Aqua-AIRS and MetOP-IASI Temperature and Water Vapor Retrievals Evaluation with Global RAOBs and Model Forecasts

By
Murty Divakarla, Chris Barnet, Mitch Goldberg,
Tom King, Eric Maddy, Xingpin Liu, Zhaohui Cheng,
Antonia Gambakorta, Fengying Sun, and Lihang Zhou

NOAA/NESDIS
Camp Springs, MD 20746

An evaluation of the IASI and AIRS Retrievals using Matched RAOB Measurements, ECMWF and NCEP-GFS Forecasts is presented. Differences due to Algorithm Differences (Channels, Cloud-Clearing), Sounding Geometry, and Spatial Sampling of the Matched Data Sets are discussed.

Comments/Suggestions are welcome

E-Mail Contact: Murty.Divakarla@noaa.gov

Acknowledgements:

- **OSDPD (Frank Tilley and Tony Reale for RAOB Match Files)**
- **ECMWF and NCEP for Model Forecasts/Analysis**

Validation Data - Algorithms

MetOp-IASI/Aqua-AIRS
Match-up Database
(Adapted to MetOP-IASI from Aqua-AIRS Validation System)

- RAOB Measurements Matched to Aqua (1:30 AM/ PM) and MetOP(9:30 AM/PM) Satellite Observations
- MetOp-IASI/AMSU-A/AMSU-B Level1B Radiances
- IASI Level-2 Retrievals
- Aqua-AIRS/AMSU-A Level1B Radiances
- AIRS Level-2 Retrievals
- NCEP-GFS (AVN) Level2-Forecast/Analysis
- ECMWF Level-2 Forecast/Analysis
- MetOp-ATOVS/NOAA-18 Level-2 Retrievals

Collocated Within ±3 Hrs. & 100 Km Radius
Data Used In this Study : November, 2007-2008

- **Emulate IASI/AIRS Retrieval Algorithms**
- **Reprocessing Options with Algorithm Upgrades, New Data, Versions**
- **Test New Ideas in the Retrieval Algorithm**

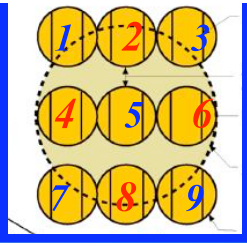
What We Did
Data Used : 01/20/2008 – 08/02/2008

- IASI/AIRS Temperature and Water Vapor Profile Retrieval Statistics with
  - » **Collocated RAOBs and other Data Sets (ECMWF, NCEP-GFS, MetOp-ATOVS) for the Same Period (Regions Sampled by Aqua and MetoP Orbits Differ)**
    - » **12,000 Accepted Matches for IASI**
    - » **~ 6,000 Accepted Matches for AIRS**
- Looked into Some Cloud-Clearing Aspects
  - » **Noise Amplification in Cloud-Cleared Radiances**
    - – **with IASI-4 FOVs *and* AIRS-9 FOVs**
- Stats for A subset of Matches Where IASI & AIRS are looking at the same Ground Location but at different times ~ 1000 Collocations
  - » **IASI Retrievals with RAOB Matches**
  - » **AIRS Retrievals with RAOB Matches**
  - » **AIRS Like IASI (Use 4 FOVs of AIRS) Retrievals with RAOB Matches**
- MetOp-IASI/AIRS Validation Web-site

Questions Addressed

- What are the expectations from IASI Level-2 Temperature and Water Vapor Products ?
  1. Whether IASI Retrievals are Comparable to AIRS Retrievals (Similar Sounding Instruments)
     - Yield
     - RMS Difference and Bias wrt RAOBs
  2. Improvement seen with the IASI/AIRS Retrievals Compared to the Currently Operating Baseline Systems
     - M2-ATOVS (9:30 AM/PM) Retrievals from the Same MetOp Platform (HIRS + AMSU-A/B)
     - NOAA-18 ATOVS (1:30 PM/AM) Retrievals are Time Coincident with Aqua-AIRS Retrievals
     - How IASI/AIRS Retrievals, ECMWF and AVN Models Compare with RAOBs ?
  3. Cloud Clearing Aspects Aqua-AIRS MetOp IASI
     - » Differences and Impacts of 9 FOVs vs. 4 FOVs

Instruments, Algorithms and Products



MetOp IASI (4 FOVs) + AMSU-A AMSU-B	*V4.7* →	IASI+AMSU-A/B Retrieval Algorithm	→ IASI Products
Aqua AIRS (9 FOVs) + AMSU-A	*V5.0* →	AIRS+AMSU-A Retrieval Algorithm	→ AIRS Products

Pondering Questions That Need Careful Attention While Evaluating Retrievals

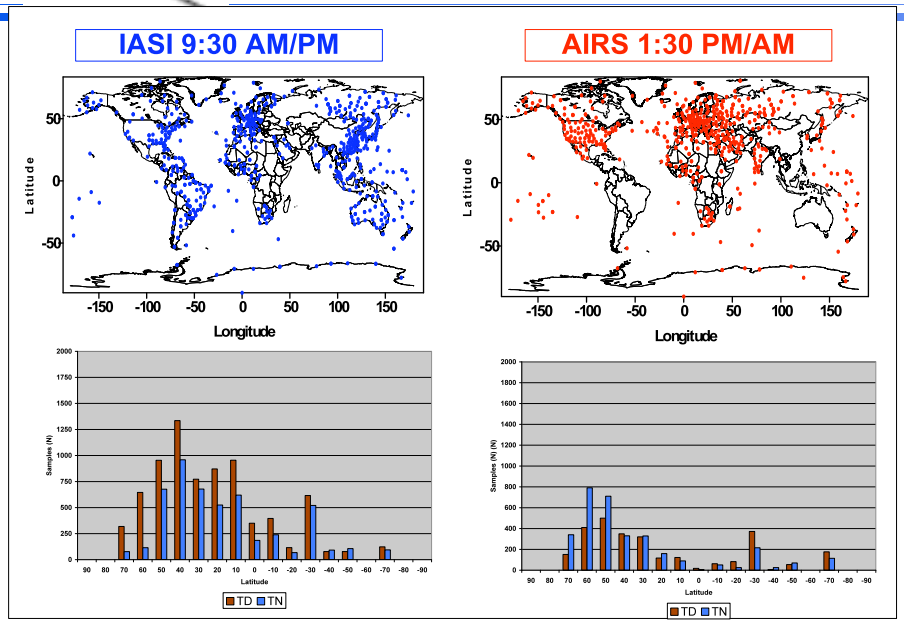
- Instrument Differences: AIRS vs. IASI, Geometry, Channels, S/N, Spectral Resolution, and other Trade-Offs
- Algorithm Differences: Three Pivotal Points: (a) Cloud Clearing IASI (4 FOVs) *vs.* AIRS (9 FOVs), (b) Channels Used in the Physical Retrieval (and the FG Reg), (c) Retrieval Conv. Criteria, Quality Indicators, Rejection Thresholds, etc.
- Consequences of Satellite Orbit Time (IASI: 9:30 AM/PM; AIRS:1:30 PM/AM) (Diurnal Differences, Regional Sampling, and Collocations with in-situ Measurments with a Stipulated Time and Distance criteria (+/- 3 HRs, 100 Km Radius)

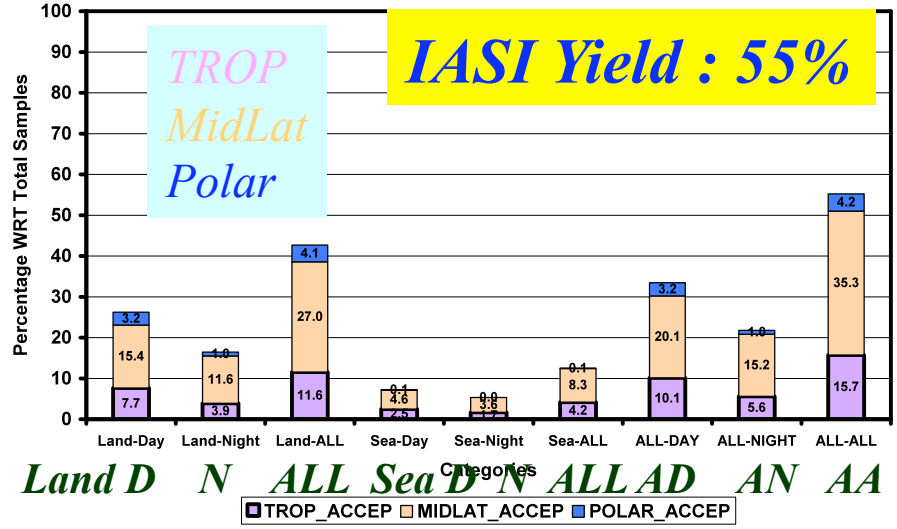
Channels Used in Physical Retrieval

	AIRS	IASI
CC	58	69
T	103	152
Q	41	87
O3	41	53
CO	36	33
CH4	59	59
CO2	70	79
HNO3	14	14
N2O	58	58
SO2	60	60

IASI and AIRS RAOB Matches

Data Used : 01/20/2008 – 08/02/2008

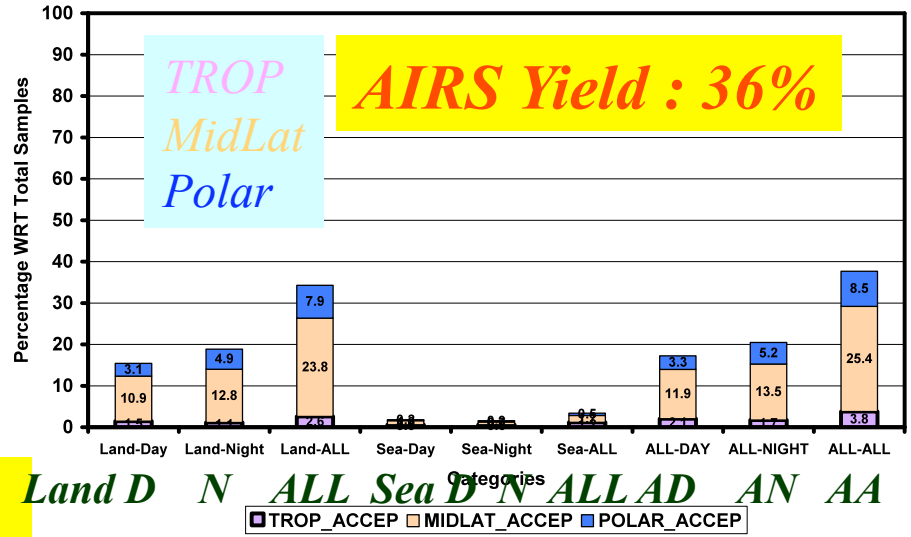




IASI- Accepted Matches (After RAOB Selection):12566

(NH:77%, SH:23%); (LAND:78%, Sea:22%); (Day:60%,Night:40%)

Tropics:28%; Mid-Lat:64% Polar:8%



AIRS- Accepted Matches (After RAOB Selection):5993

(NH:79%,SH:21%); (LAND:91%, Sea:9%); (Day:46% Night:54%)

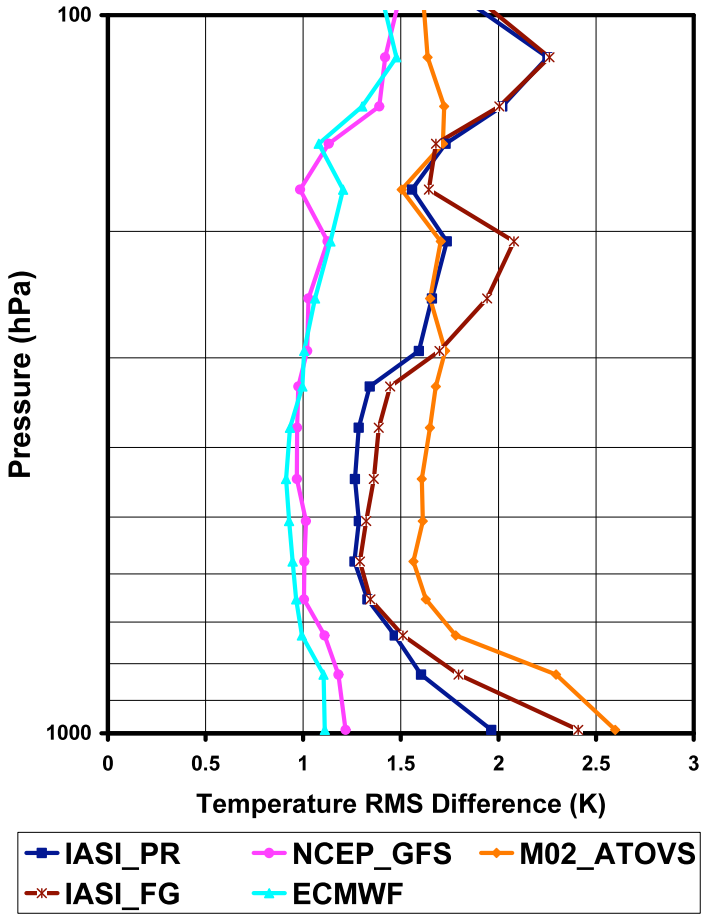
Tropics:10%; Mid-Lat:68% Polar:22%

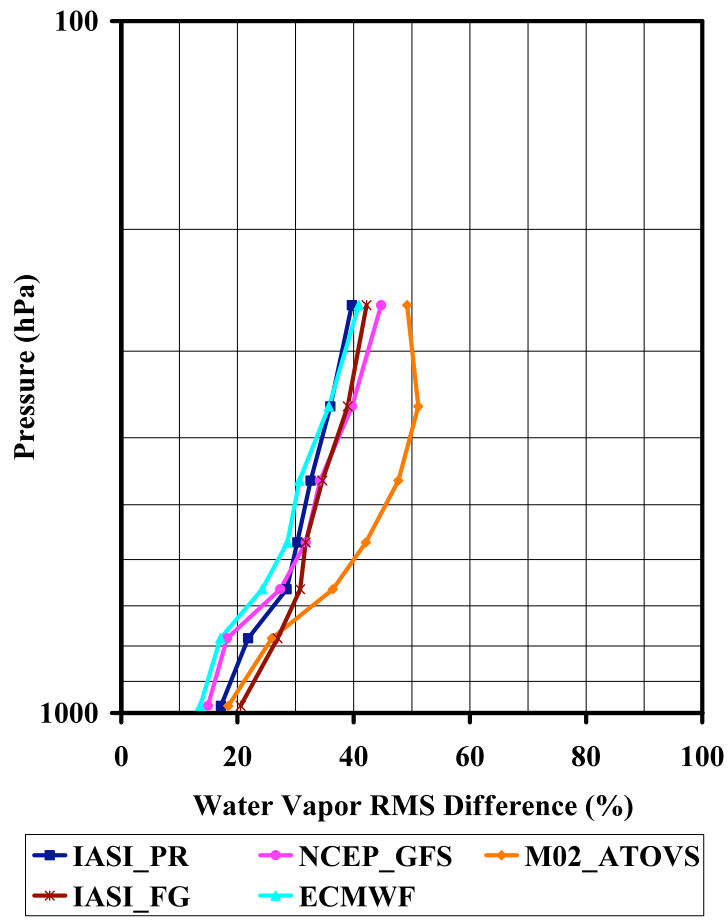
Long-term AIRS Yield (2002-2007) was a little higher than 50%. Recently we started seeing lower yield in the year 2008

IASI- T(p), q(p) RMS Difference

Global (L+S+Coast) NSAMP=12,666 Yield: 55%

Acceptance Criteria: Mid-Troposphere Temp Flag = 0



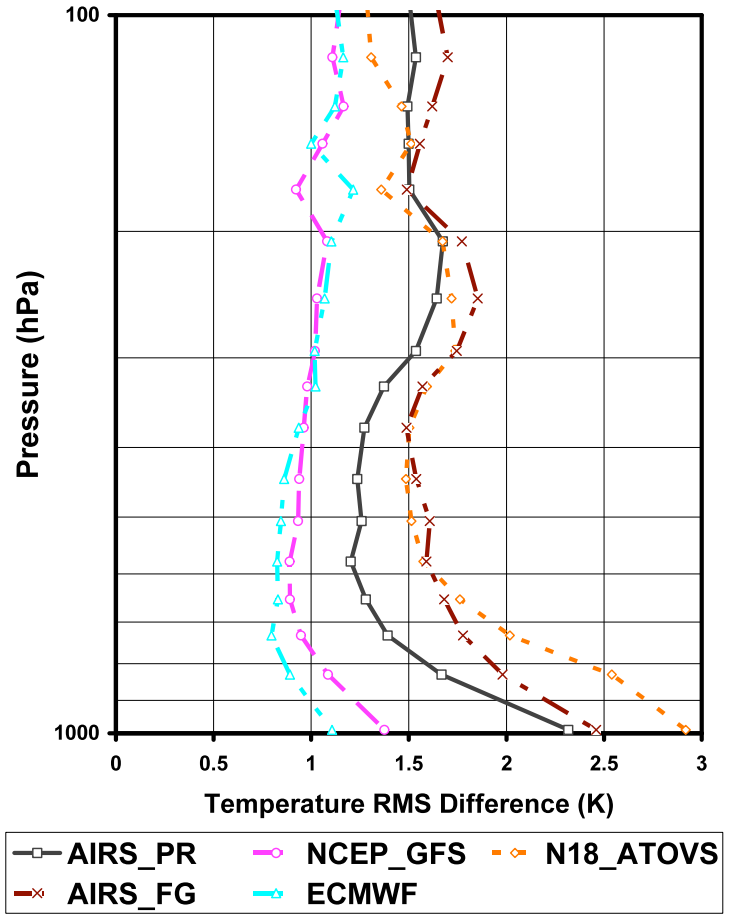


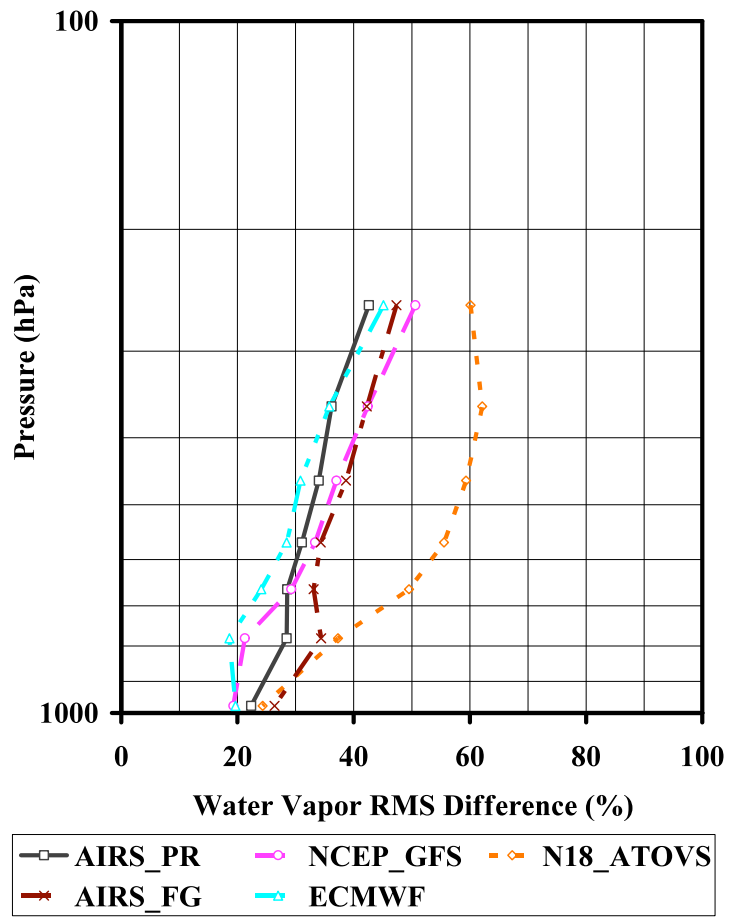
RAOB *vs.* IASI AVN ATOVS ECMWF FG

AIRS- T(p), q(p) RMS Difference

Global (L+S+Coast) NSAMP=5,993, Yield: 36%

Acceptance Criteria: Mid-Troposphere Temp Flag = 0



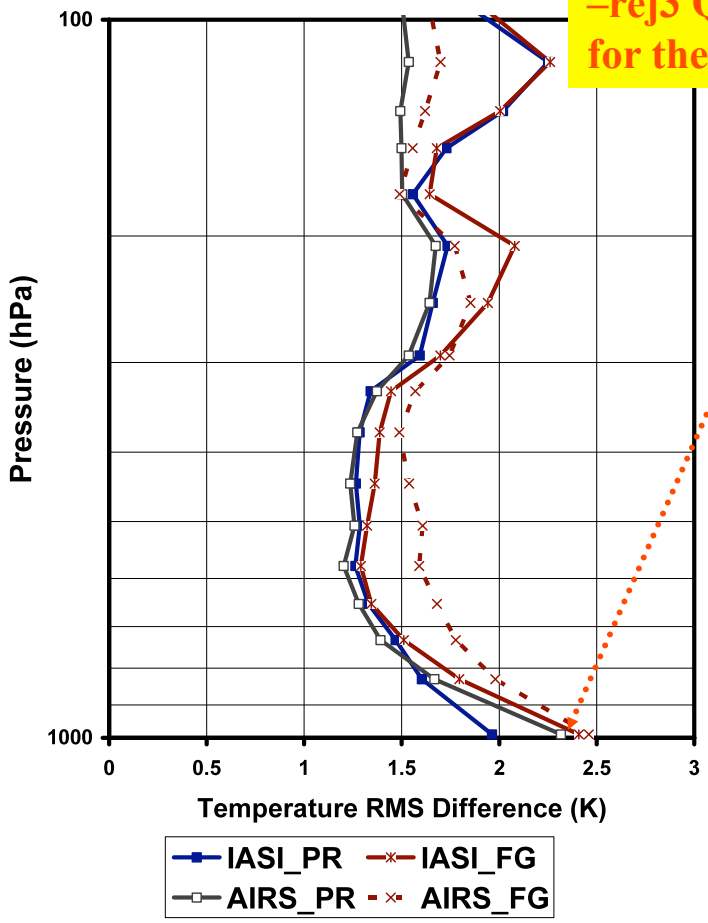


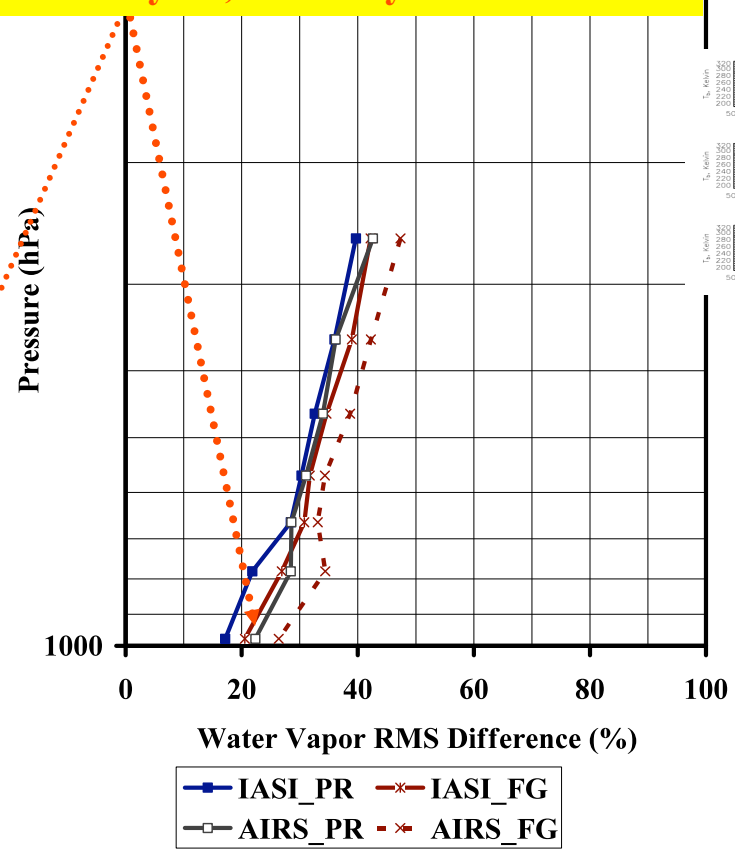
RAOB *vs.* AIRS AVN ATOVS ECMWF FG

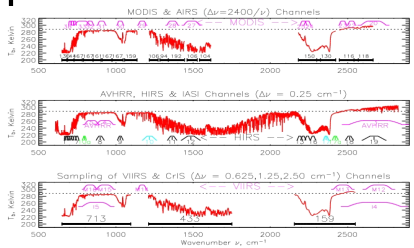
Dotted Lines : AIRS

IASI & AIRS Physical Ret vs. First Guess T(p), q(p) RMS Difference (Global)

•AIRS has difficulty close to the surface with –rej3 QA. The V5 QA improves the Statistics for the lowest layers, but the yield reduces.





