Initial IASI Radiance Assimilation Experiments in the NCEP Global Data Assimilation System

James Jung
Li Bi
Todd Schaack
Steve Ackerman (PI)

Overview

- BUFR Issues, Data Processing and GSI Modifications
- Experiment Design
- Results
- Future Work

BUFR Issues, Data Processing and Software modifications

- BUFR issues resolved
  - Modified BUFR tables
  - Improved memory efficiency
  - Updated NCEP BUFR library
- IASI data processing in real time
  - Operational time constraints being used
  - Data files are being generated for GDAS and GFS
  - Data are being pushed to the NOAA R&D IBM for testing
  - Not operational until BUFR library acceptance tests are complete
- GSI modifications
  - Read_IASI subroutine
    - Thinning routine
    - Quality Control
  - CRTM upgrade

IASI Experiment

- December 2007 version of GDAS/GFS at T382L64
- Used EUMETSAT channel selection
  - Longwave only (648.75 – 1320.0 cm^{-1})
  - 165 channels
- Thinned to 180 km
  - Clearest FOV based on AVHRR cloud fraction
- Radiance QC similar to AIRS

IASI Experiment

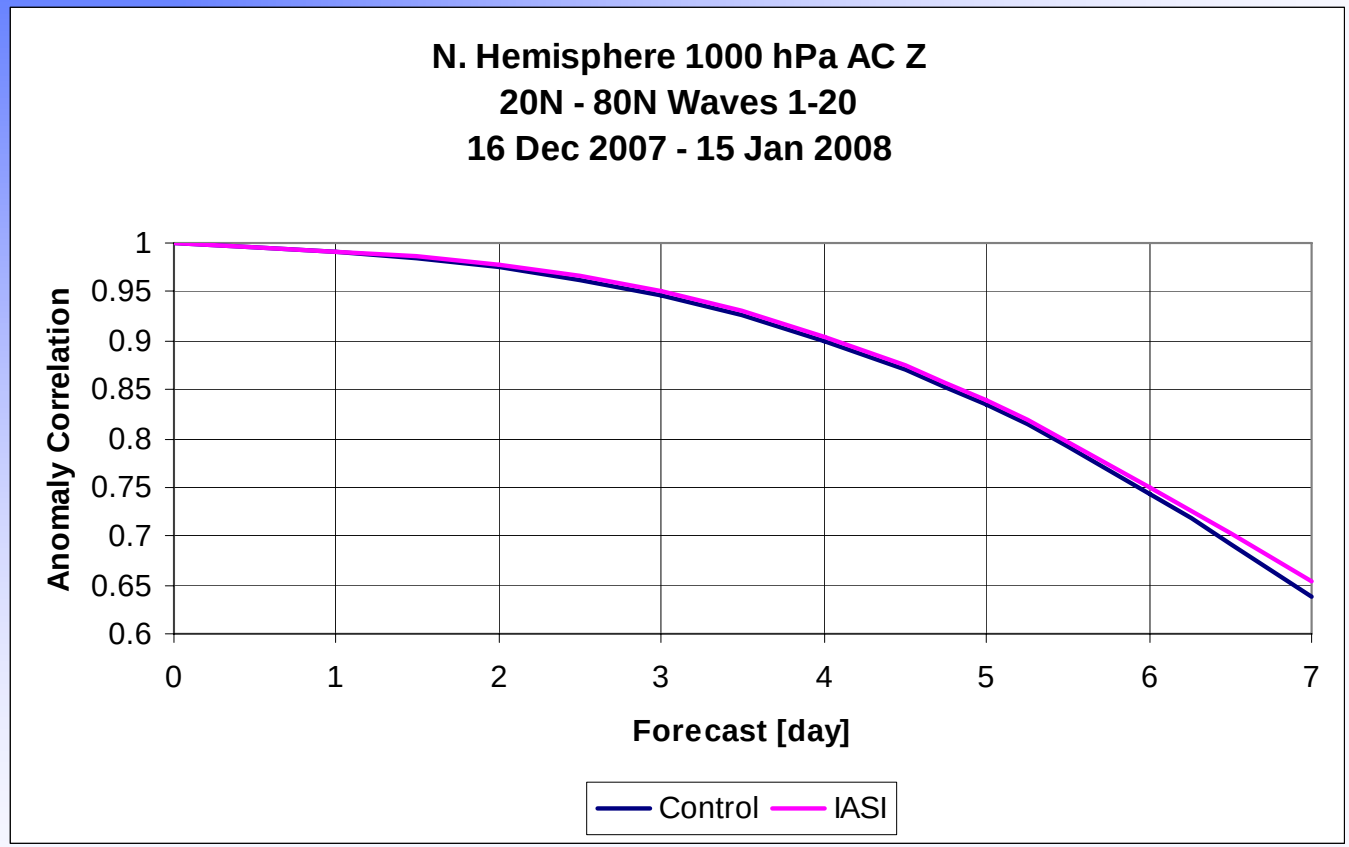
- All operational data types used
  - Including METOP's AMSUA, MHS, HIRS
- One month used for bias correction calculation / spinup
- Two Seasons
  - 10 July – 31 August 2007
  - 1 Dec 2007 – 15 Jan 2008
- Last 30 days used for analysis


