



The Validation of AIRS Retrievals

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Outline:

August Data Release & New Results

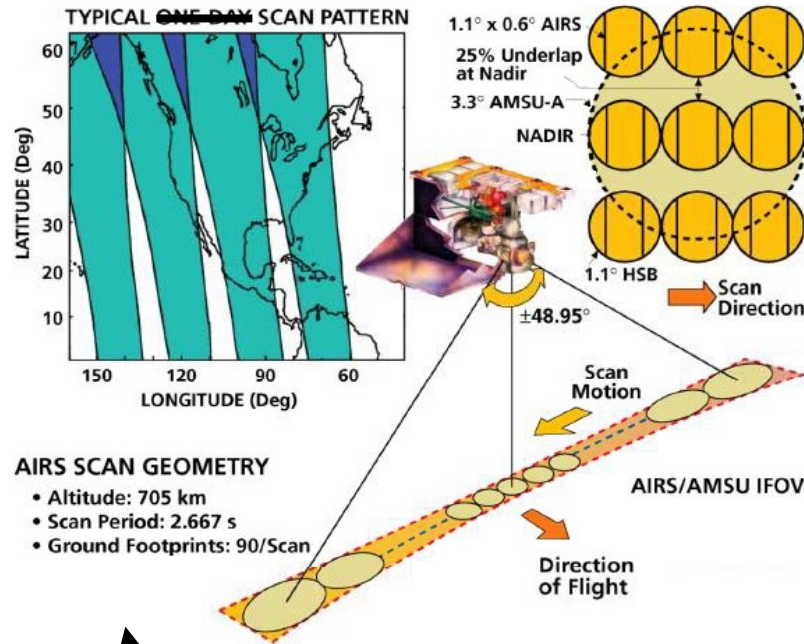
- Public Data Release in August: Oceans between 40°S and 40°N
 - *Further restricted so retrieved sea surface temperatures (SST) agree with NCEP forecast within ± 3 K*
 - *a simple, temporary substitute for self-consistent indicators*
 - *recent analyses show this is not a perfect quality indicator*
 - *internal quality indicators are under development*
 - *Validated Quantities:*
 - SST
 - ECMWF model, buoys, shipborne spectrometer
 - Temperature profiles (T)
 - ECMWF, sondes
 - Water vapor profiles (q)
 - ECMWF, sondes
- Exploratory Analyses: Some preliminary results



The AIRS / AMSU / HSB Retrieval System

- Utilizes a combination of *infrared* and *microwave* observations
 - *AIRS*: 2378 IR channels, 15 km horizontal resolution
 - *HSB*: 4 MW channels, 15 km horizontal resolution
 - *AMSU*: 15 MW channels, 50 km horizontal resolution
 - *Vis/NIR*: 4 channels, 2 km resolution (daytime-only diagnostics)
- Each retrieval uses 9 AIRS spectra, 9 HSB spectra, 1 AMSU spectrum
- Invert these radiances to geophysical quantities of cloud cleared radiance, T and q profiles, cloud properties, surface T and emissivity, trace gases.

The AIRS / AMSU / HSB Viewing Geometry



1. AMSU footprint, 45 km across at nadir, contains 9 AIRS spectra

– THIS IS THE RETRIEVAL GRANULARITY.