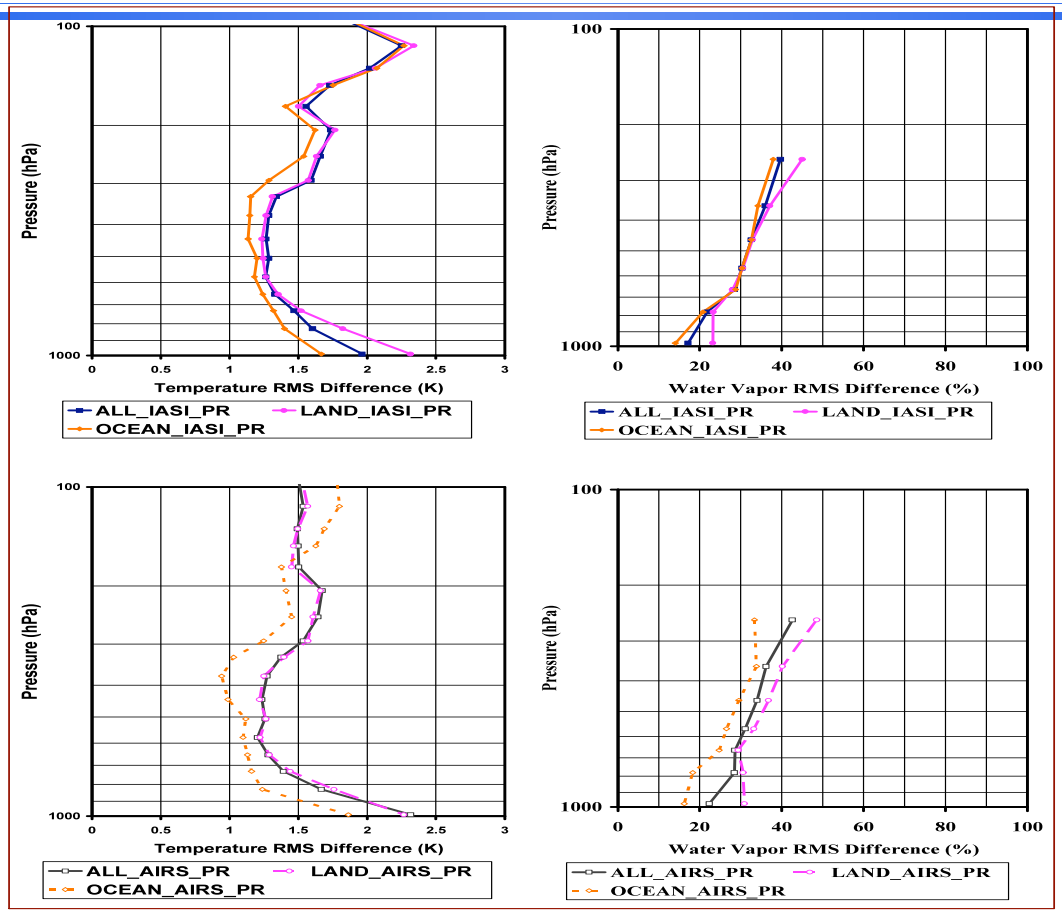


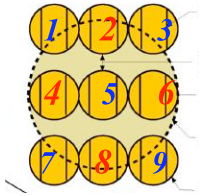
Solid lines : IASI, Dotted Lines : AIRS

RAOB *vs.* IASI_PR AIRS_PR IASI_FG AIRS_FG

IASI & AIRS T(p), q(p) RMS Difference Physical Retrievals: *LAND SEA ALL*

MetOp IASI T(p), q(p) as of Today

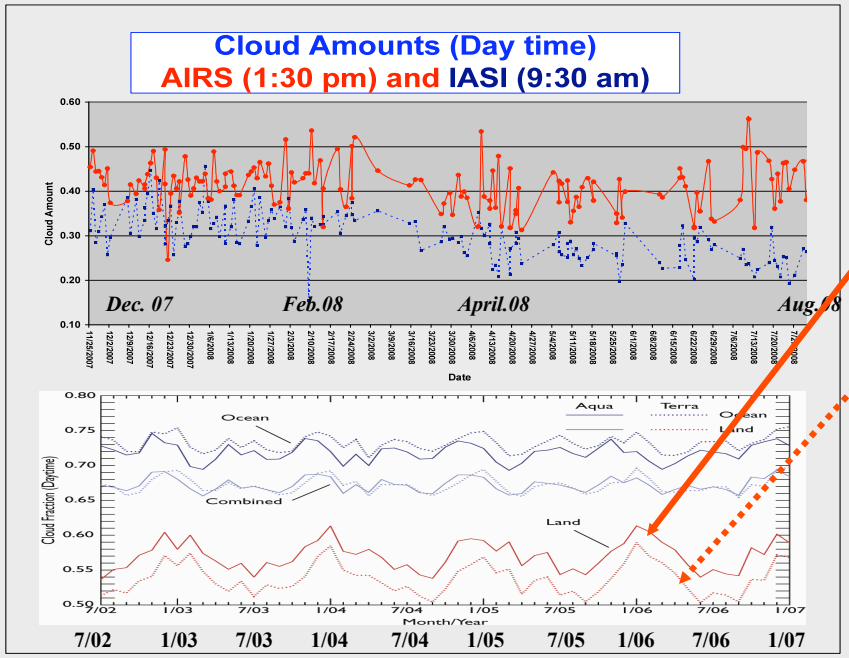




Aqua-AIRS V5: T(p), q(p) with -Rej3 Option

N-IASI(ALL)=12,666, N-AIRS(ALL)=5,993;
N-IASI(Sea) 2,848, N-AIRS (Sea):540

Experiments: Noise Amplification in Cloud Cleared Radiance

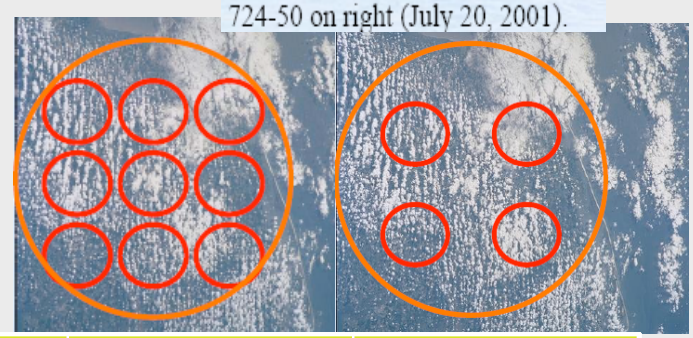


MODIS Derived Time Series of Cloud Fraction during the Daytime (M. D. King, S. Platnick et al. – NASA GSFC)

MODIS Aqua-Land

MODIS Terra-Land

(http://eol.jsc.nasa.gov). STS104-724-50 on right (July 20, 2001).



	AIRS	IASI
FOR (50Km)	9 FOVs	4 FOVs
Channels Used for CC	58 (LW, Window)	69 (LW,SW Window
Ampl Factor	1/3 = A = 10	1/2 = A = 10
Error in ή	Probably Lower	Probably Higher
Cloud Contrast	Probably Higher	Probably Lower

$$R_1(n) = (1-\alpha_1)\cdot R_{\mathrm{clr}}(n) + \alpha_1 \cdot R_{\mathrm{cld}}(n)$$

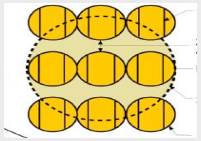
$$R_2(n) = (1-\alpha_2)\cdot R_{\mathrm{clr}}(n) + \alpha_2 \cdot R_{\mathrm{cld}}(n)$$

$$\eta = \alpha_1/(\alpha_2-\alpha_1)$$

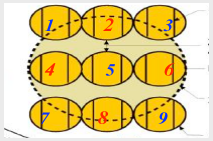
$$R_{\mathrm{ccr}}(n) = \overline{R_j(n)} + \sum_{j=1} \eta_j \cdot \left(\overline{R_j(n)} - R_j\right)$$

$$A = \sqrt{1/N_f(1+\sum\acute{\eta})^2+\sum\acute{\eta}^2}$$

IASI Retrievals (4 FOVs)



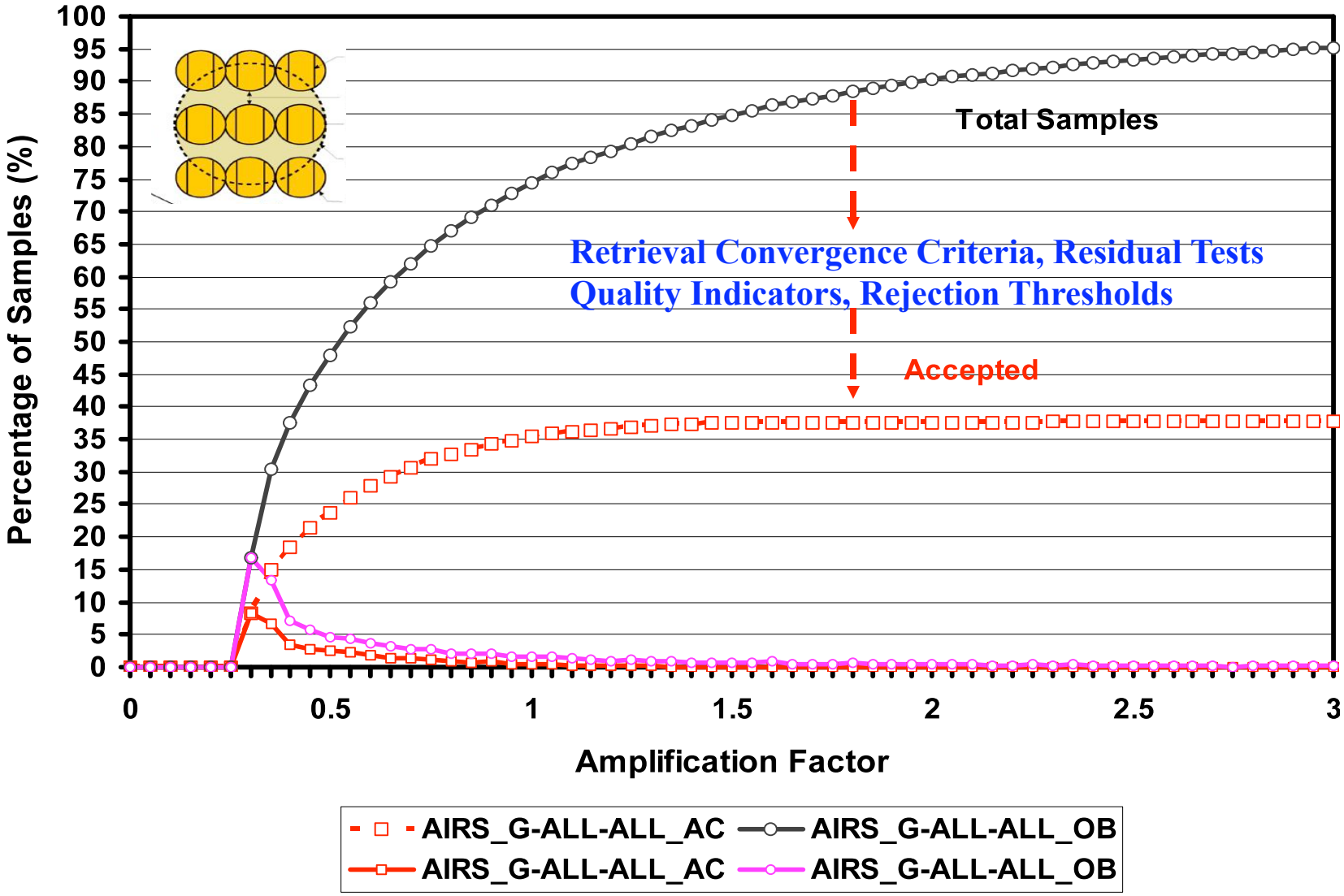
AIRS Retreivals (9 FOVs)



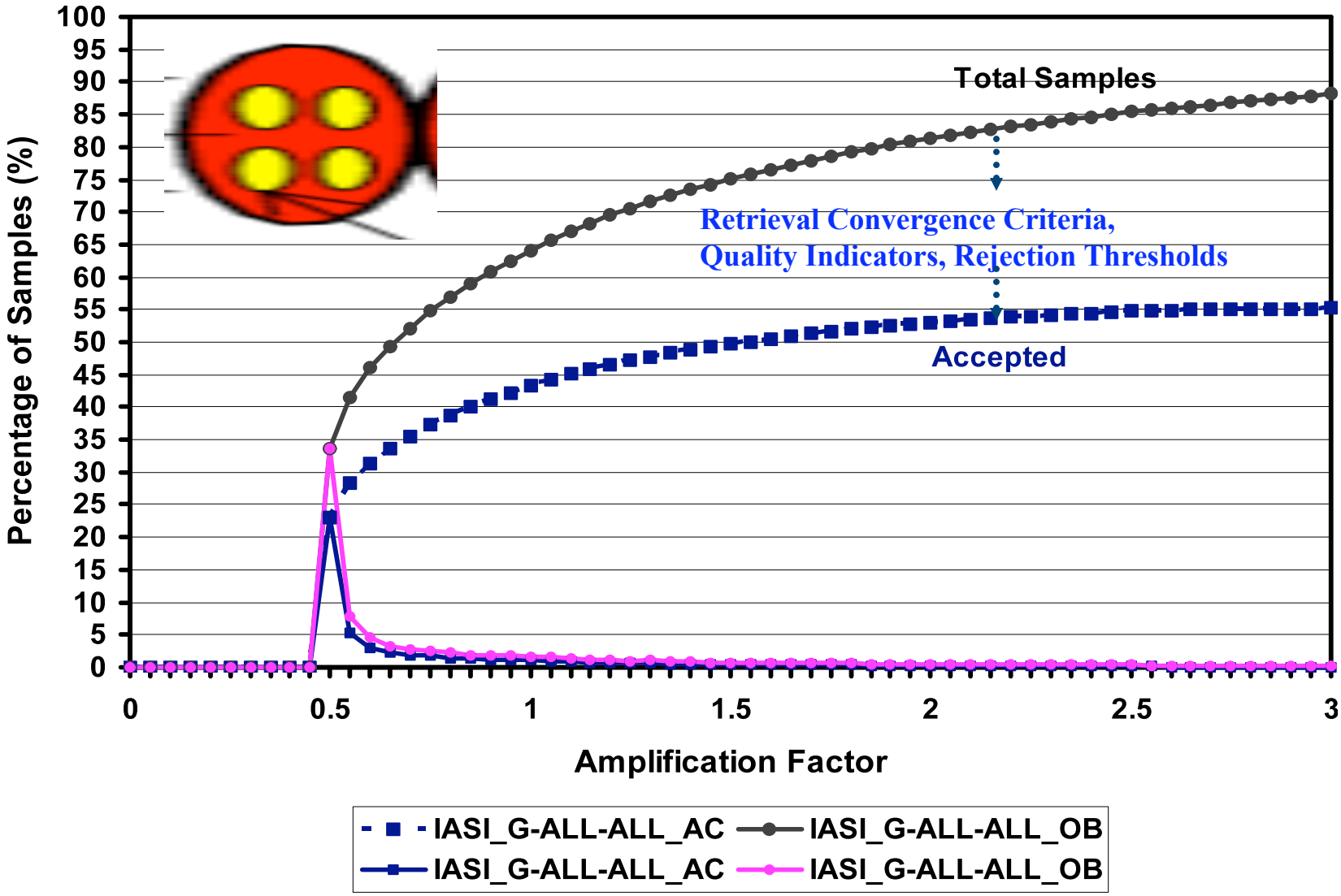
AIRS Like IASI 4 FOVs 2,4,6,8

THREE Experiments

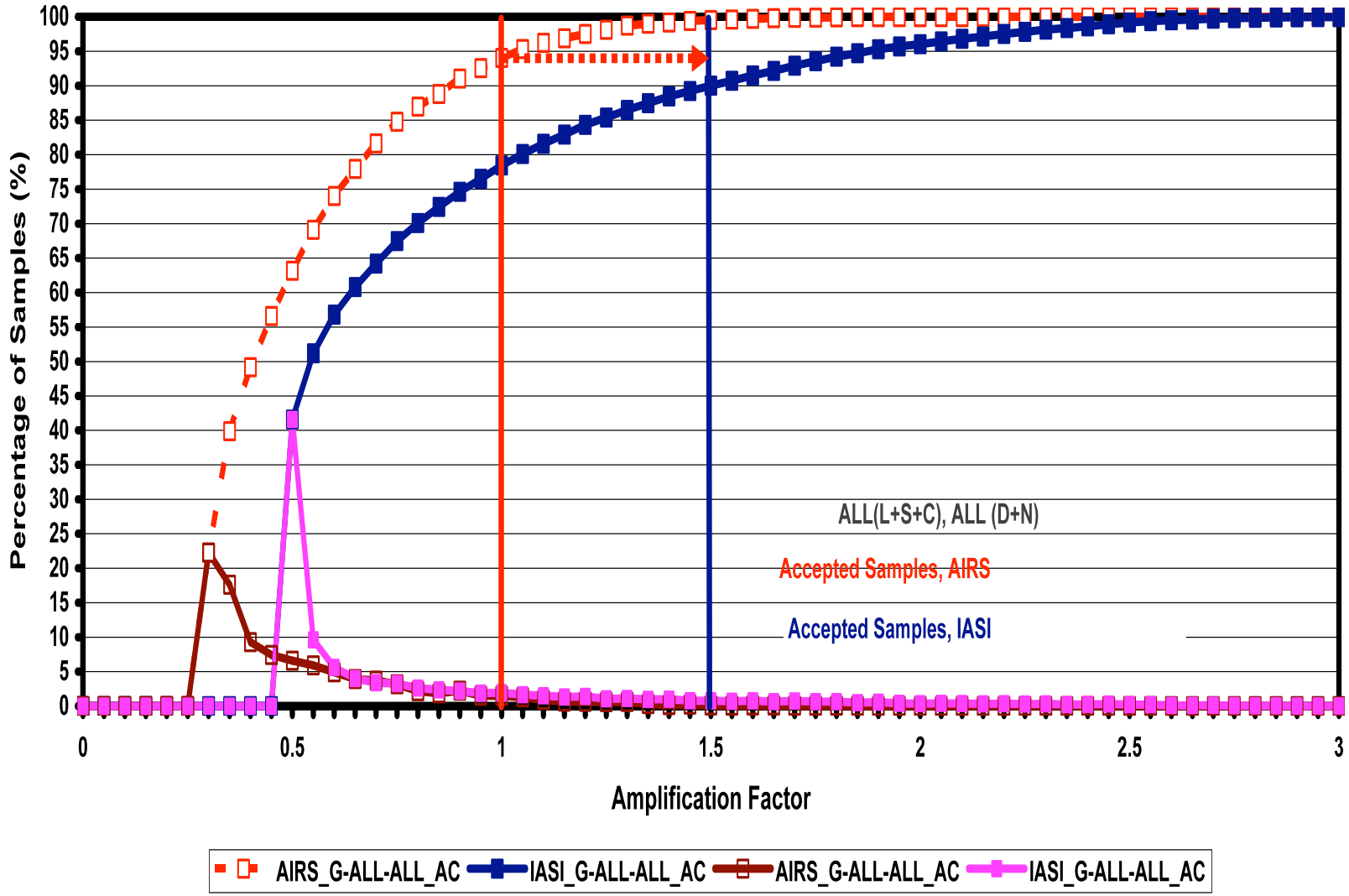
Noise Amplification in Cloud Clearing Procedure
Global Samples AIRS (9 FOVs)



