AIRS Real-Time Sounding Profile Retrieval for IMAPP (International MODIS/AIRS Processing Package) Users

Elisabeth Weisz, Hung-Lung Huang, Jun Li,
Suzanne Seemann, Eva Borbas, Liam Gumley

Cooperative Institute for Meteorological Satellite Studies (CIMSS)
University of Wisconsin-Madison

- Introduction
- IMAPP AIRS Retrieval (RTV) Algorithm
- Global, Granule and single Profile RTV Results
  (Comparison with Operational AIRS RTV Product, ECMWF Analysis, MODIS and GOES RTV)
- Conclusions

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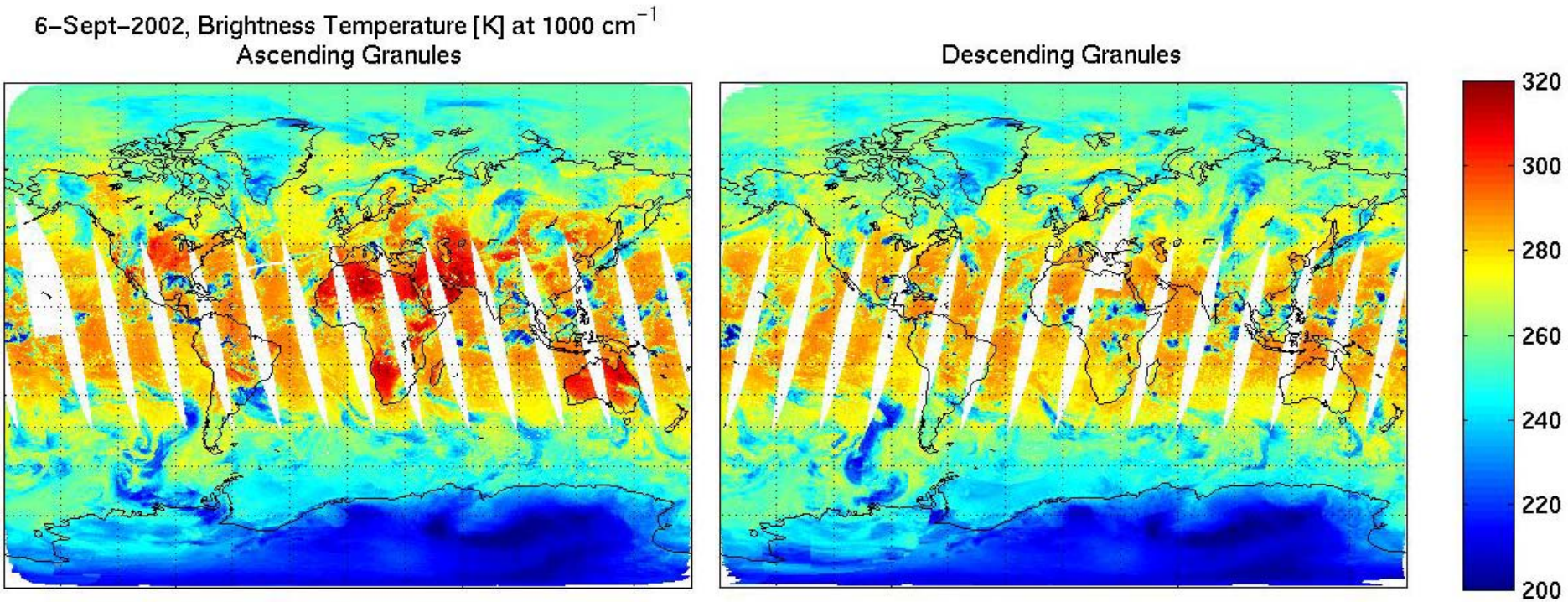
The Atmospheric Infrared Sounder on AQUA

- 2378 channels, spectral ranges: 3.7 - 4.61 μm, 6.2 - 8.22 μm, 8.8 - 15.4 μm;
- Spectral resolution: $\lambda/d\lambda$ >1200
- Altitude: 705 km, Swath: 1650 km, 90 Ground Footprints, 1.1° IFOV
- 6 min and 125 MB per Granule (135x90 pixels), 240 granules per day



AIRS Clear-Sky Retrieval (RTV) at CIMSS

- Regression Retrieval of T, q, Ts, TPW, O3, and ε_s under clear conditions

Regression Model: $X = C\ Y$

Least squares regression solution: $C = X\ Y^T\ (Y\ Y^T)^{-1}$

X…Atmospheric State, C…Coefficients, Y…Measurements

→ SelChans RTV, nch=337
→ PC regression RTV, npc=30

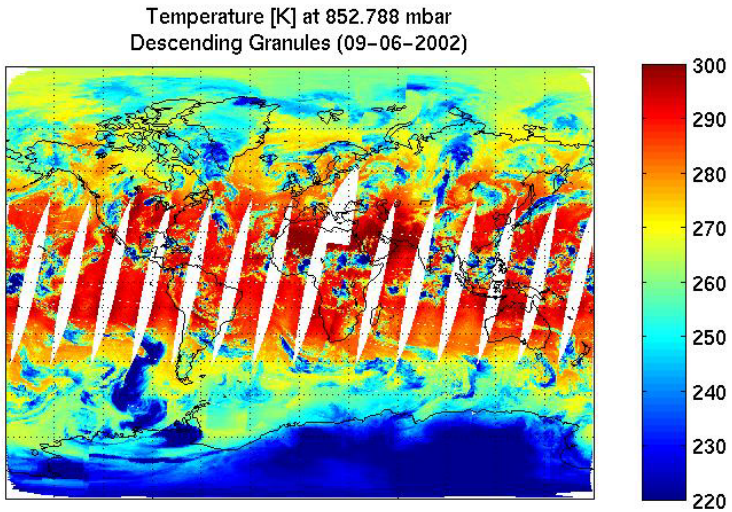
- Preparation of multiple Trainingsets
- Forward Model Calculations using SARTA
- Application of BT/scanang-classification scheme
- Use of MODIS Cloudmask product for AIRS FOVs cloud detection
- Retrieval Validation/Comparison: ECMWF analysis, global RAOBs, MODIS and GOES Retrievals

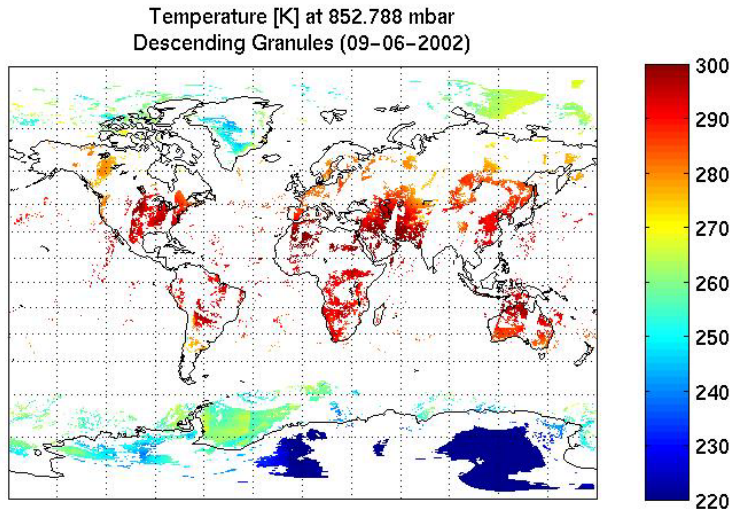
→ TIGR3 & Noaa88 & special desert and polar cases
→ Ecosystem assigned to each point to get realistic surface pressure, surface skin temperature and surface emissivity.

Class	BT@1000 cm^{-1} training	BT@1000 cm^{-1} observations
1	BT ≤ 260	BT ≤ 255
2	250<BT≤270	255<BT≤265
3	260<BT≤280	265<BT≤275
4	270<BT≤290	275<BT≤285
5	280<BT≤300	285<BT≤295
6	290 < BT	295 < BT

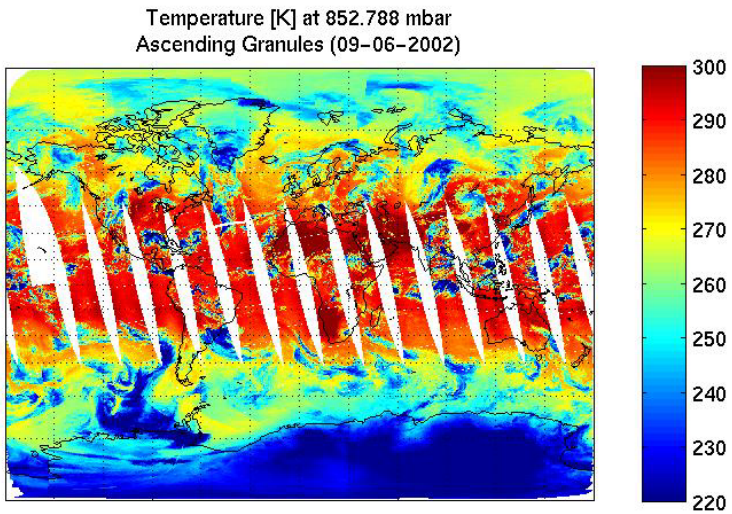
Global IMAPP AIRS Single FOV RTV Results: Temperature [K] at 850 mbar (09-06-2002)

