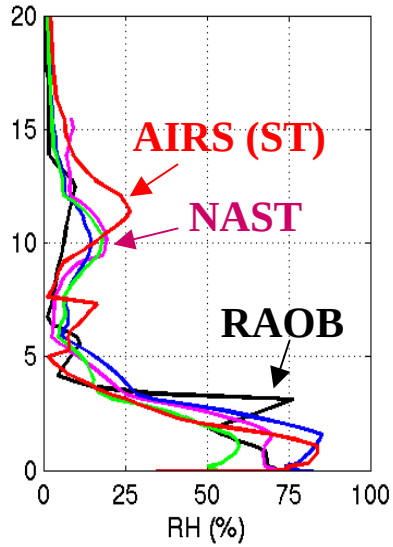
Inter-Comparisons at Trapani/Birgi, Italy (04/09/08)

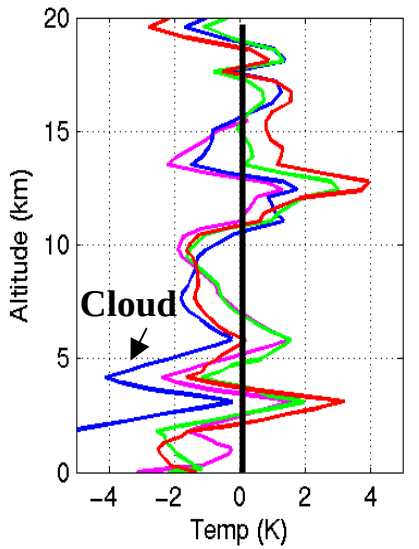
Trapani/Birgi (37.92N 12.5]

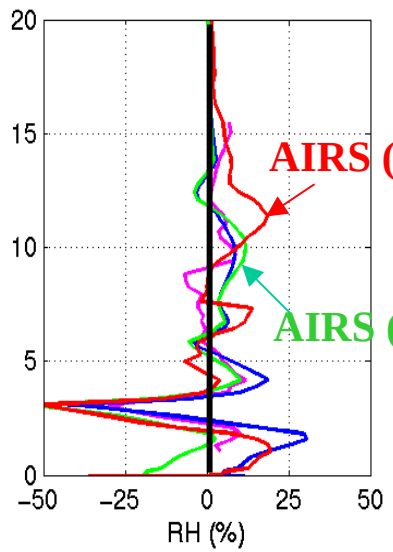
Retrieved Surface Skin Temperature









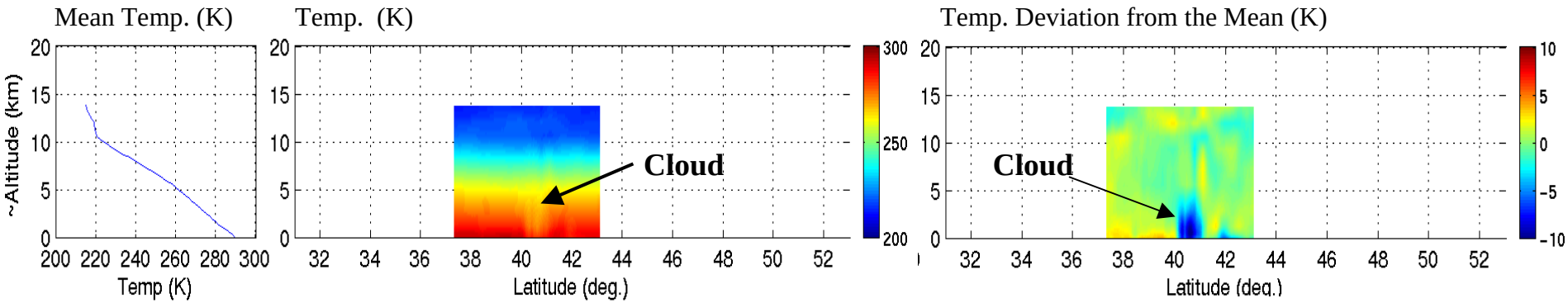


Deviation from RAOB

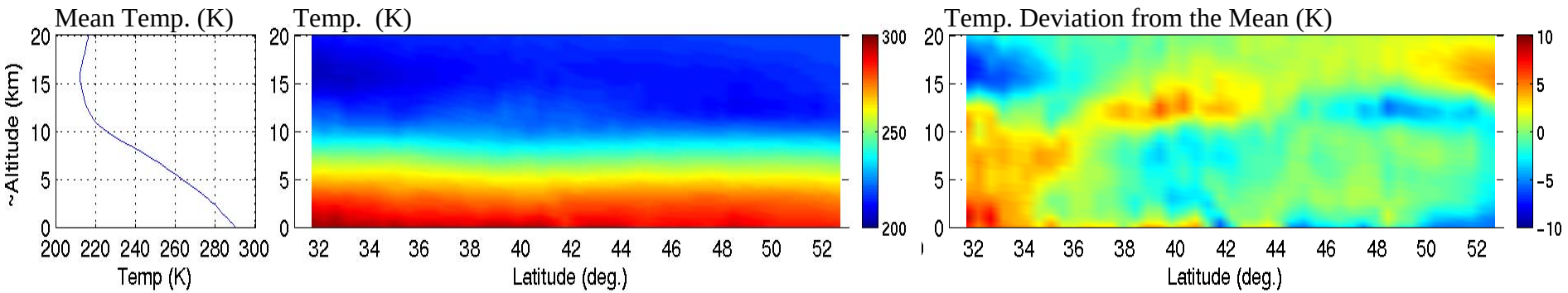
Raob 23Z | N-team NAST 00Z | N-team AIRS 01Z | N-team CC AIRS 01Z | A-team AIRS 01Z