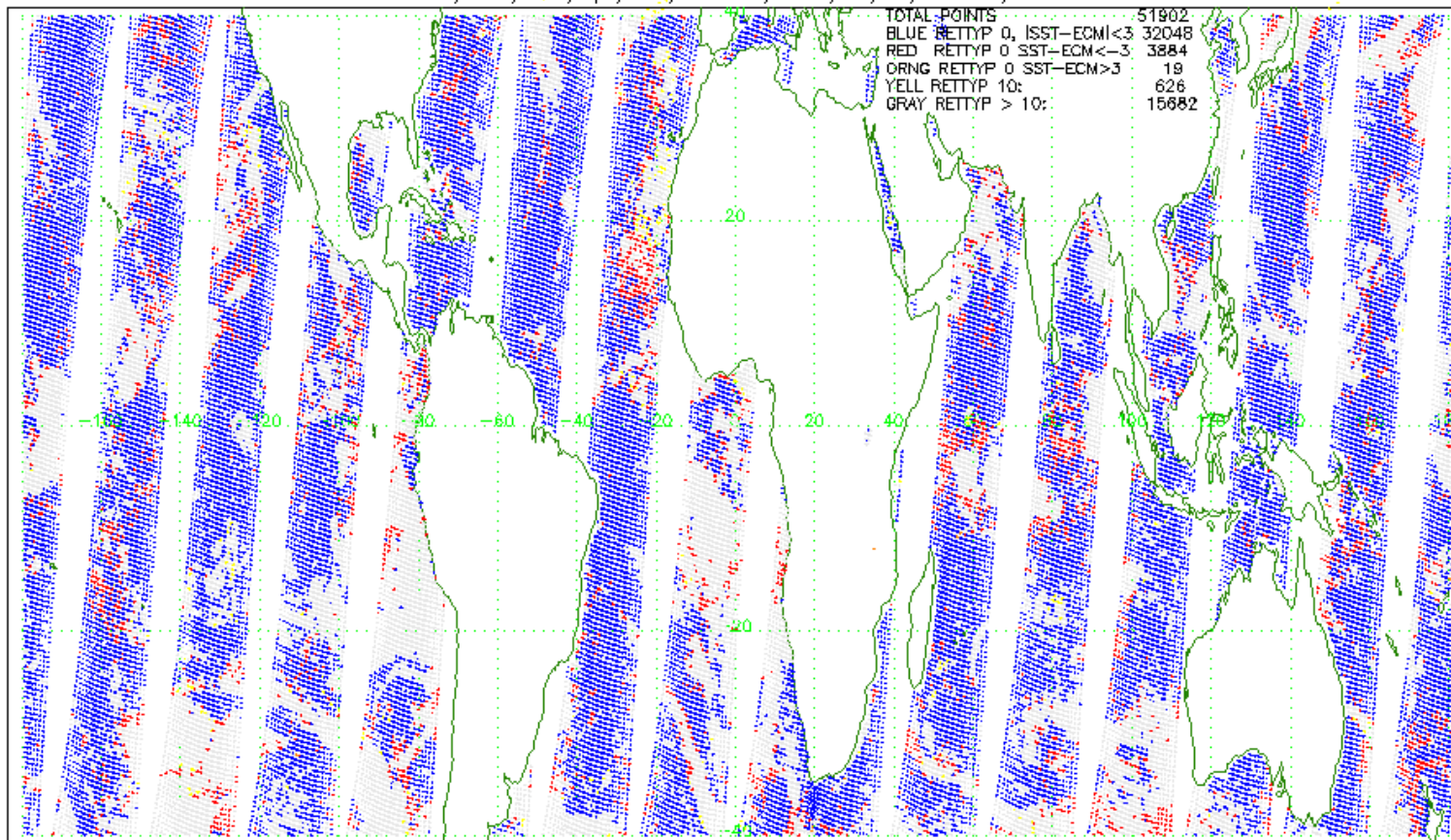
2. Viewing swath 30 AMSU footprints or ~1650 km wide.