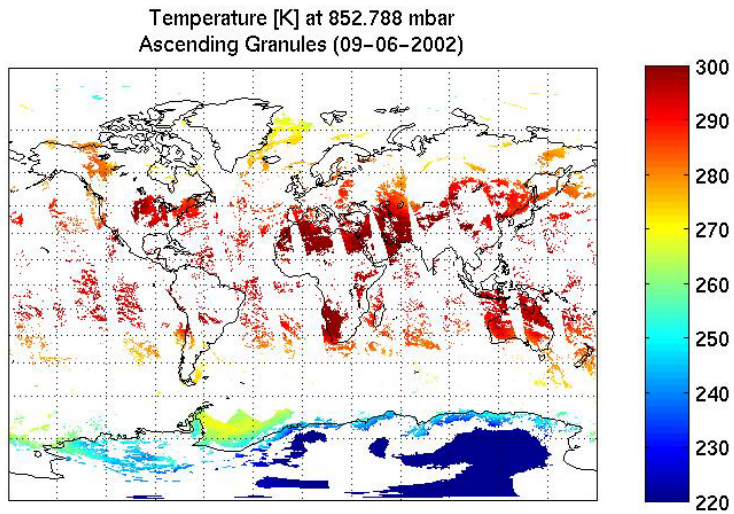
Descending Grans





Ascending Grans



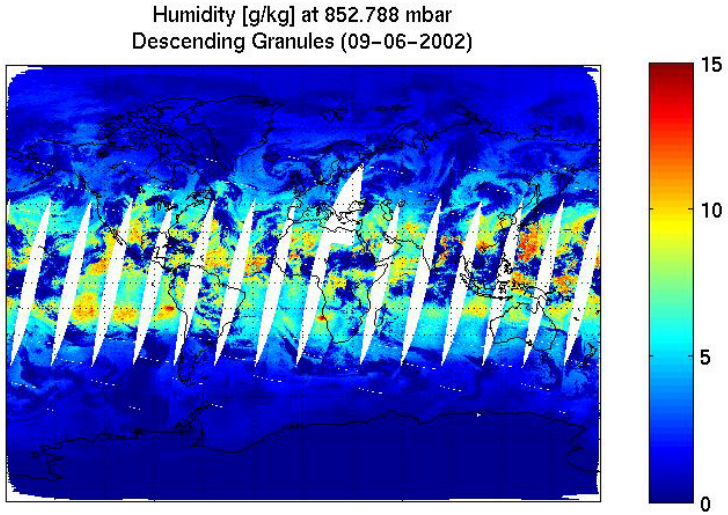


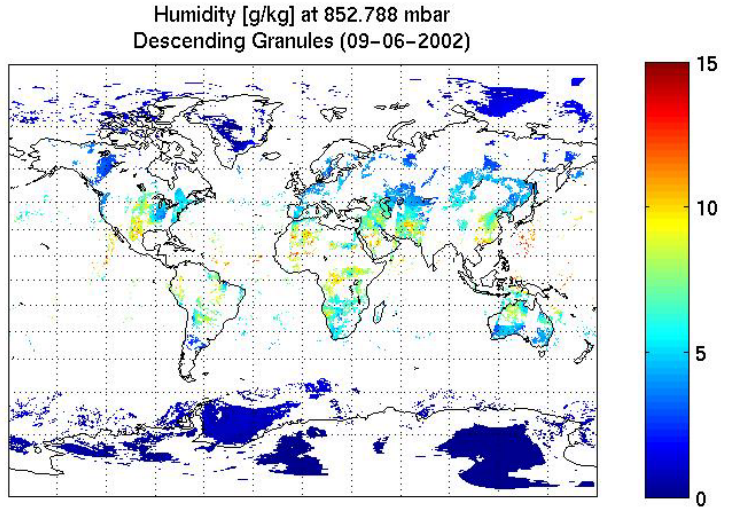
Without Cloudmask

With Cloudmask

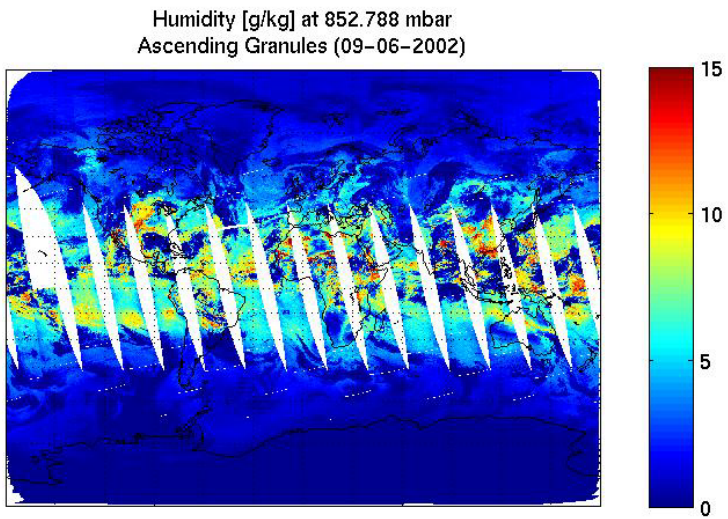
Global IMAPP AIRS Single FOV RTV Results: Humidity [g/kg] at 850 mbar (09-06-2002)

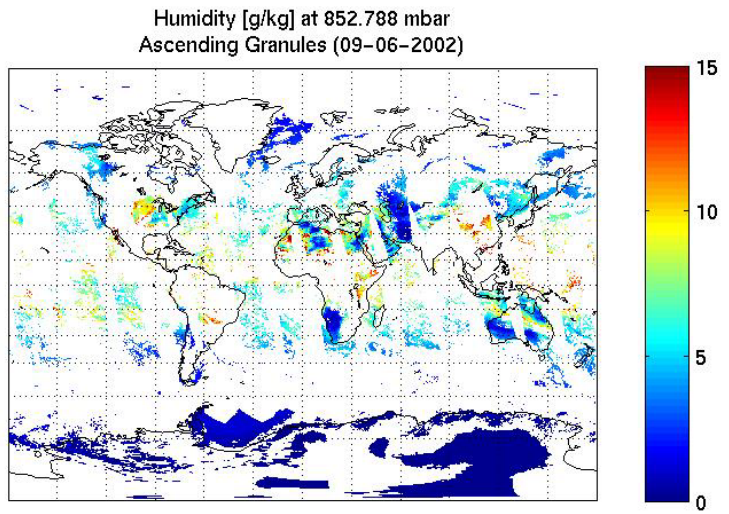
Descending Grans





Ascending Grans



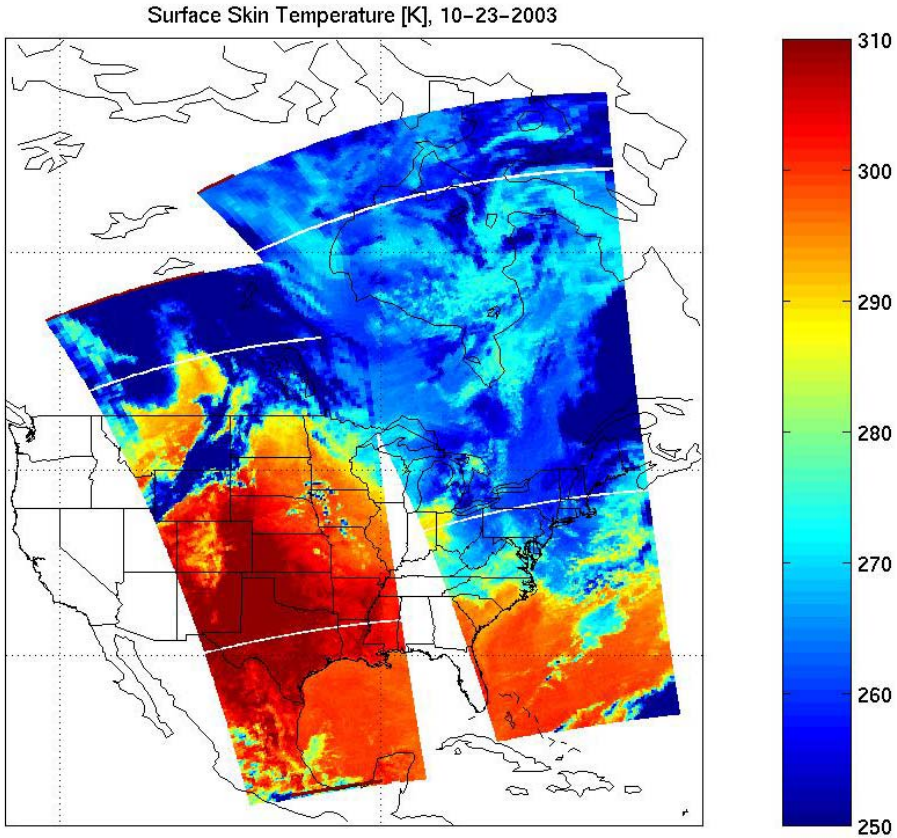


Without Cloudmask

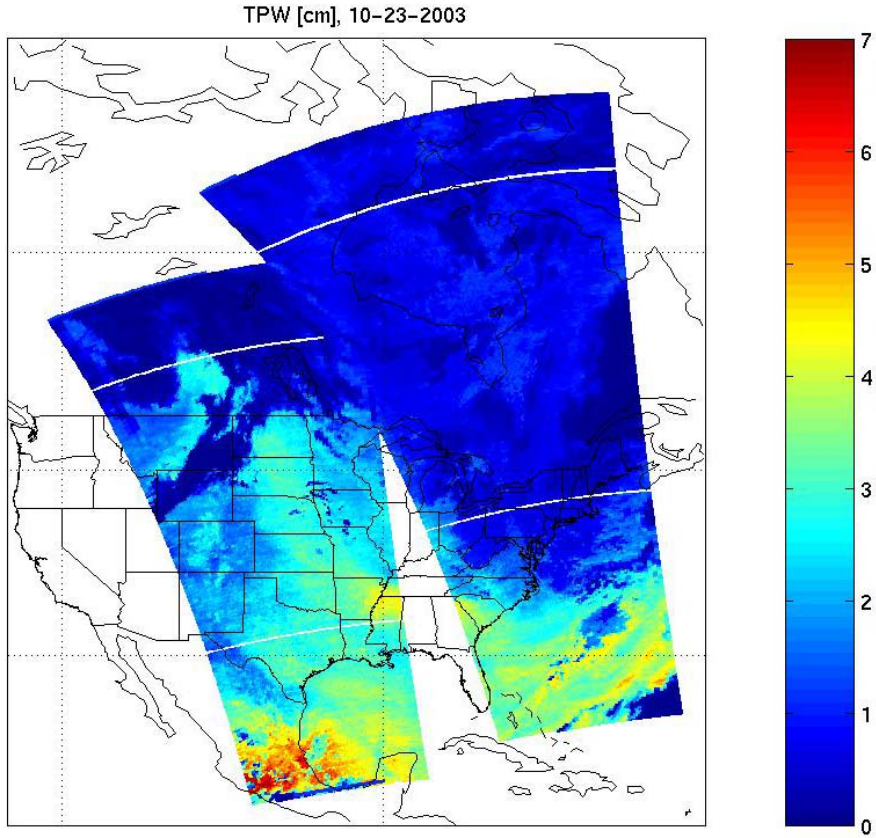
With Cloudmask

IMAPP AIRS Single FOV RTV: CIMSS Direct Broadcast Area (10-23-2003,Day)

Surface Skin Temperature [K] (no cloudmask)