Temperature Cross Section Inter-Comparison (04/09/08)

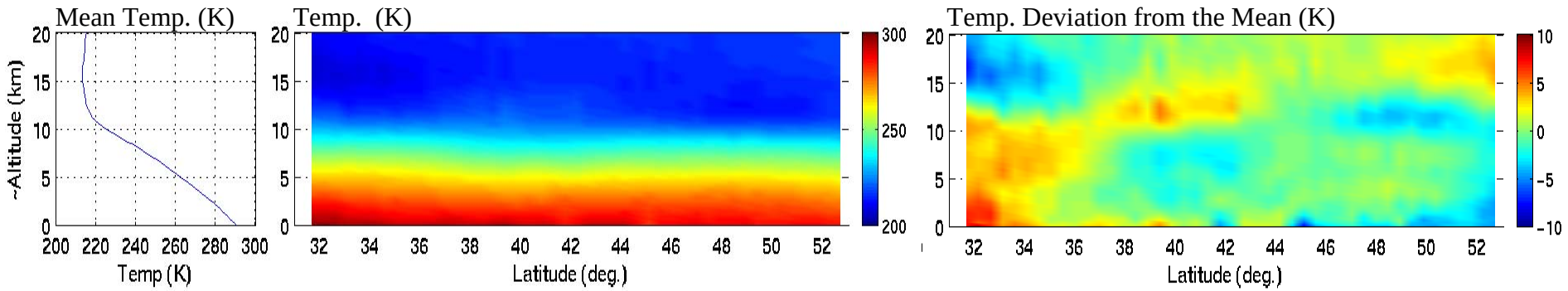
(1) NAST-Team NAST Retrieval



(2) NAST-Team AIRS Retrieval (CC)

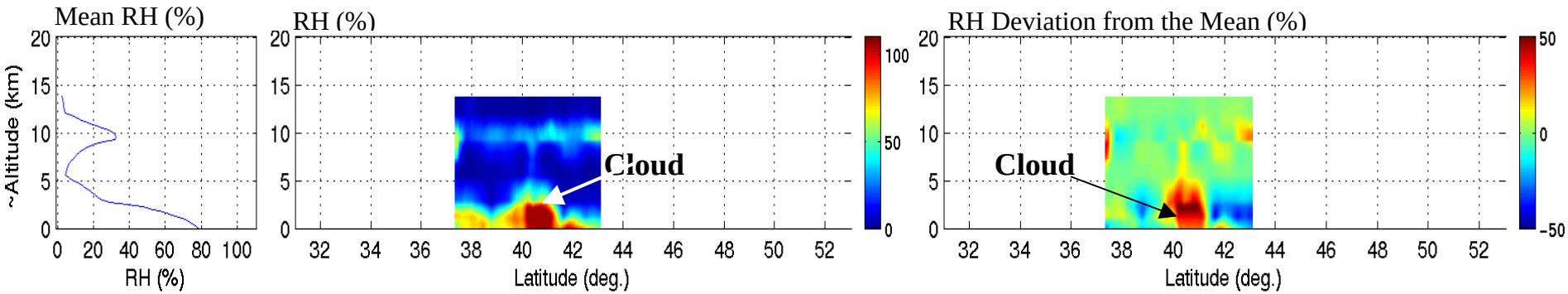


(3) AIRS-Team AIRS Retrieval (CC) ..ver. 4.0

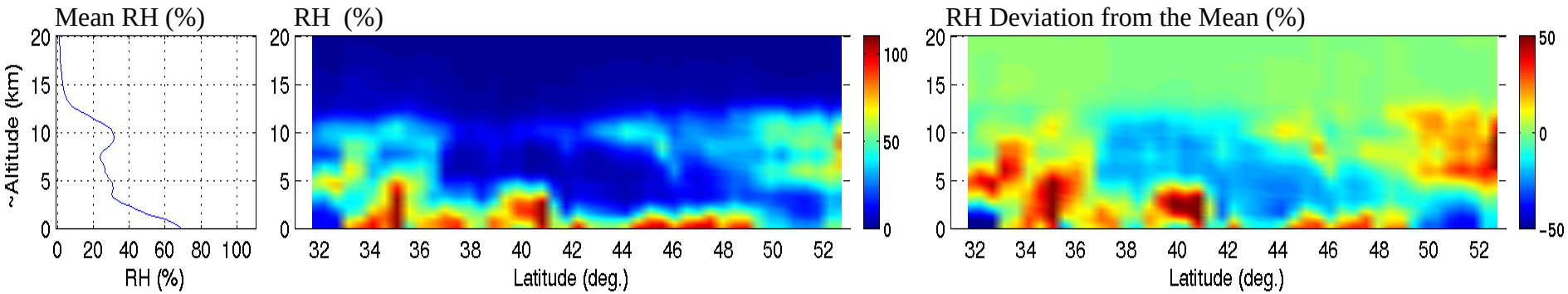


Moisture Cross Section Inter-Comparison (04/09/08)