3. The result: 324,000 retrievals per day

Effect of Constraining SST to $\pm 3\text{K}$ from Forecast

6 September 2003, Nighttime

/dom/files/ops/test/ValRun2/2002/09/06/airx2ret/

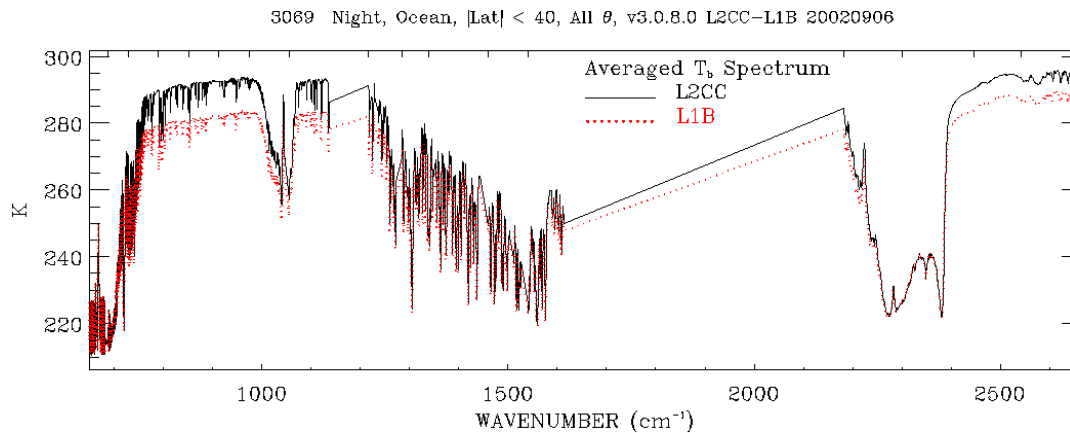


BLUE: Full IR retrievals **GRAY:** Other retrieval types

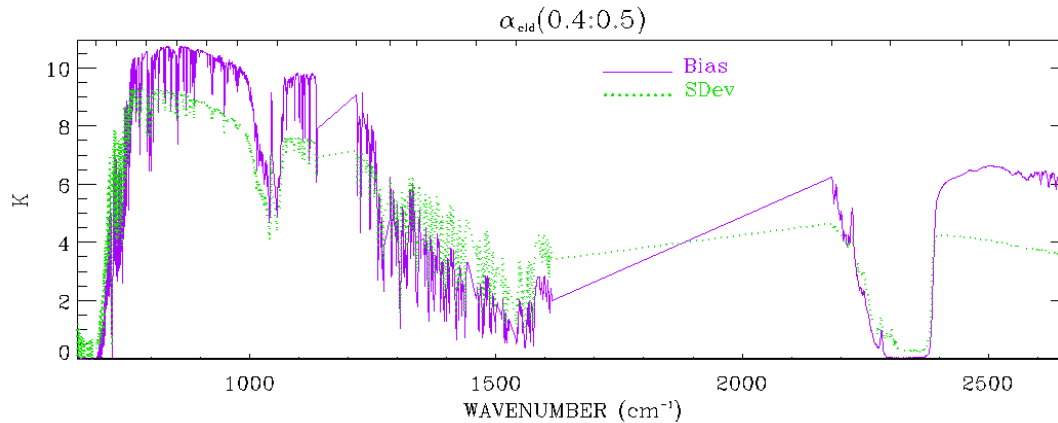
RED: Full IR where $|SST - Forecast SST| > 3\text{ K}$

Magnitude of Cloud Clearing

6 Sept 2002, Retrieved Cloud Fraction: 40-50%



Top: Average observed spectrum & average cloud cleared spectrum

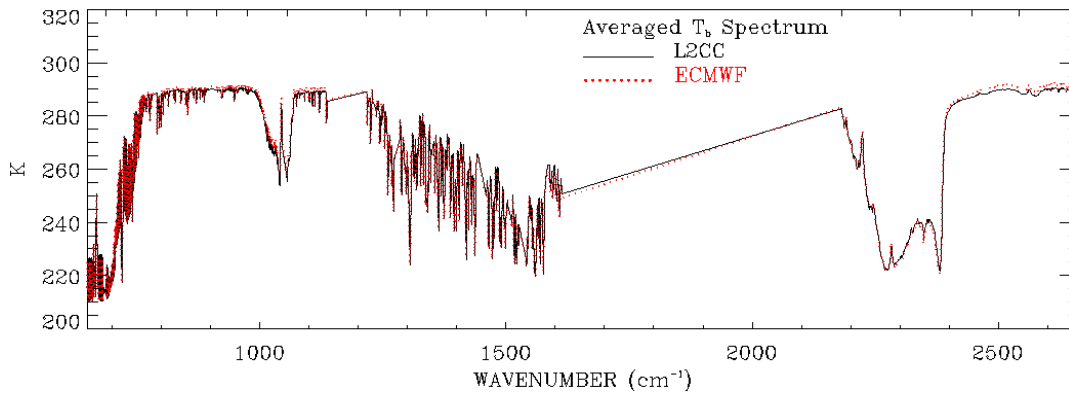


Bottom: Statistics of cloud correction.