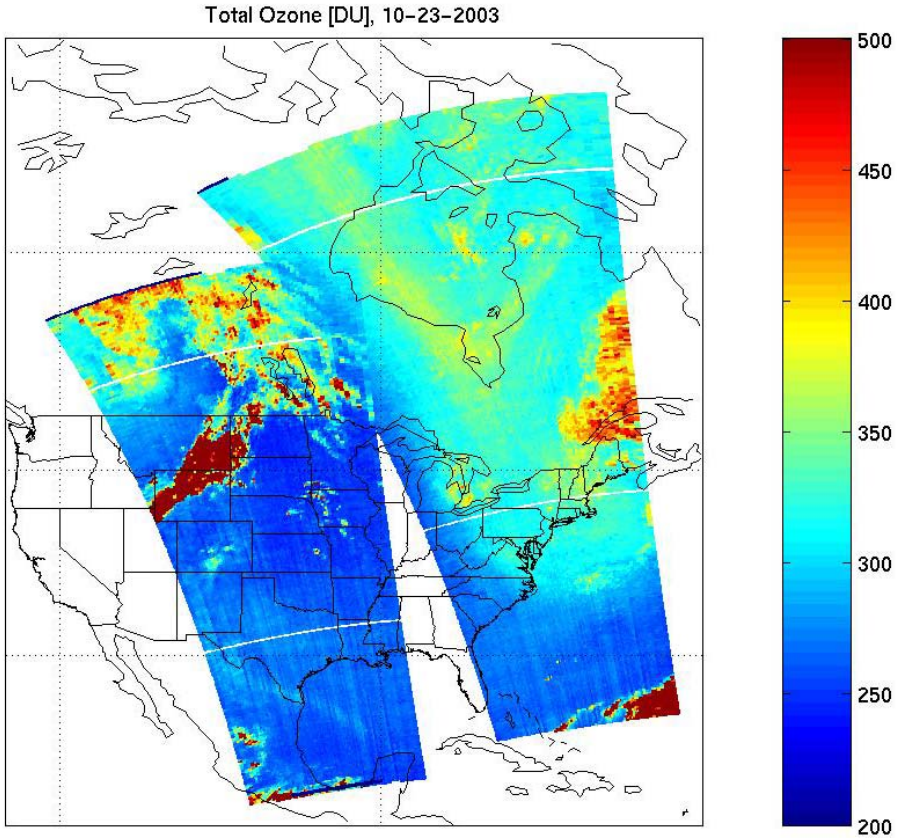


Total Precipitable Water [cm] (no cloudmask)

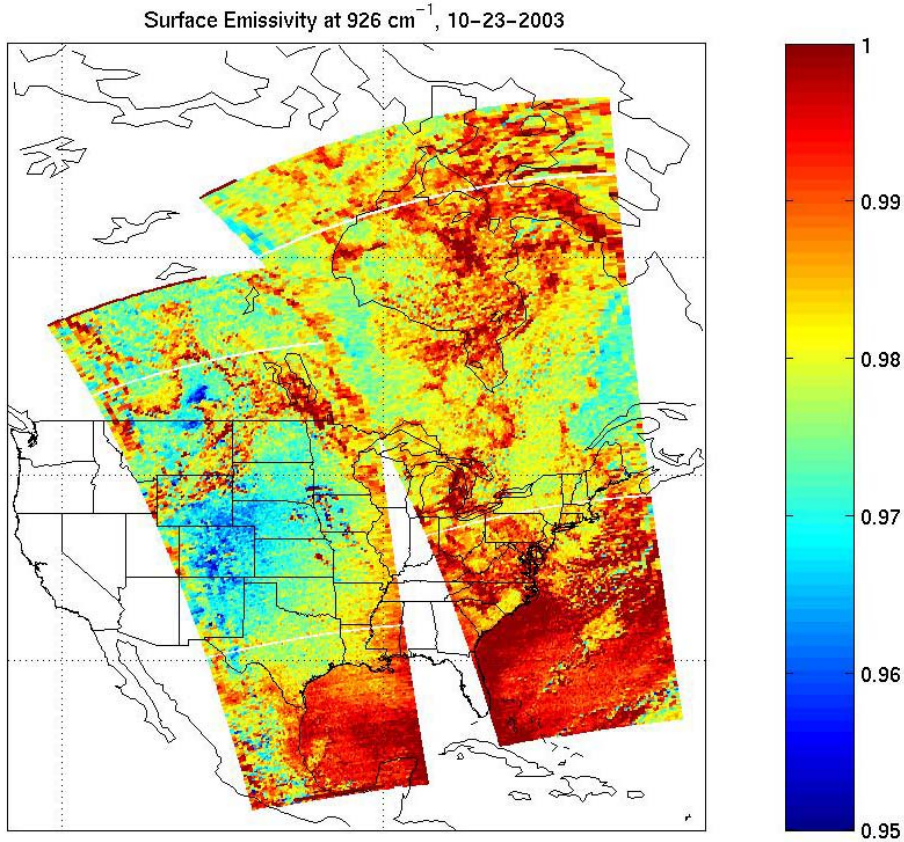


IMAPP AIRS Single FOV RTV: CIMSS Direct Broadcast Area (10-23-2003,Day)

Total Ozone [DU] (no cloudmask)



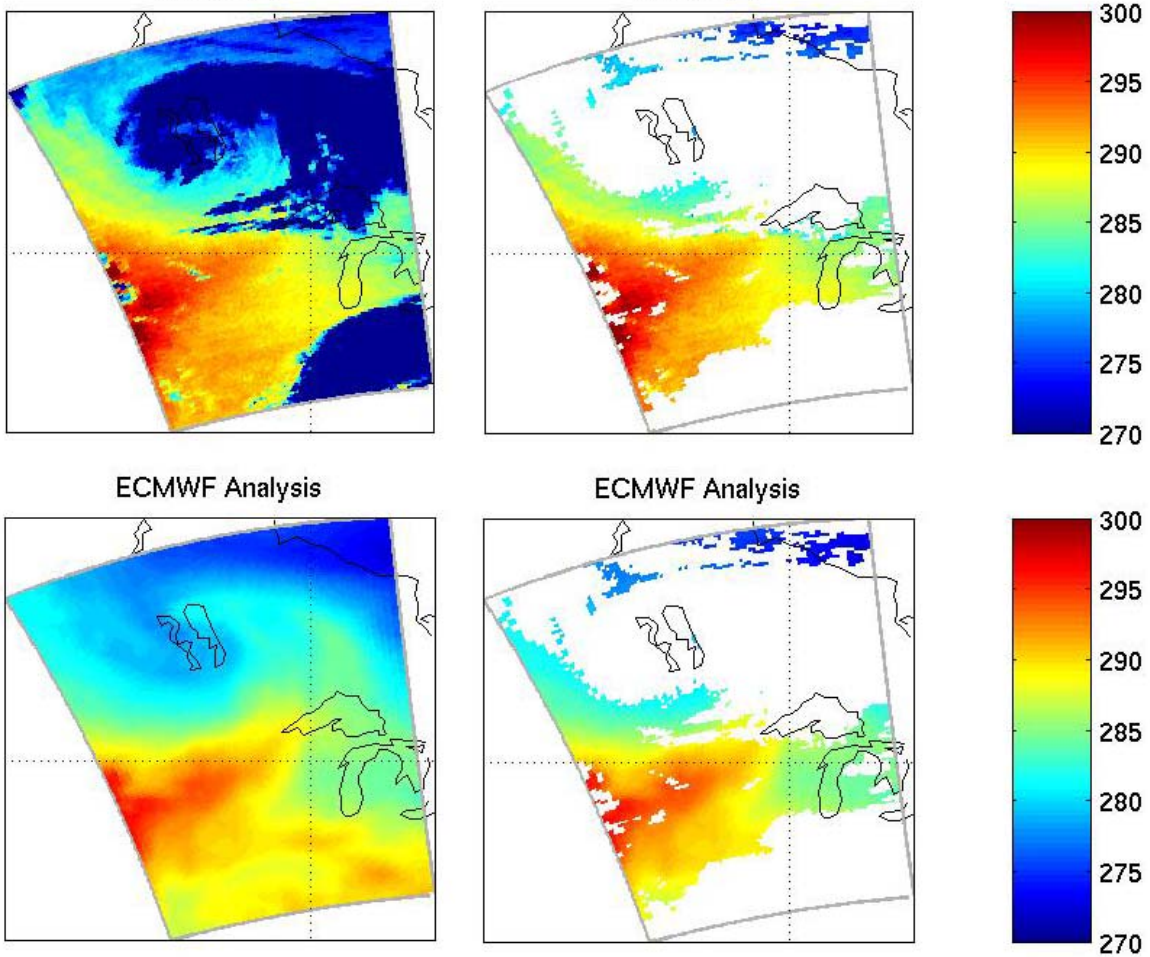
Surface Emissivity @926 cm^{-1} (no cloudmask)

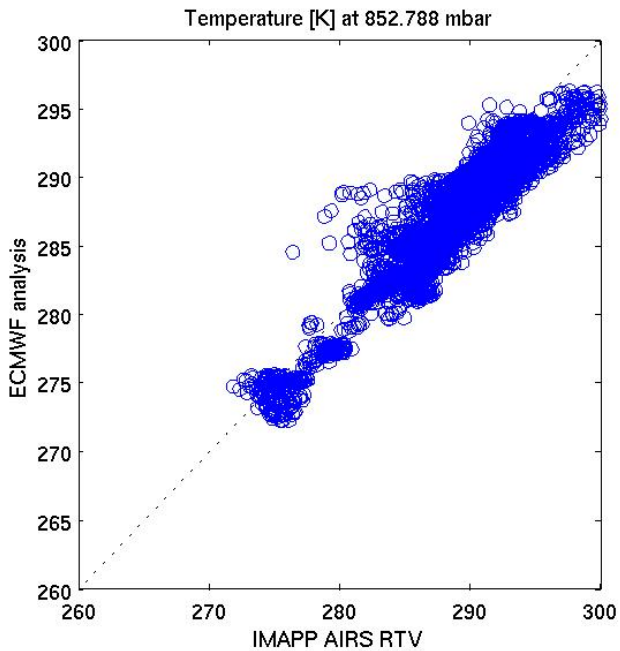


IMAPP AIRS Single FOV RTV vs. ECMWF Analysis : Temperature at 850 mbar (09-02-2003,192,Day)