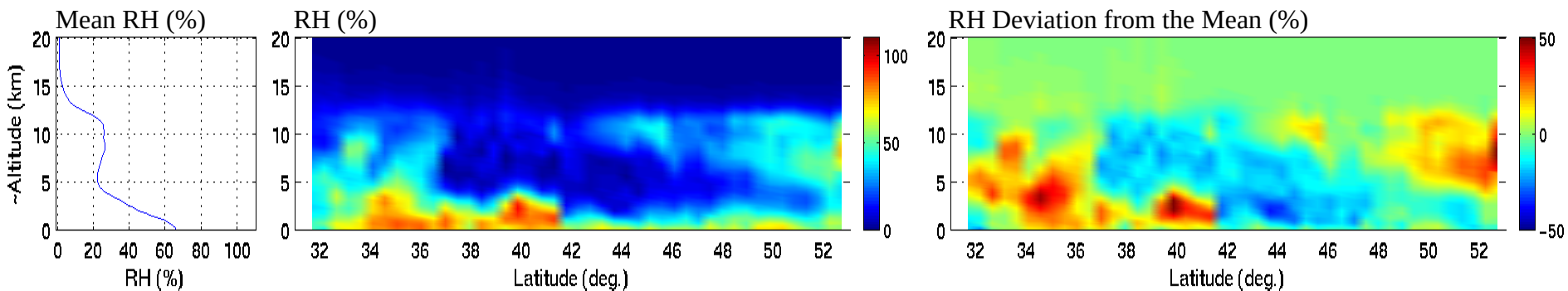
(1) NAST-Team NAST Retrieval



(2) NAST-Team Retrieval (CC)



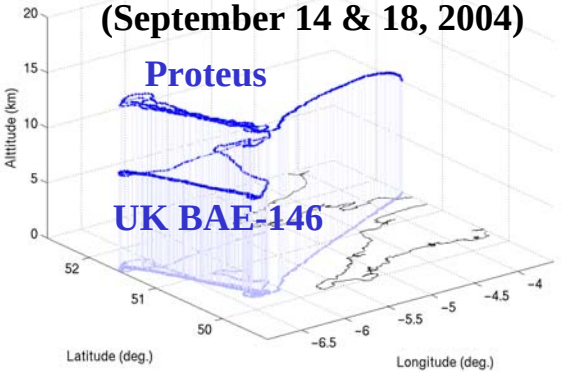
(3) AIRS-Team Retrieval (CC) ..ver. 4.0



United Kingdom (Air Chemistry)

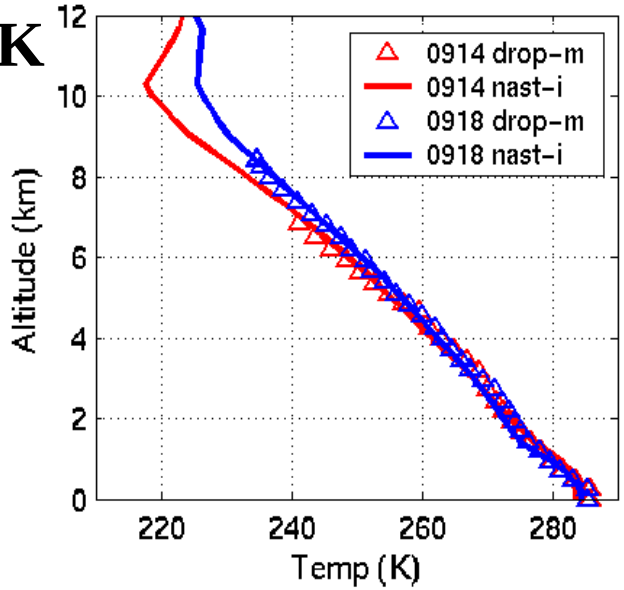
SW Sea of Wales, UK

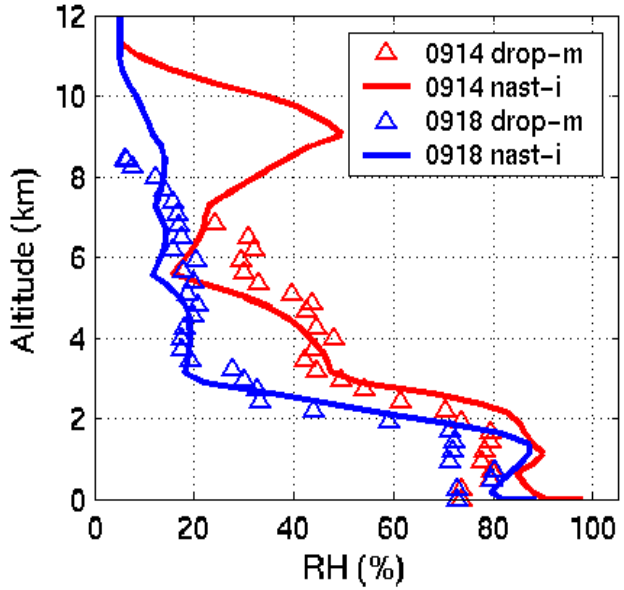
(September 14 & 18, 2004)