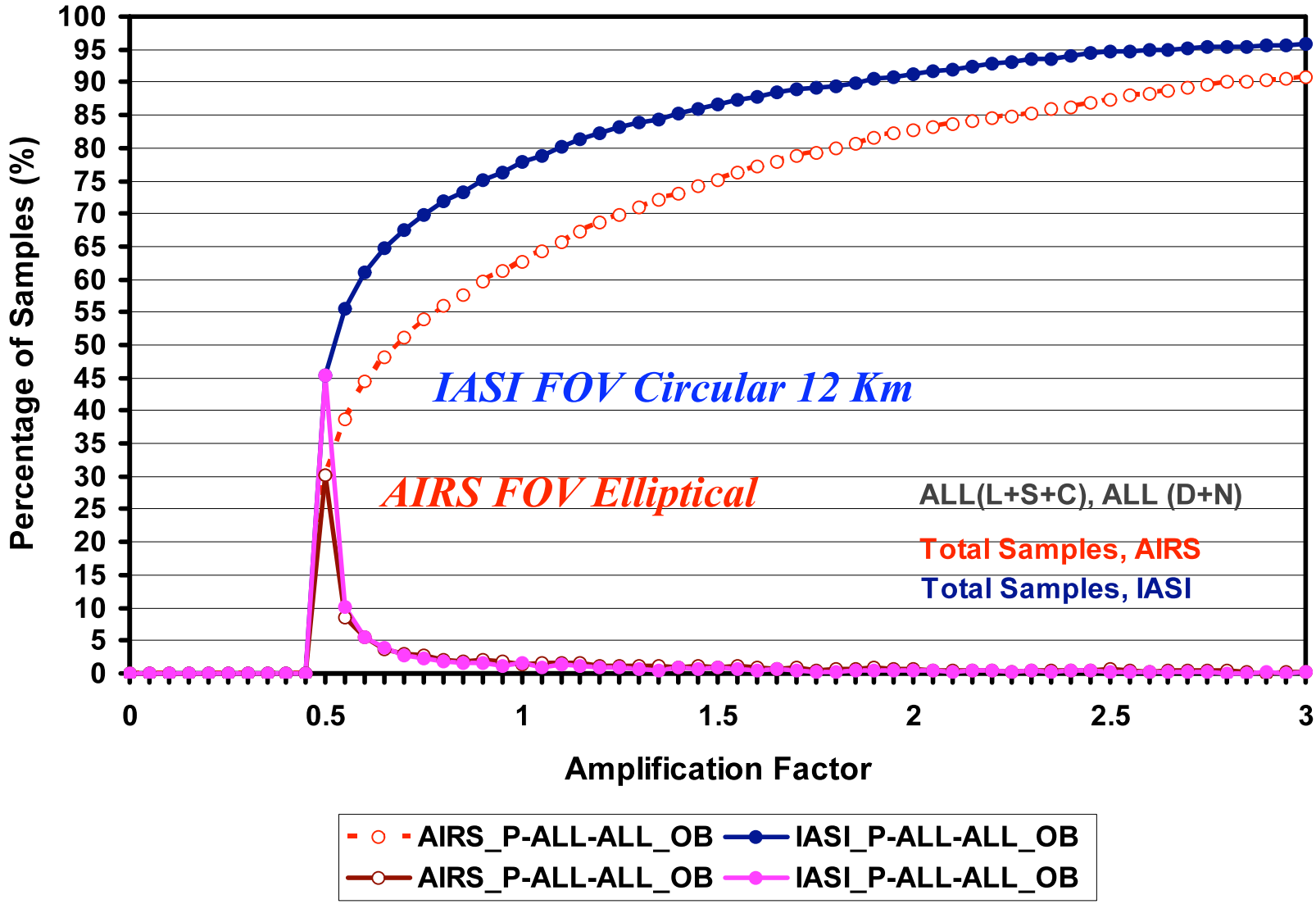
Noise Amplification in Cloud Clearing Procedure
Global Samples IASI (4 FOVs)



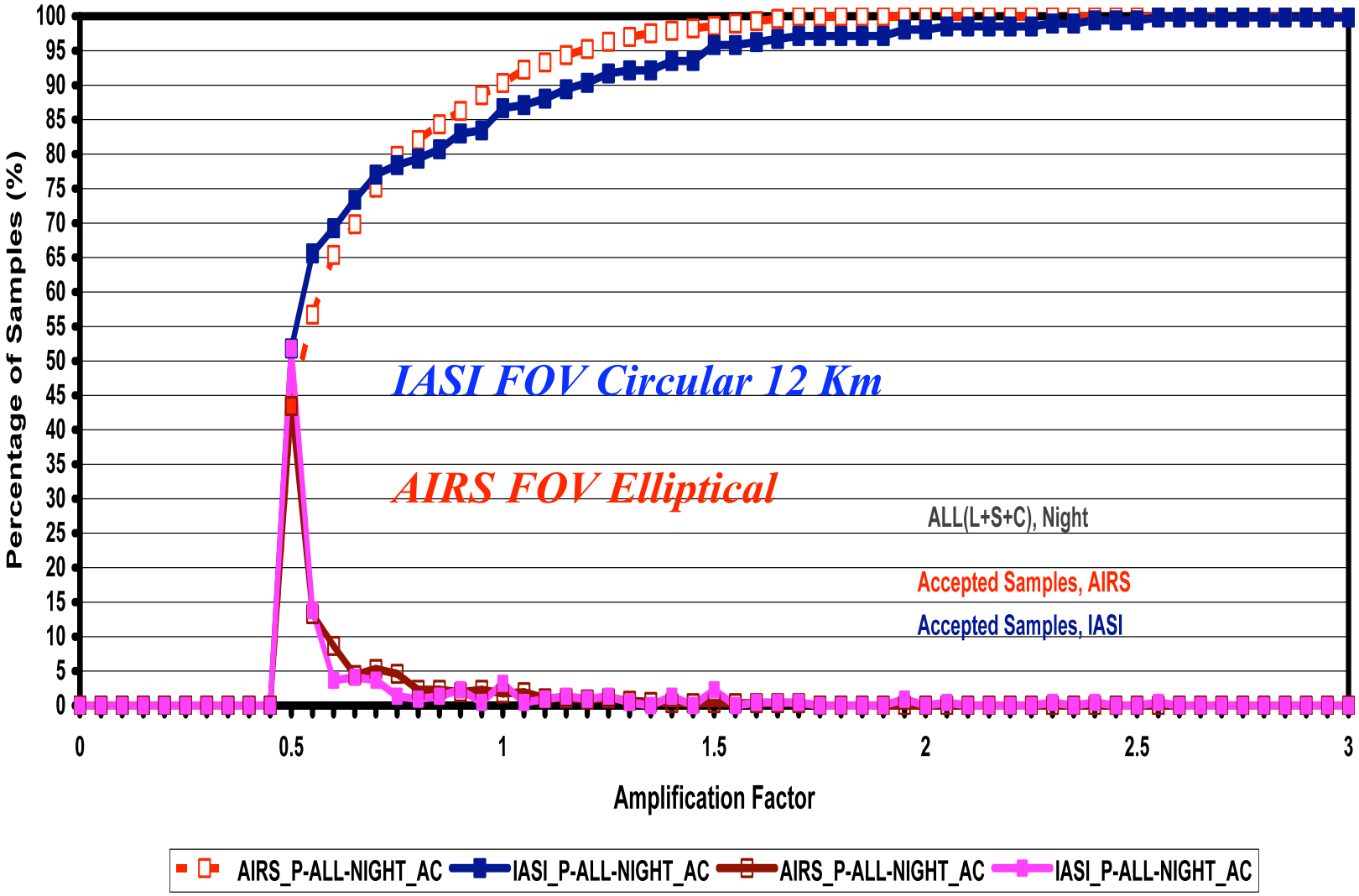
AIRS and IASI Accepted Samples Global



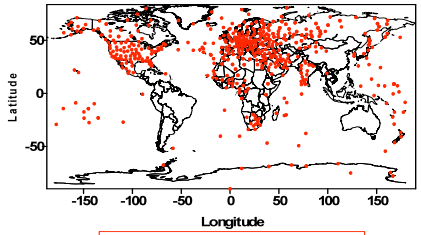
AIRS (FOVs 2, 4, 6, 8) like IASI and IASI Polar Samples



AIRS (FOVs 2, 4, 6, 8) like IASI and IASI Polar Samples

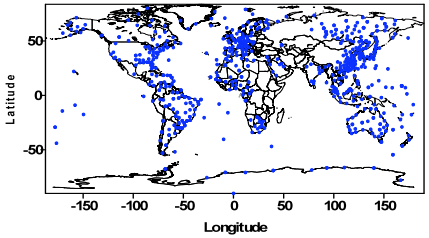


IASI and AIRS Retrieval Stats Using A Common Data Set



AIRS 1:30 PM/AM

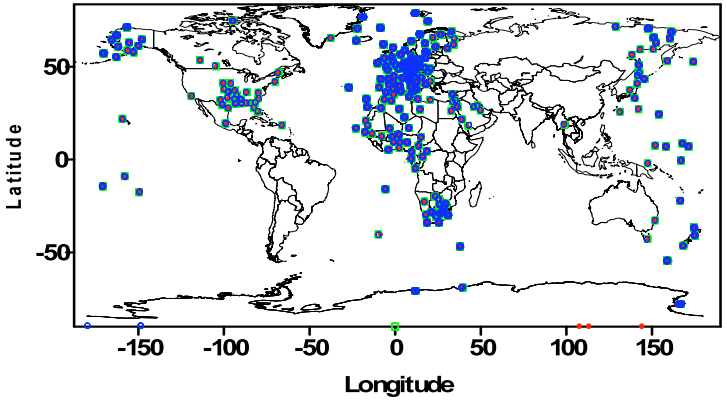
Space-Collocated Matches of AIRS/IASI with RAOBs



IASI 9:30 AM/PM

Matched Locations of MetOp-IASI, Aqua-AIRS with RAOBs

AIRS (1:30 AM/PM) RAOB IASI (9:30 AM/PM)

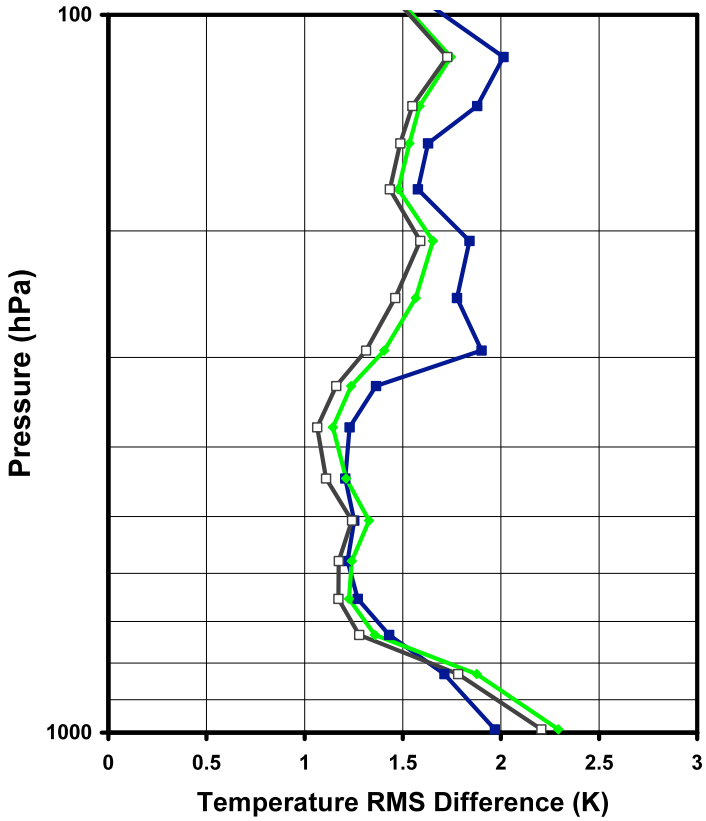


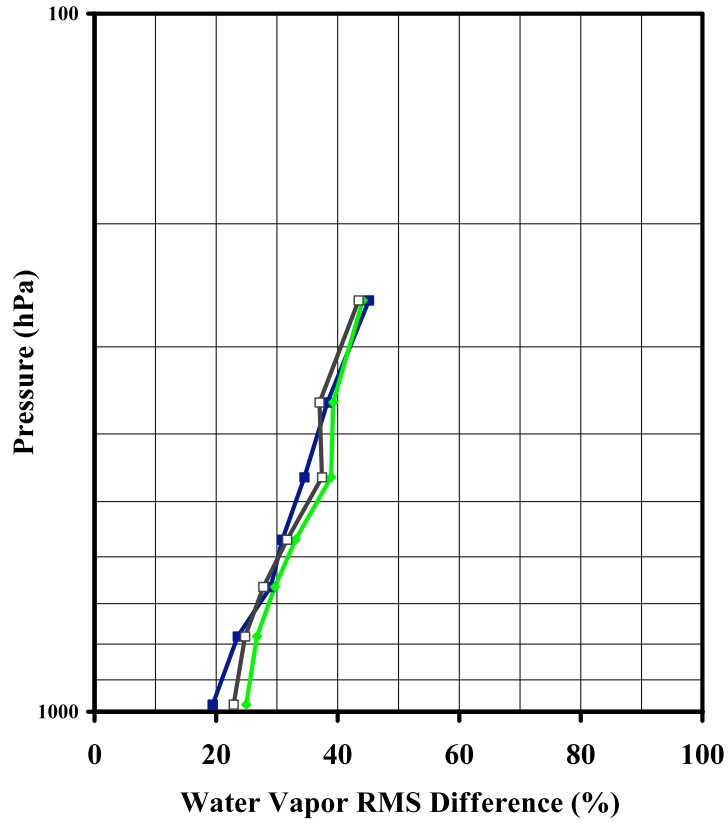
IASI & AIRS
Radiances
Retrievals
RAOBs
+
Corresponding
ECMWF
AVN
ATOVS RET

- Experiments and Retrieval Statistics with IASI and AIRS Matches at the Same Locations
- (1) IASI Retrievals
- (2) AIRS Retrievals
- (3) AIRS Like IASI Retrievals (AIRS FOVs:2,4,6,8)

IASI & AIRS and AIRS Like IASI with –Rej3 T(p), q(p) RMS Difference

Common Data Set Yield : 55%, 36%, 32%





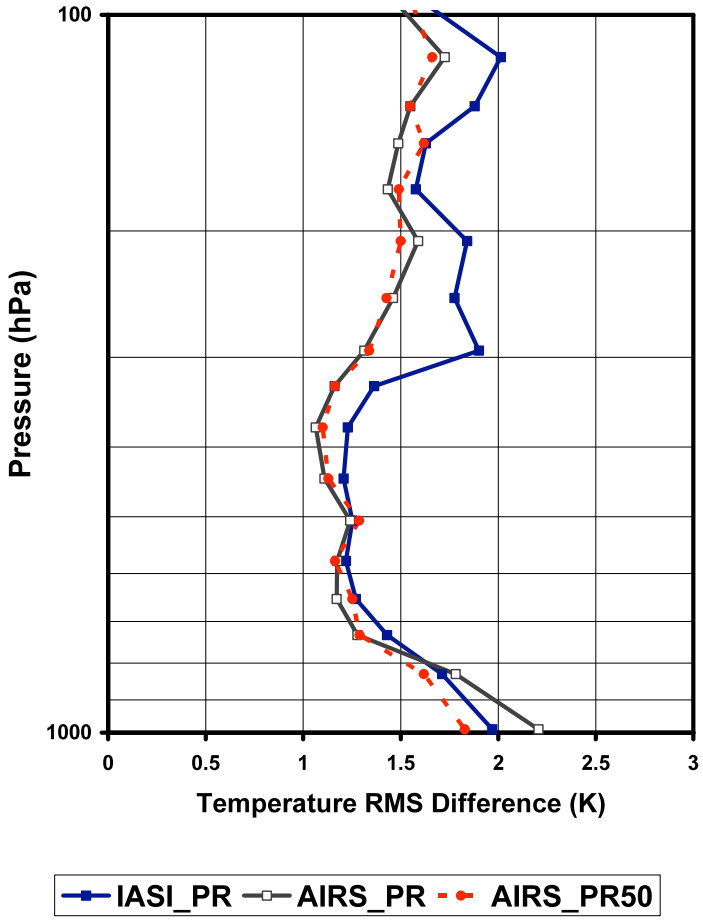
IASI_PR — AIRS_PR_4FOV_WGT — AIRS_PR

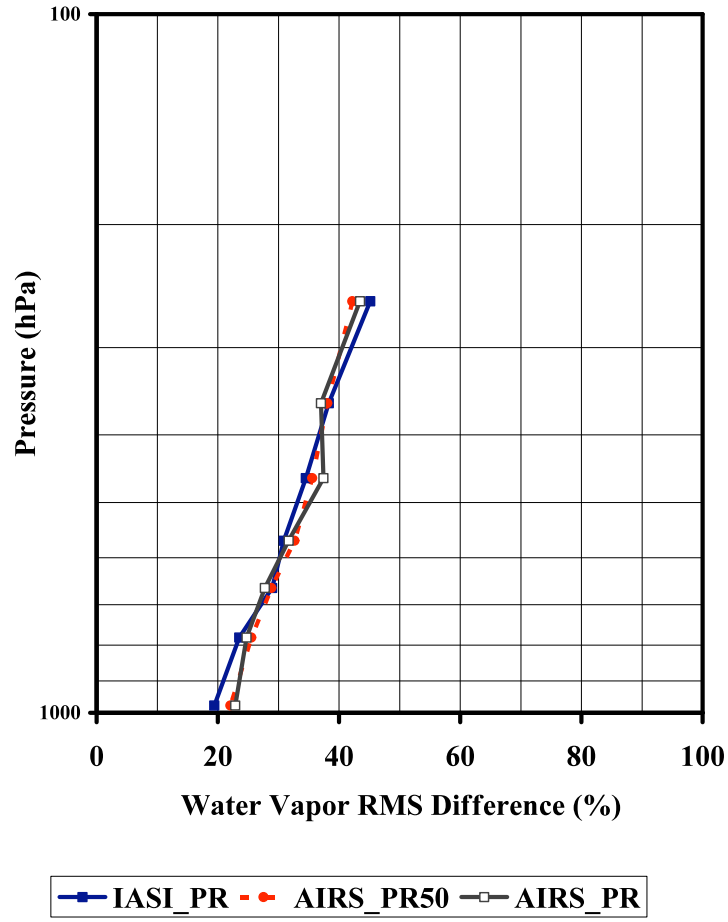
IASI_PR — AIRS_PR_4FOV_WGT — AIRS_PR

IASI, AIRS with –Rej3 Option, AIRS with 4 FOVs –Rej3

IASI & AIRS Collocated to the same Ground Location

IASI & AIRS with –Rej3 and V50 QA
T(p), q(p) RMS Difference
Common Data Set Yield: 55%, 36%, 20%





IASI, AIRS with –Rej3 Option, AIRS with V5 QA

IASI & AIRS Collocated to the same Ground Location

Questions Addressed
IASI and AIRS - With Global RAOBs

- Whether IASI Retrievals are Comparable with the AIRS Retrievals In terms of
  - Accuracy – YES
  - Yield – YES - Higher than AIRS Yield (Currently)
  - Global Temperature Retrieval: IASI and AIRS are comparable.
    - Over Oceans: AIRS Mid-Troposphere Temperatures are slightly better
  - Global Water Vapor Retrieval: IASI is slightly better
    - Over Oceans: AIRS and IASI are comparable, with AIRS showing better upper level water vapor RMS
  - IASI Retrievals Need to Improve Over the Polar Regions both in terms of yield and RMS
- How much improvement is seen with the IASI (and AIRS) retrievals compared to the ATOVS
    - At Least half a Degree RMS improvement over M2-ATOVS Retrievals
    - Substantial Improvement over M2-ATOVS water vapor retrievals
- In the presence of a Hyper-spectral Sounder like the AIRS, the AMSU-B adds little or NO Improvement to the Retrieval of Water Vapor.

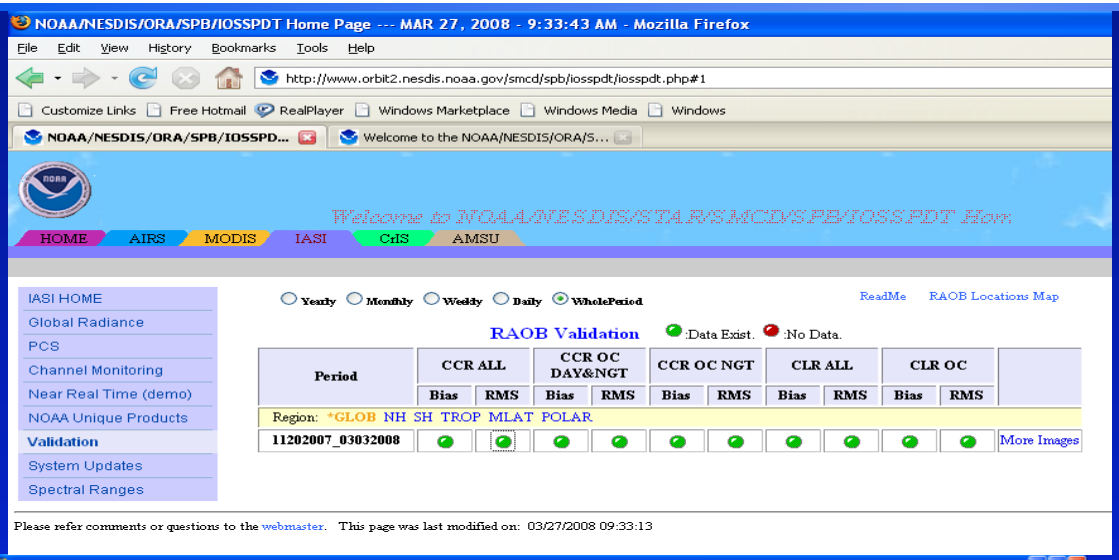
Summary- Cloud-Clearing

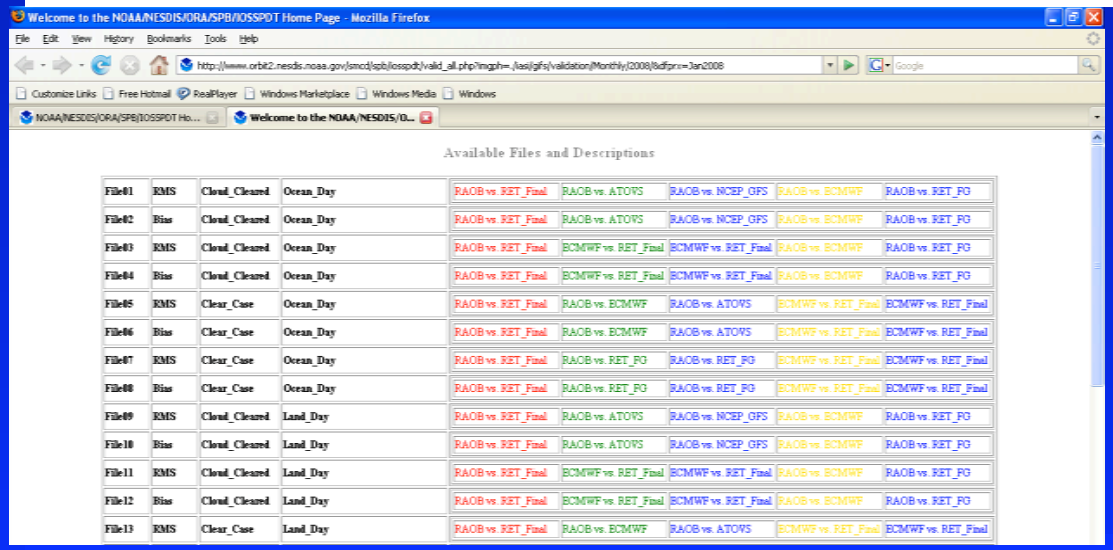
- AIRS retrievals appear to enjoy some of the advantages with 9FOV cloud-clearing compared to IASI 4 FOV cloud clearing. Noise amplification plots reveal better distribution of total and accepted samples that eventually improves cloud-cleared radiances despite the fact that there could be more clouds in the afternoon over land.
- AIRS like IASI experiment (4 FOV AIRS) with real data shows a slight advantage in cloud-clearing compared to IASI retrievals. This could be due to the geometry of the AIRS FOVs (Overlapping and spread-out) vs. IASI FOVs (Circular and Closer) where AIRS might be having a better S/N compared IASI.