AIRS FOV RTV

ECMWF ANL





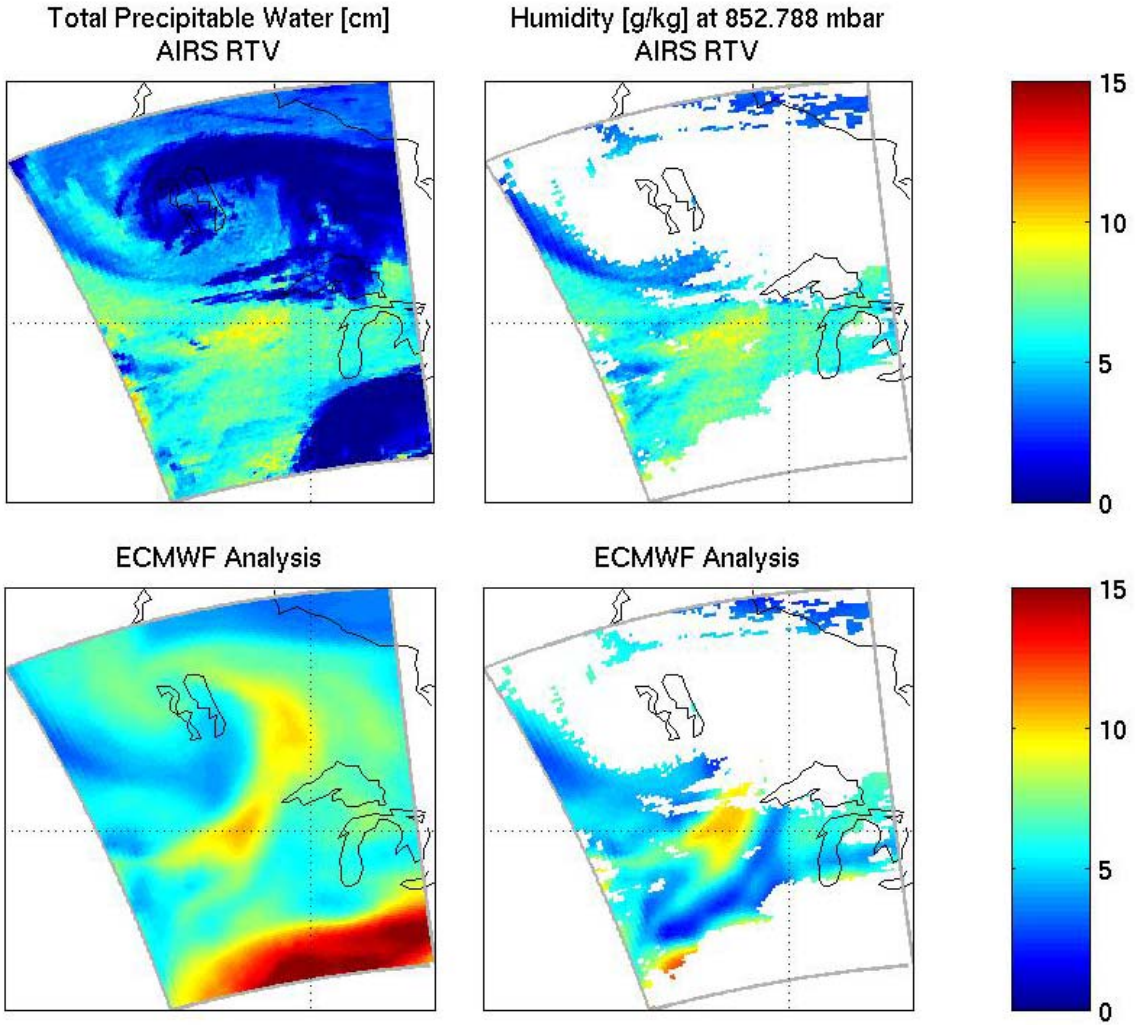
Without Cloudmask

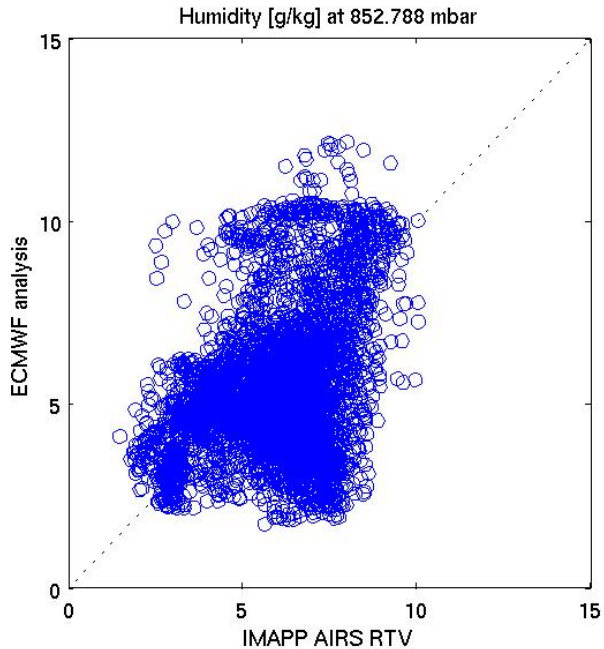
With Cloudmask

IMAPP AIRS Single FOV RTV vs. ECMWF Analysis : Humidity at 850 mbar (09-02-2003,192,Day)

AIRS FOV RTV

ECMWF ANL





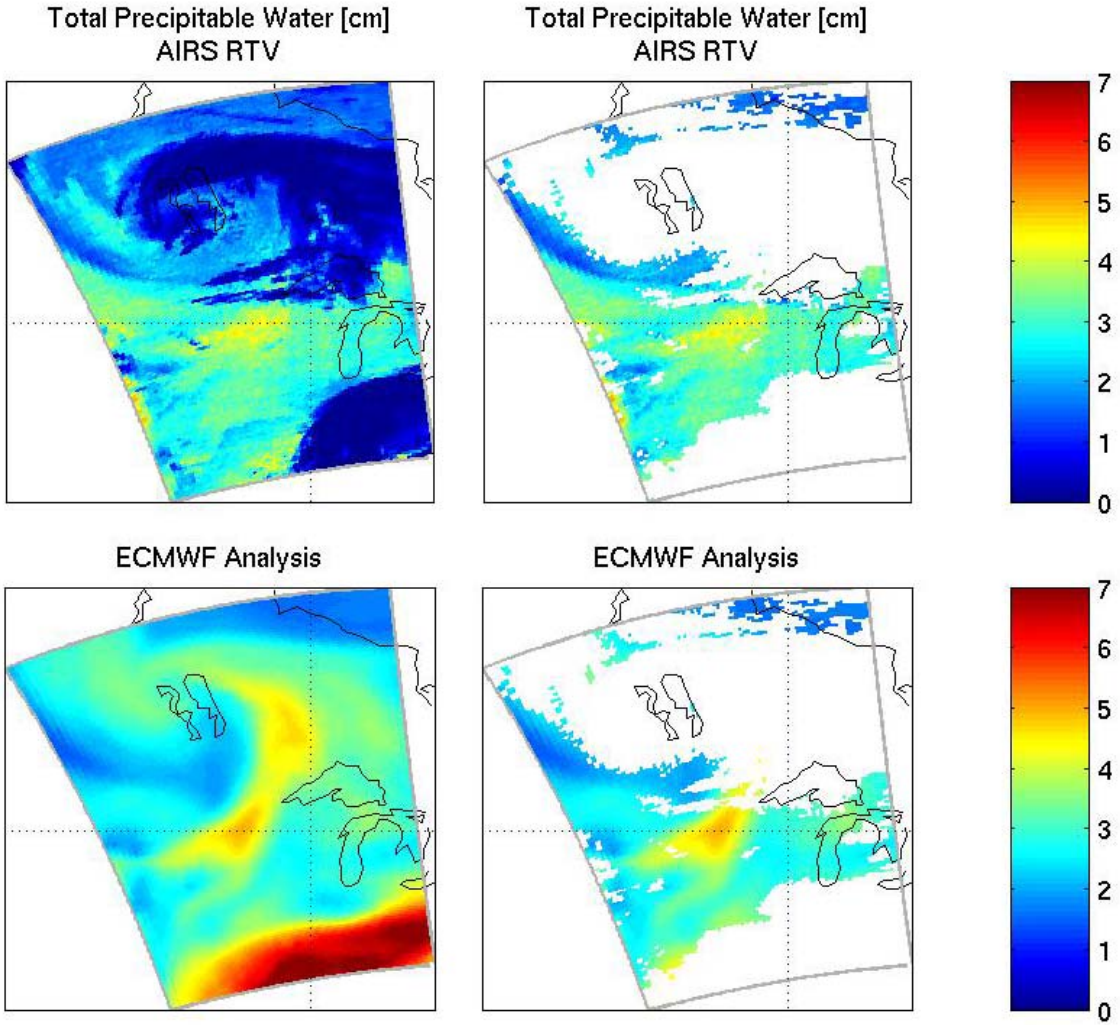
Without Cloudmask

With Cloudmask

IMAPP AIRS Single FOV RTV vs. ECMWF Analysis : TPW (09-02-2003,192,Day)