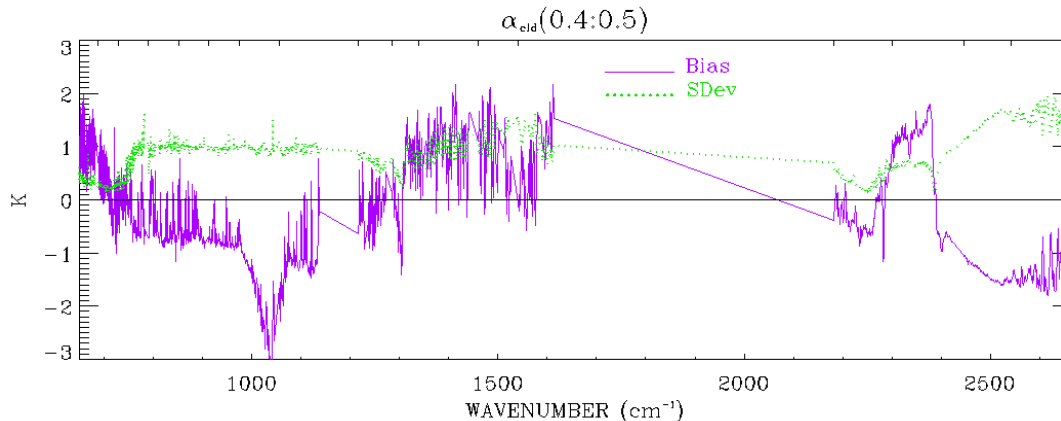
Validating Cloud-Cleared Radiance

6 September 2002, night, cloud fractions of 40-50%

26 Final Clr, Night, Ocean, |Lat| < 40, All θ , v3.0.8.0 L2CC-ECMWF Sim V7 RTA 20020906



Top: AIRS CC Rad & Calculated w/ECMWF



Bottom: Difference stats

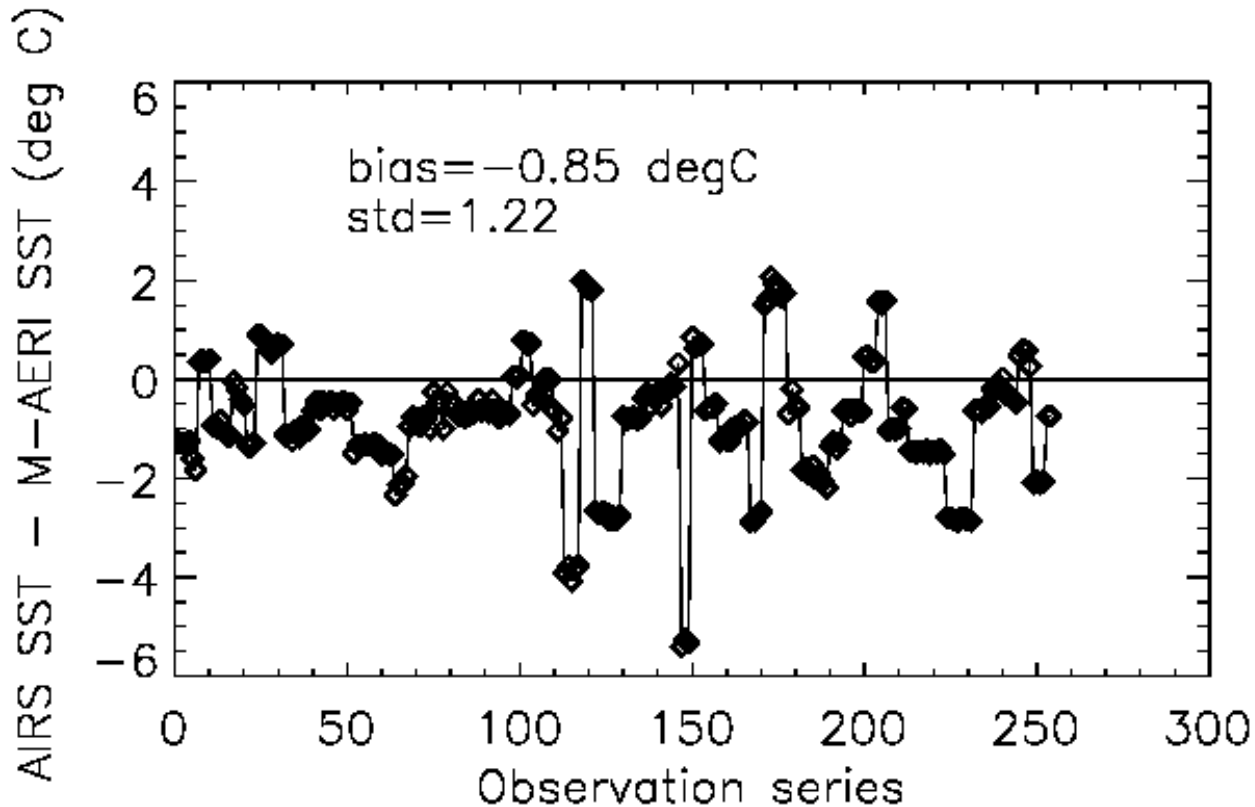
Summary:

- Errors ~1K for <50% cover
- Increase to ~3K at 70%

AIRS SST Compared with Shipborne Radiometer

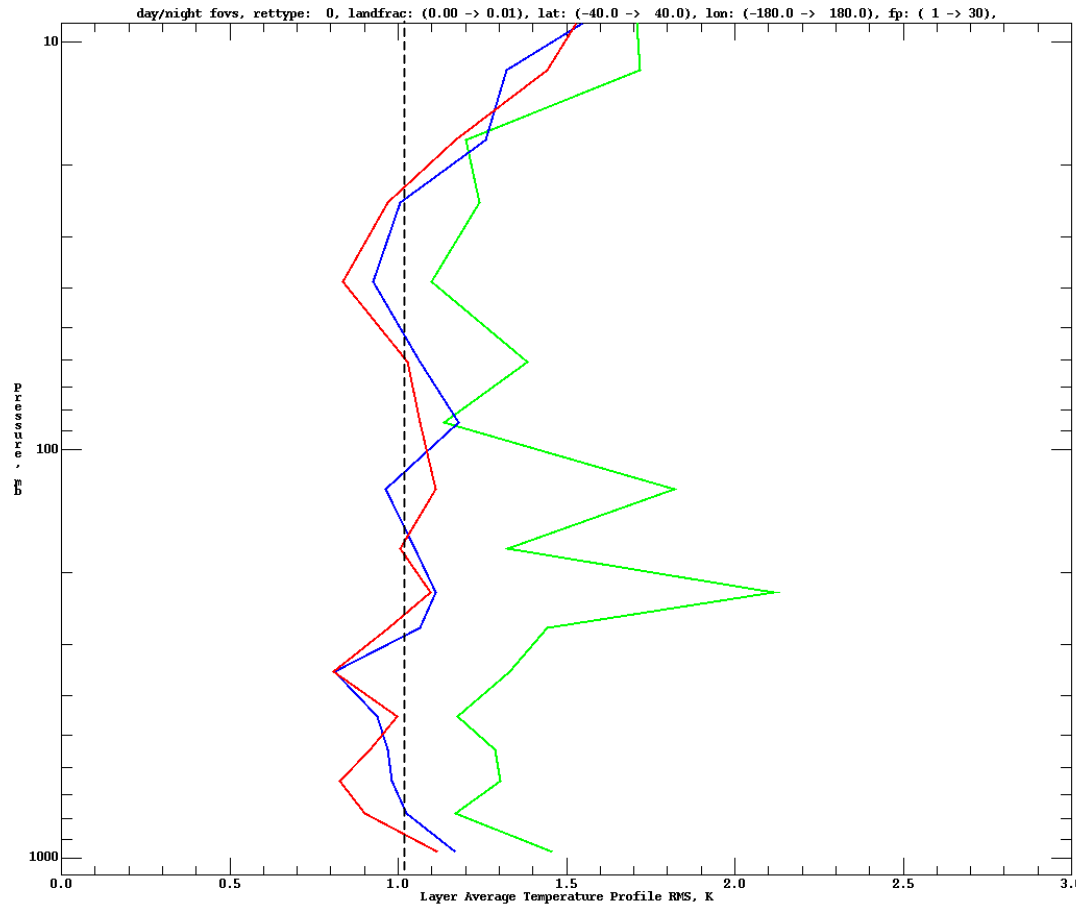
M-AERI on *Explorer of the Seas*, Caribbean, Fall 2002