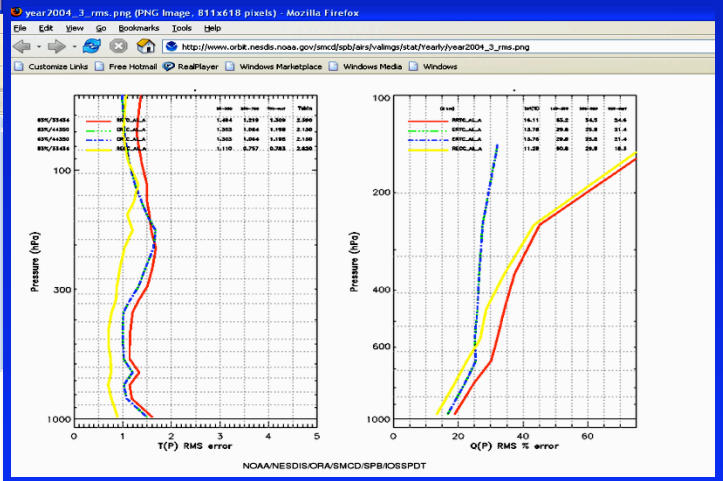
Summary-Future Work

- IASI Retrieval Algorithm - Optimization
  - » Cloud-Clearing
    - – 4 FOVs – Show Inability to identify uniform scenes and tendency of Confusion with Overcast (Especially over Polar Regions) – Better QA, and Residual Tests
    - – Cloud Clearing /Channel Optimization (Use of shortwave channels in cloud-clearing (YES/NO ?)
    - – Clear Flag Detection
  - » Retrieval Convergence Criteria, Residual Tests, Rejection Criteria
  - » FG improvement with more Training Data
- IASI global retrievals for the region 60S – 60 N are quite comparable to AIRS with a relatively larger yield than the yield currently seen with the AIRS.
- With improvements expected in the FG IASI training samples, and expected optimization in cloud-clearing, IASI Retrievals are bound to improve.
- However even with the current Algorithm, the results are quite comparable. In next 3 months with all the expected changes we are planning, IASI Instrument and the Algorithm shows lot of potential.

Web Interface for IASI/AIRS Validations
You Name it – You Have it







http://www.orbit2.nesdis.noaa.gov/smcd/spb/iosspdt/iosspdt.php#1

Thank You for your Attention

Backup Slides

Earlier Papers Using the Results from the NOAA/NESDIS IASI/AIRS Validation System

- **AIRS-V4 T(p), q(p) Validations, JGR**

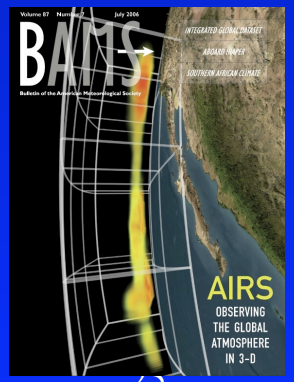
Validation of Atmospheric Infrared Sounder temperature and water vapor retrievals with matched radiosonde measurements and forecasts
Murty G. Divakarla,1 Chris D. Barnet,2 Mitchell D. Goldberg,2 Larry M. McMillin,2 Eric Maddy,3 Walter Wolf,3 Lihang Zhou,3 and Xingpin Liu3
Received 21 April 2005; revised 3 November 2005; accepted 23 November 2005; published 6 April 2006.
http://www.agu.org/journals/jd/jd0607/2005JD006116/2005JD006116.pdf

- **AIRS-V4, V5 O3(p), Total Ozone Validations, JGR**

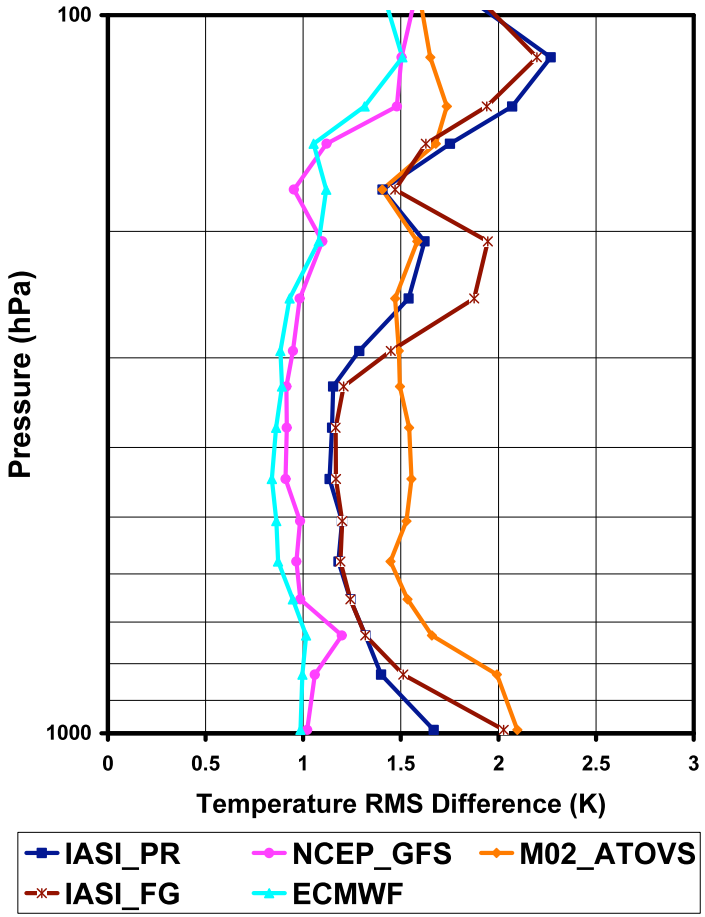
Evaluation of Atmospheric Infrared Sounder ozone profiles and total ozone retrievals with matched ozonesonde measurements, ECMWF ozone data, and Ozone Monitoring Instrument retrievals
Murty Divakarla,1 Christopher Barnet,2 Mitchell Goldberg,2 Eric Maddy,3 Fredrick Irion,4 Mike Newchurch,5 Xingpin Liu,3 Walter Wolf,2 Lawrence Flynn,2 Gordon Labow,6 Xiaozhen Xiong,3 Jennifer Wei,3 and Lihang Zhou3
Received 23 August 2007; revised 12 May 2008; accepted 29 May 2008; published 13 August 2008.
http://www.agu.org/journals/jd/jd0815/2007JD009317/

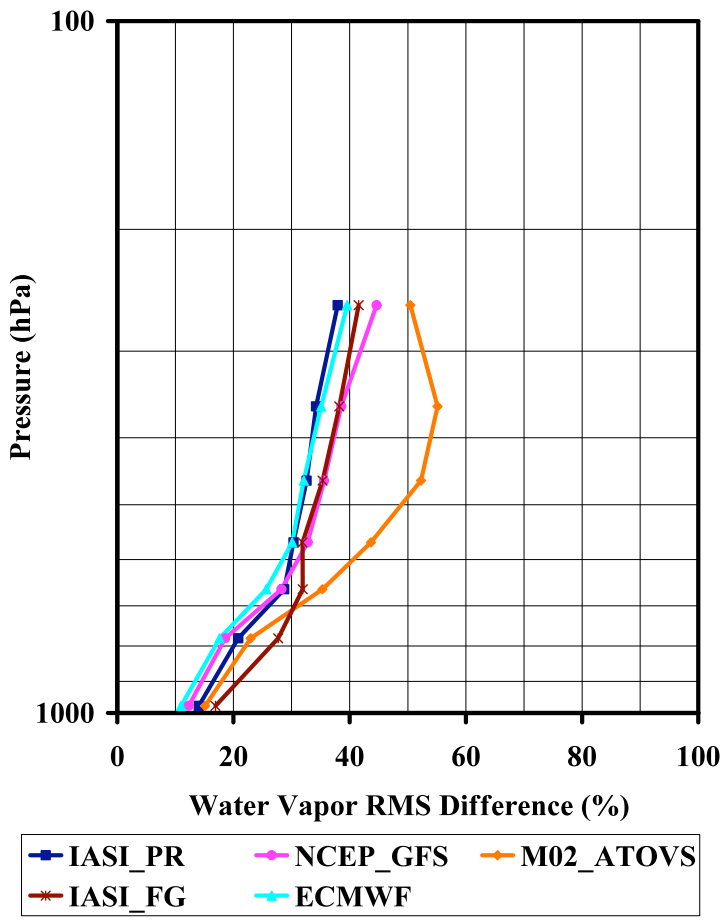
- **AIRS**

Improving Weather Forecasting and Providing New Data on Greenhouse Gases
BY MOUSTAFA T. CHAHINE, THOMAS S. PAGANO, HARTMUT H. AUMANN, ROBERT ATLAS,* CHRISTOPHER BARNET, JOHN BLAISDELL, LUKE CHEN, MURTY DIVAKARLA, ERIC J. FETZER, MITCH GOLDBERG,CATHERINE GAUTIER, STEPHANIE GRANGER, SCOTT HANNON, FREDRICK W. IRION, RAMESH KAKAR,EUGENIA KALNAY, BJORN H. LAMBRIGTSEN, SUNG-YUNG LEE, JOHN LE MARSHALL, W. WALLACE MCMILLAN,LARRY MCMILLIN, EDWARD T. OLSEN, HENRY REVERCOMB, PHILIP ROSENKRANZ, WILLIAM L. SMITH,DAVID STAELIN, L. LARRABEE STROW, JOEL SUSSKIND, DAVID TOBIN, WALTER WOLF, AND LIHANG ZHOU, BAMS, July 2006



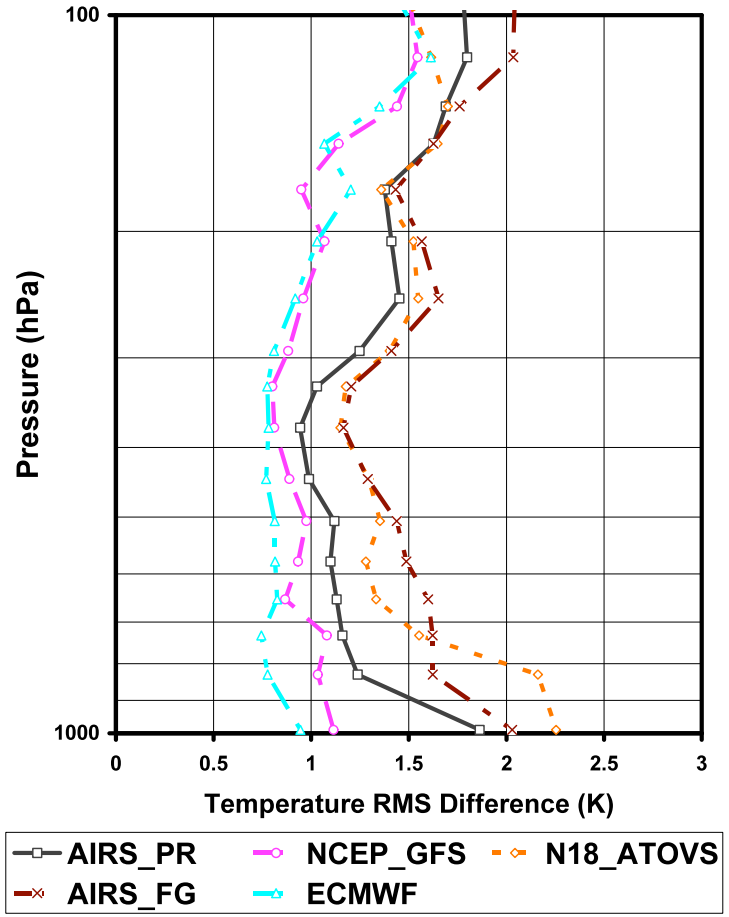
IASI- T(p), q(p) RMS Difference
Sea Samples NSAMP=2,848

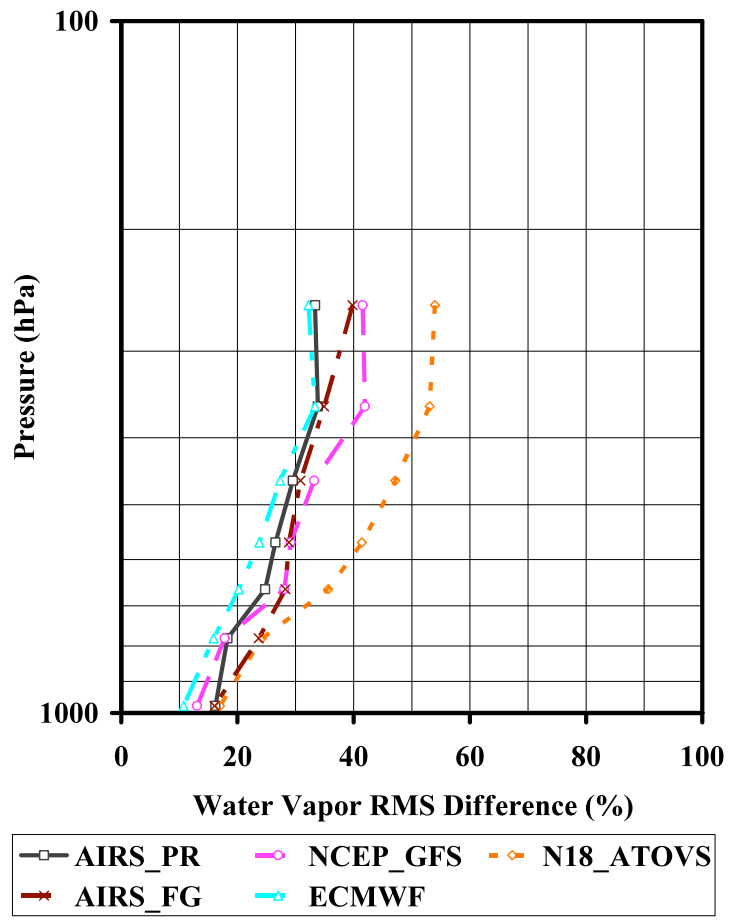




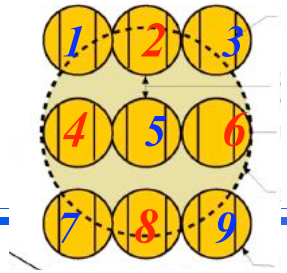
RAOB *vs.* IASI AVN ATOVS ECMWF FG

AIRS - T(p), q(p) RMS Difference
Sea Samples NSAMP=540



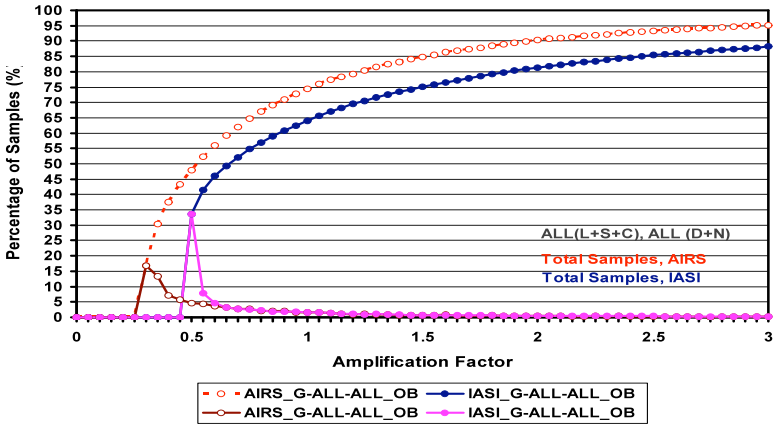


RAOB *vs.* AIRS AVN ATOVS ECMWF FG

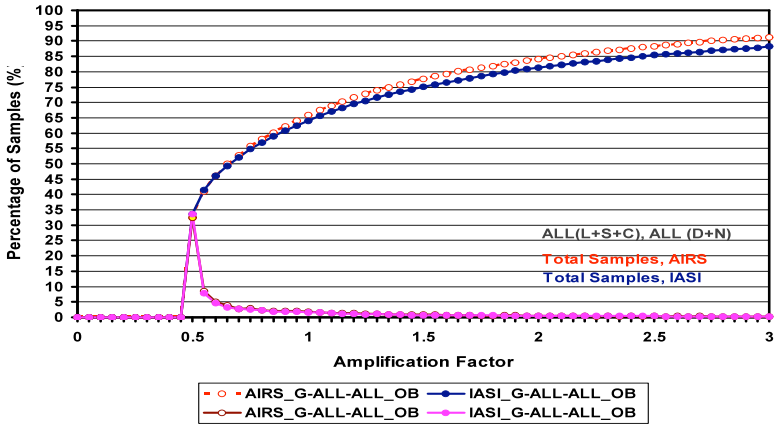


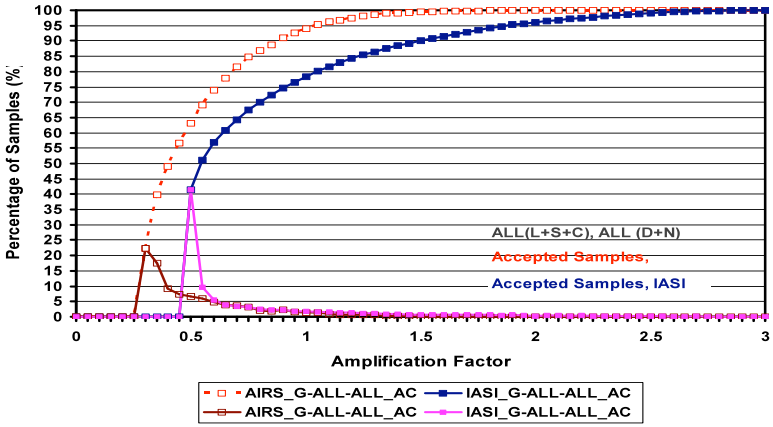
AIRS (9FOVs), AIRS (4FOVs) Like IASI and IASI

TOTSAMP AIRS, IASI

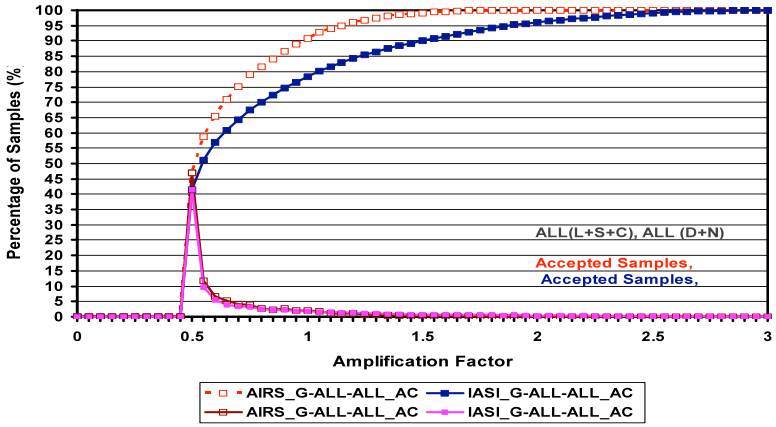


TOTSAMP AIRS Like IASI, IASI





Accepted Sample AIRS, IASI



Accepted Sample AIRS Like IASI, IASI

Datasets and Evaluation

- Bias and RMS difference Statistics with Reference to RAOBs.
  - Statistics for MetOp-IASI (9:30AM/PM)
    - Acceptance Criteria: Mid-Troposphere Temp Flag = 0
    - Solid Lines for IASI (9:30 AM/PM)
      - RAOB *vs.* IASI Final - Physical Retrievals
      - RAOB *vs.* IASI Fast Regression (FG)
      - RAOB *vs.* MetOp-ATOVS Retrievals
      - RAOB *vs.* ECMWF Forecast
      - RAOB *vs.* NCEP-GFS Analysis/Forecast Fields
  - Similar Statistics for Aqua-AIRS (1:30 PM/AM)
    - Dotted Lines
      - Similar Color Convention
    - Acceptance Criteria: Mid-Troposphere Temp Flag = 0
    - (I do have comparison with V5 QA also)
  - These Figures are only a few selected ones. Go to our website to see RMS and Bias Plots for
    - Any region (tropics, midlat, polar, global)
    - Any category: land/sea; day/night etc.