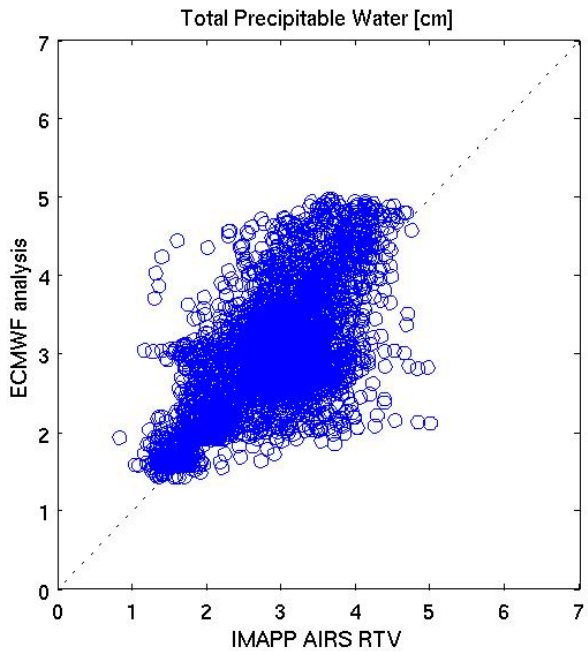
AIRS FOV RTV

ECMWF ANL



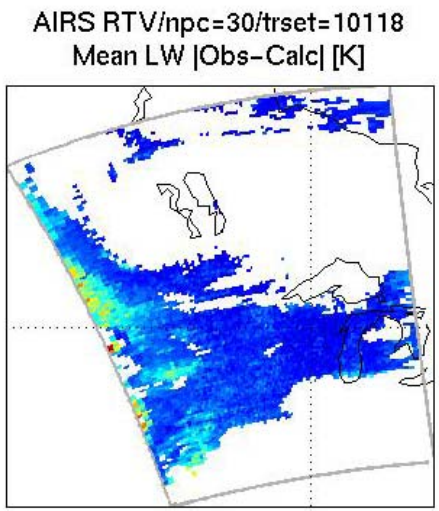
Without Cloudmask

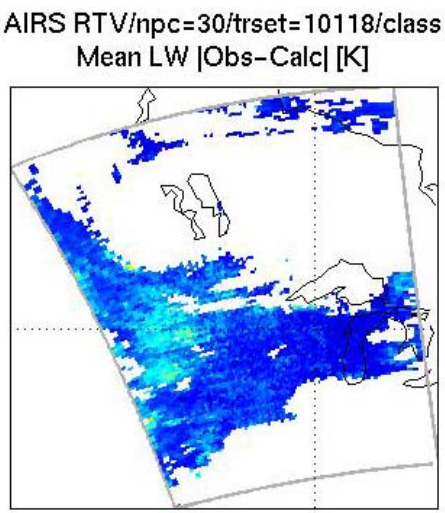
With Cloudmask

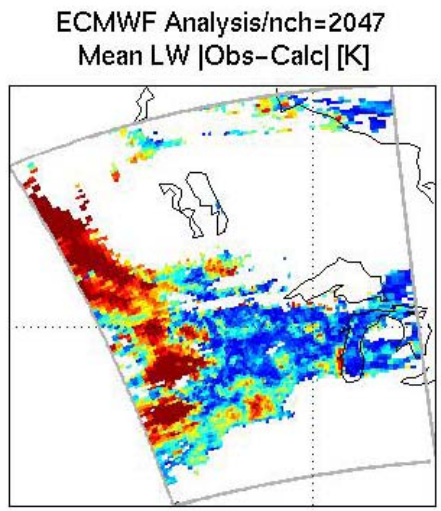


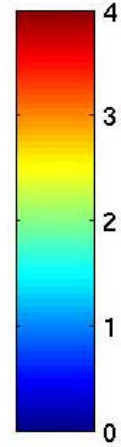
IMAPP AIRS Single FOV BT Residual vs. ECMWF : Spectral Mean (09-02-3003,192,Day)

LW Mean

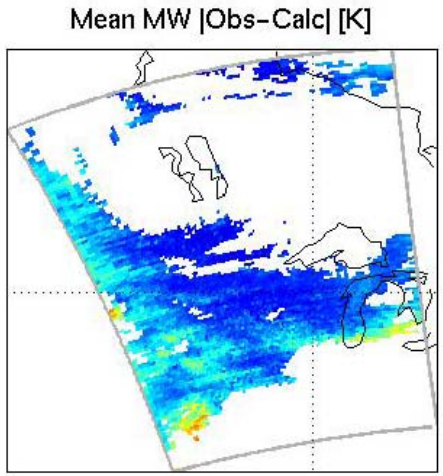


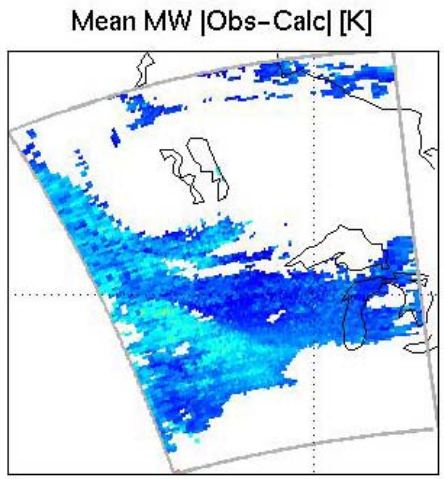


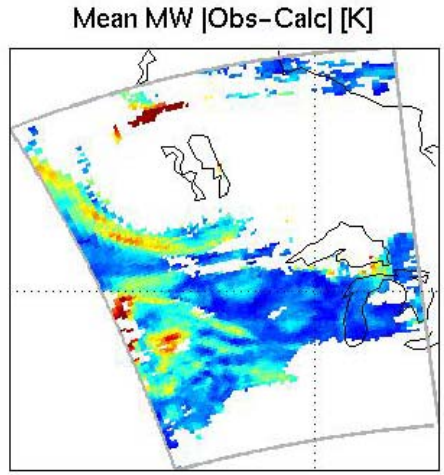


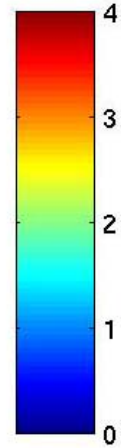


MW Mean









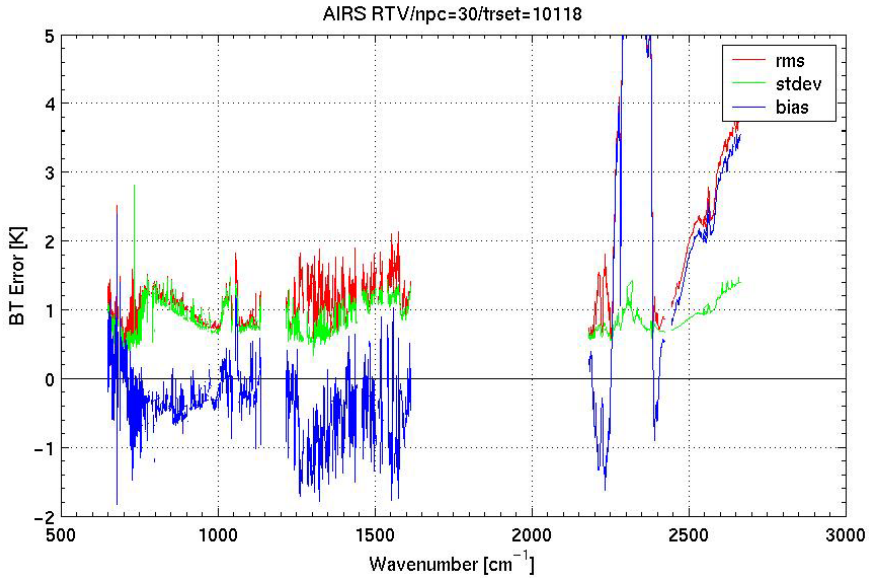
RTV (no BT-class)

RTV (with BT-class)

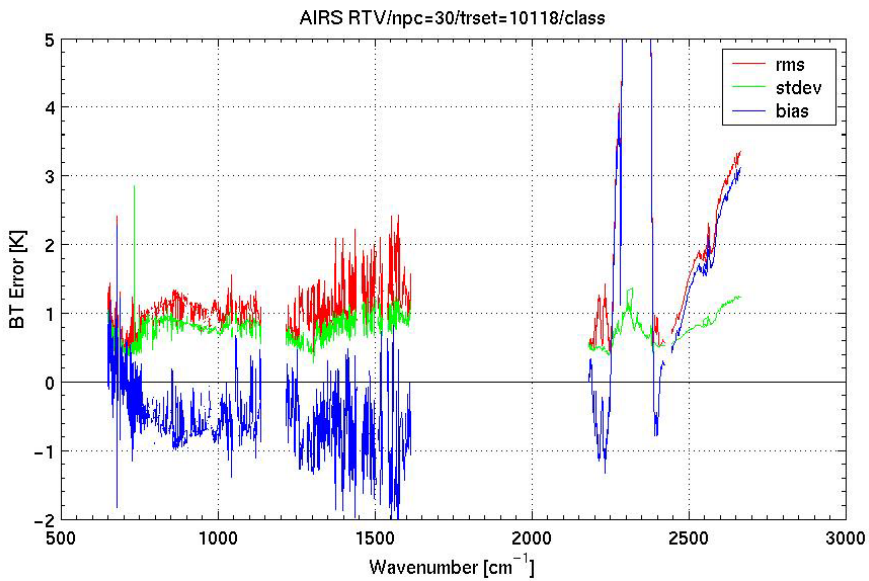
ECMWF ANL

IMAPP AIRS Single FOV BT Residual vs. ECMWF : Spatial Mean (09-02-3003,192,Day)

RTV (no BT-class)



RTV (with BT-class)