These Are Our Best SST Comparison Data
(Not preselected by SST difference with NCEP forecast)



Temperature Profile Differences with ECMWF

6 September 2002, day and night, 40S-40N, oceans



Red: RMS Error,
full IR retrievals

Green: Microwave only

Blue: Regression

Dashed line = 1 K / km.

NOTE: We can also
achieve this without
'peeking' at forecast SST.

Total Water Vapor

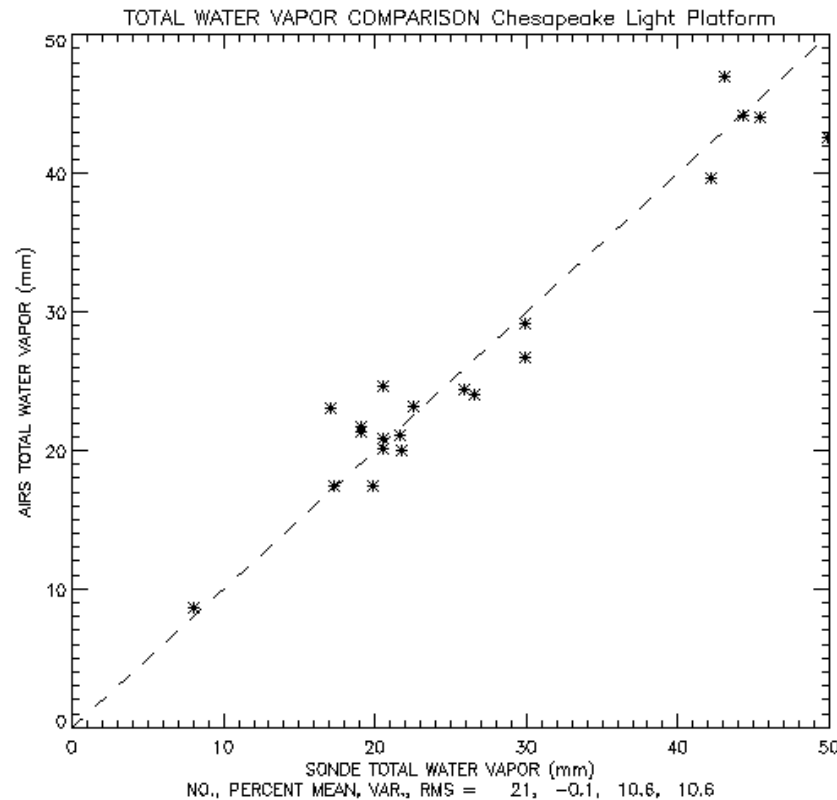


General agreement with 3 'truth' data sets
 Except... Dry bias in very wet areas

Data source	Relative Bias, percent	Relative RMS, percent
ECMWF analyses	0.01	16.2
Operational sondes	1.9	13.7
Dedicated Sondes, Chesapeake Platform	-0.1	10.6
Dedicate Sondes, Nauru* (ARM TWP)	-10.0	11.4

*Nauru is THE global water vapor maximum (Piexoto & Oort, 1993)

Total Water from Sondes at Chesapeake Light Platform



September-October 2002; Dynamic range is a mix of meteorology and burst balloons!