JOINT CENTER FOR SATELLITE DATA ASSIMILATION
NOAA NASA JCSDA Navy Air Force

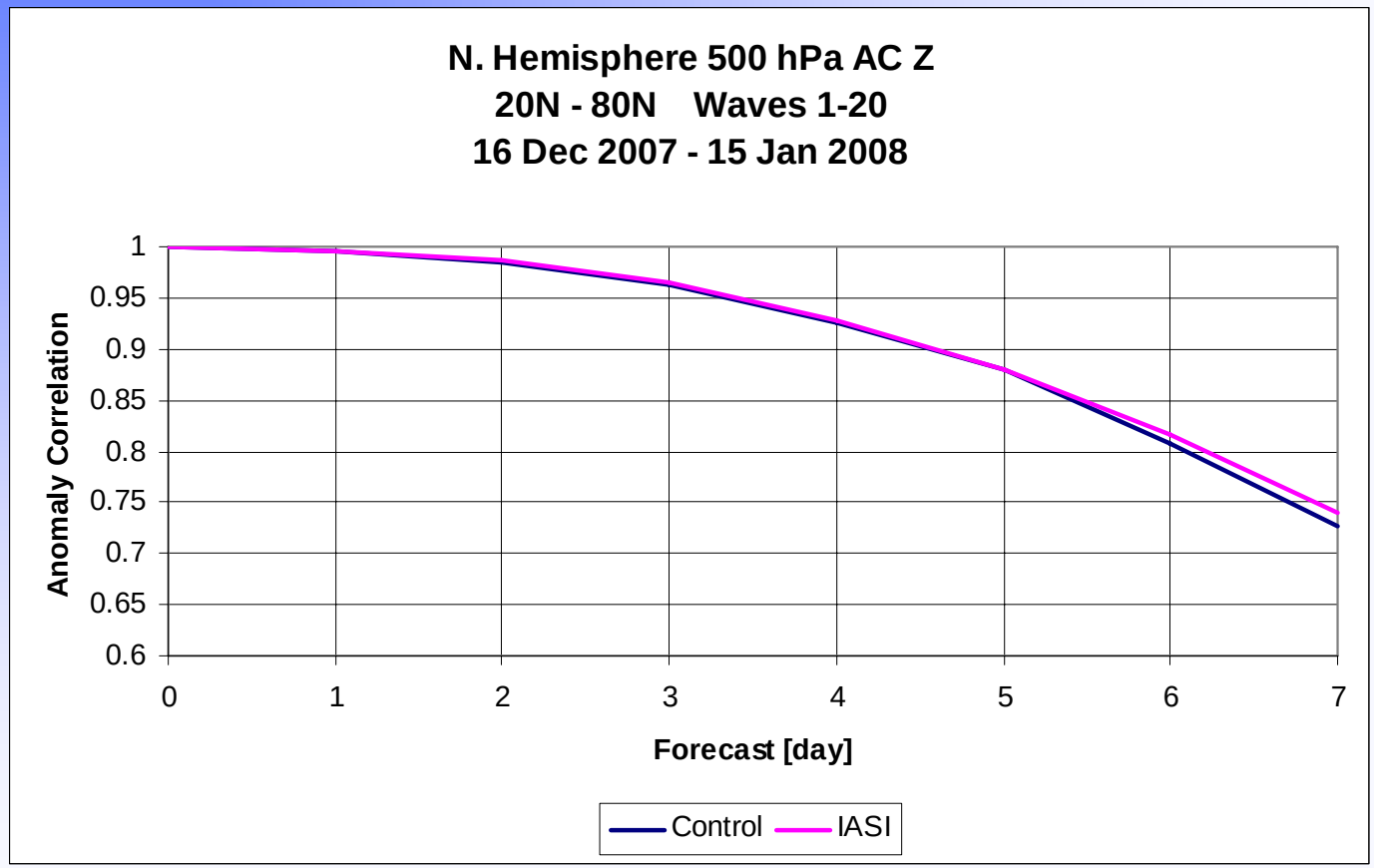
Results


CIMSS

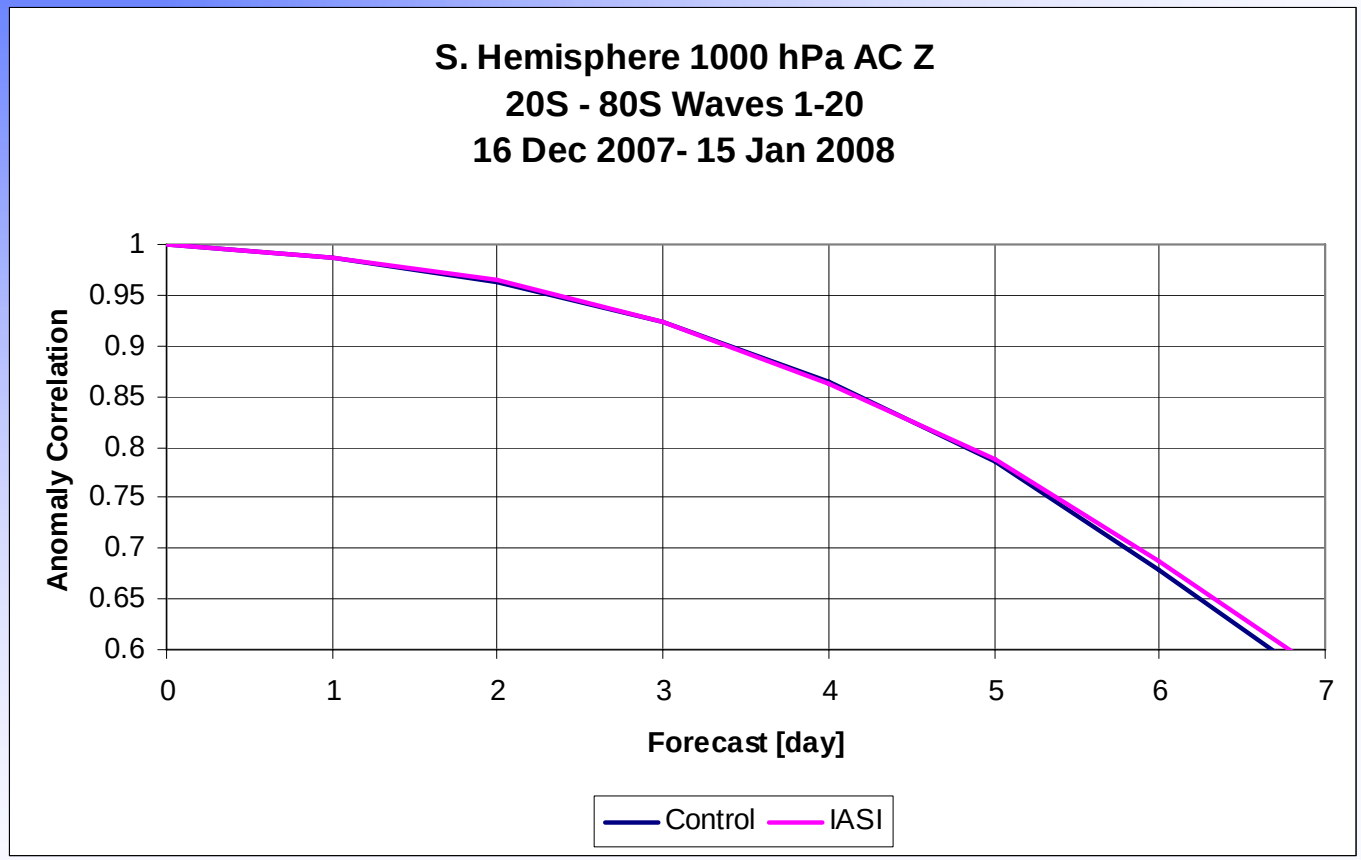
1000 hPa Anomaly Correlations for the Northern Hemisphere



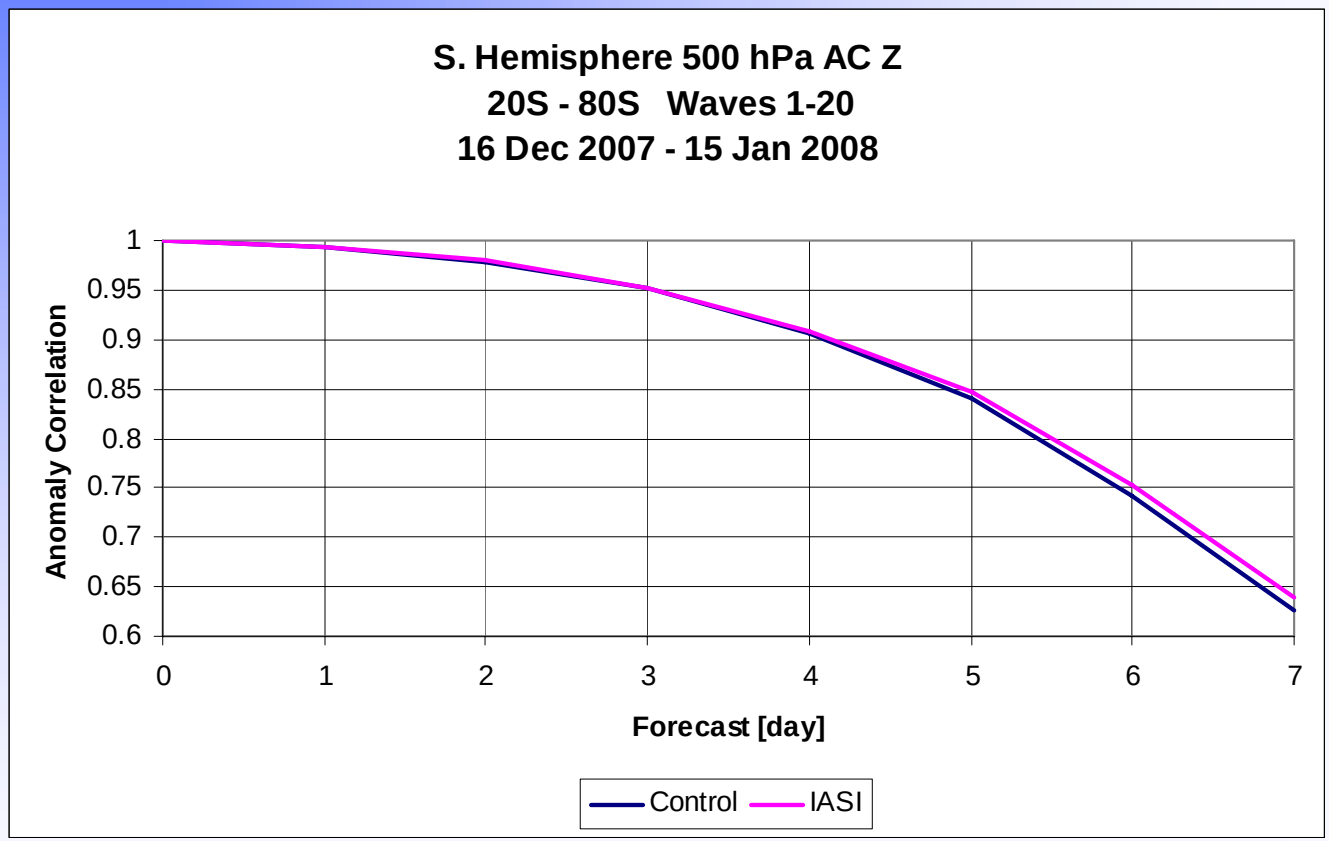
500 hPa Anomaly Correlations for the Northern Hemisphere