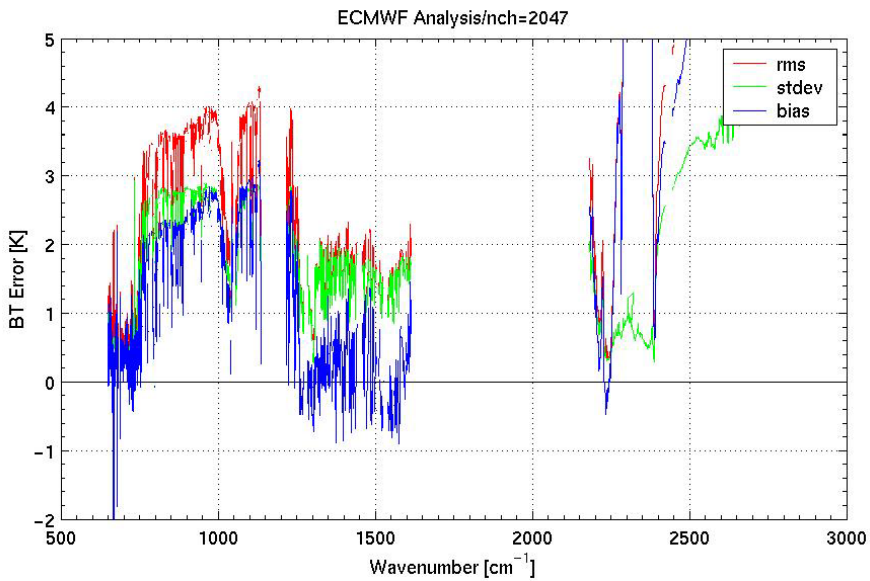


RMS of Residual

Stdev of Residual

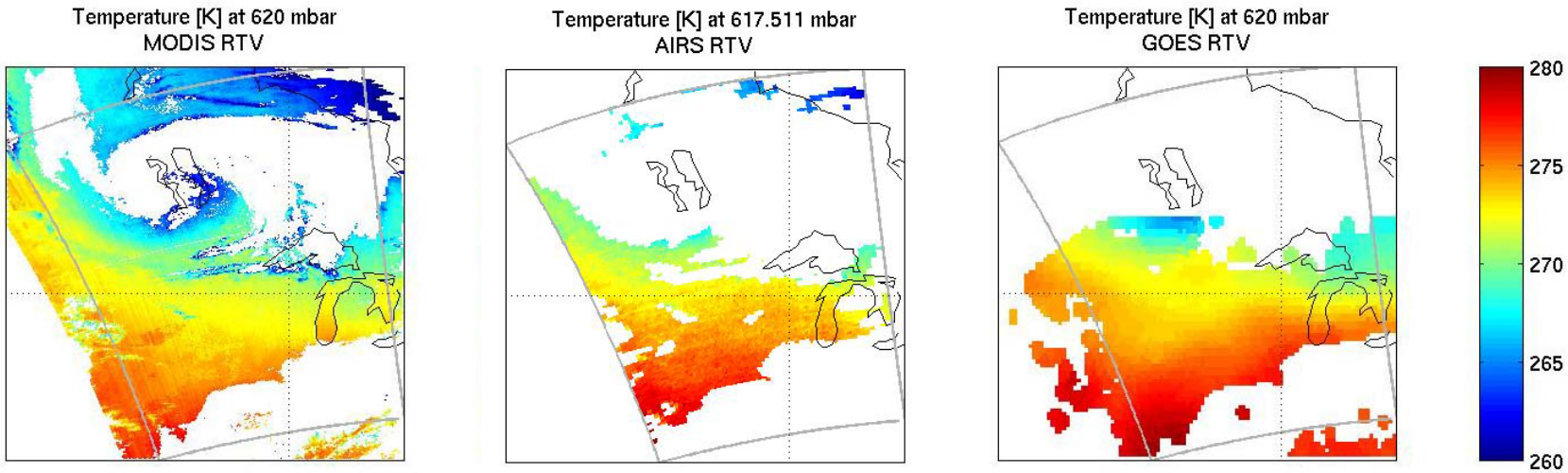
Mean of Residual

ECMWF ANL

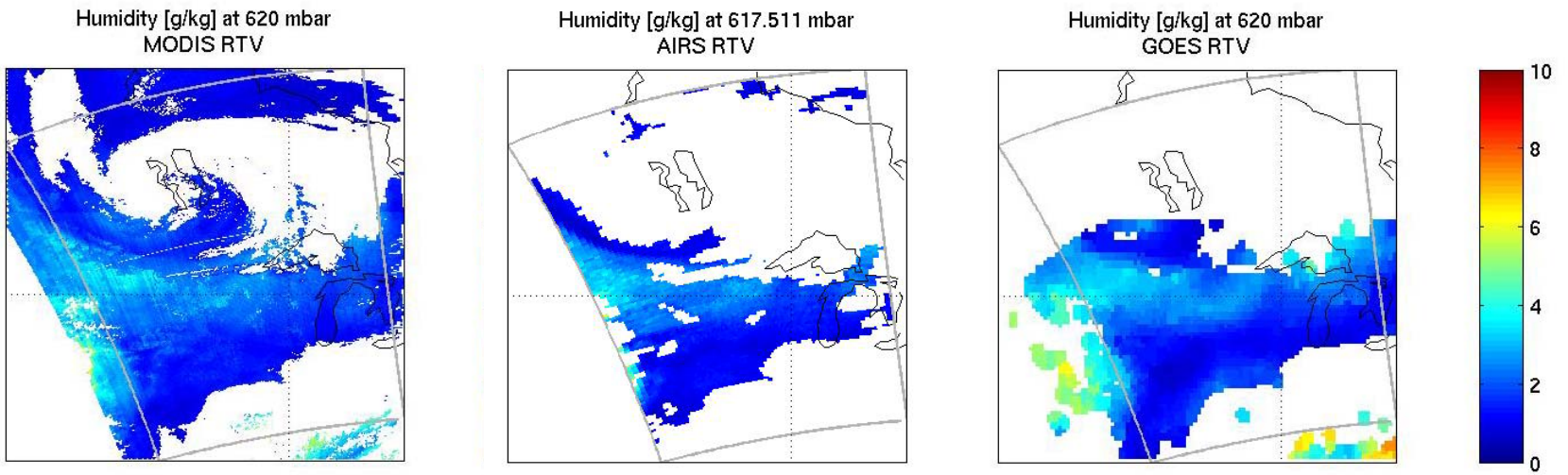


IMAPP AIRS Single FOV RTV vs MODIS and GOES RTV: T and q at 620 mbar (09-02-2003,192,Day)

Temperature @620



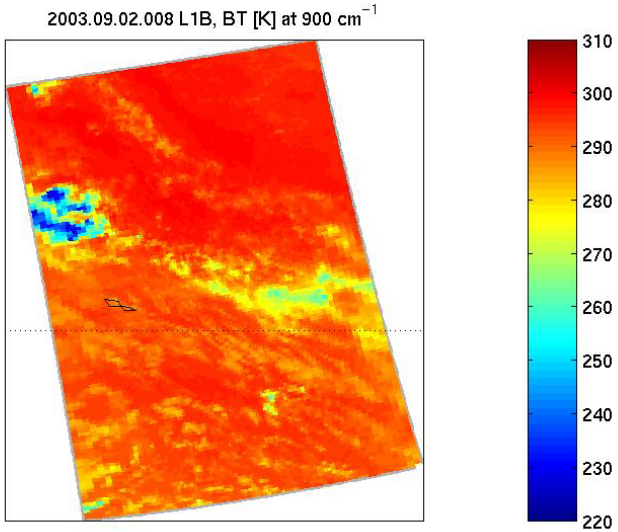
Humidity @620



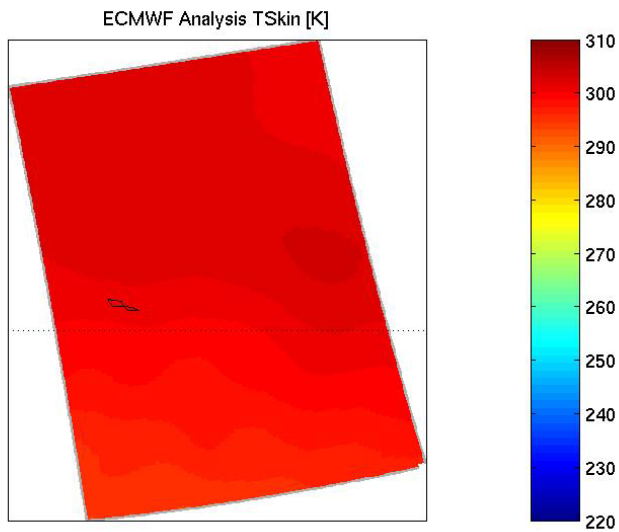
MODIS RTV AIRS FOV RTV GOES RTV

Operational L2 Cloud-Cleared Std Product (Ocean): Case 1 (09-02-2003,8,Day)

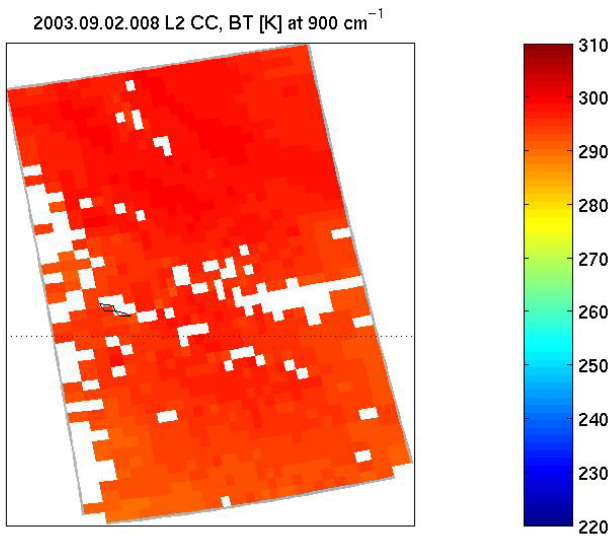
L1B BT @900



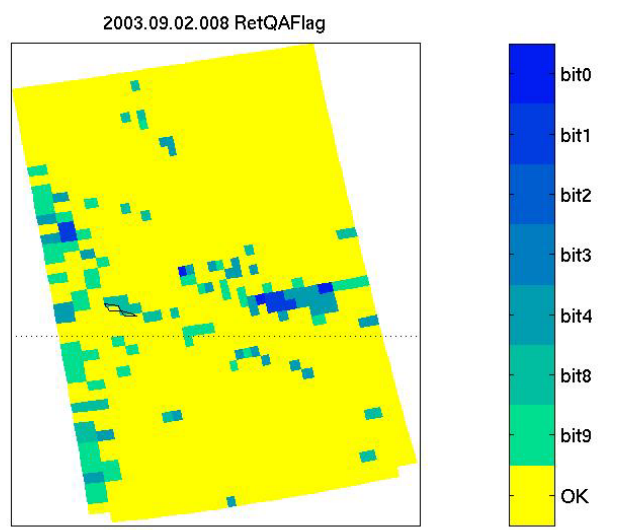
ECMWF TSkin



Op L2 CC @900

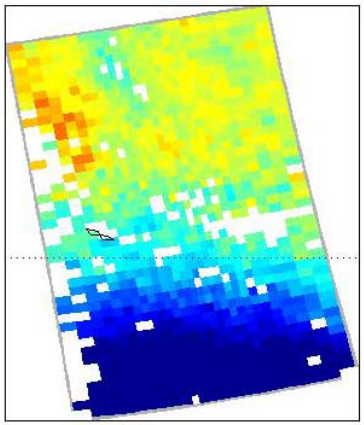


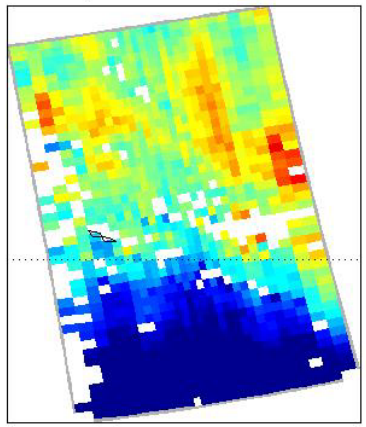
Op L2 QAFlag

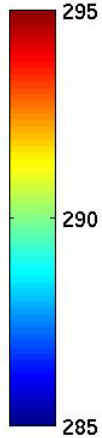


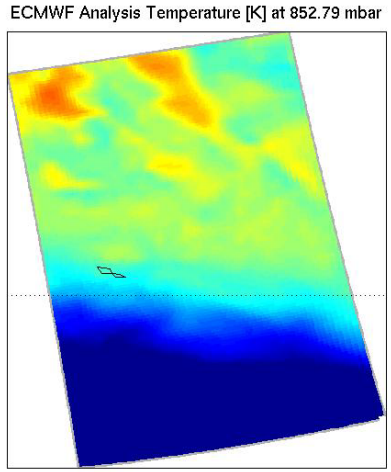
IMAPP AIRS FOR 3x3 Retrieval vs Op AIRS RTV and ECMWF ANL: Case 1 (09-02-2003,8,Day)

