



# Assimilation of GOES Hourly and Meteosat winds in the NCEP Global Forecast System (GFS)

**Xiujuan Su, Jaime Daniels, John Derber,  
Yangrong Lin, Andy Bailey, Wayne Bresky,  
Hongming Qi**



# Outline



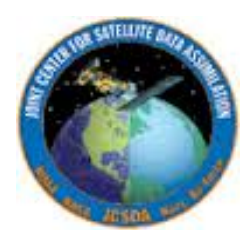
- **Review of Effort and Goals**
- **Evaluation of winds: data quality**
- **Experimental Setup and Approach**
- **Results**
- **Next Step**



# Review of Effort and Goals



- **Assimilate GOES hourly winds in the NCEP/GFS**
  - Infrared cloud drift and water vapor cloud top winds (Task 1)
  - Visible and short-wave infrared winds (Task 2)
- **Improve the quality control procedures associated with assimilation of satellite derived winds**
- **Transition updates into the next official GFS build for operations**

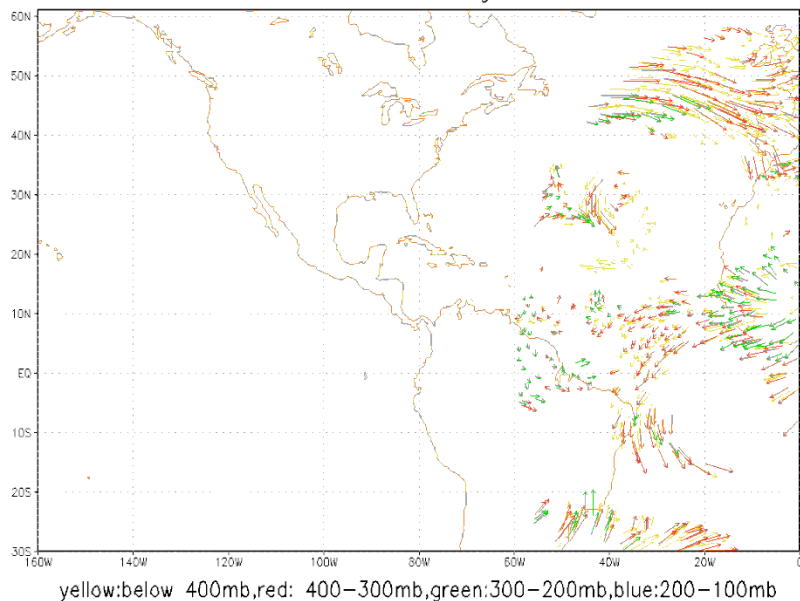


# Meteosat WV Cloud Top Winds

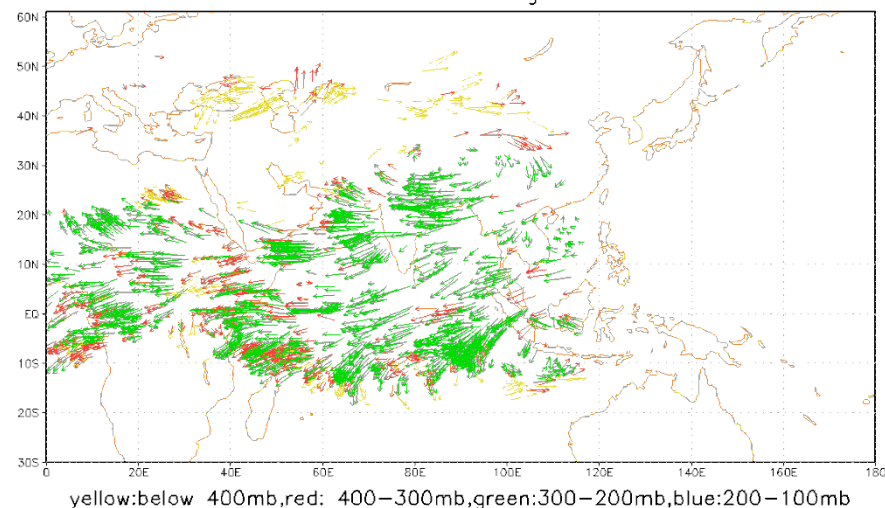


- **Meteosat -7 and 9 (current 10) satellite winds are one of high quality winds, covering Indian ocean and Atlantic ocean sounding area.**