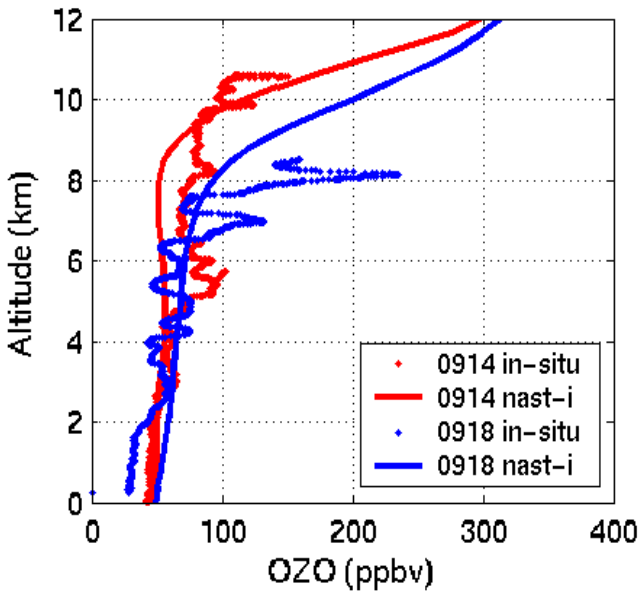


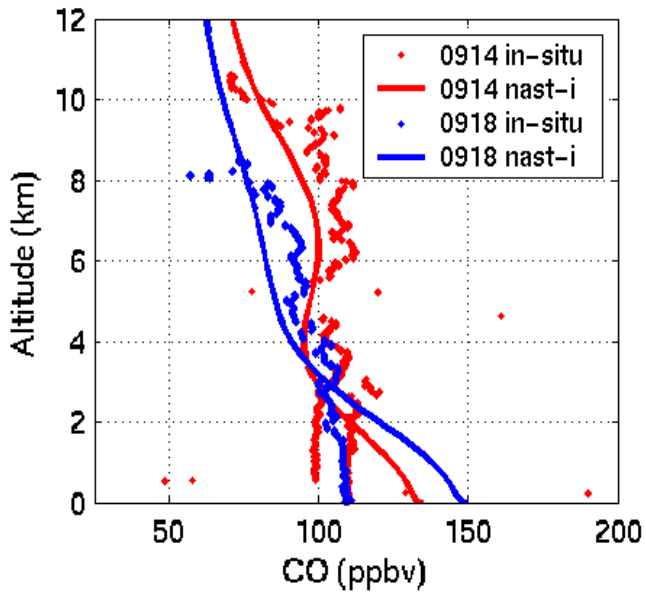
Four day interval measurements taken at the same geographical location and local time

Day-to-day variations shown by NAST-I retrievals are validated with aircraft in-situ measurements





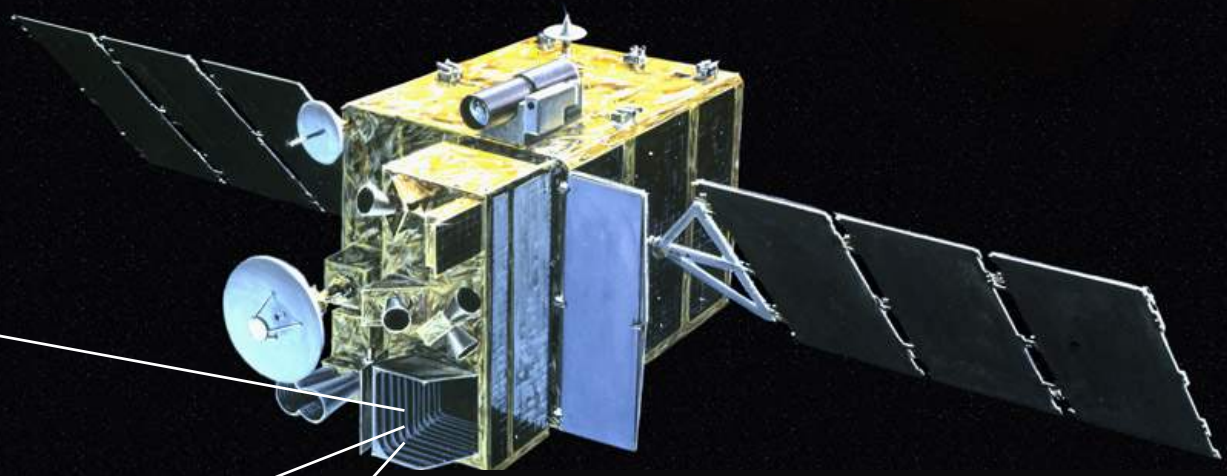


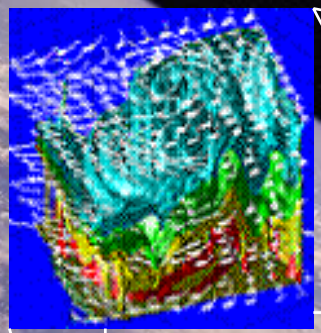


Geostationary Imaging Fourier Transform Spectrometer

New Technology for Atmospheric Temperature, Moisture, Chemistry, & *Winds*

"GIFTS"