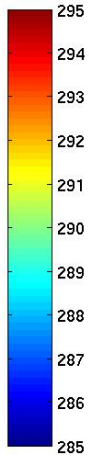
Temperature @850



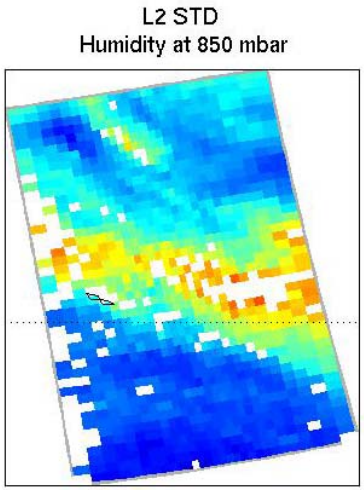


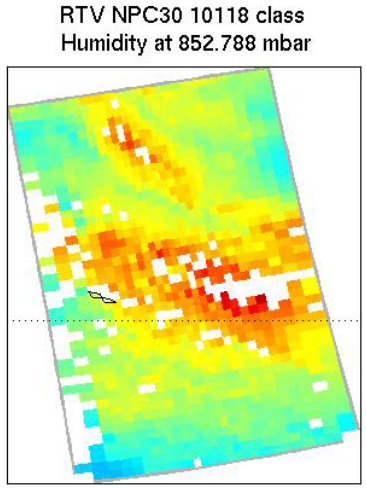


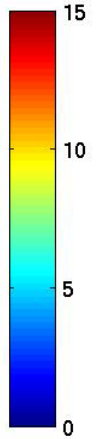


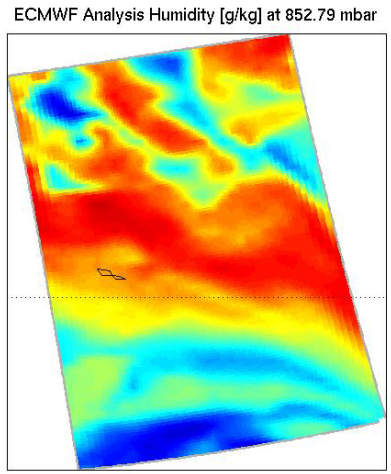


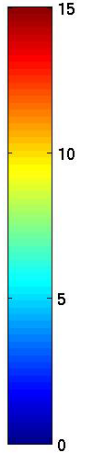
Humidity @850











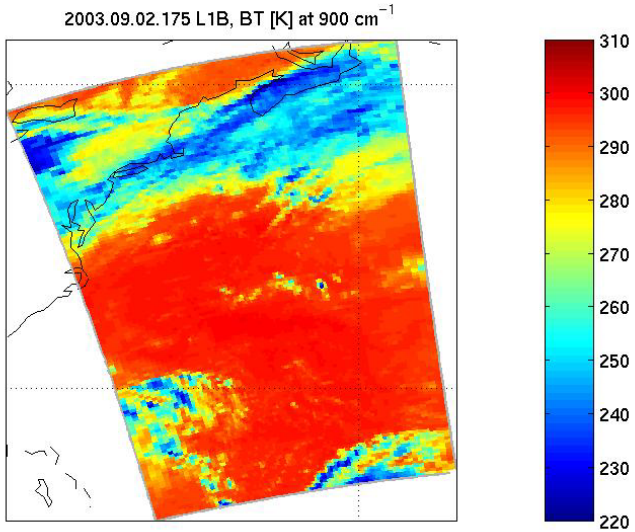
Op AIRS RTV

AIRS FOR RTV

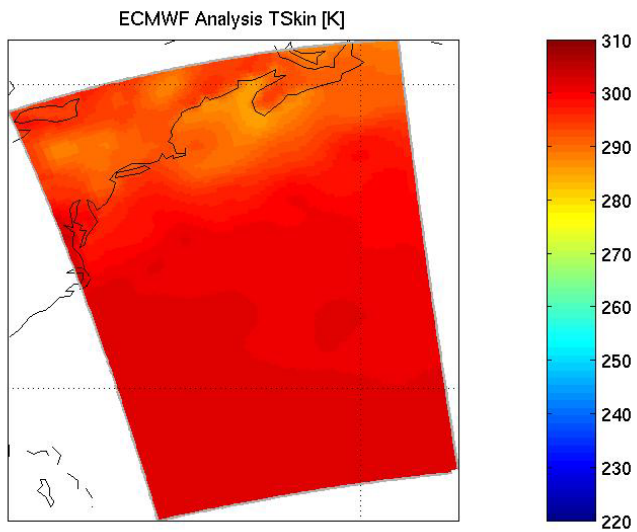
ECMWF ANL

Operational L2 Cloud-Cleared (CC) Std Product (Ocean): Case 2 (09-02-2003,175,Day)

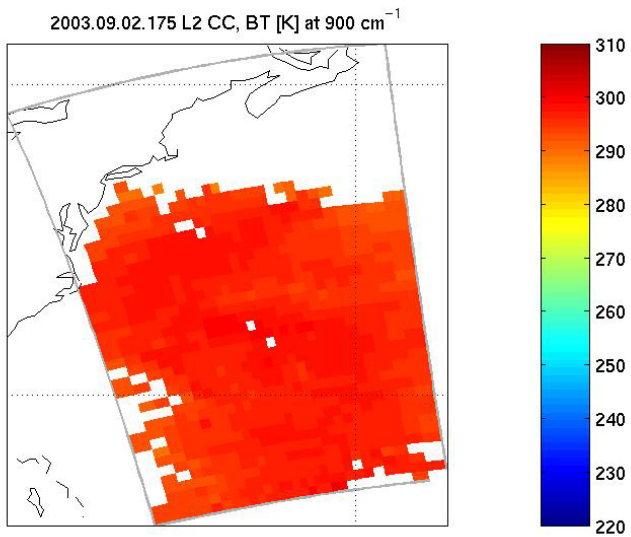
L1B BT @900



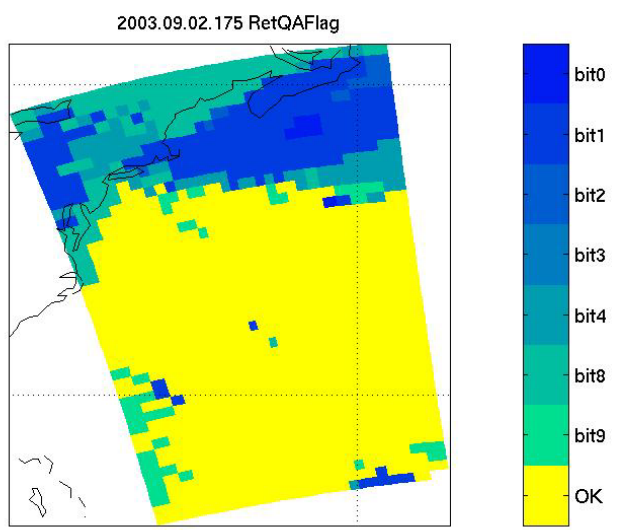
ECMWF TSkin



Op L2 CC @900

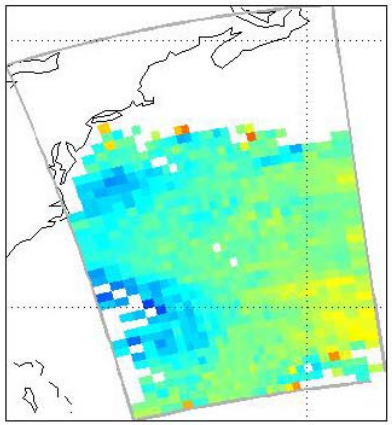


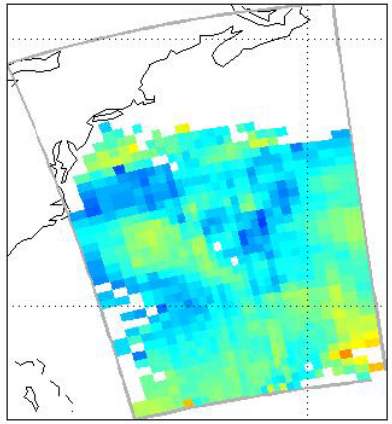
Op L2 QAFlag

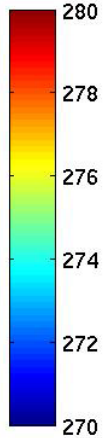


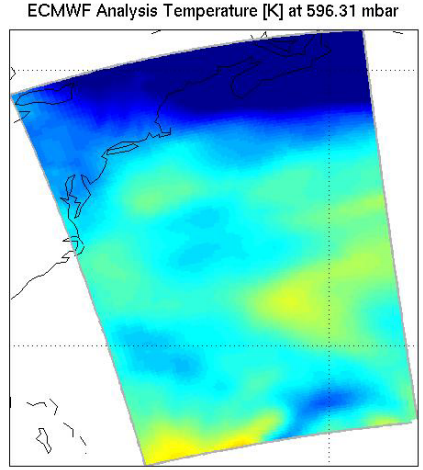
IMAPP AIRS FOR 3x3 Retrieval vs Op AIRS RTV and ECMWF ANL: Case 2 (09-02-2003,175,Day)