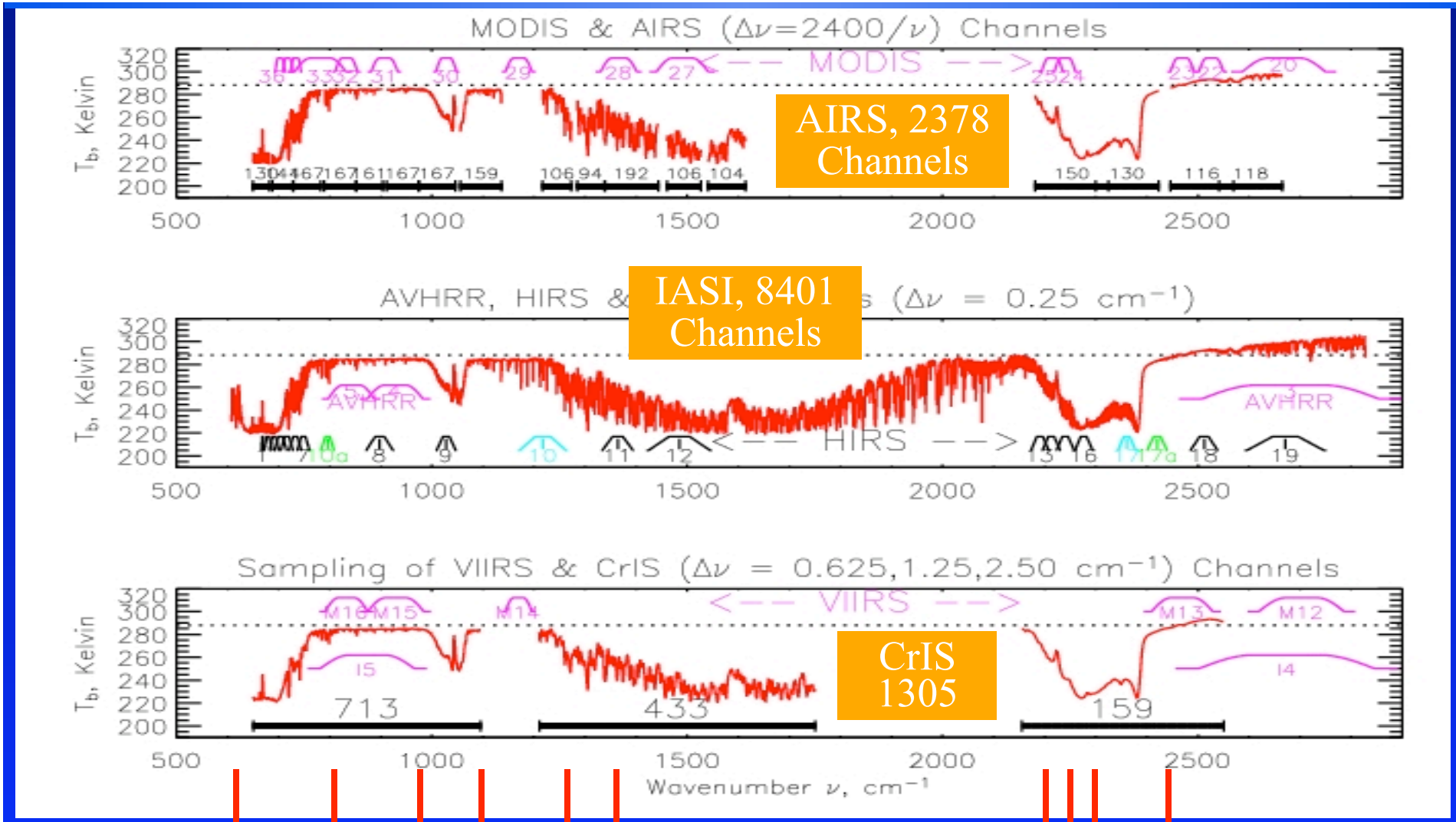
http://www.orbit2.nesdis.noaa.gov/smcd/spb/iosspdt/iosspdt.php#1

Datasets and Evaluation

- Bias and RMS difference Statistics with Reference to RAOBs.
  - Statistics for MetOp-IASI (9:30AM/PM)
    - Acceptance Criteria: Mid-Troposphere Temp Flag = 0
    - Solid Lines for IASI (9:30 AM/PM)
      - RAOB *vs.* IASI Final - Physical Retrievals
      - RAOB *vs.* IASI Fast Regression (FG)
      - RAOB *vs.* MetOp-ATOVS Retrievals
      - RAOB *vs.* ECMWF Forecast
      - RAOB *vs.* NCEP-GFS Analysis/Forecast Fields
  - Similar Statistics for Aqua-AIRS (1:30 PM/AM)
    - Dotted Lines
      - Similar Color Convention
    - Acceptance Criteria: Mid-Troposphere Temp Flag = 0
    - (I do have comparison with V5 QA also)
  - These Figures are only a few selected ones. Go to our website to see RMS and Bias Plots for
    - Any region (tropics, midlat, polar, global)
    - Any category: land/sea; day/night etc.

http://www.orbit2.nesdis.noaa.gov/smcd/spb/iosspdt/iosspdt.php#1

Spectral Coverage of Thermal Sounders (Example Radiances: AIRS, IASI, & CrIS)

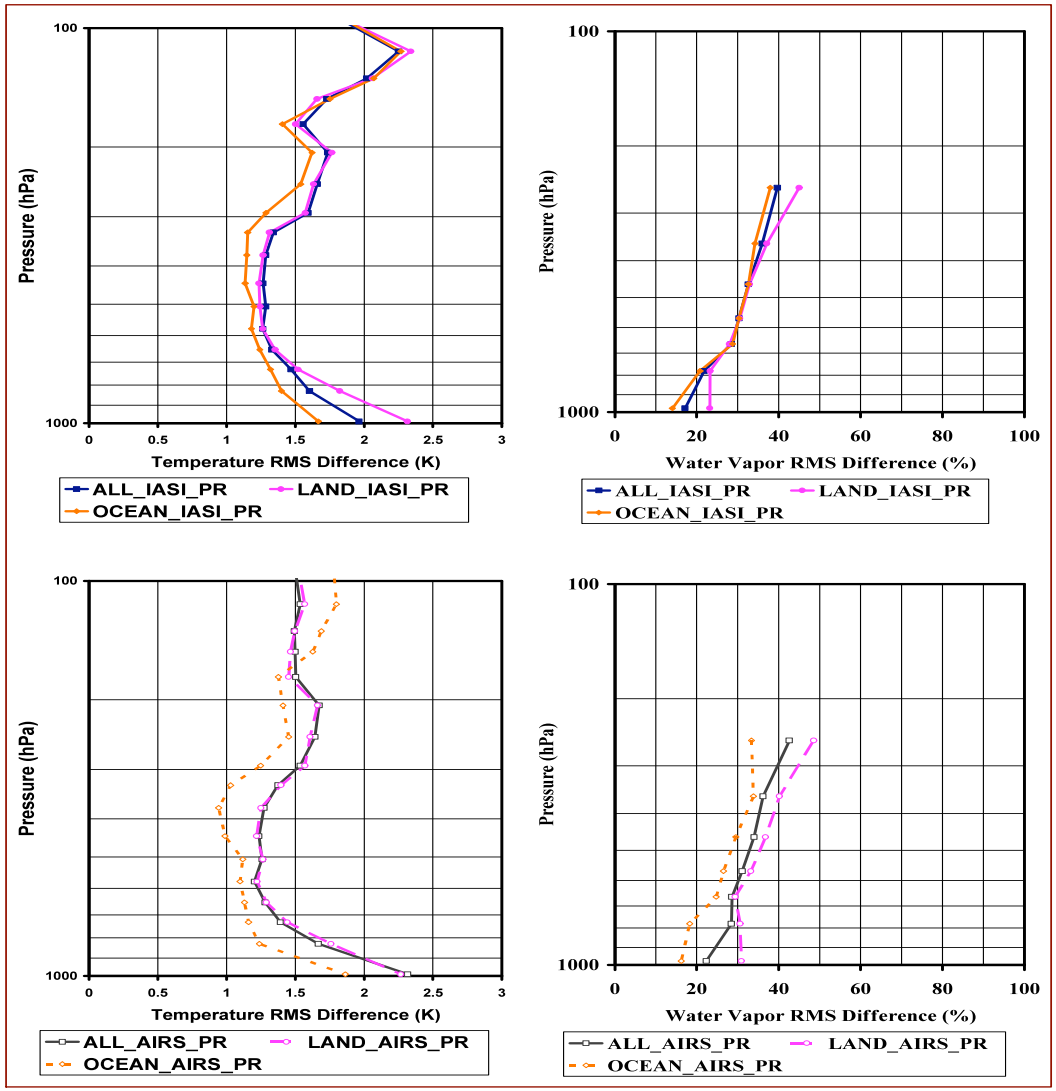


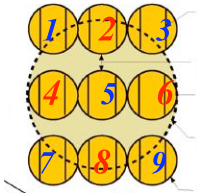
CO_2 O_3 CH_4 CO CO_2

IASI & AIRS T(p), q(p) RMS Difference

LAND SEA ALL

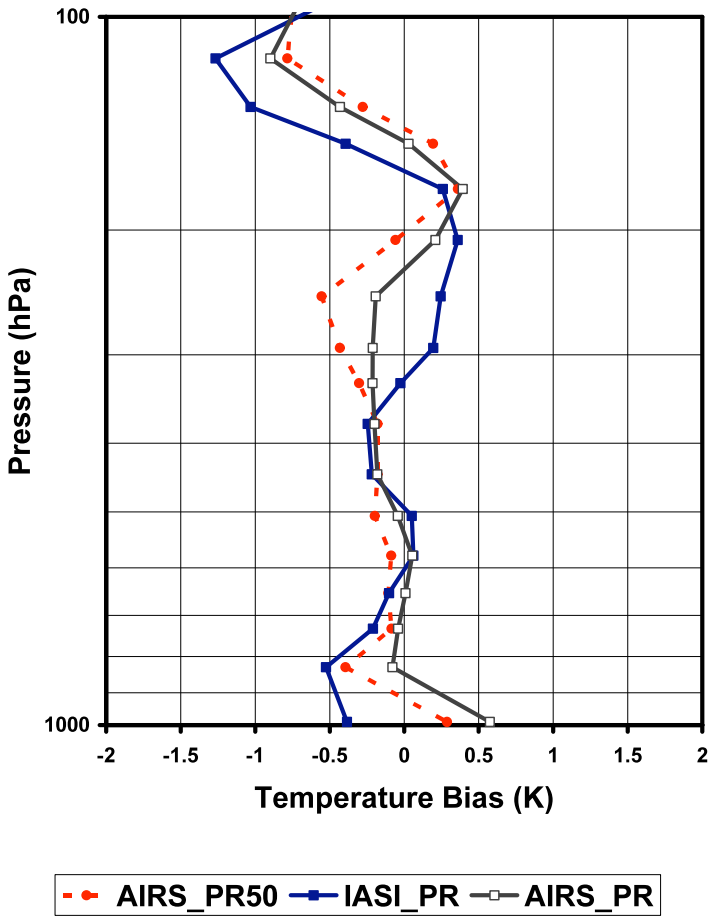
MetOp IASI T(p), q(p) as of Today

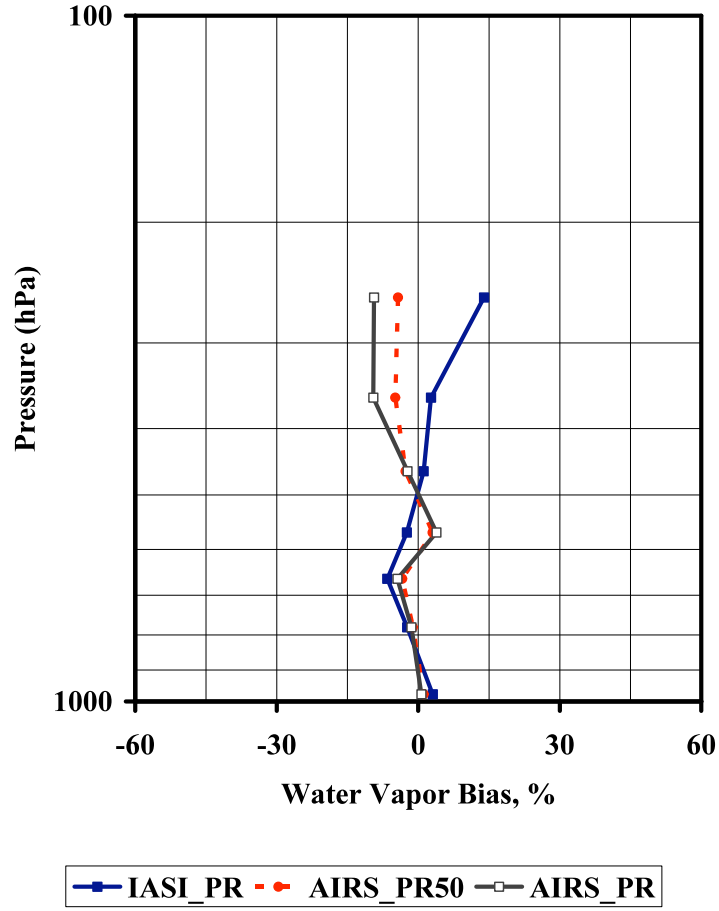




Aqua-AIRS V5: T(p), q(p) with -Rej3 Option

IASI & AIRS with –Rej3 and V50 QA Flags
T(p), q(p) Bias (Common Data Set)



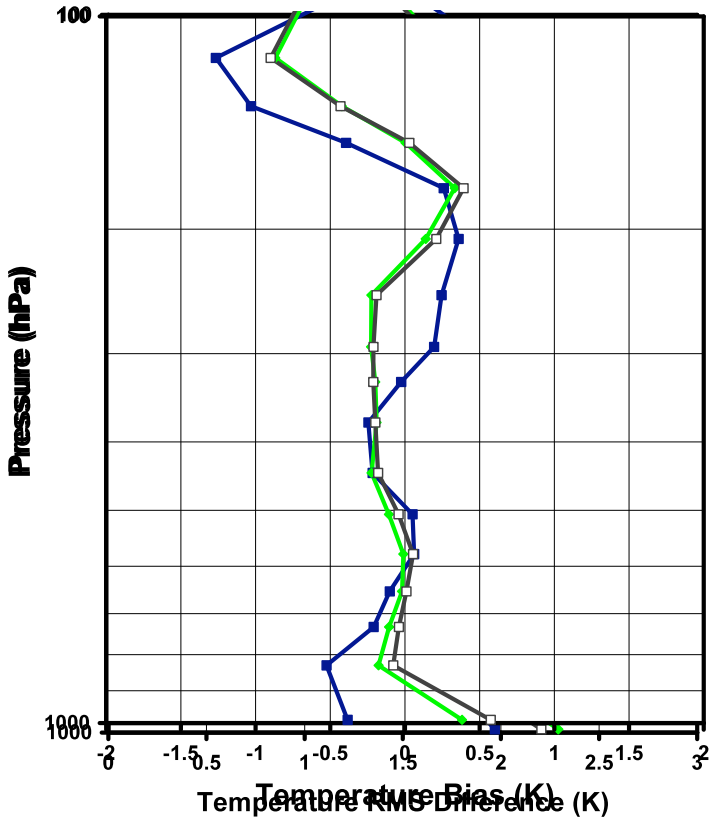


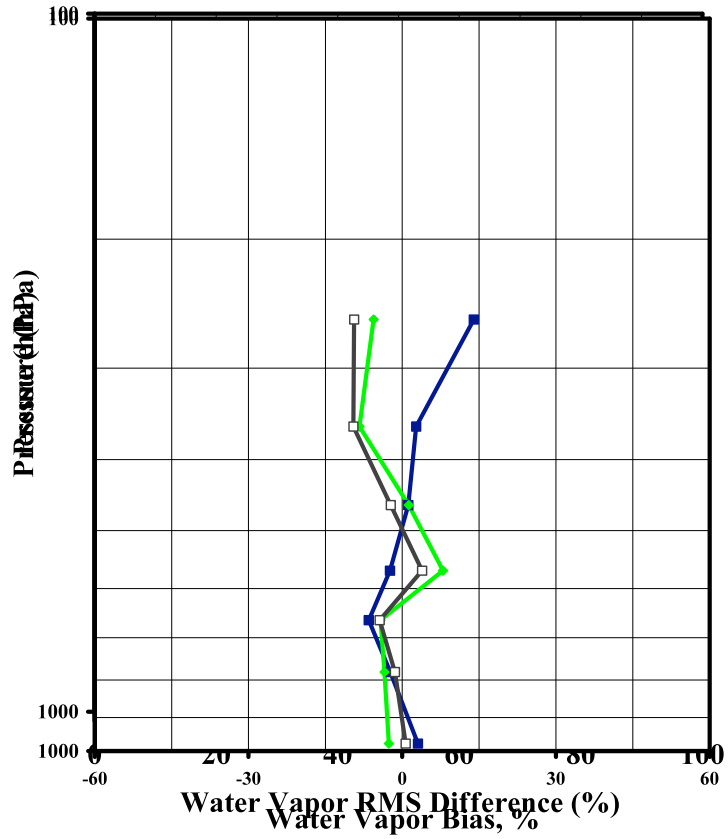
IASI, AIRS with –Rej3 Option, AIRS with V5 QA

IASI & AIRS Collocated to the same Ground Location

IASI & AIRS and AIRS Like IASI with –Rej3 T(p), q(p) Bias

Common Data Set





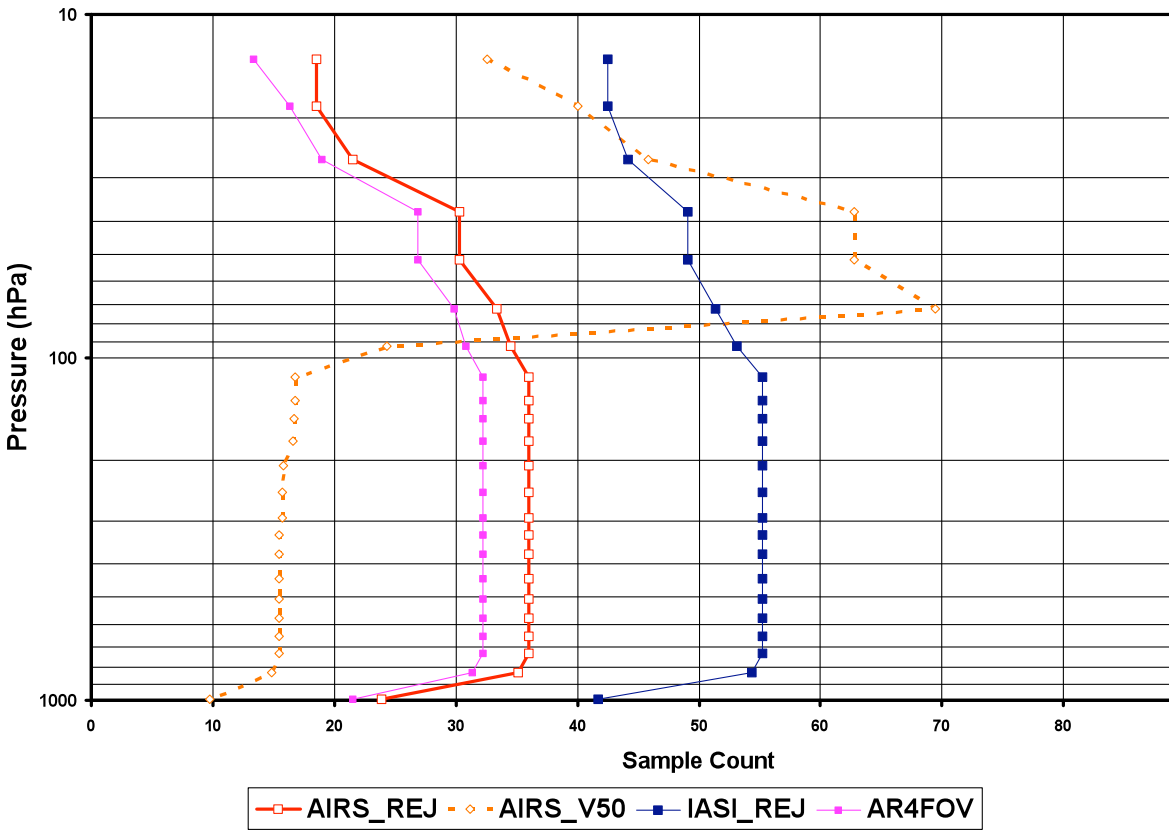
IASI_PR AIRS_PR_4FOV AIRS_PR PR

IASI_PR AIRS_PR_4FOV AIRS_PR PR

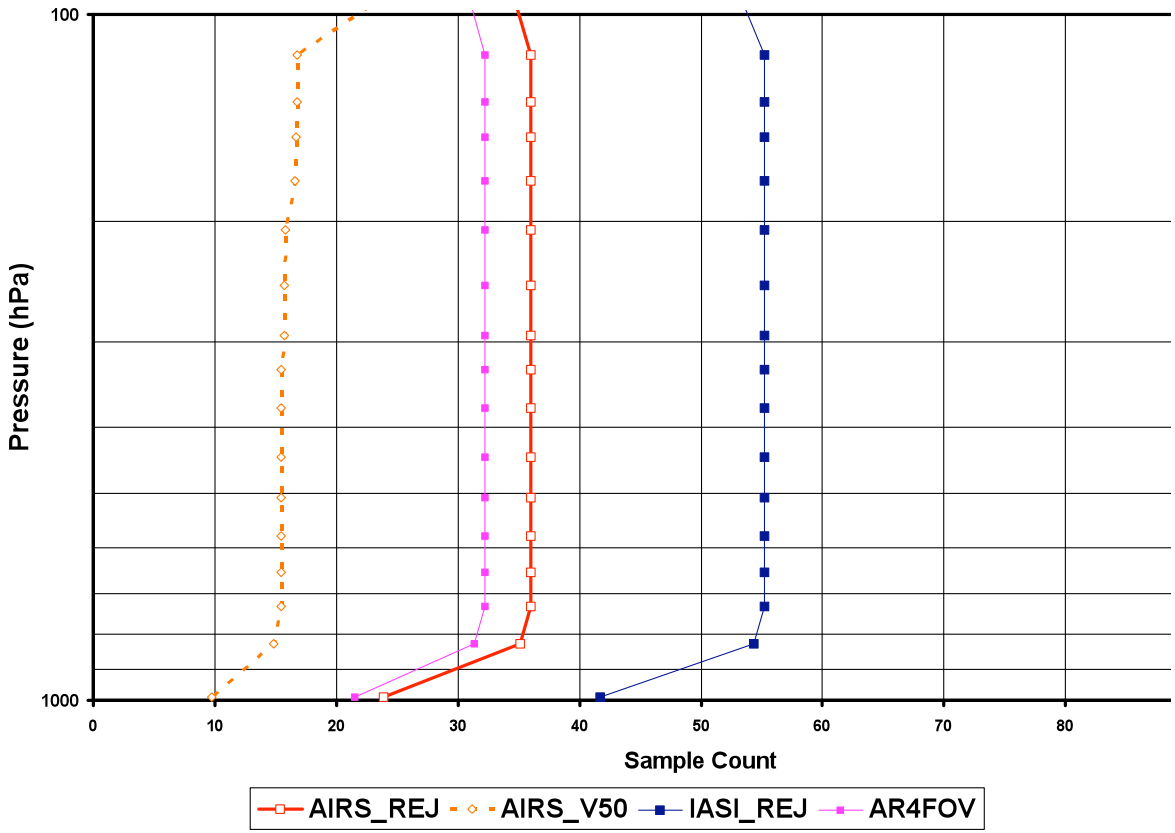
IASI, AIRS with –Rej3 Option, AIRS with 4 FOVs –Rej3

IASI & AIRS Collocated to the same Ground Location

Yield.