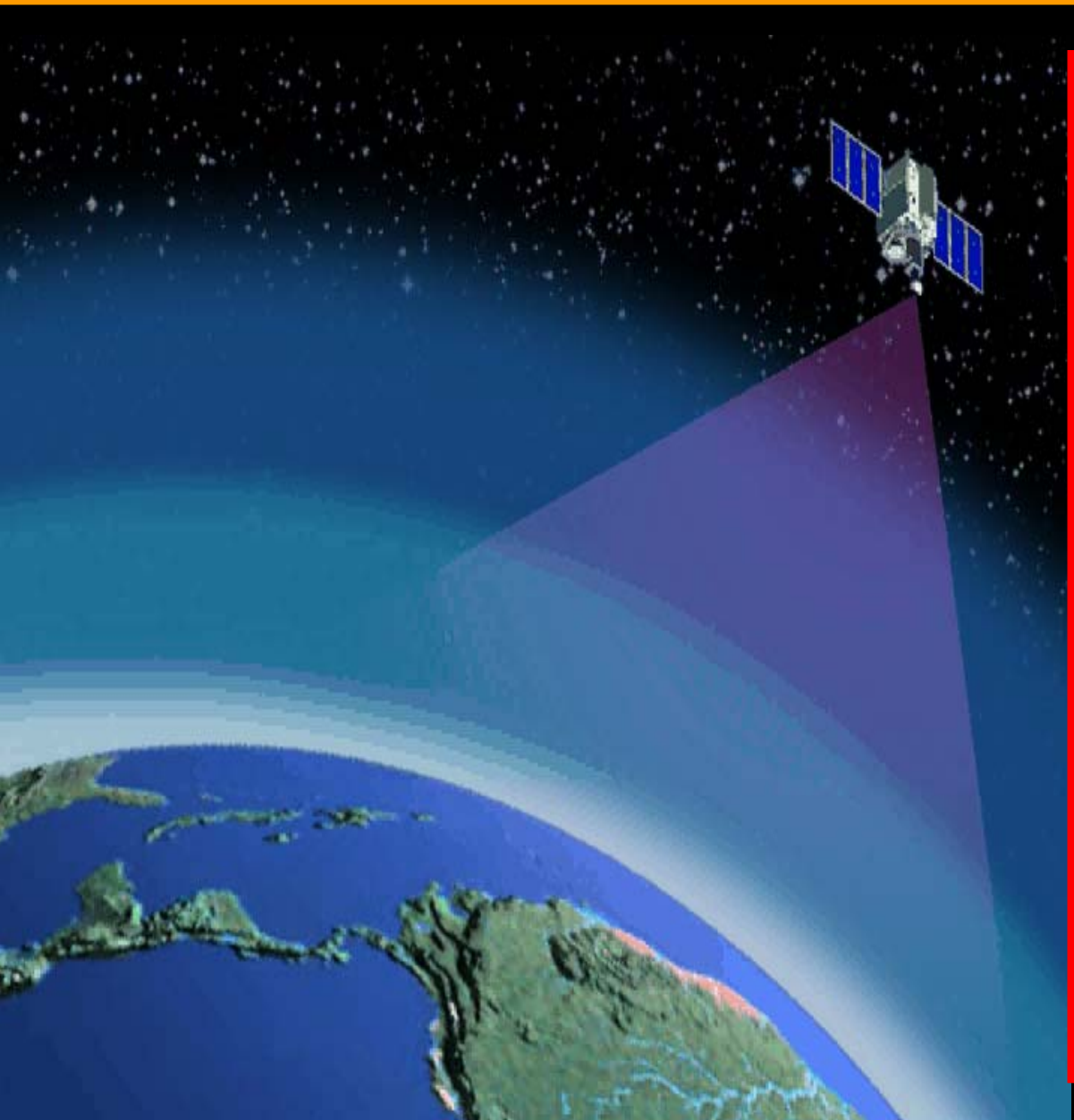
4-d Digital Camera:

Horizontal: Large area format Focal Plane detector Arrays

Vertical: Fourier Transform Spectrometer

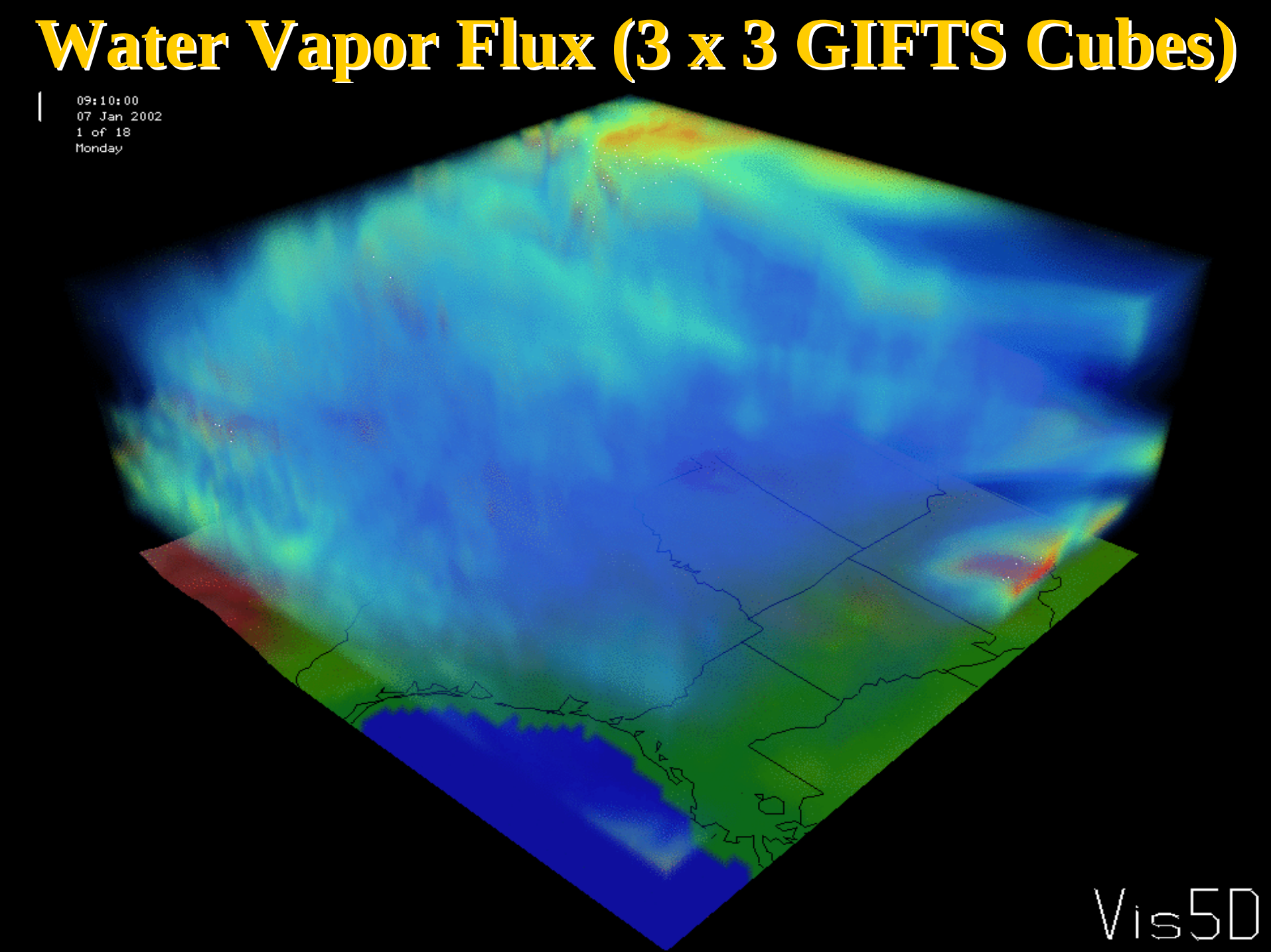
Time: Geostationary Satellite

GIFTS Sampling Characteristics



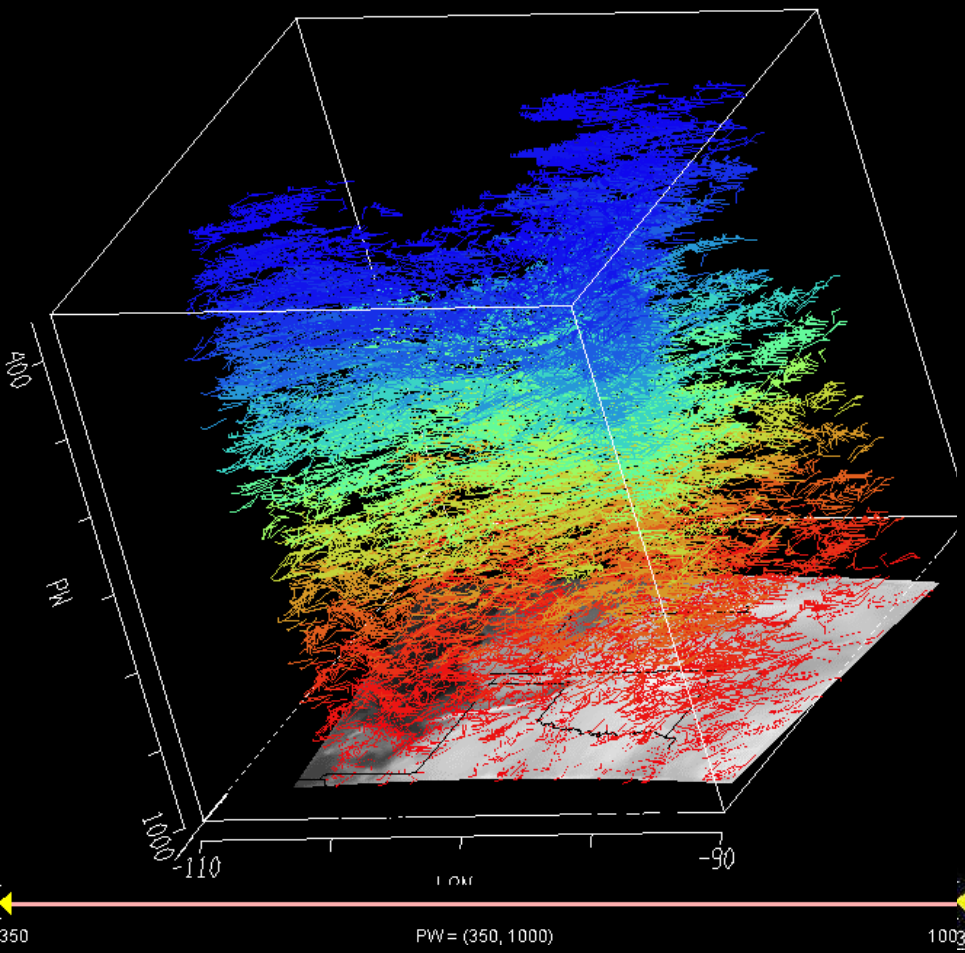
- Two 128x 128 Infrared focal plane detector arrays with 4 km footprint size
- A 512 x 512 Visible focal plane detector arrays with 1 km footprint size
- Field of Regard 512 km x 512 km at satellite sub-point
- Ten second full spectral resolution integration time per Field of Regard
- ~ 80,000 Atmospheric Soundings every minute

Water Vapor Flux (3 x 3 GIFTS Cubes)