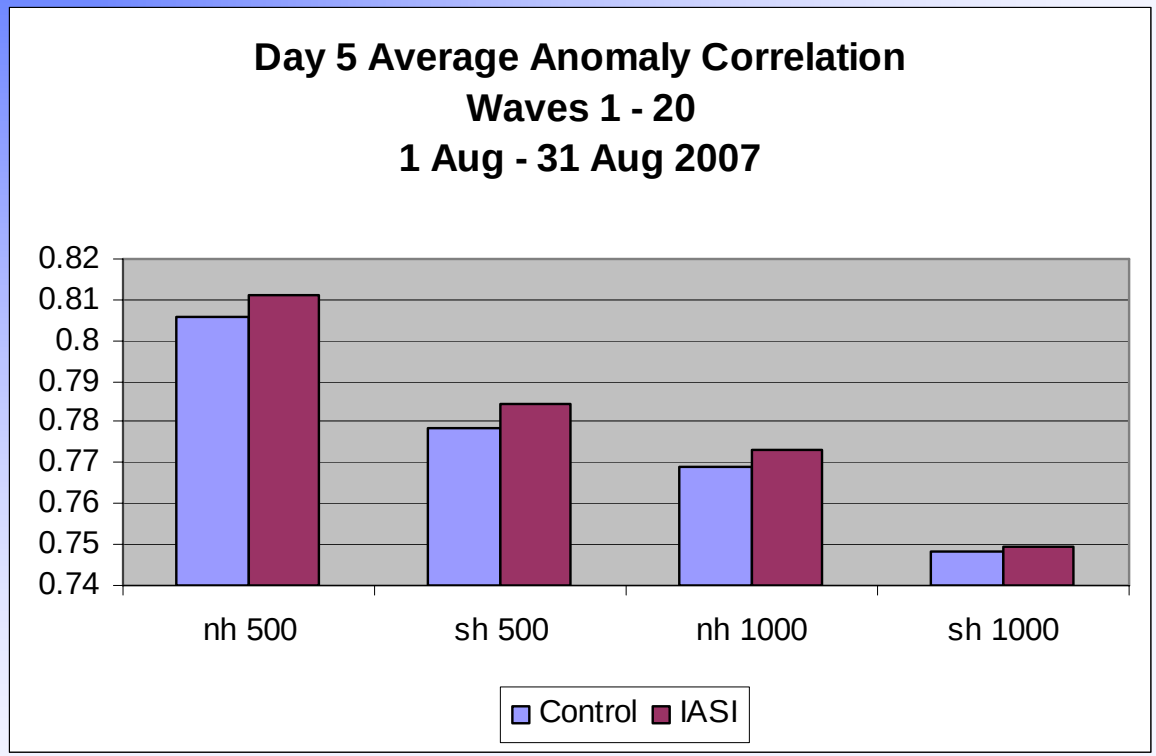
1000 hPa Anomaly Correlations for the Southern Hemisphere



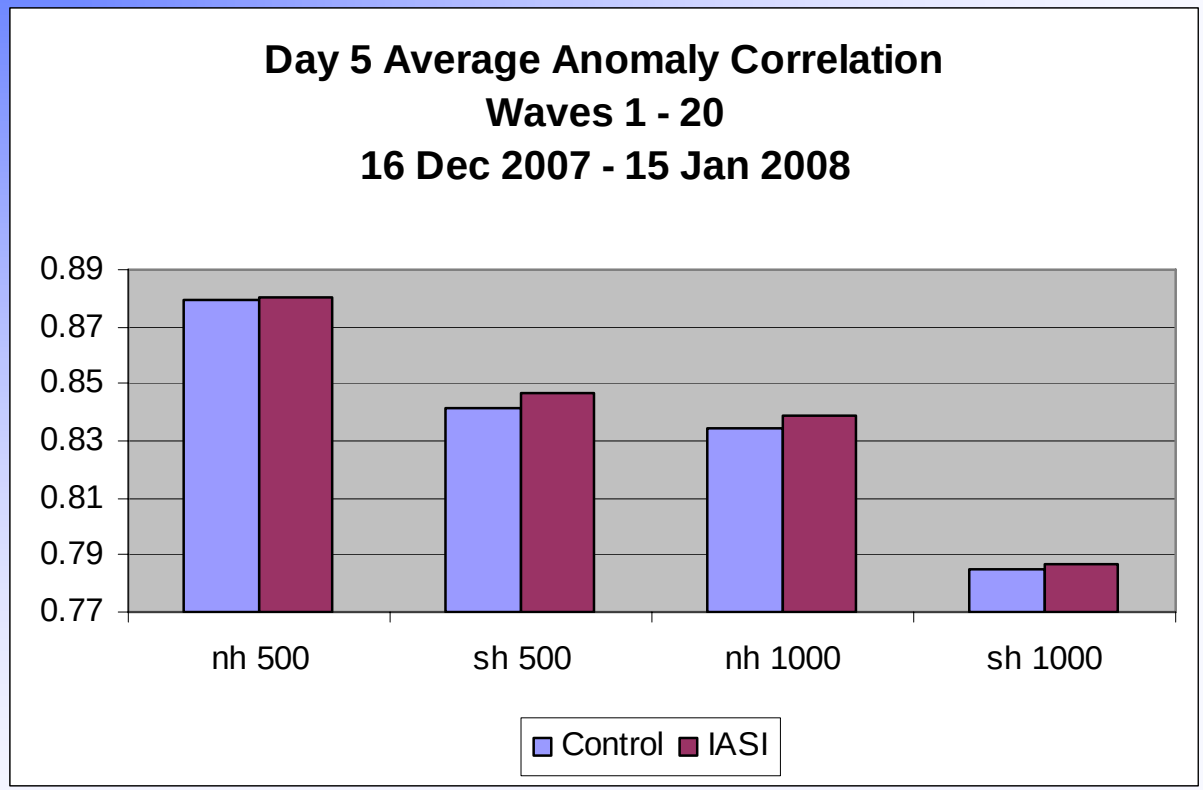
500 hPa Anomaly Correlations for the Southern Hemisphere



Summary of Day 5 Anomaly Correlations for August 2007



Summary of Day 5 Anomaly Correlations for Dec 2007 – Jan 2008



Forecast Impact

$$FI(x,y) = 100 \times \left\{ \left(\sqrt{\frac{\sum_{i=1}^{N} (C_i - A_i)^2}{N}} - \sqrt{\frac{\sum_{i=1}^{N} (D_i - A_i)^2}{N}} \right) \Big/ \sqrt{\frac{\sum_{i=1}^{N} (D_i - A_i)^2}{N}} \right\}$$