Water Vapor Profile

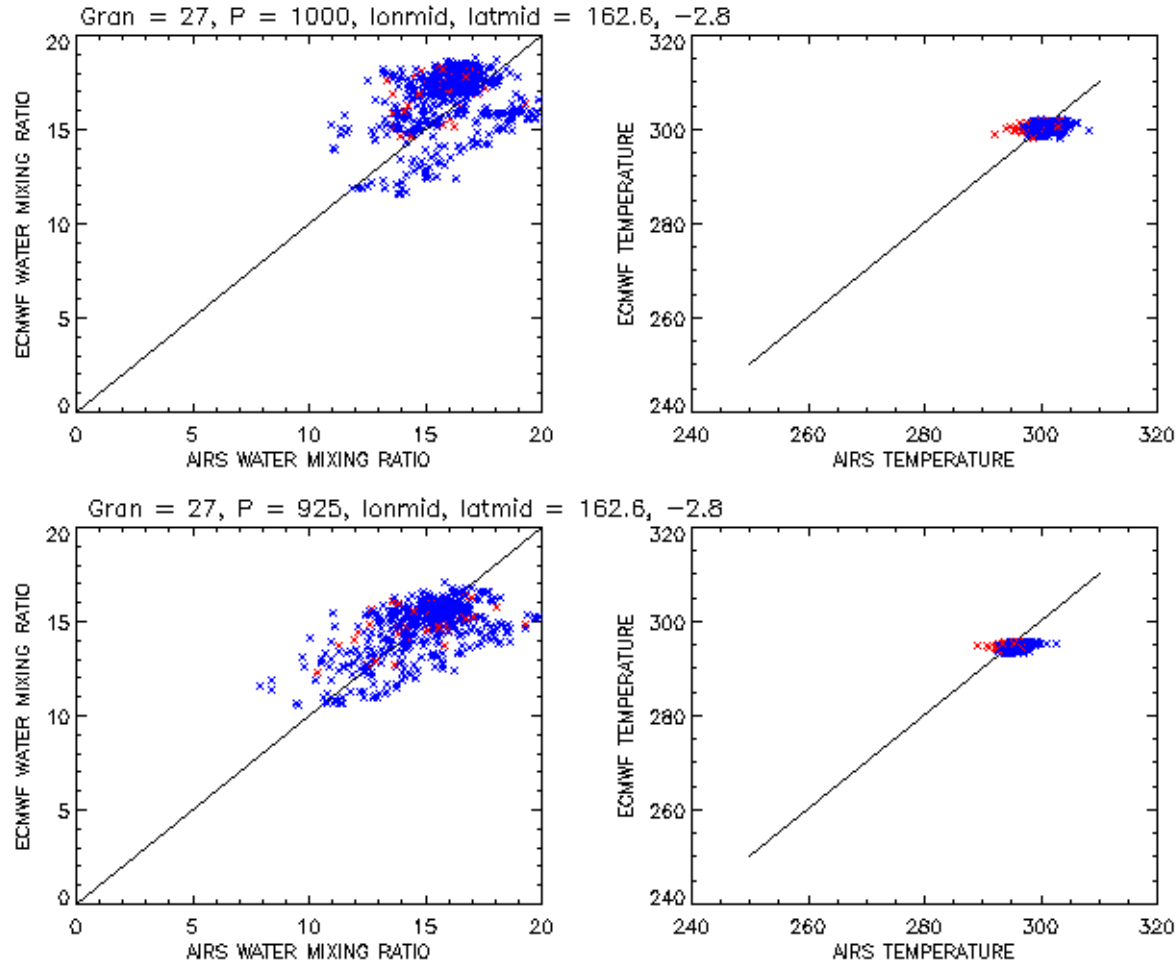
ECMWF, sondes in agreement to 500 mb

Layer	ECMWF (%)	Operational Sondes (%)
1100 to 700 mb	-1.8 ± 9.6	3.6 ± 11.0
700 to 500 mb	-1.1 ± 31.2	0.0 ± 26.5
500 to 350 mb*	-12.5 ± 30.0	-3.7 ± 50.5

*Are these errors from AIRS or the correlative data?

Upper tropospheric humidity is currently a major validation activity

AIRS and ECMWF at Nauru (ARM TWP)



Tropical Western Pacific

Conclusions:

Cloud-Cleared Rad., SST, Temperature, Water Vapor

- Cloud cleared radiance based only on ECMWF
 - ~ 0.5 to 3 K, strongly dependent on cloud fraction
- General agreement for other quantities from multiple data sources
 - SST: $\sim 0.9 \pm 1$ K from buoys, ECMWF, radiometer
 - Temperature profile: $\sim 0.2 \pm 0.6$ - 1.2 K from sondes and ECMWF
 - lower trop most difficult
 - Total water vapor: $\sim 1 \pm 10$ - 15% from sondes and ECMWF
 - Water vapor profile: $\sim 1 \pm 10$ - 30% from sondes, ECMWF
 - best results in lower troposphere



Some Preliminary Results:

Retrieving Small-Scale Structure near the Surface

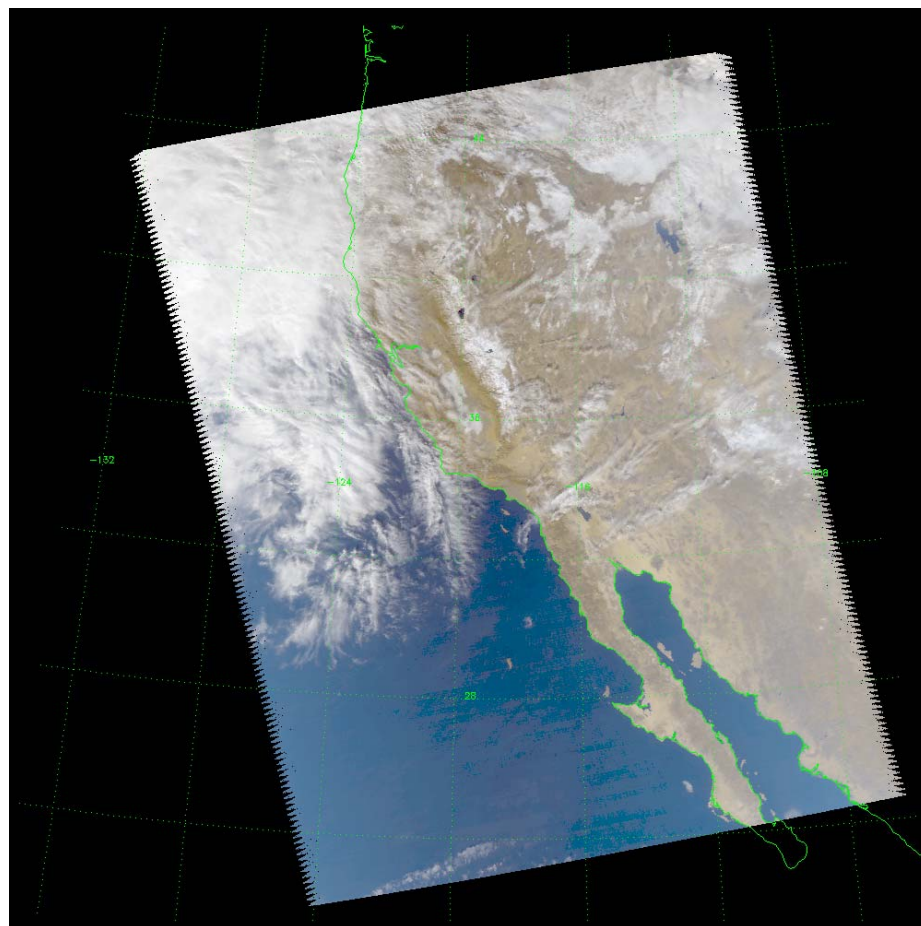
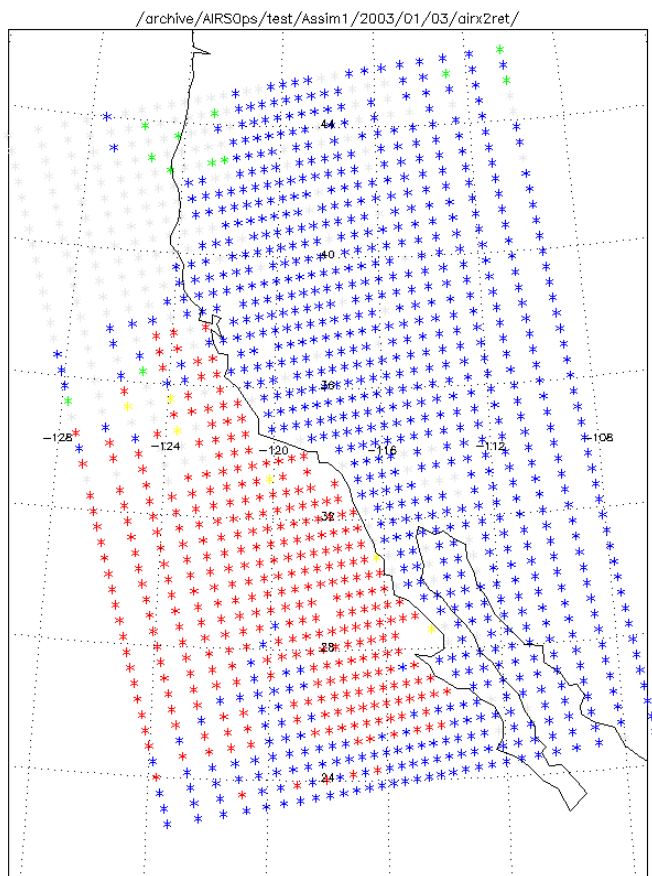
- Today's Example: Temperature inversions off west coast of Mexico and US.