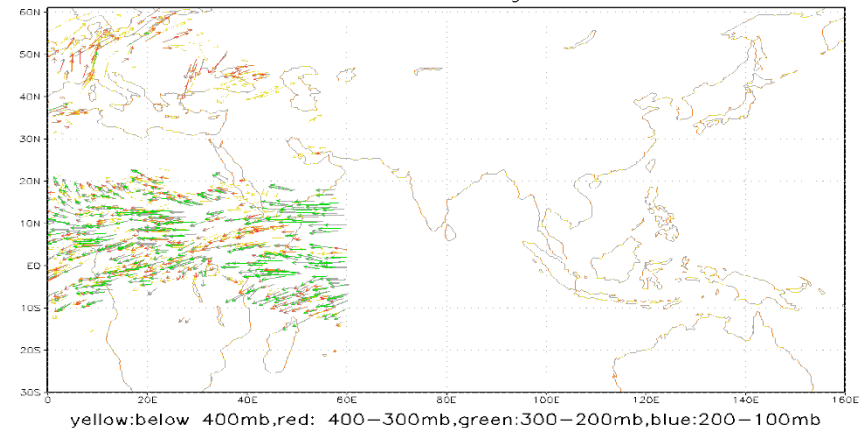
An example of Meteosat-9 WV data distribution at different heights



An example of Meteosat-7 WV data distribution at different heights



An example of Meteosat-9 WV data distribution at different heights

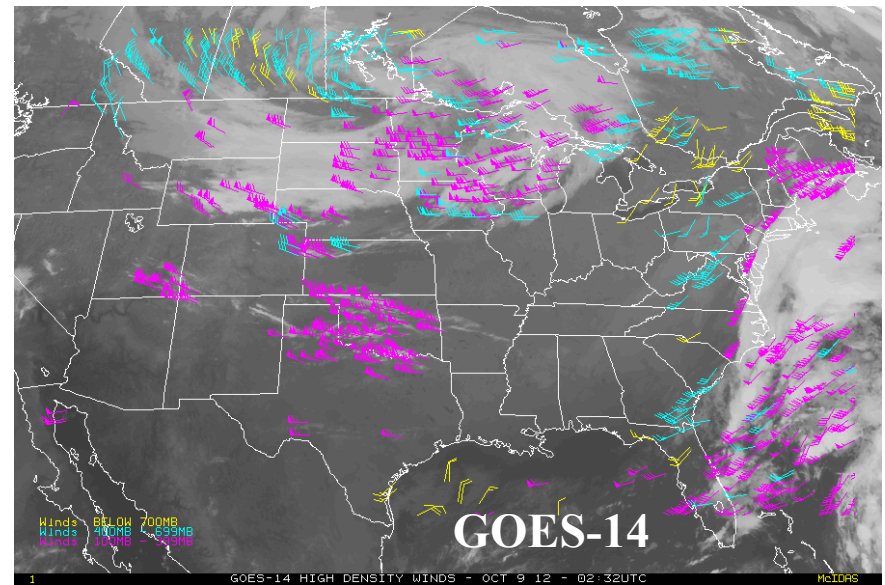
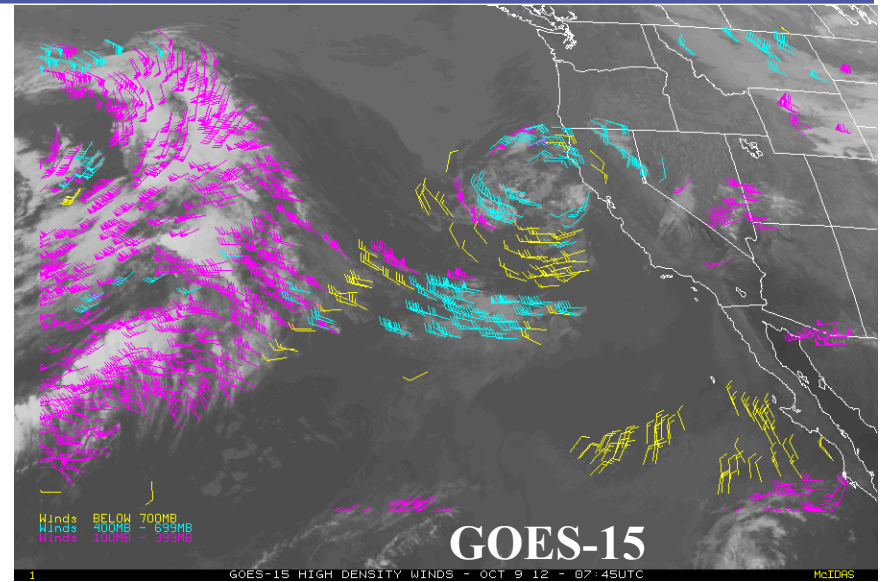