Error in Control

Error in Experiment

Error in Experiment

C = Control Forecast

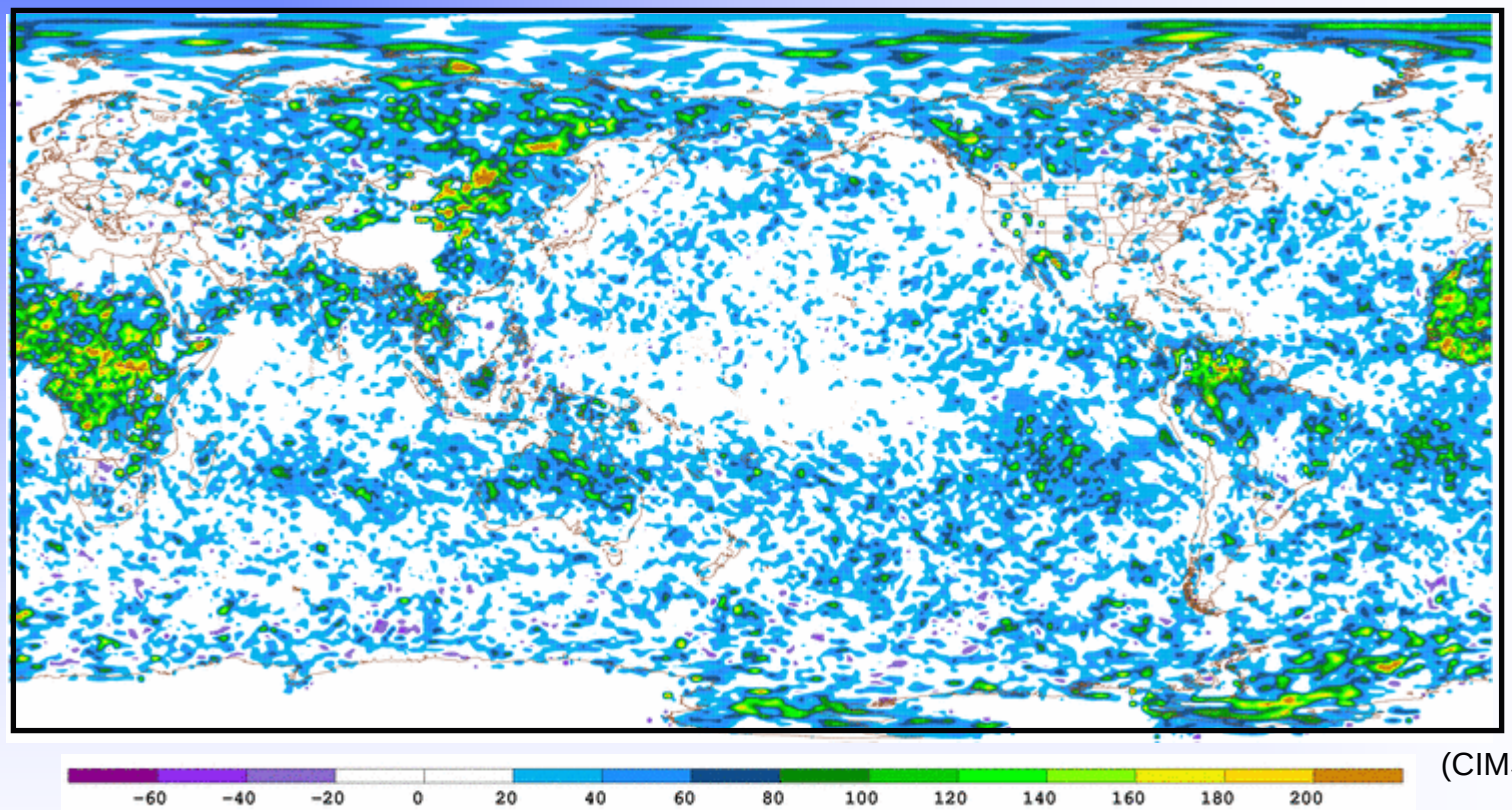
D = Experiment Forecast

A = Analysis valid at forecast time

N = Number of forecasts

Forecast Impact

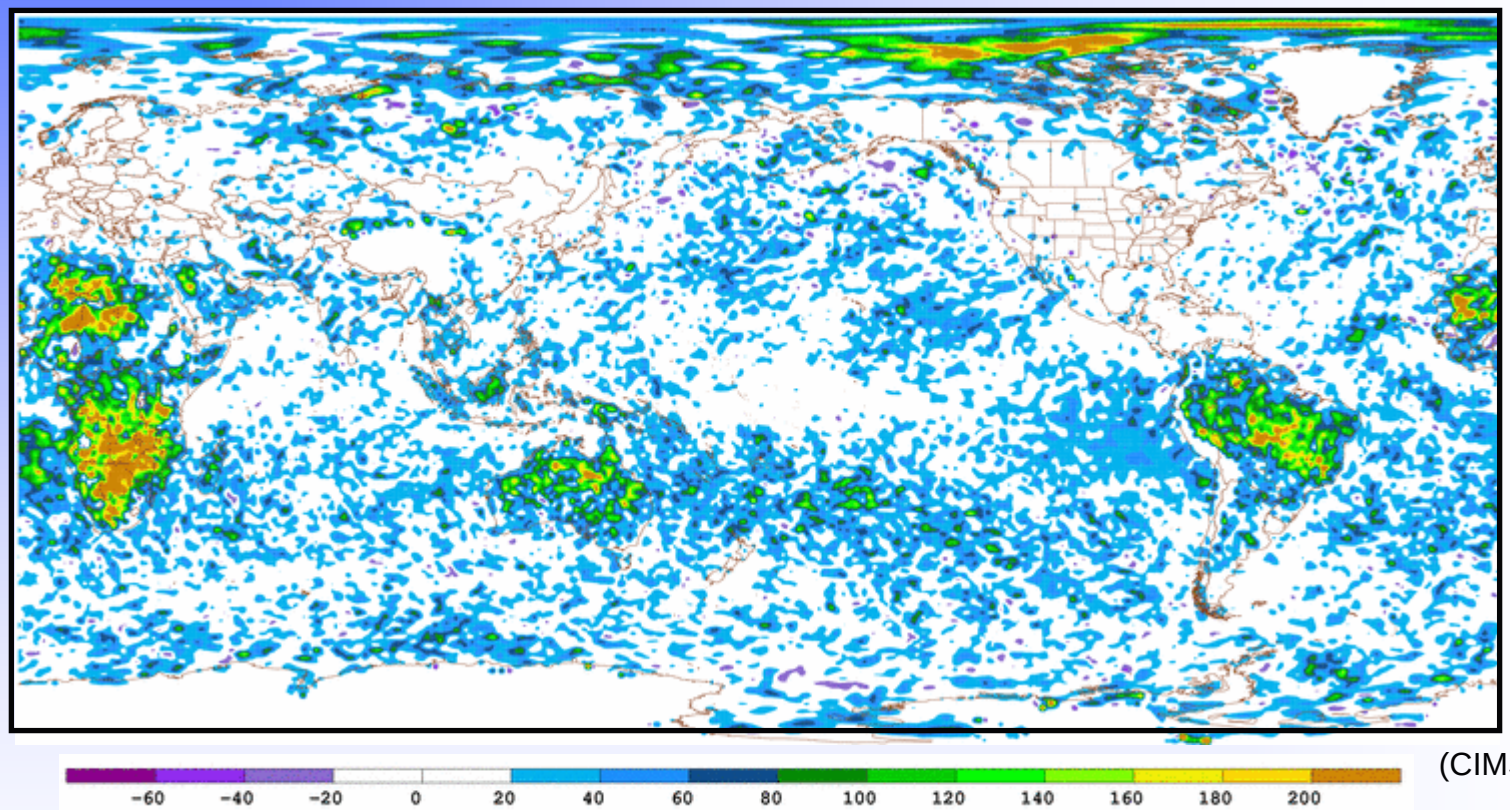
850hPa RH FCST IMPACT 12HR IASI AUG 2007



(CIMSS)

Forecast Impact

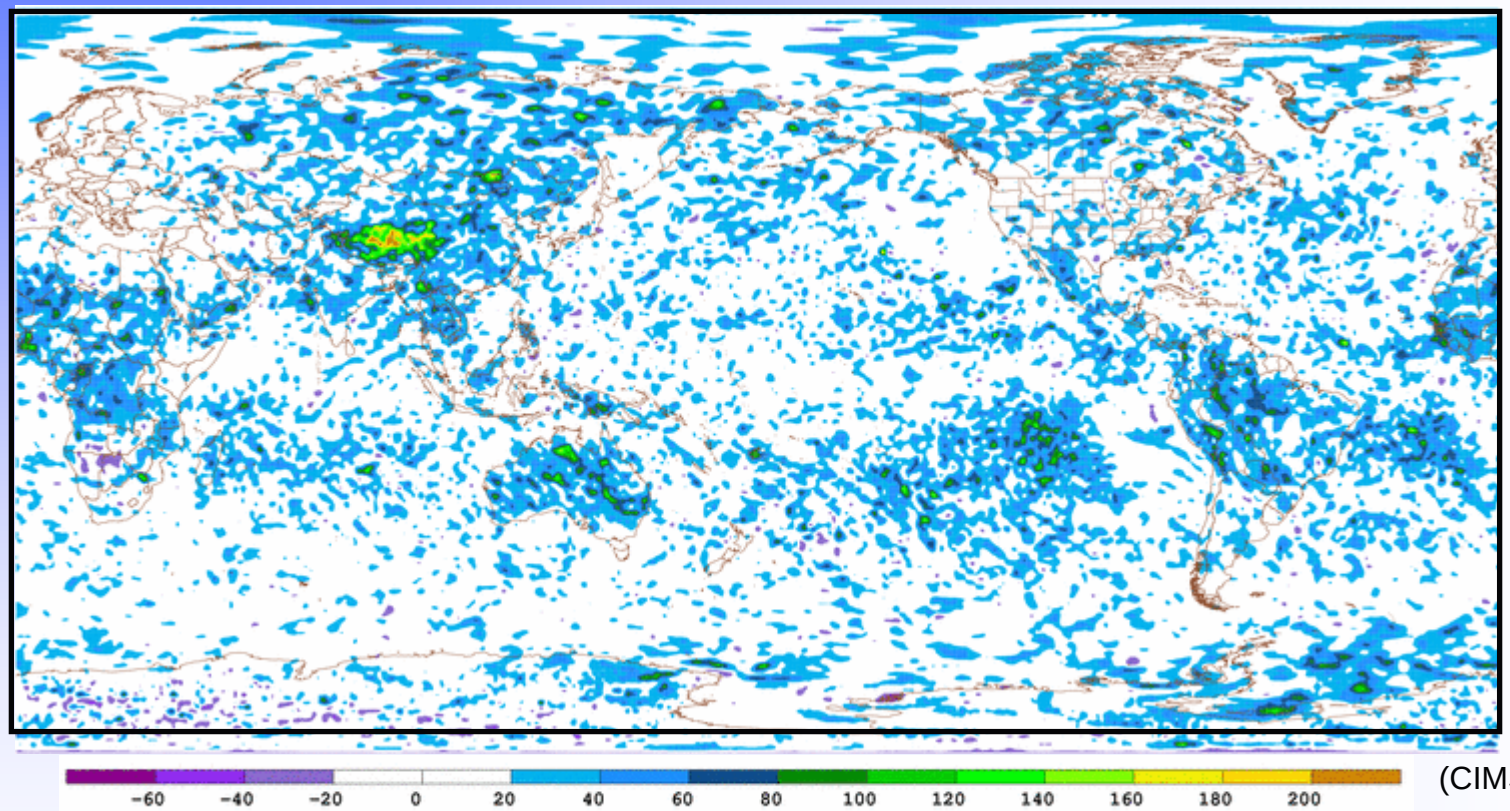
850hPa RH FCST IMPACT 12HR IASI DEC 2007



(CIMSS)