Near-Surface Temperature Inversions

Granule 210, 3 January 2003

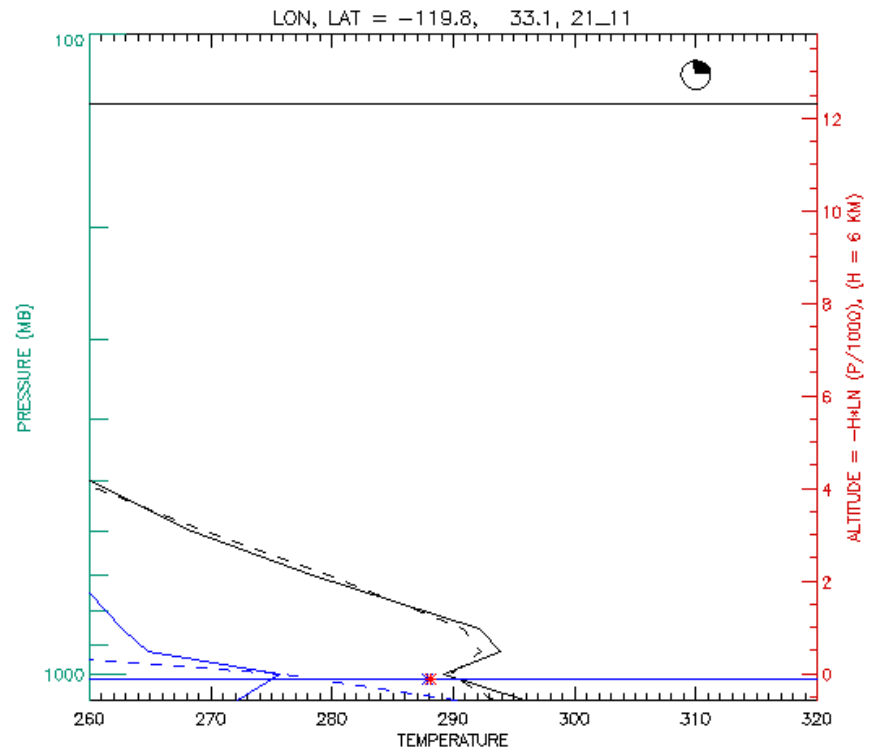
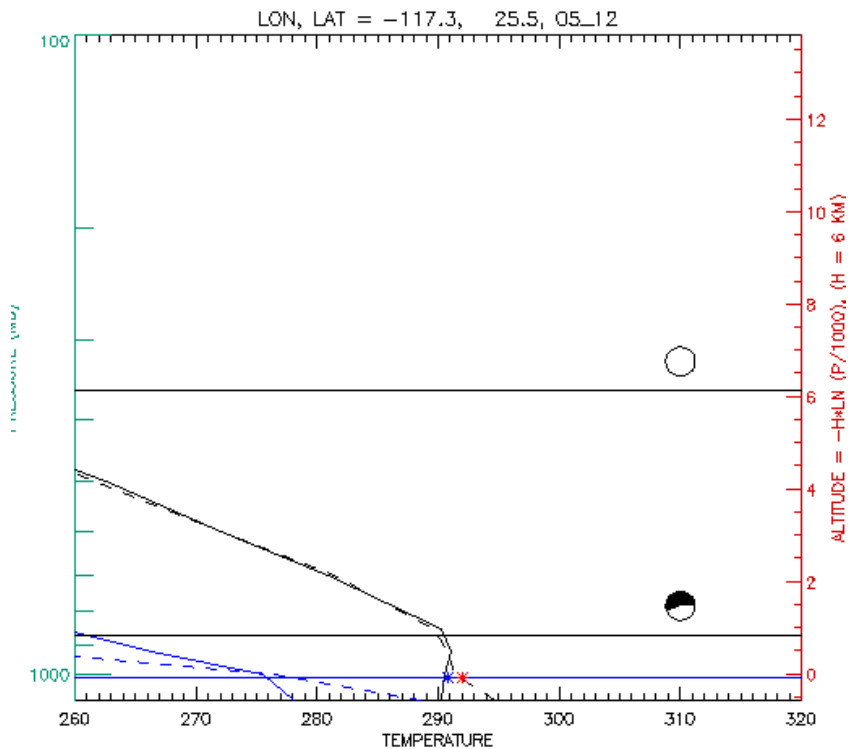
Left: 'Good' (SST) inversions in red

Right: Vis/NIR image



Good Agreement with ECMWF in Temperature

Black = T, Blue = T_{dew} Smooth: AIRS, Dashed: ECMWF
 Blue Asterisk = AIRS SST, Red Asterisk = ECMWF SST



NOTE: T agrees well, humidity does not!

Conclusions: **Exploratory Analyses**

- Small vertical scale structure is seen in the AIRS retrievals.
 - Particularly apparent in temperature, supported by ECMWF
 - Cloud fields are consistent with Vis/NIR (not shown).
 - Currently examining humidity