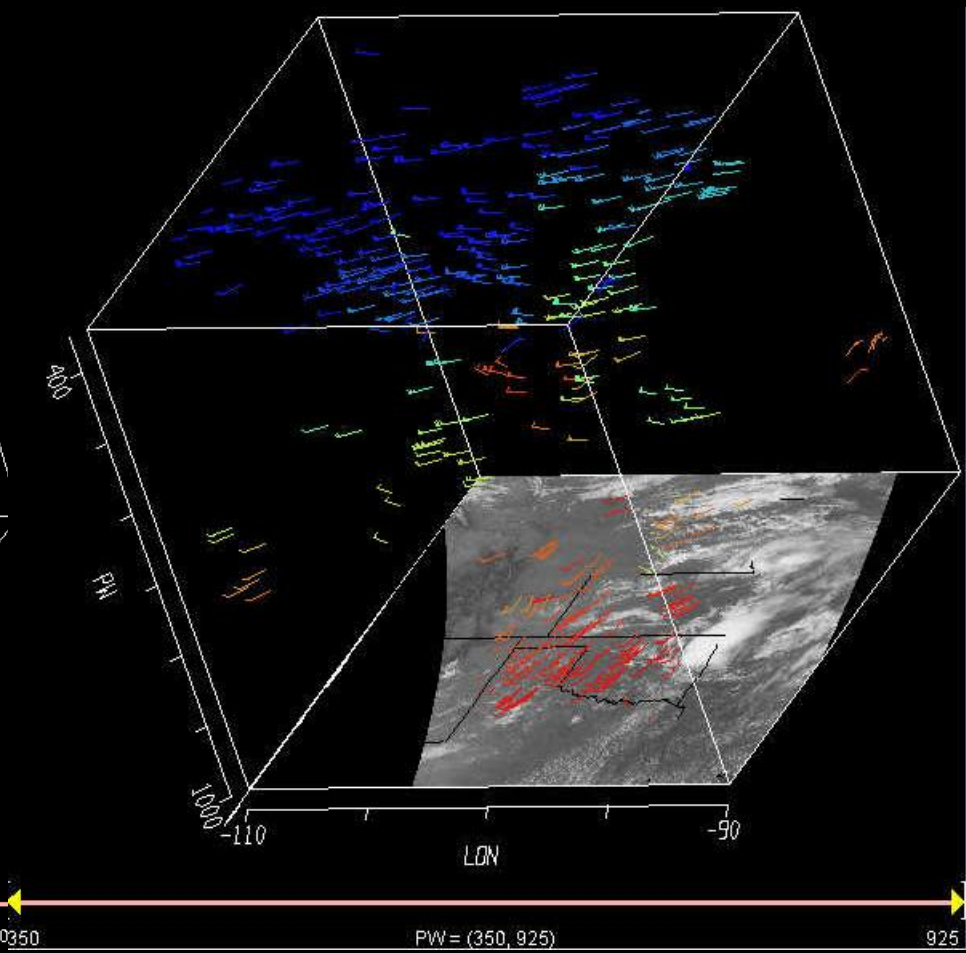


Primary Objective of the Geo-Sounder - Winds Profiles

GIFTS - Simulation

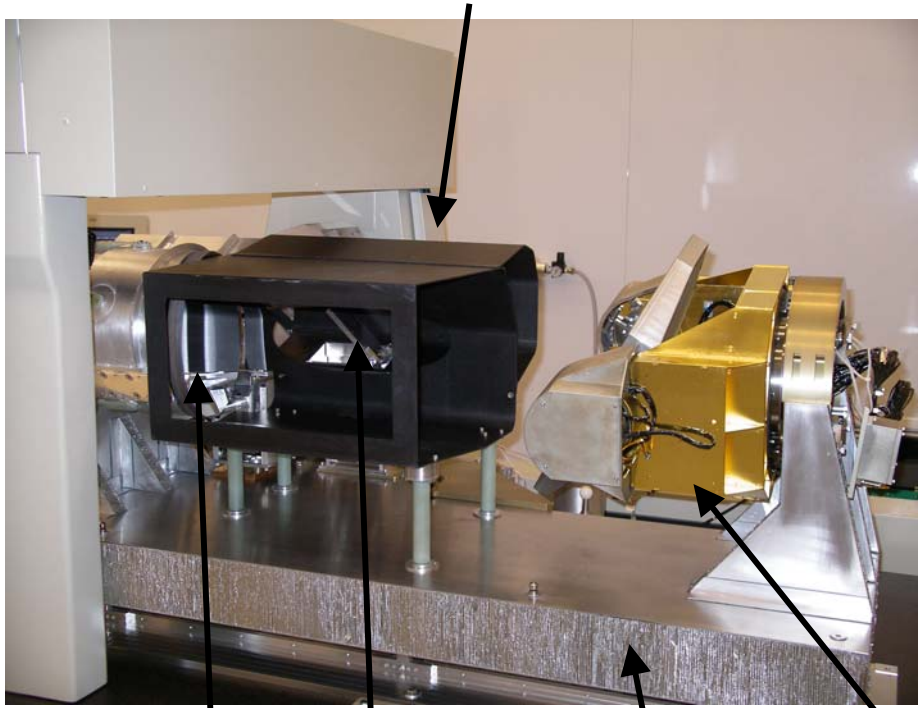


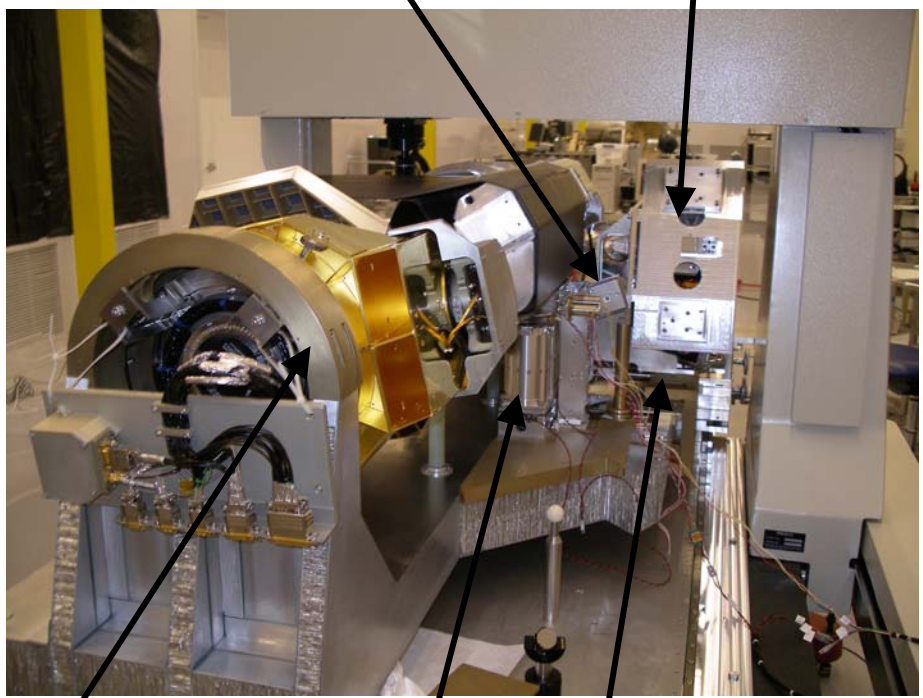
GOES - Observation



CIMSS

GIFTS EDU to be Ground Tested





Although GIFTS waits for a space flight opportunity GIFTS-like instruments are expected to fly on next generation operational geostationary weather satellites

Summary

- New ultra spectral remote sensing capabilities enable accurate atmospheric weather and chemistry depictions
- Latest (Ver 4.0) Aqua AIRS retrievals have been validated with radiosonde, dropsonde, and high vertical resolution airborne NAST-I soundings
- Future satellite ultra high spectral remote sensing instruments will provide most of the temperature and water vapor profile data for global data assimilation.
- Wind profiles will be provided by future ultra high spectral resolution geostationary satellite spectrometers

International TOVS Study Conference, 14th, ITSC-14, Beijing, China, 25-31 May 2005. Madison, WI, University of Wisconsin-Madison, Space Science and Engineering Center, Cooperative Institute for Meteorological Satellite Studies, 2005.