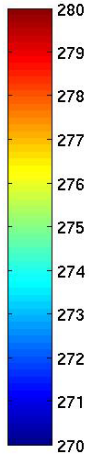
Temperature @600



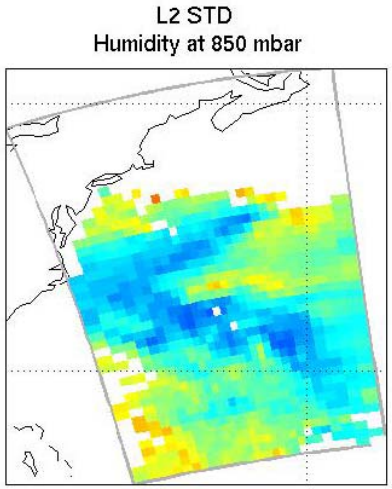


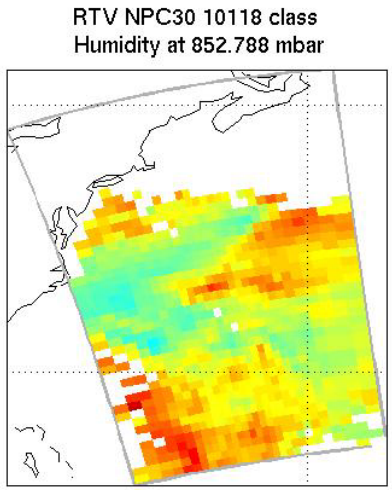


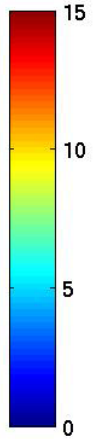


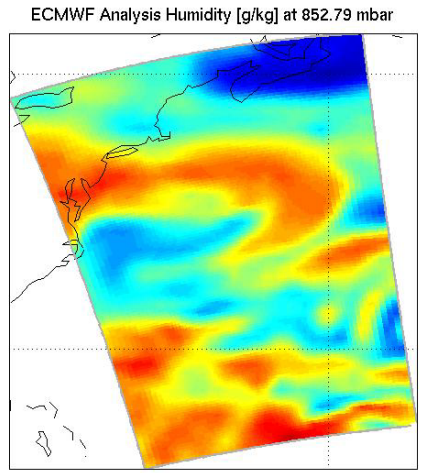


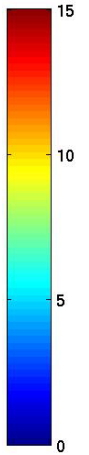
Humidity @850











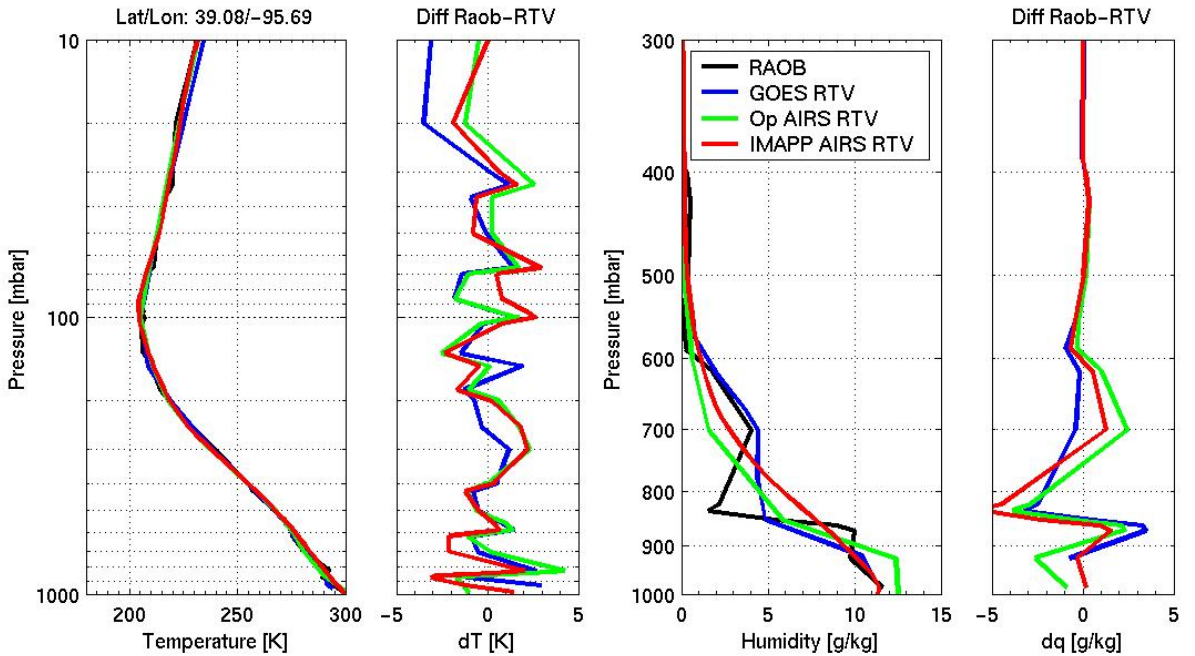
Op AIRS RTV

AIRS FOR RTV

ECMWF ANL

Single FOV Retrieval 1: (09-02-2003,192)

Profile RTV



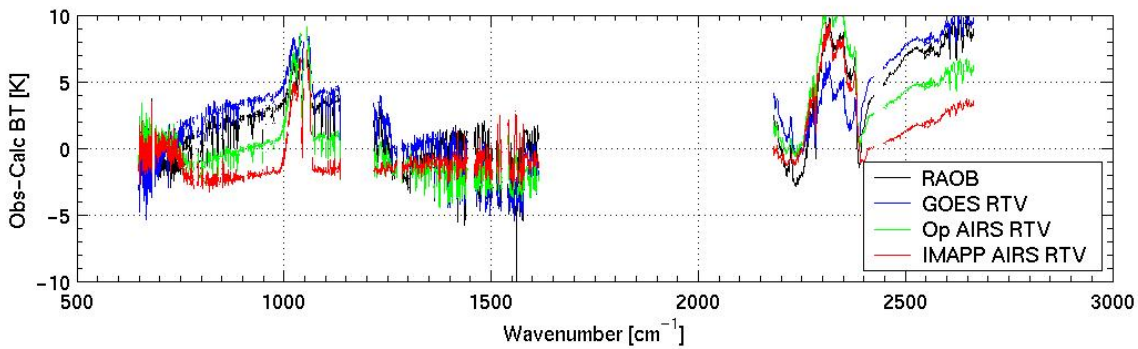
RAOB

GOES RTV

OP AIRS RTV

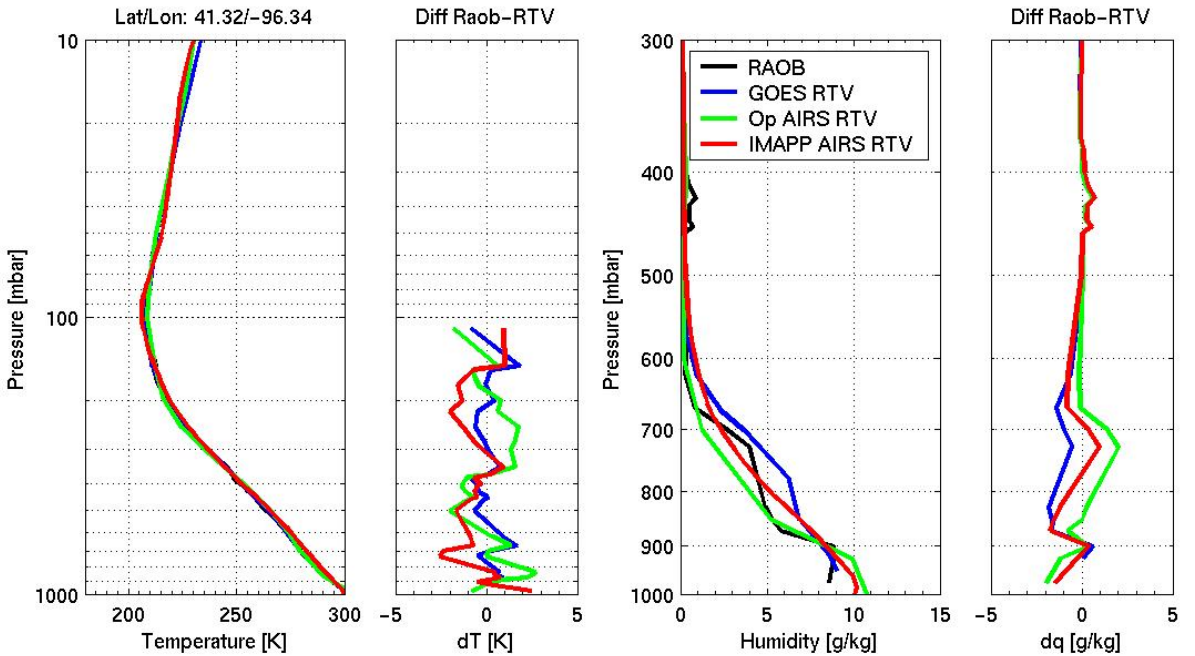
IMAPP AIRS RTV

BT Residual [K]

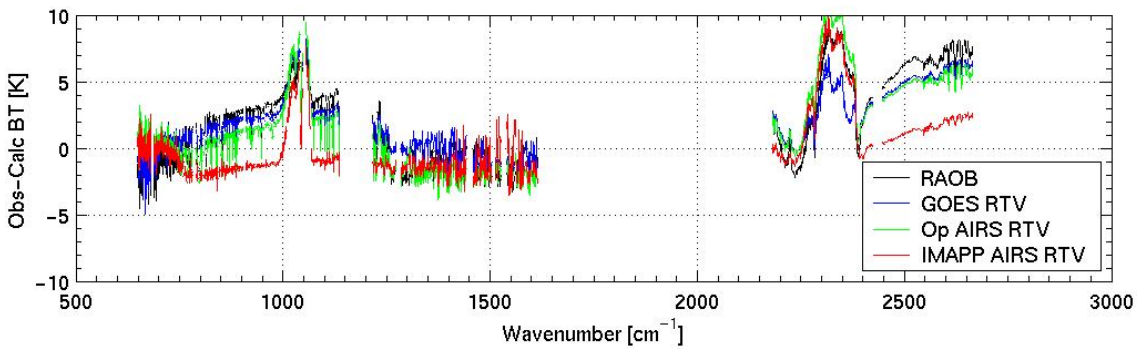


Single FOV Retrieval 2: (09-02-2003,192)

Profile RTV



BT Residual [K]



RAOB

GOES RTV

OP AIRS RTV

IMAPP AIRS RTV

Conclusions

- Clear-Sky Regression Retrieval Algorithm (pre-release version 0) has been tested using AIRS measurements under various conditions and considered stable.
- Validation/Comparison with various data sets: results are convincing and encouraging.
- Version 1 Real-Time DB global retrieval algorithm available in near-future (as part of IMAPP) .
- Further Investigation and preparation of training and validation data is ongoing.
- Current statistical retrieval approach to be complemented by a non-linear iterative physical approach (version 2).