Forecast Impact

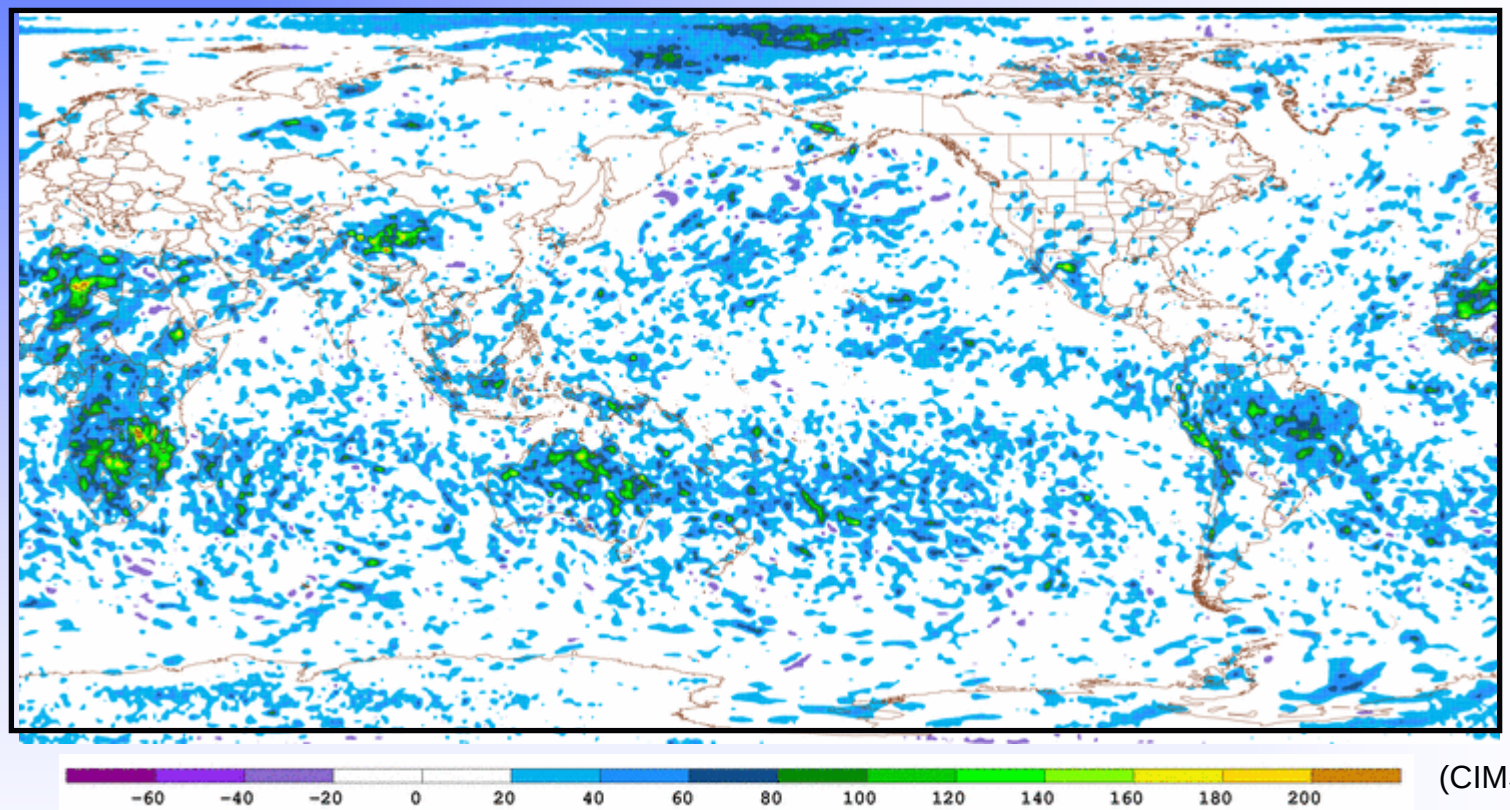
PRECIP WATER FCST IMPACT 12HR IASI AUG 2007



(CIMSS)

Forecast Impact

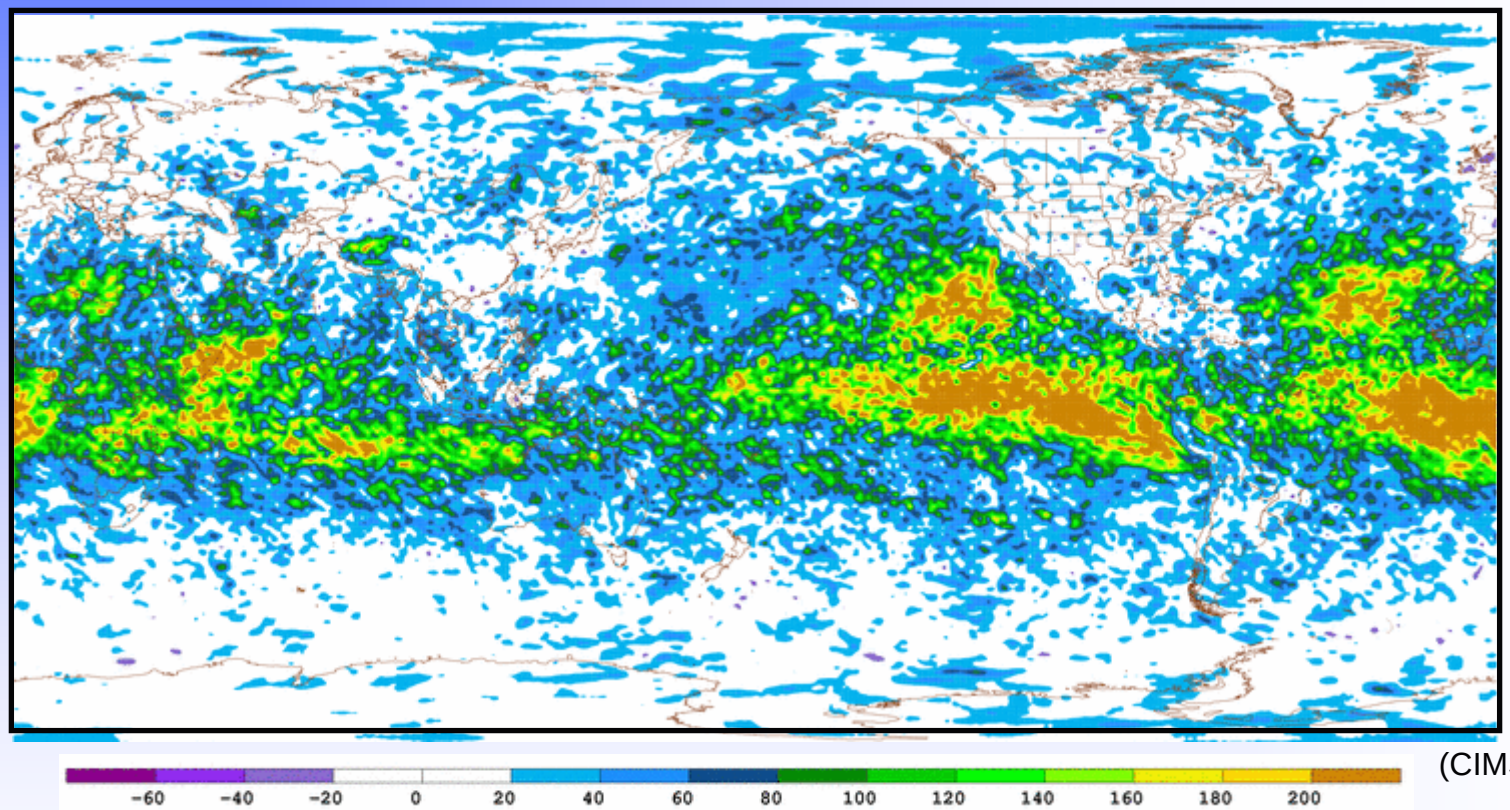
PRECIP WATER FCST IMPACT 12HR IASI DEC 2007



(CIMSS)