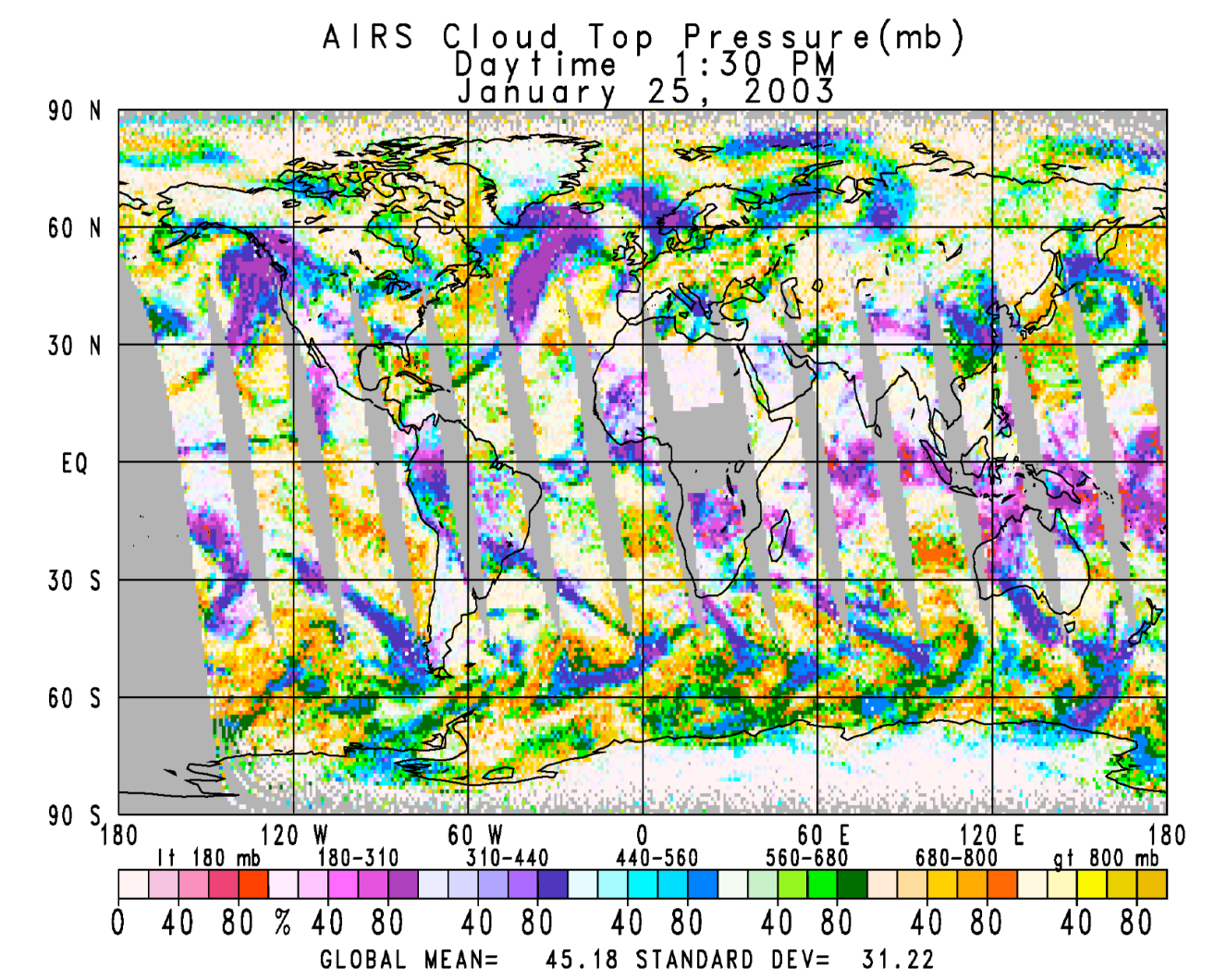

10
100
1000
Pressure (hPa)
0
10
20
30
40
50
60
70
80
Sample Count
AIRS_REJ
AIRS_V50
IASI_REJ
AR4FOV

Yield.

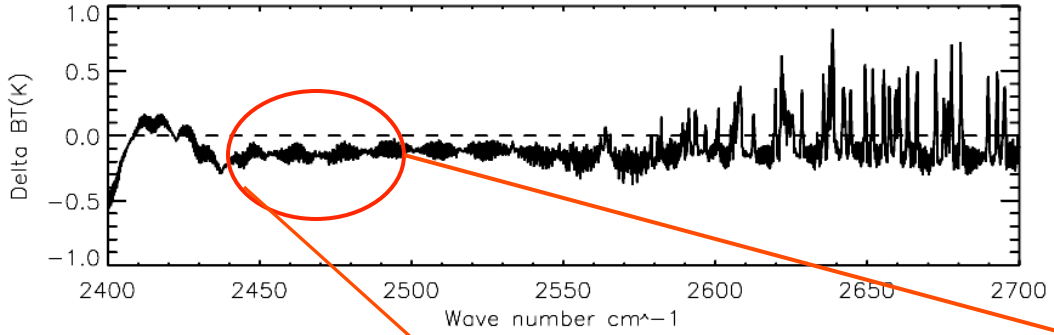

100
1000
Pressure (hPa)
0
10
20
30
40
50
60
70
80
Sample Count
AIRS_REJ
AIRS_V50
IASI_REJ
AR4FOV

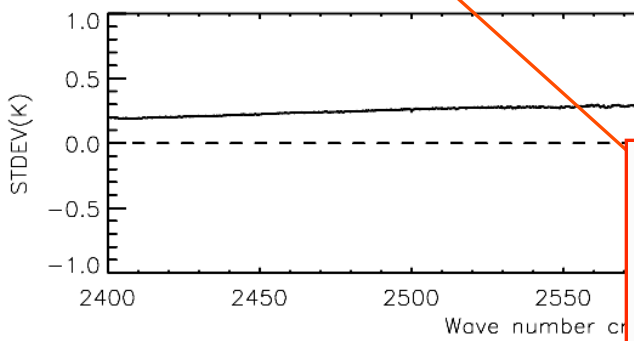
Cloud-Clearing Aspects
IASI 4 FOVs and AIRS 9 FOVs

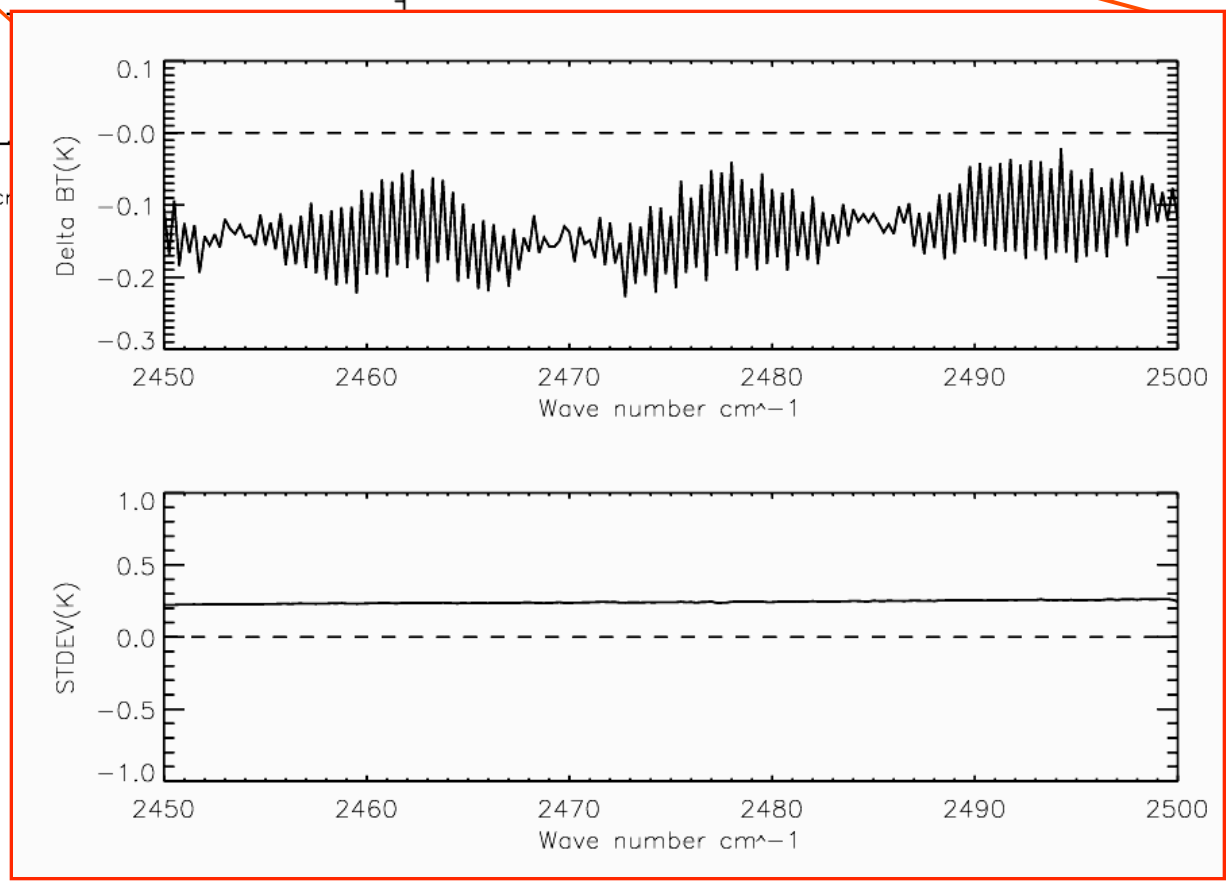
- **Noise Amplification in the Cloud Cleared Radiance**



~ -0.15 K fringes in the shortwave band:
RTA problems?
Instrument problems?
(Antonia)







Statistics AIRS QA –rej3 option (Whole Profile is Accepted/Rejected)

Temperature			Water Vapor			Ozone		
Layer	Upper Prs (hPa)	Lower Prs (hPa)	Layer	Upper Prs (hPa)	Lower Prs (hPa)	Layer	Upper Prs (hPa)	Lower Prs (hPa)
15	103	126	1	0	201	1	0	2
16	126	142	2	201	314	2	2	4
17	142	160	3	314	407	3	4	8
18	160	190	4	407	516	4	8	16
19	190	223	5	516	618	5	16	32
20	223	273	6	618	707	6	32	66
21	273	314	7	707	853	7	66	126
22	314	344	8	853	1100	8	126	223
23	344	407				9	223	359
24	407	478				10	359	535
25	478	535				11	535	754
26	535	618				12	754	1100
27	618	684						
28	684	778						
29	778	879						
30	879	1100						

- RAOB/O3SND is taken as Reference.
- Temperature Stats for 1 Km Layers 1000-0.1 hPa
- Water Vapor Stats 2 km layers 1000-200 hPa
- Ozone – Umkehr Layers 1000-10 hPa
- %RMS is computed by Weighting RMS difference with Truth in the layer.
- %Bias is computed by (AIRS-Truth)/Truth)

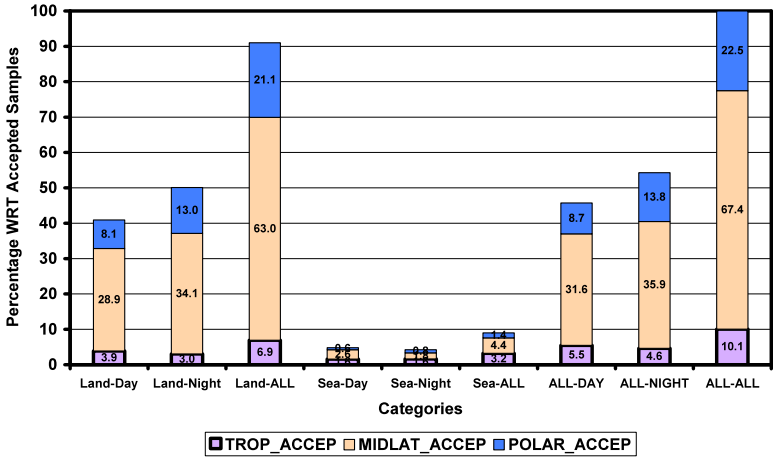
IASI and AIRS RAOB Matches p16

AIRS- Accepted Matches (After RAOB Selection):5993
(NH:79%,SH:21%); (LAND:91%, Sea:9%); (Day:46% Night:54%)
Tropics:10%; Mid-Lat:68% Polar:22%

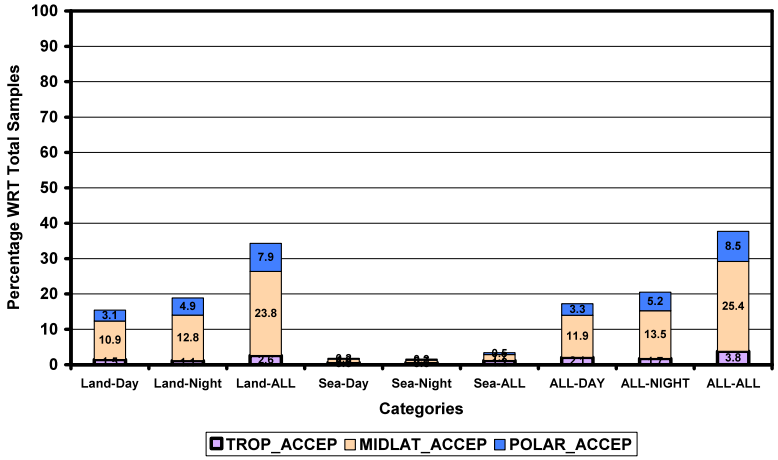
IASI- Accepted Matches (After RAOB Selection):12566
(NH:77%, SH:23%); (LAND:78%, Sea:22%); (Day:60%,Night:40%)
Tropics:28%; Mid-Lat:64% Polar:8%

AIRS

AIRS - Global Data Accepted Samples (NSAMP = 5993)
Percentages are With respect to the Total Number of Accepted Samples 5993

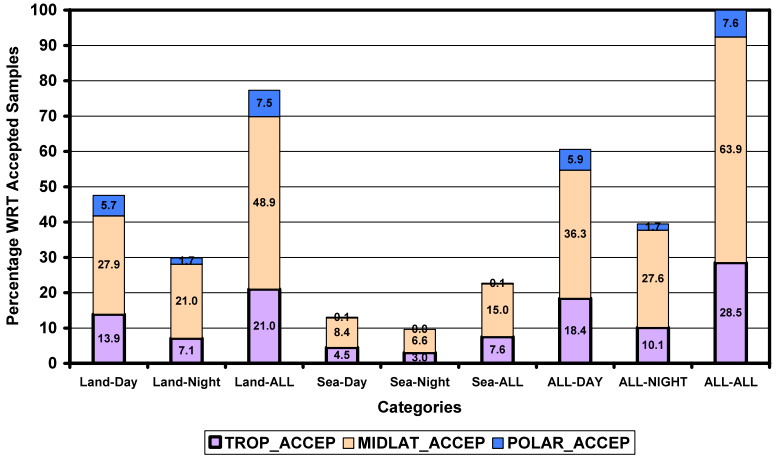


AIRS - Global Data Accepted Samples (NSAMP = 5993)
Percentages are With respect to theTotal Sample Size of :15903)

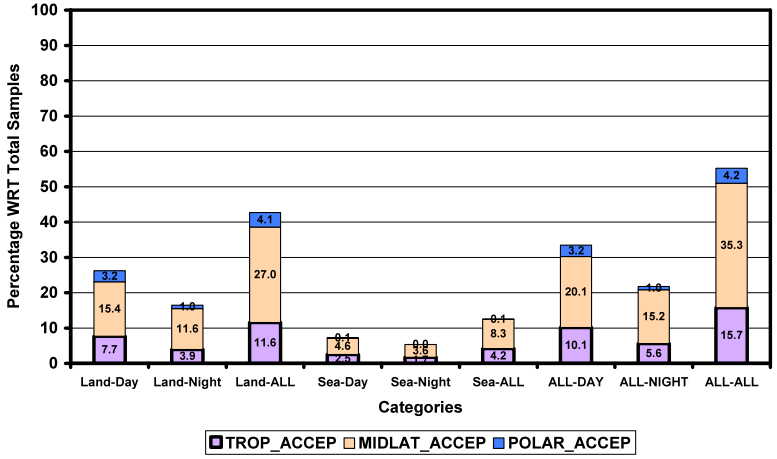


IASI

IASI - Global Accepted Samples (NSAMP = 12566)
Percentages are With respect to the Total Number of Accepted Samples 12566



IASI - Global Data Accepted Samples (NSAMP = 12566)
Percentages are With respect to theTotal Sample Size of :22760)

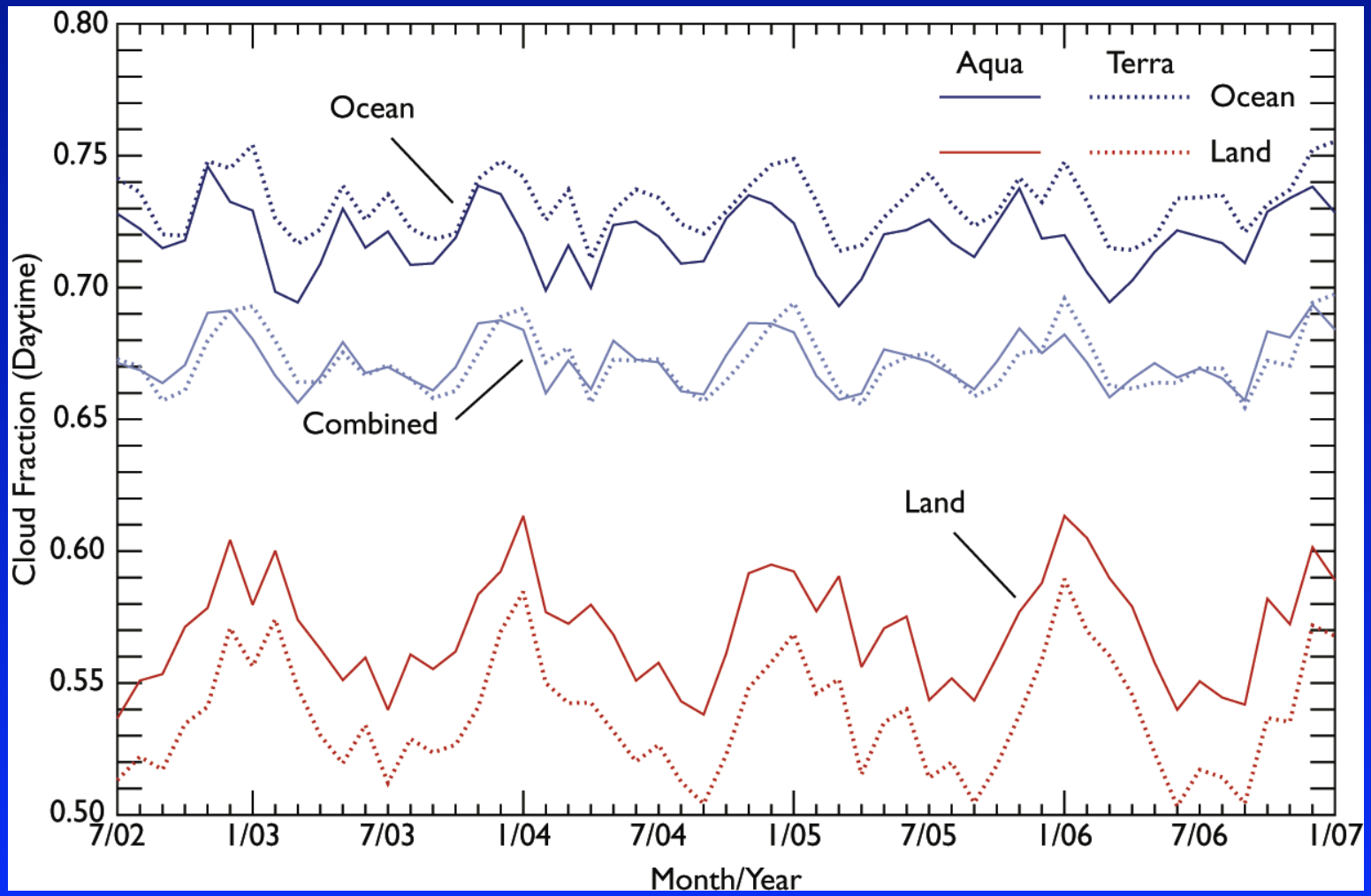


Accepted % WRT Total Accepted (N)