Forecast Impact

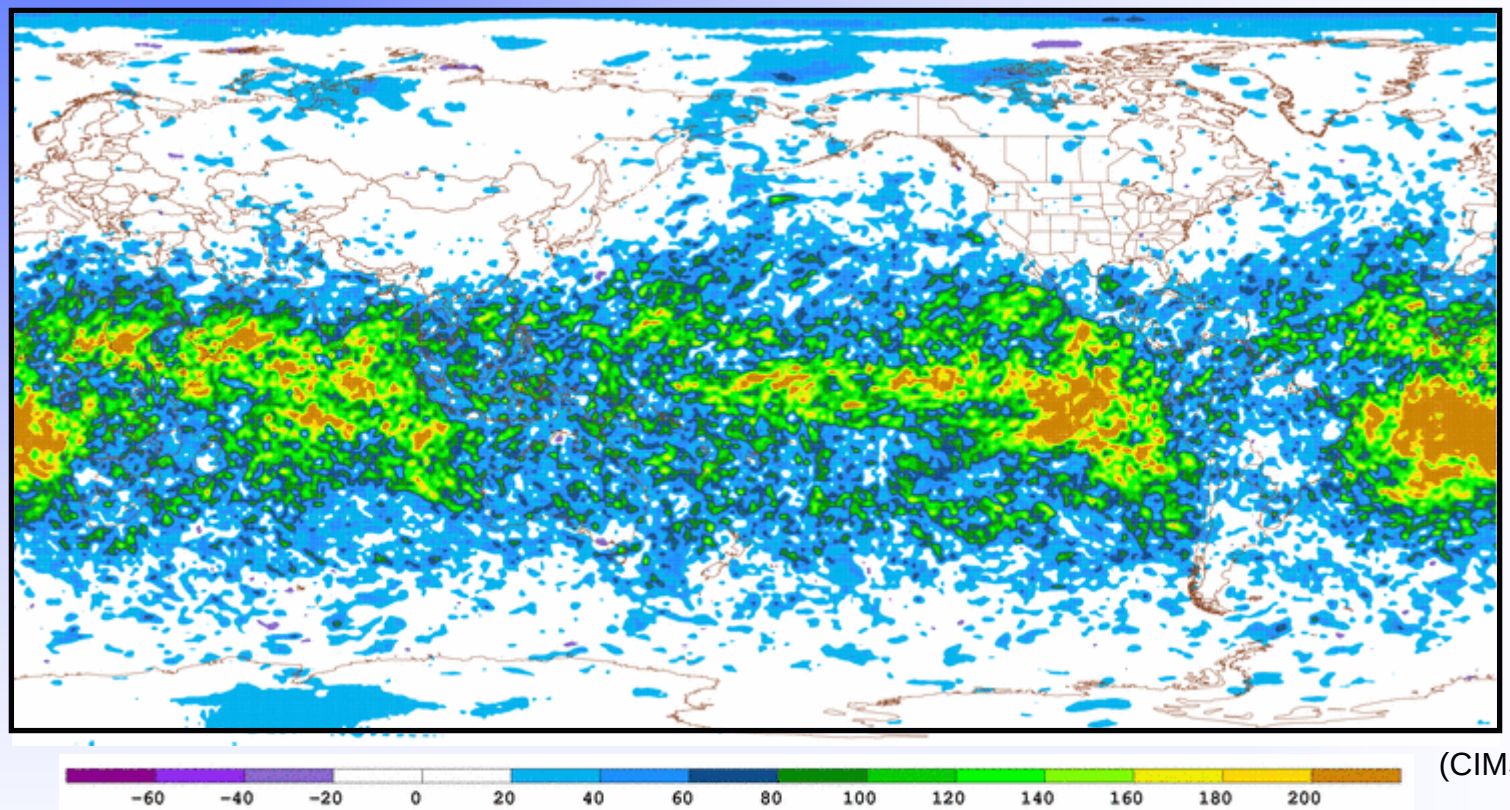
500hPa TEMP FCST IMPACT 12HR IASI AUG 2007



(CIMSS)

Forecast Impact

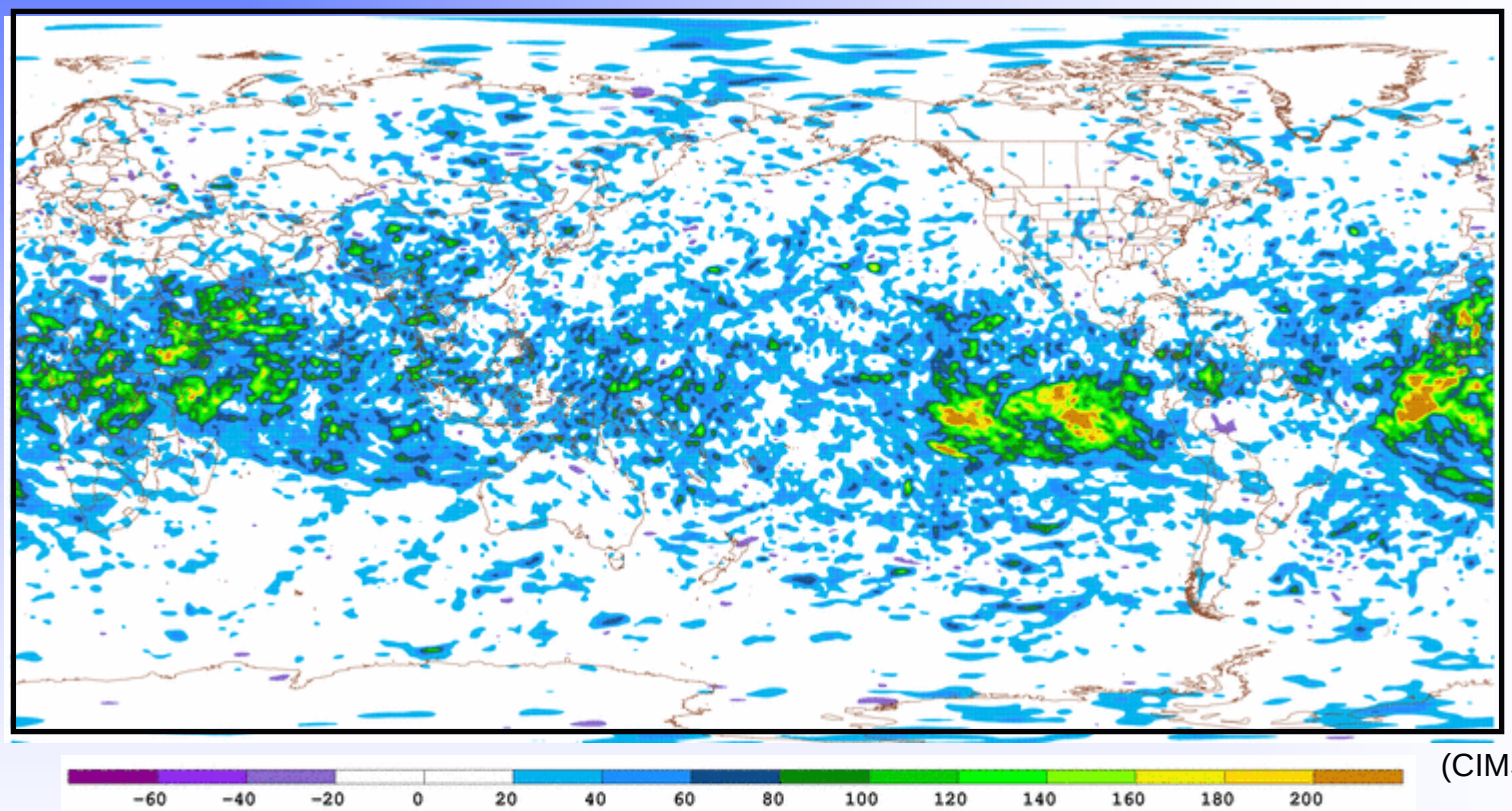
500hPa TEMP FCST IMPACT 12HR IASI DEC 2007



(CIMSS)

Forecast Impact

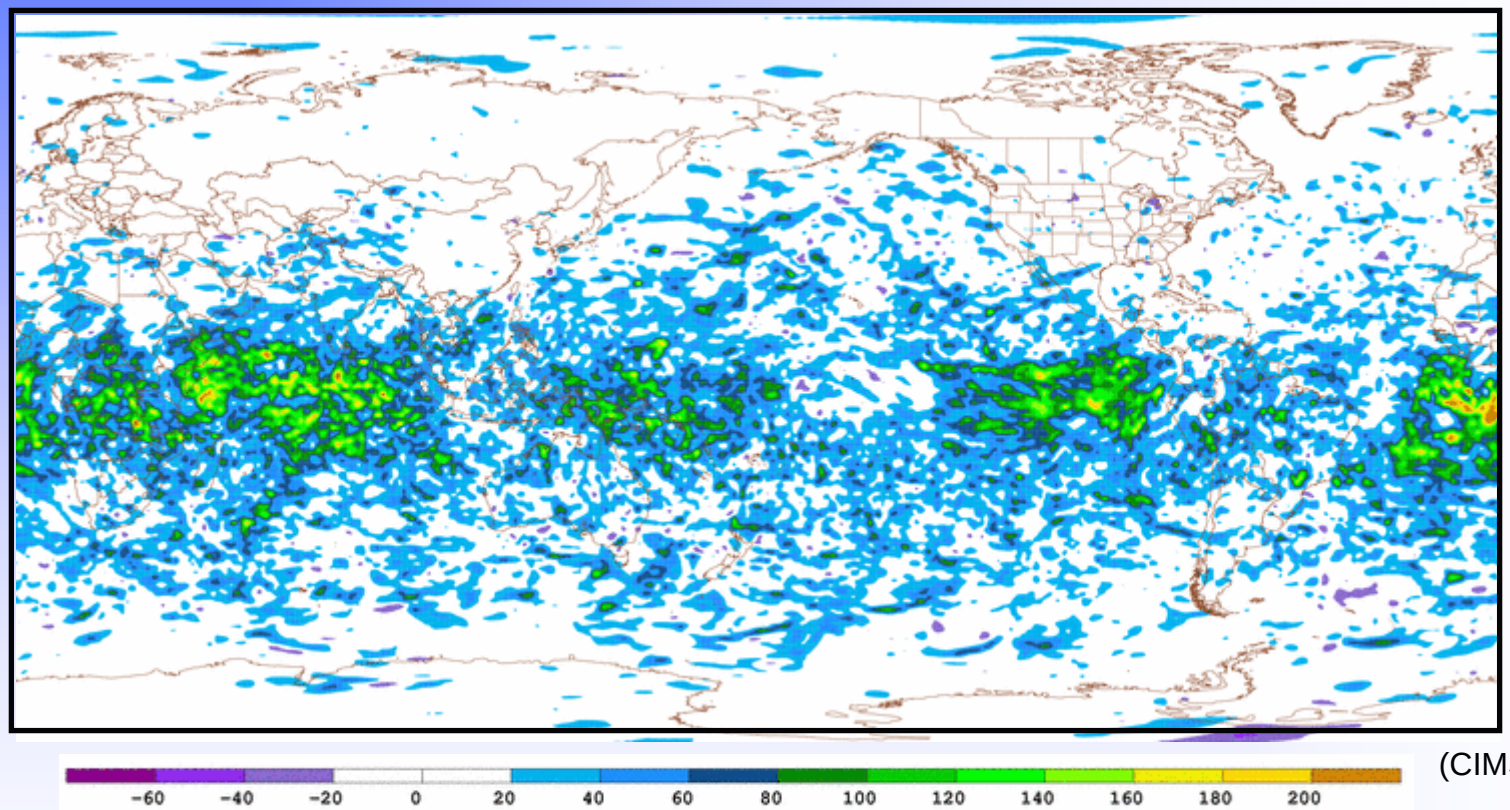
250hPa UGRD FCST IMPACT 12HR IASI AUG 2007