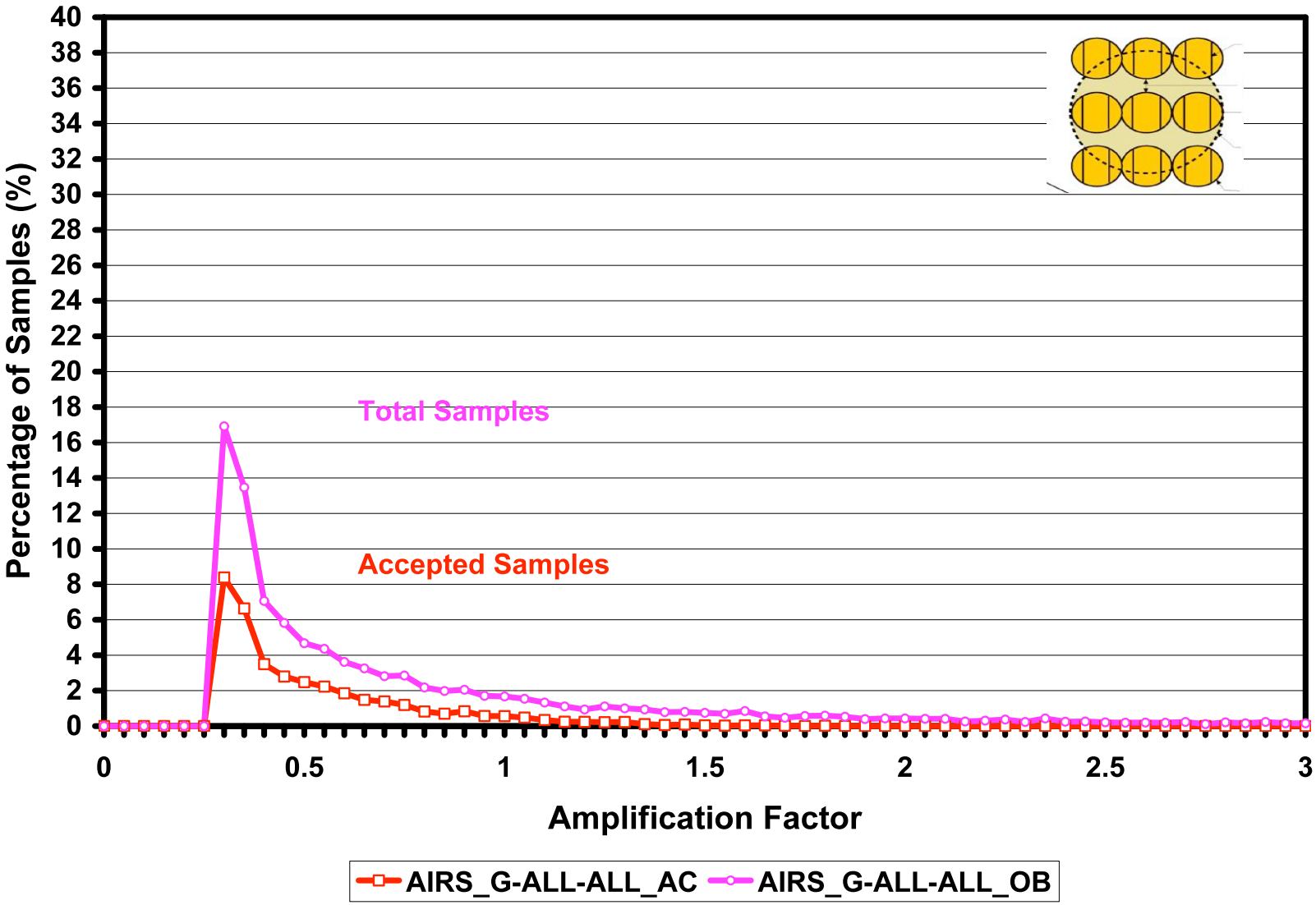
Accepted % WRT Total Sample

Time Series of Cloud Fraction during the Daytime (M. D. King, S. Platnick et al. – NASA GSFC)

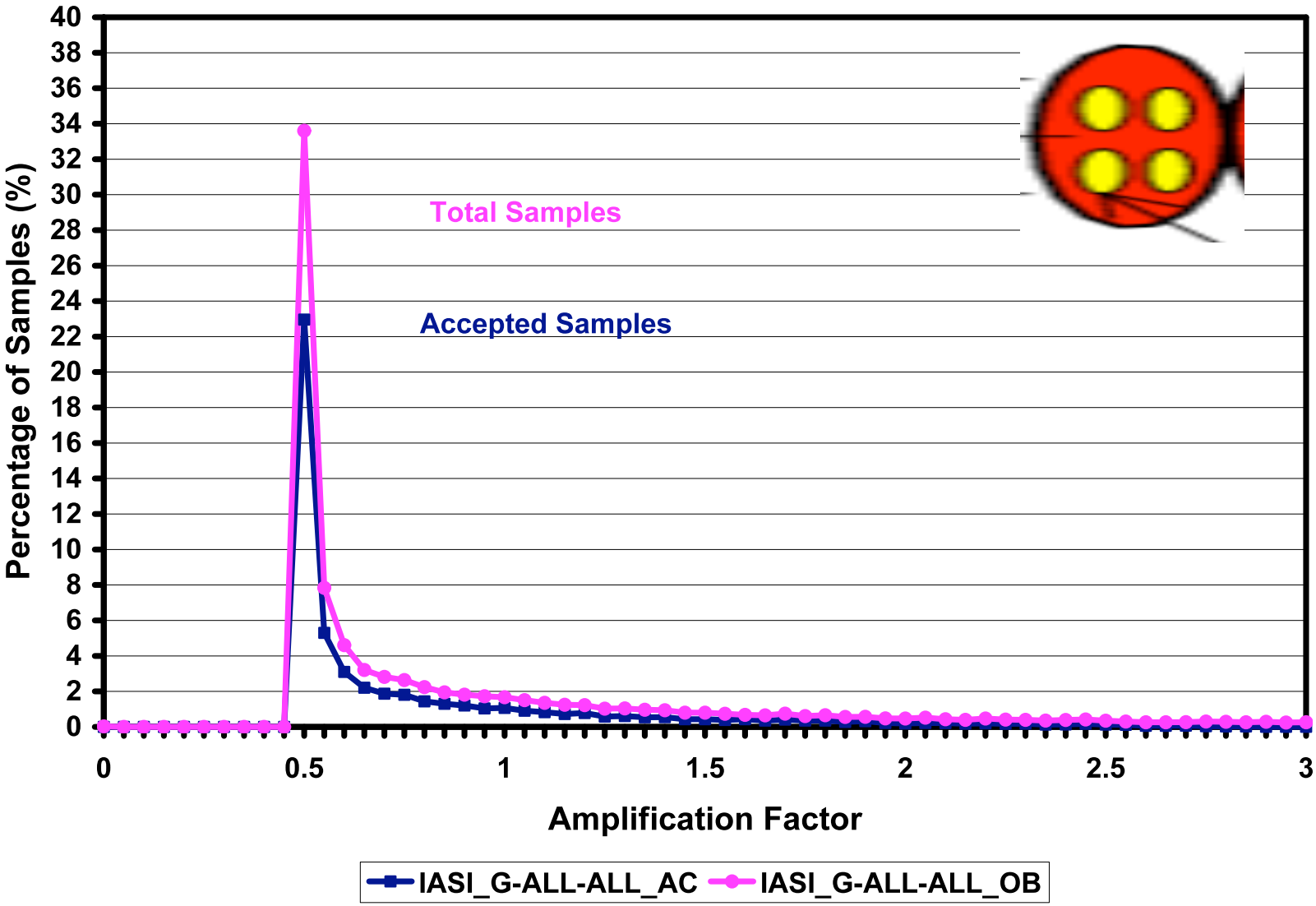
July 2002 – January 2007



Noise Amplification in Cloud Clearing Procedure
AIRS (9 FOVs)

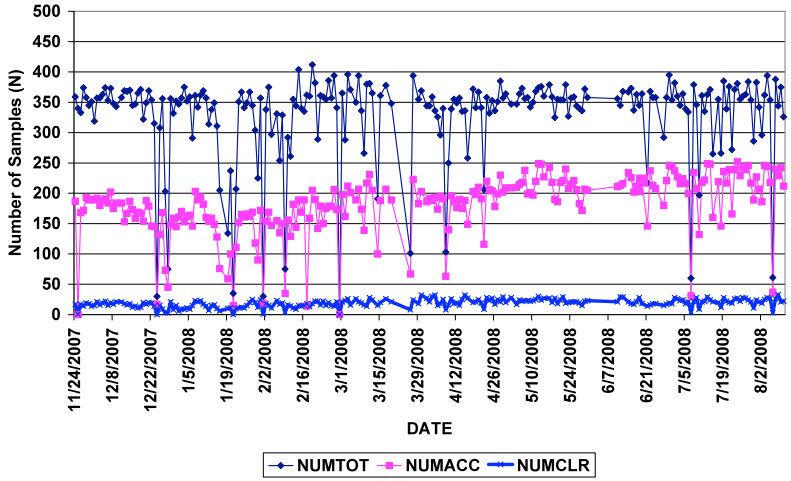


Noise Amplification in Cloud Clearing Procedure IASI (4 FOVs)

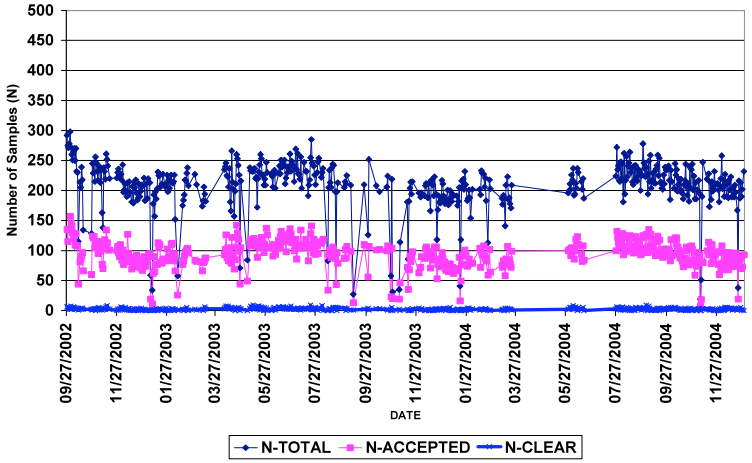


IASI Yield Compared to AIRS Long-term Yield

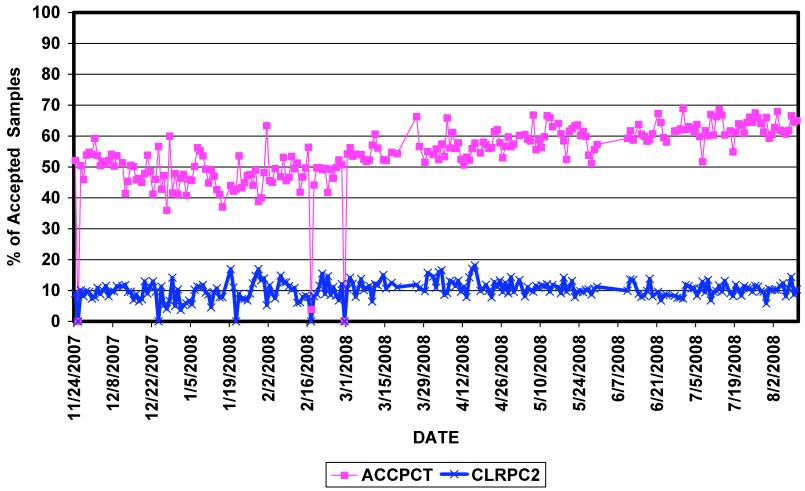
IASI Yield: Total, Accepted, Clear Cases



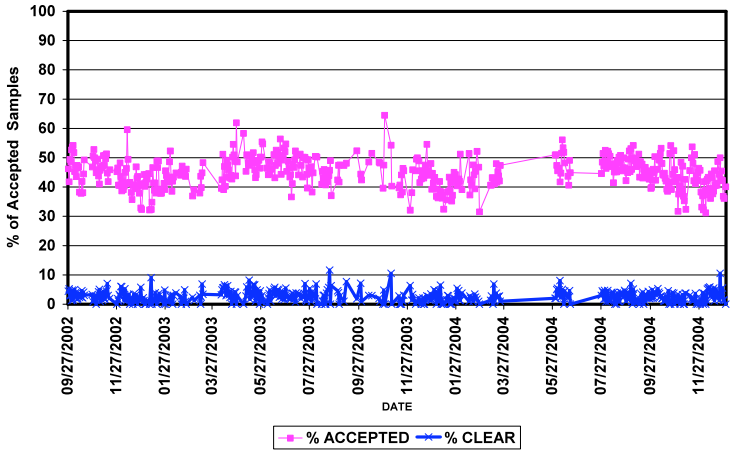
Aqua-AIRS V4 Yield: Total, Accepted, Clear Cases



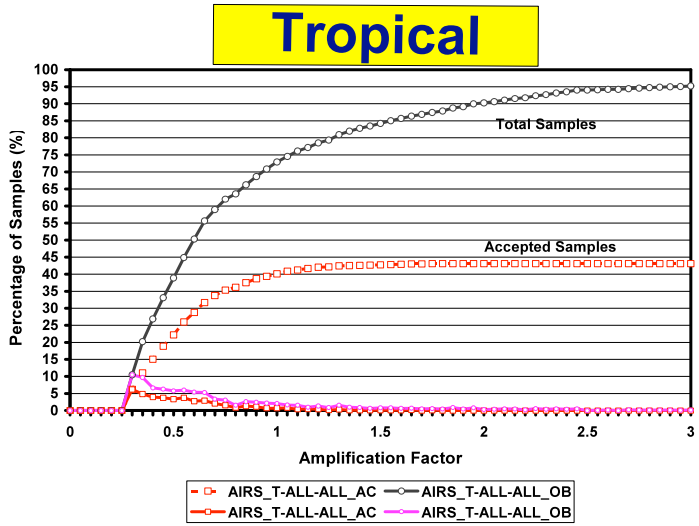
IASI Yield: %Accepted, %Clear Cases

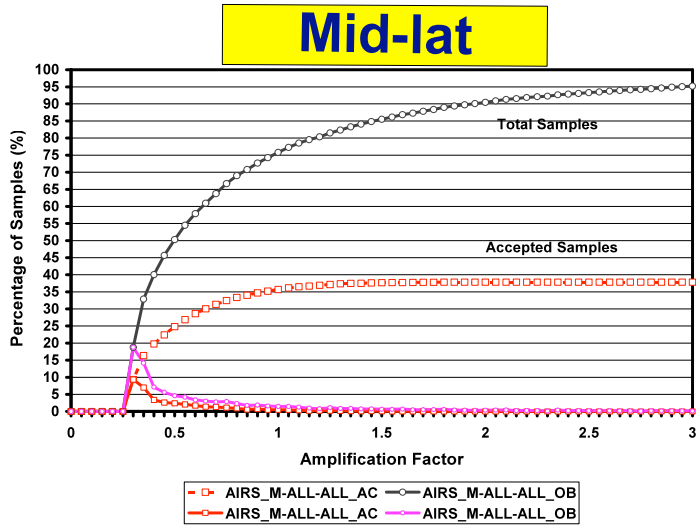


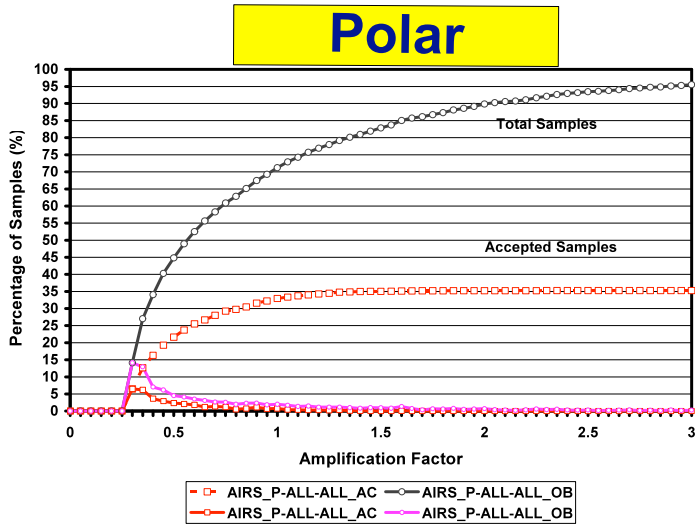
Aqua-AIRS V4 Yield: %Accepted, %Clear Cases

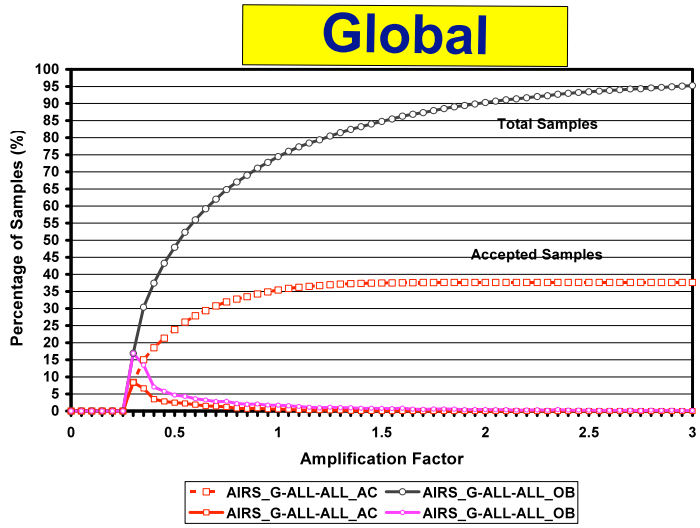


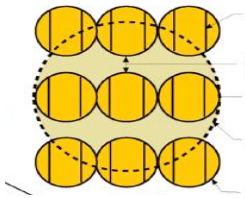
Noise Amplification in Cloud Clearing Procedure AIRS (9 FOVs)



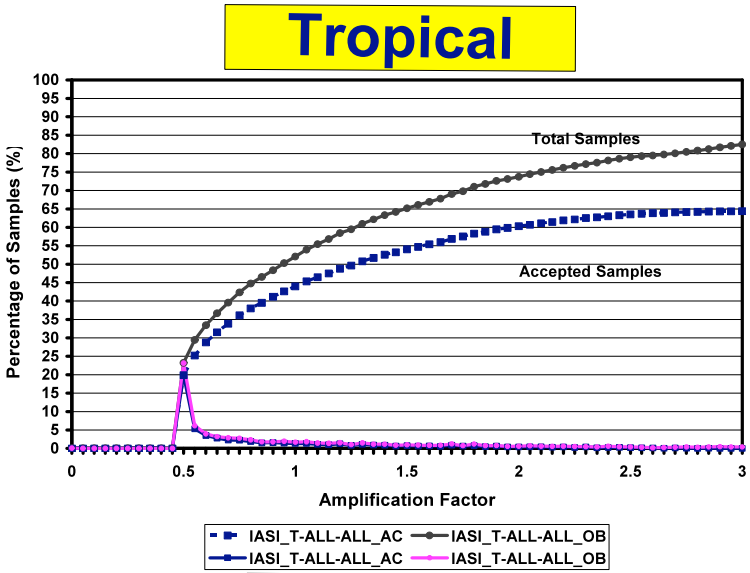


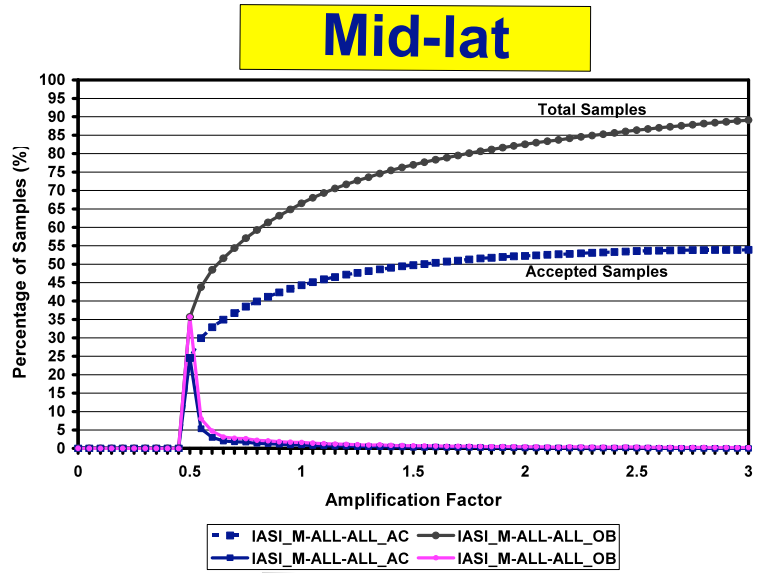


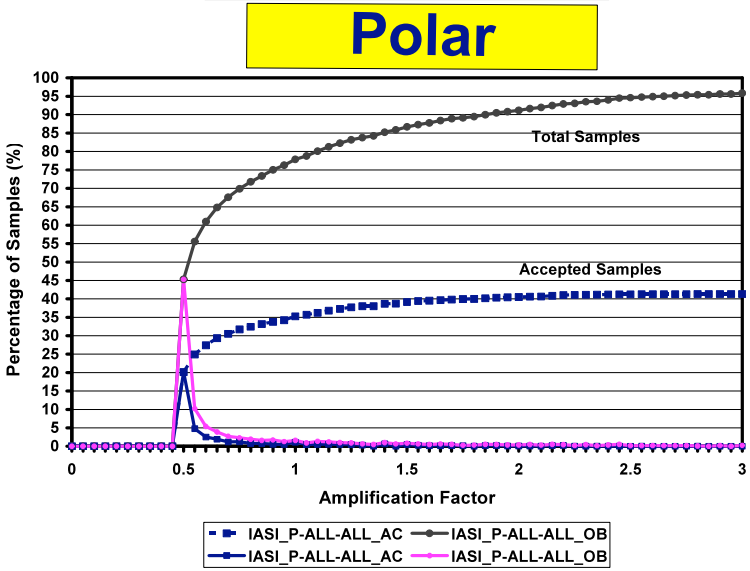


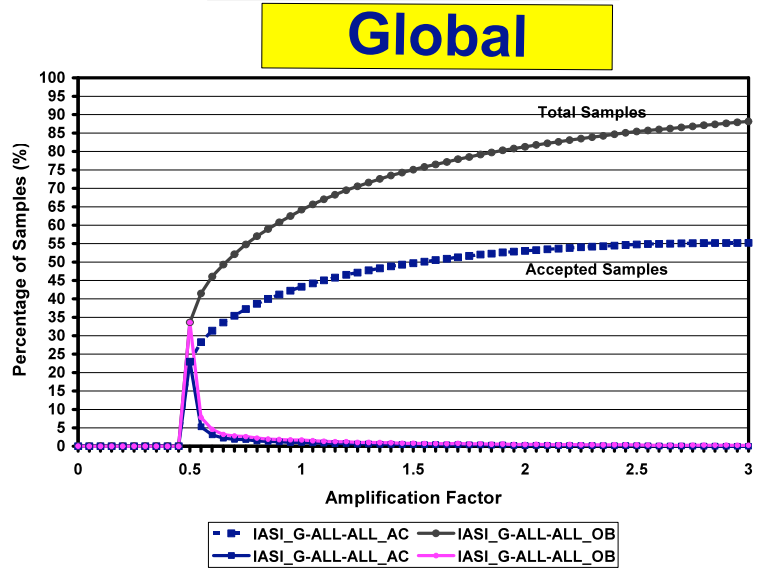


Noise Amplification in Cloud Clearing Procedure IASI (4 FOVs)