(CIMSS)

Forecast Impact

250hPa UGRD FCST IMPACT 12HR IASI DEC 2007



(CIMSS)

Summary

- Completed a two season assimilation impact study of IASI longwave radiances.
- Anomaly correlations are generally improved for both hemispheres and seasons by using IASI.
- Forecast Impacts of temp, moisture and wind are generally positive.

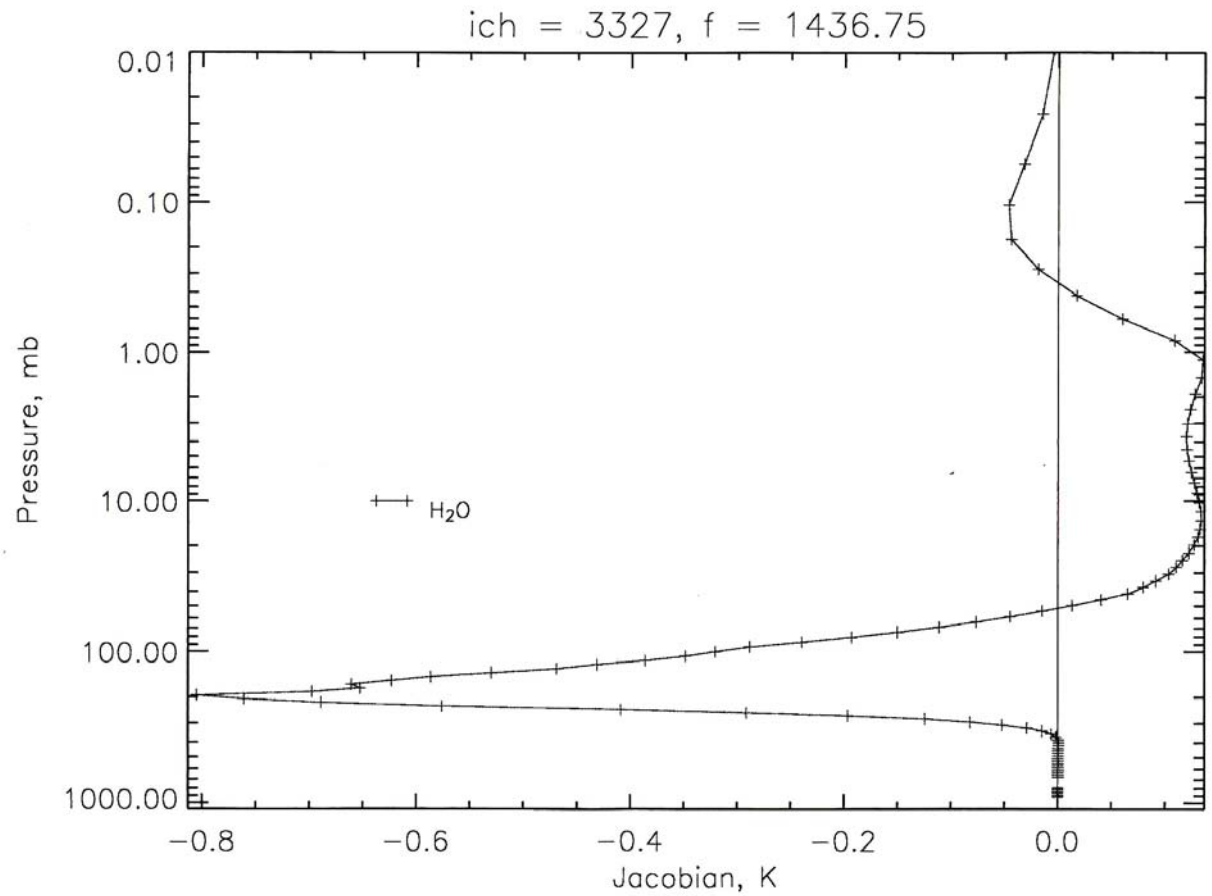
Progress

- IASI BUFR issues are resolved
  - New BUFR table adopted
  - Memory requirements significantly reduced
  - In NCEP Operations testing
- IASI data
  - Real time processing with operational time constraints
  - Not in NCEP operations yet
- GSI Modifications
  - Two season tests completed
  - Software transitioned to NCEP
  - In parallel testing

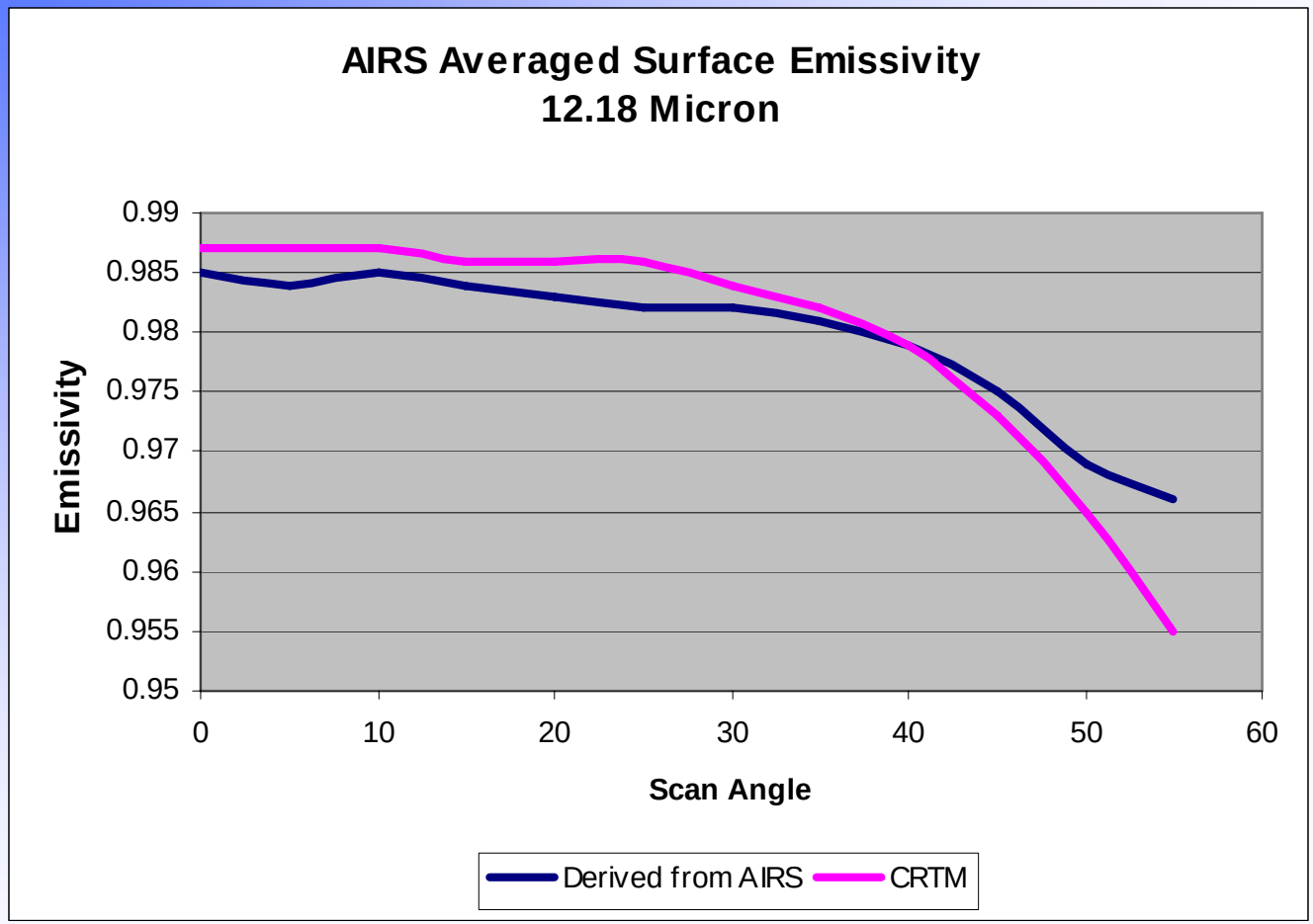
Future Work

- IASI water vapor channels
  - Assimilation issues
  - Model moisture issues
  - Potential collaboration with Paul van Delst, Chris Barnet, and others
- Investigate the infrared scan angle dependence of ocean surface emissivity and potentially improve the CRTM's interpolation routine.
  - Potential collaboration with Paul van Delst and Nick Nali(?)
- ASCAT assimilation
  - Continued work with Li Bi, Zorana Jelenak and John Derber
- Geostationary Winds
  - Investigate the use of expected error for improving impact to NWP
  - Potential collaboration with Dave Santek, Xiujuan Su, Jaime Daniels, John Le Marshall and others.