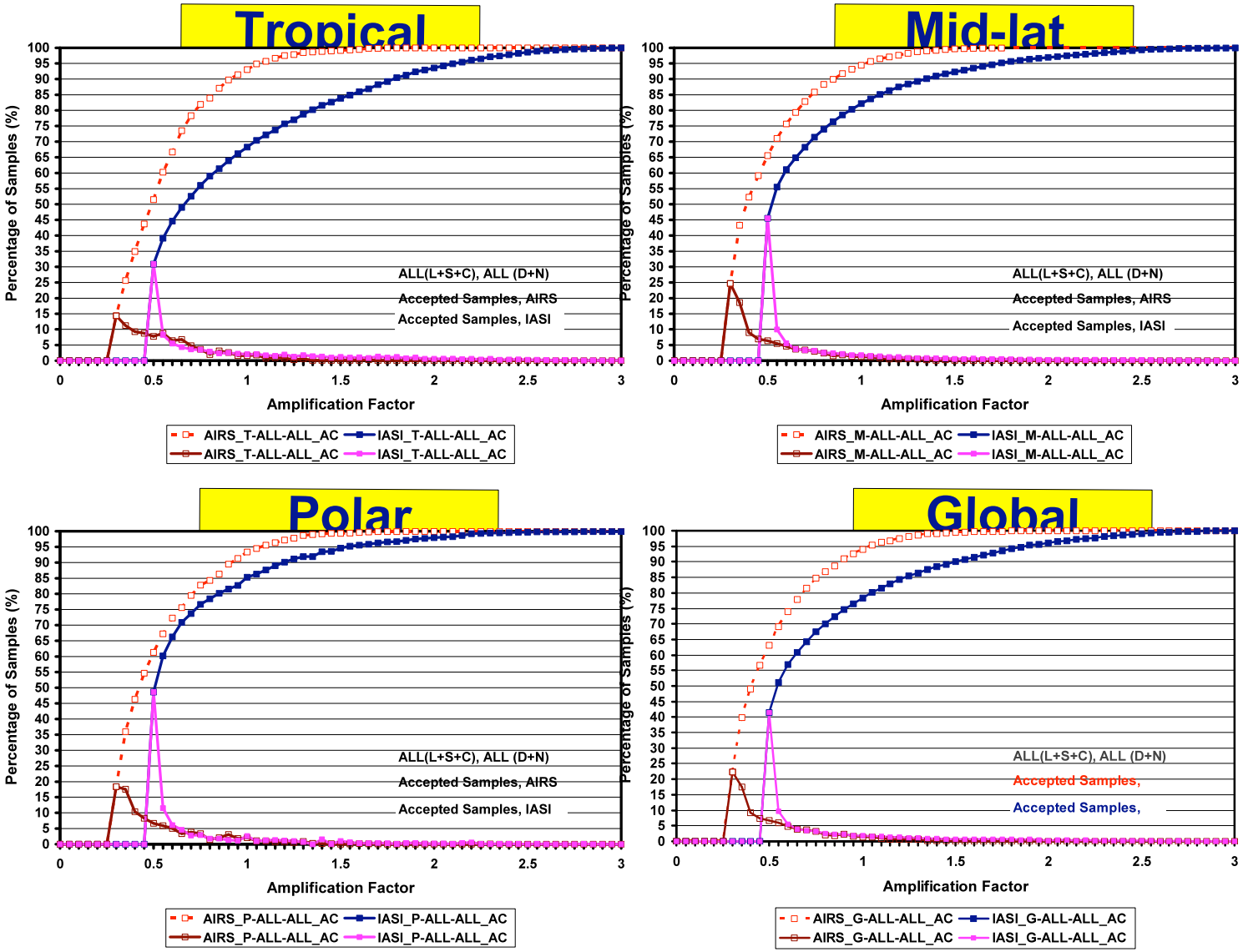


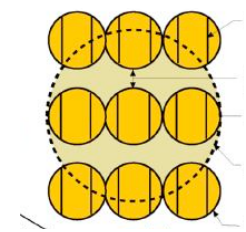




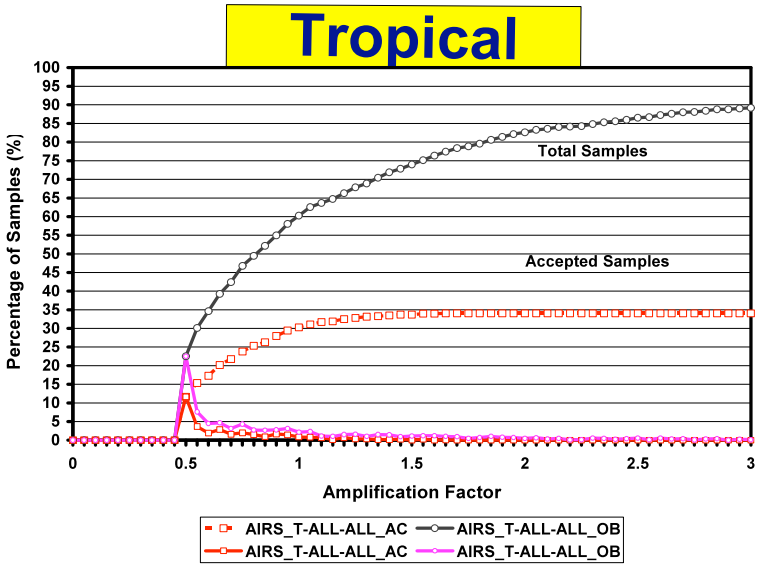


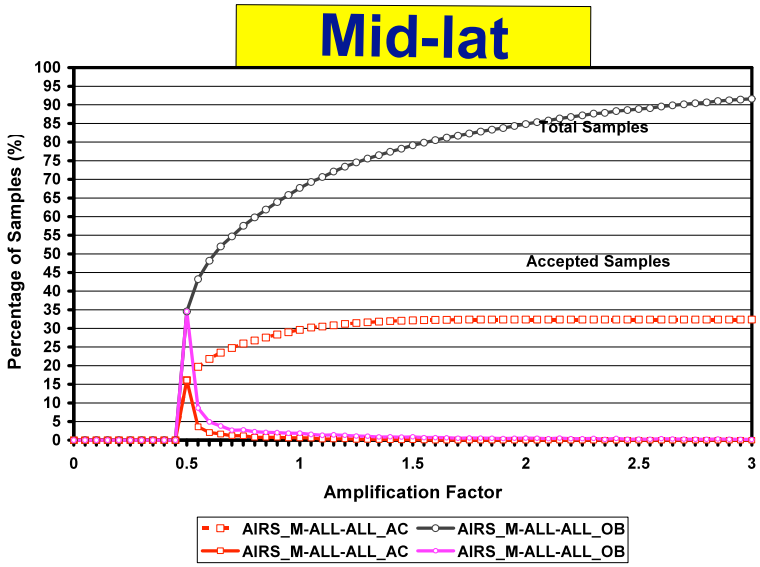
AIRS (9 FOVs) and IASI 4 FOV Percentage of Accepted Samples for each bin wrt to Total Number of Accepted Samples

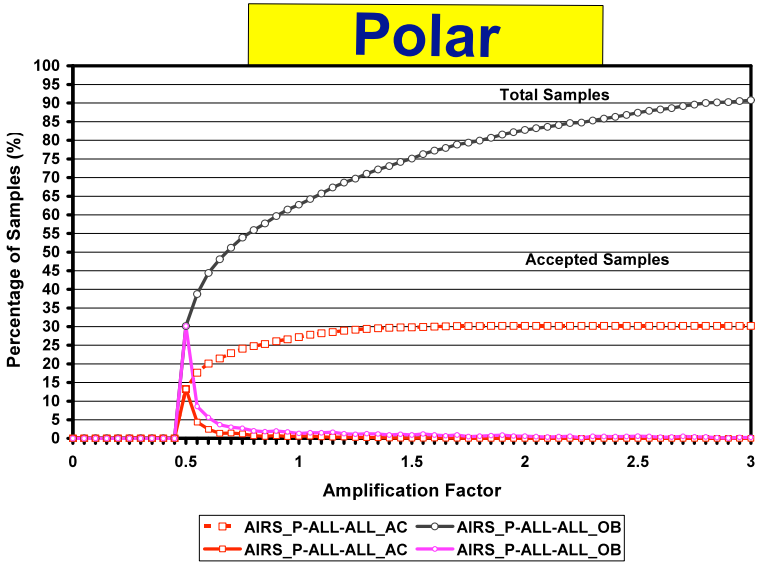


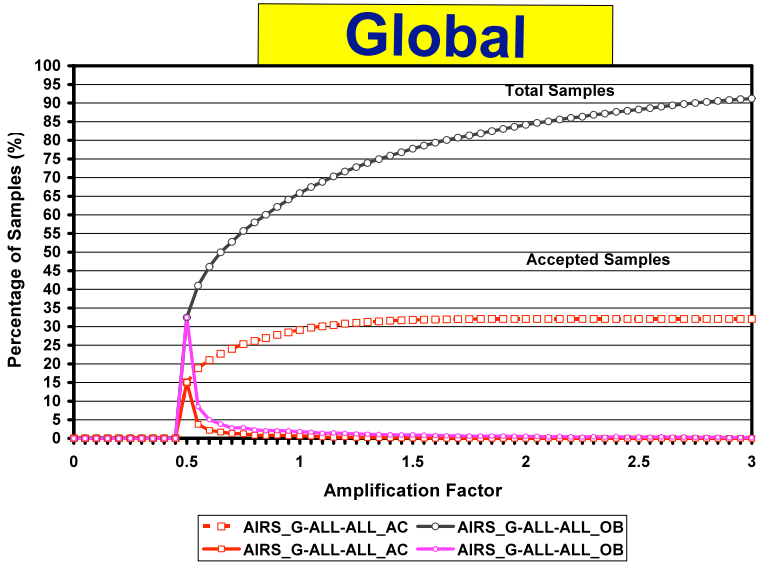


AIRS like IASI
Choose FOVs 2, 4, 6, 8 to Form IASI

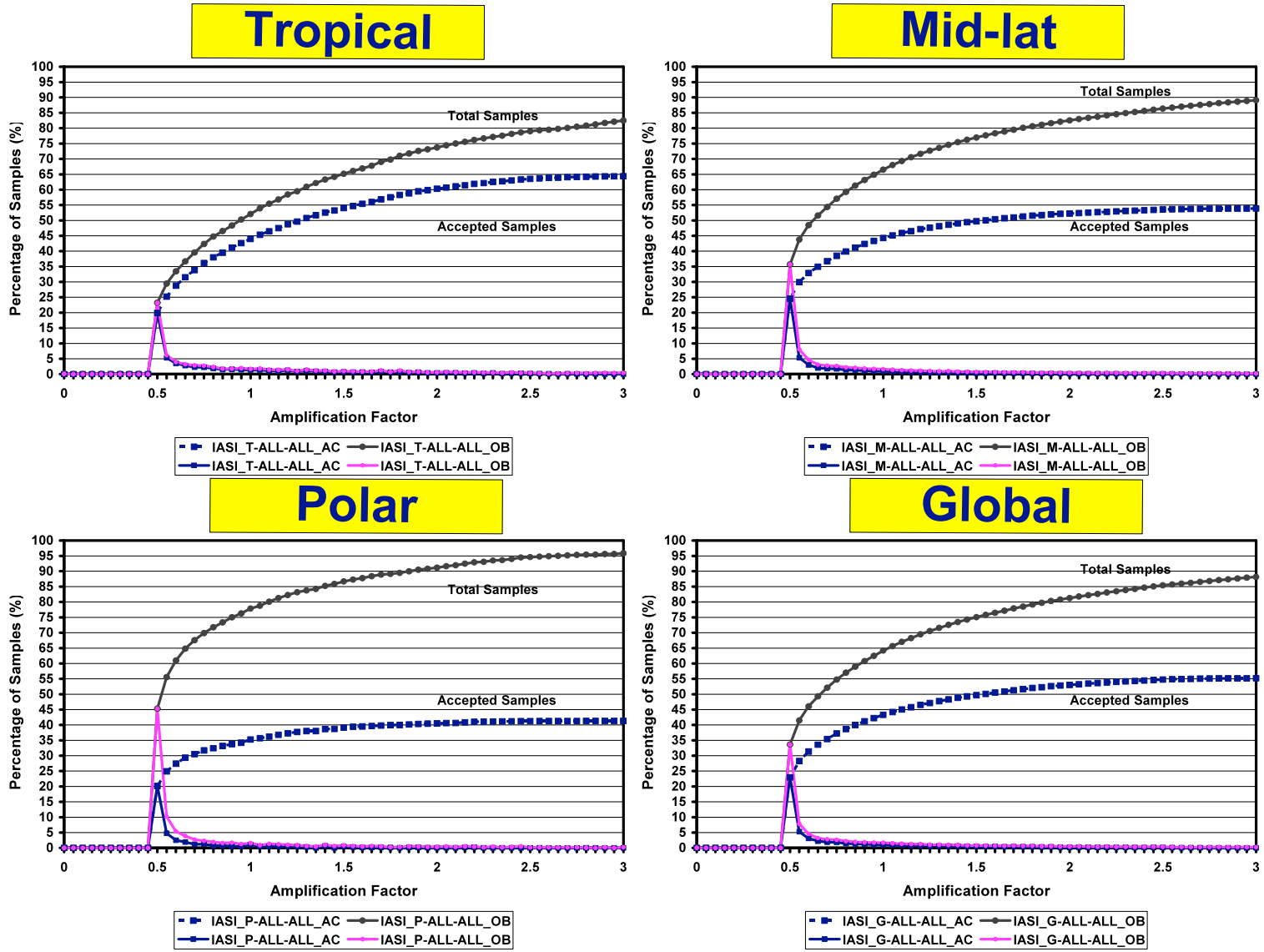








Noise Amplification in Cloud Clearing Procedure IASI (4 FOVs)



Validation Data

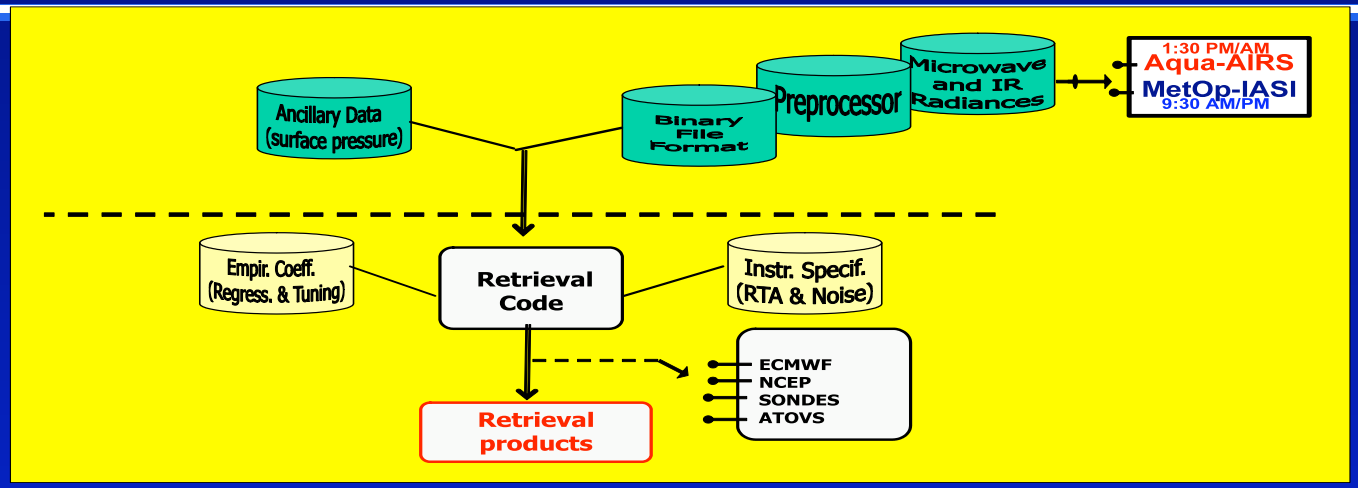
MetOp-IASI/Aqua-AIRS
Match-up Database
(Adapted to MetOP-IASI from Aqua-AIRS Validation System)

- RAOB Measurements Matched to Aqua (1:30 AM/ PM) and MetOP(9:30 AM/PM) Satellite Observations
- MetOp-IASI/AMSU-A/AMSU-B Level1B Radiances
- IASI Level-2 Retrievals
- Aqua-AIRS/AMSU-A Level1B Radiances
- AIRS Level-2 Retrievals
- NCEP-GFS (AVN) Level2-Forecast/Analysis
- ECMWF Level-2 Forecast/Analysis
- MetOp-ATOVS/NOAA-18 Level-2 Retrievals

Collocated Within ±3 Hrs. & 100 Km Radius
Data Used In this Study : November, 2007-2008

Source of RAOB Data : OSDPD MDB

Validation Data - Algorithms



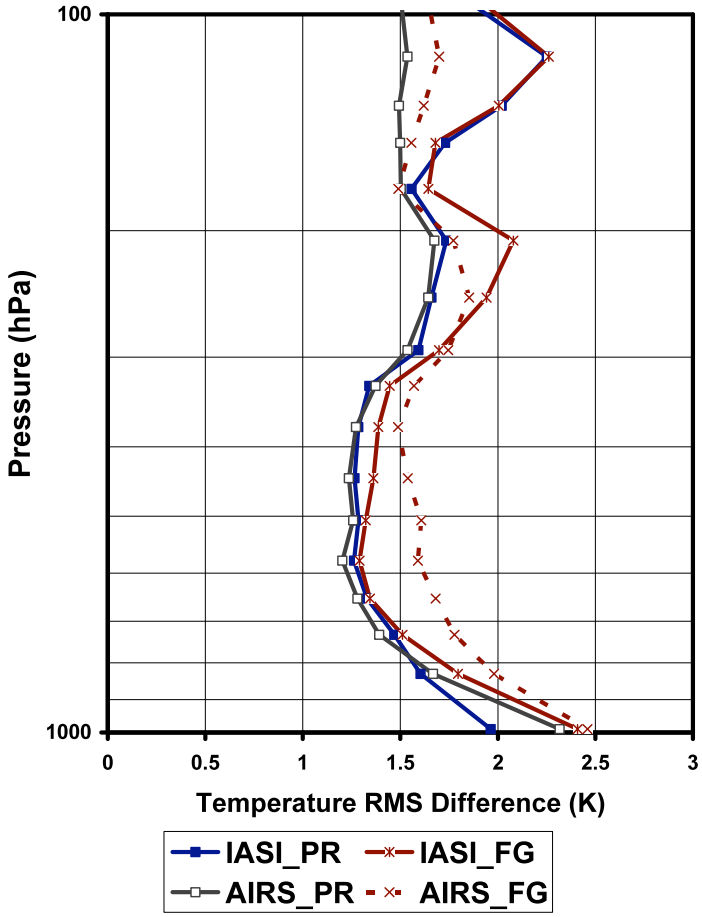
MetOp-IASI/Aqua-AIRS
Match-up Database
(Adapted to MetOP-IASI from Aqua-AIRS Validation System)

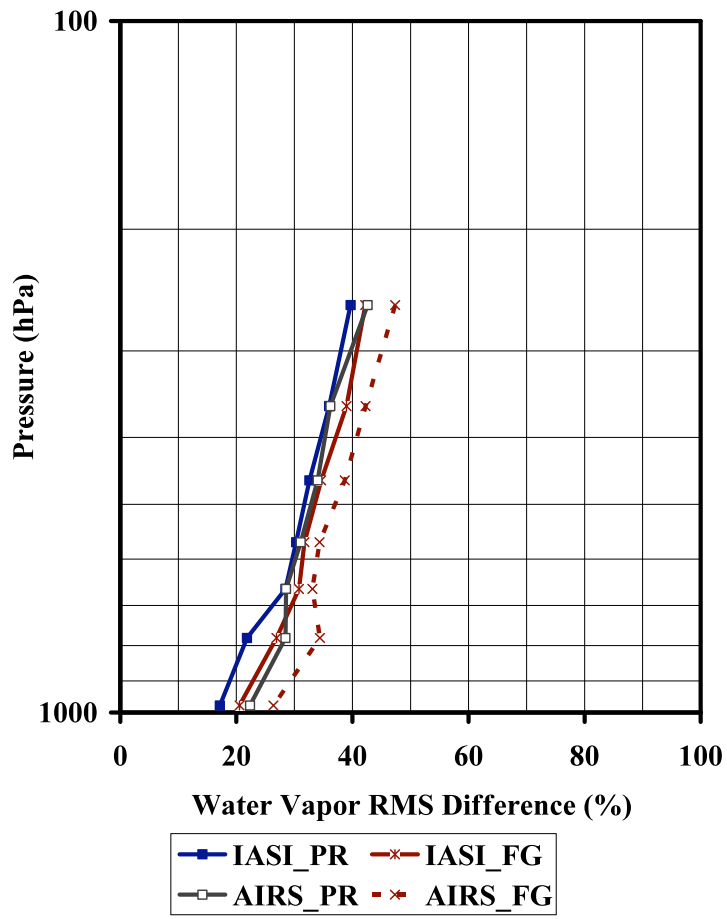
- RAOB Measurements Matched to Aqua (1:30 AM/ PM) and MetOP(9:30 AM/PM) Satellite Observations
- MetOp-IASI/AMSU-A/AMSU-B Level1B Radiances
- IASI Level-2 Retrievals
- Aqua-AIRS/AMSU-A Level1B Radiances
- AIRS Level-2 Retrievals
- NCEP-GFS (AVN) Level2-Forecast/Analysis
- ECMWF Level-2 Forecast/Analysis
- MetOp-ATOVS/NOAA-18 Level-2 Retrievals

Collocated Within ±3 Hrs. & 100 Km Radius
Data Used In this Study : November, 2007-2008

- **Emulate IASI/AIRS Retrieval Algorithms/Versions**
- **Reprocessing Options with Algorithm Upgrades, New Data**
- **Testing New Ideas in the Retrieval Algorithm**

IASI & AIRS Physical Ret vs. First Guess T(p), q(p) RMS Difference (Global)





Solid lines : IASI, Dotted Lines : AIRS

RAOB *vs.* IASI_PR AIRS_PR IASI_FG AIRS_FG