IASI Water Vapor Jacobian



Ocean Infrared Emissivity



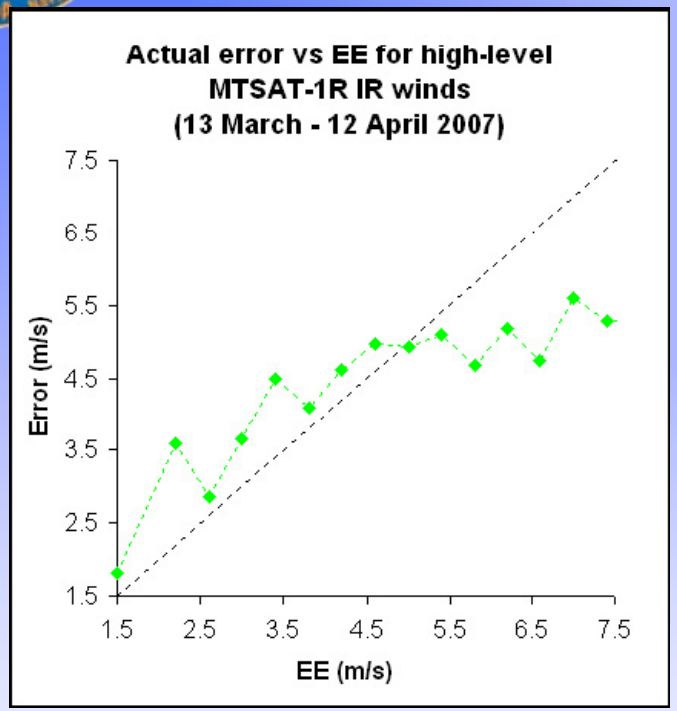


Fig. 2 (a) Measured error (m/s) versus EE for high-level MTSAT-1R IR winds (13 March - 12 April 2007

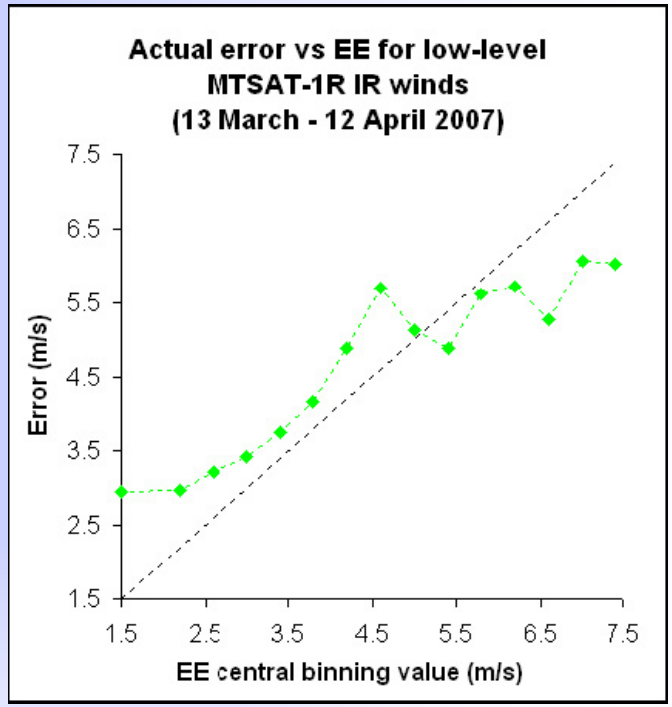


Fig. 2 (b) Measured error (m/s) versus EE for low-level MTSAT-1R IR winds (13 March - 12 April 2007)

Australian Government
Bureau of Meteorology

From J. Le Marshall

CIMSS

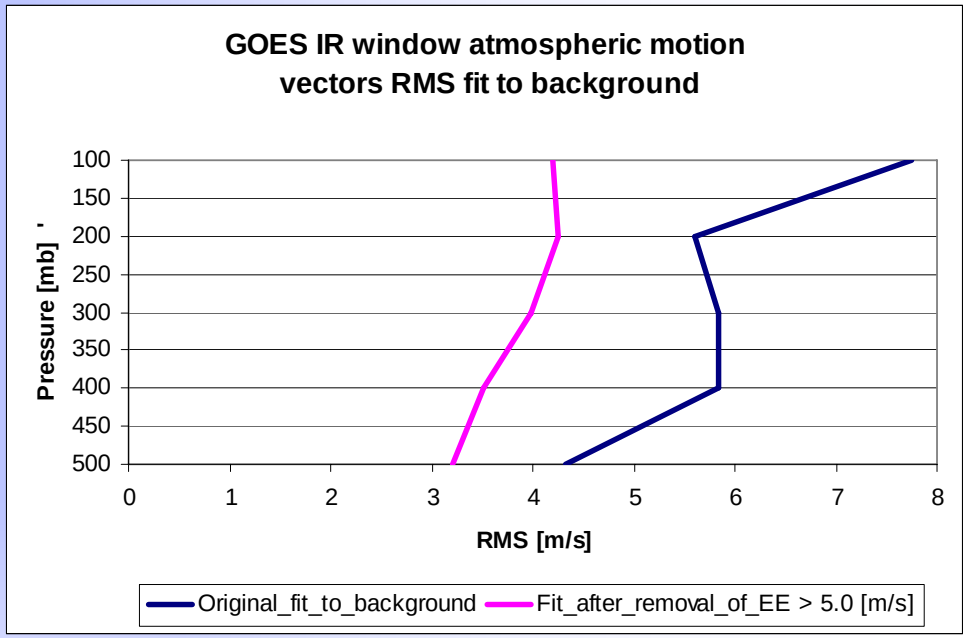
HRIT IR1 AMV/RAOB Comparison: 24 January – 20 February, 2008 v1 15min.						
Wind Level	**LOW** ERR=0,EE<3.5				**High** ERR=0,QI=.6-1.	
Wind Type	**AMV**		**Background**		**AMV**	**Background**
RAOB/AMV Sep	**75**	**150**	**75**	**150**	**150**	**150**
No of Vectors	**53**	**264**	**53**	**264**	**2953**	**2953**
Bias m/s	**0.27**	**0.3**	**-0.26**	**-.28**	**-0.05**	**-0.92**
MMVD	**2.40**	**2.83**	**2.56**	**2.73**	**4.04**	**4.17**
RMS VD m/s	**2.72**	**3.24**	**2.76**	**3.08**	**4.59**	**4.81**

HRIT IR1 AMV/RAOB Comparison: 24 January – 20 February, 2008 v2 15min.						
Wind Level	**LOW** ERR=0,EE<3.5				**High** ERR=0,QI=.6-1.	
Wind Type	**AMV**		**Background**		**AMV**	**Background**
RAOB/AMV Sep	**75**	**150**	**75**	**150**	**150**	**150**
No of Vectors	**53**	**264**	**53**	**264**	**3254**	**3254**
BIAS m/s	**-0.08**	**-0.21**	**-0.26**	**-0.28**	**0.80**	**-1.07**
MMVD m/s	**2.22**	**2.71**	**2.56**	**2.73**	**3.82**	**4.28**
RMS VD m/s	**2.53**	**3.12**	**2.76**	**3.08**	**4.41**	**4.92**

GOES-E IR AMV/RAOB Comparison:9 April – 26 April, 2008 v1.		
Wind Level	**LOW** ERR=0,EE<3.5	
Wind Type	**AMV**	**Background**
RAOB/AMV Separation	**50**	**50**
No of Vectors	**46**	**46**
MMVD m/s	**2.30**	**2.32**

J. Le Marshall

Satellite Winds Expected Error Tests



Acknowledgements

- Stephen Lord, John Derber, Russ Treadon (NCEP) for GFS/GDAS software and advice.
- Paul van Delst (SAIC) for help with the CRTM
- Tom King (NESDIS), Dennis Keyser, Stacie Bender and Jack Woollen (NCEP) for help with BUFR issues
- The JCSDA for the computer time required for these experiments