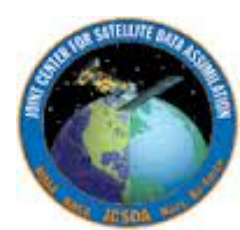


# GOES Hourly Winds



- **Same winds retrieval algorithm with a few updates**
  - Improved height assignment of low level AMVs over ocean when a low level temperature inversion is detected
  - Image scan line time defines the time for each satellite wind observation
  - BUFR files contain the Expected Error (EE) and QI quality indicators
- **More timely, reduced latency (15-30 minutes)**





# Evaluation of Winds



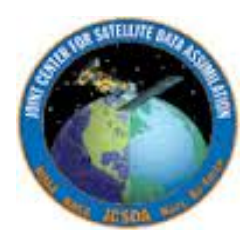
- **Time window about cycle time used in GSI**
  - Half hour window for current operational GOES winds (3-hourly)
  - Three hour window used for GOES hourly winds and Meteosat WV cloud top winds
  - Data count: About 4 to 6 times of current 3 hourly GOES winds. About 7000 counts after 200kmx200kmx100mb thinning for Meteosat winds
- **The evaluation of data quality**
  - Two weeks data to study O-B statistics, relationship between O-B statistics and quality marks QI and EE.



# Data Quality: Summary (GOES Hourly wind)



- **GOES hourly winds have similar quality as current operational GOES winds**
- **The relative hour from cycle time do not impact the data quality**
- **The RMS of O-B winds decrease with higher values of quality marks of QI at all levels**
- **RMS of O-B increases linearly with normalized EE (normalized EE=original EE/speed).**
- **Most winds have QI values higher than 85 (about 75%) at all levels.**



# **Data Quality: Summary (Meteosat winds)**



- **The data quality is similar to GOES cloud top water WV winds, O-B RMS slight larger than O-B RMS of GOES cloud top WV winds**
- **About 55 percent of winds with QI values over 85.**





# Current Assimilation Strategy



- **Based on above O-B statistics results, the quality control schemes and observation errors were determined for GOES hourly IR and WV cloud top and Meteosat WV cloud top winds**
- **The several parallel experiments were set up to assimilate these winds into NCEP data assimilations and forecast system. First, the parallel experiments from July 1 to August 15 and from November 15 to December 31, 2012 were set up to assimilate each product respectively, then another experiment was set up from July 10 to August 31 to assimilate the two products (plus JMA profiler winds).**



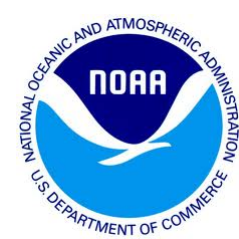
# Current Assimilation Strategy



- **QI greater than 85 as a filter for both satellite winds**
- **Normalized EE as a filter for GOES hourly winds**
- **The first several experiments use March 1 2013 GSI version and current operational forecast system with T574L64 for individual product test**
- **The combined parallel experiment uses beginning of April 2013 version GSI (version number 27524) and current forecast system.**

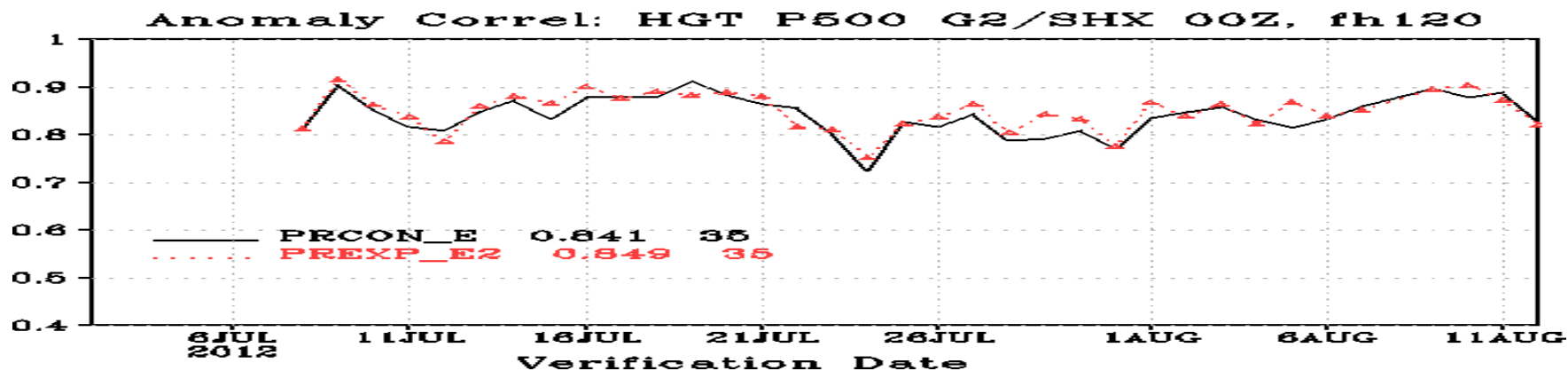
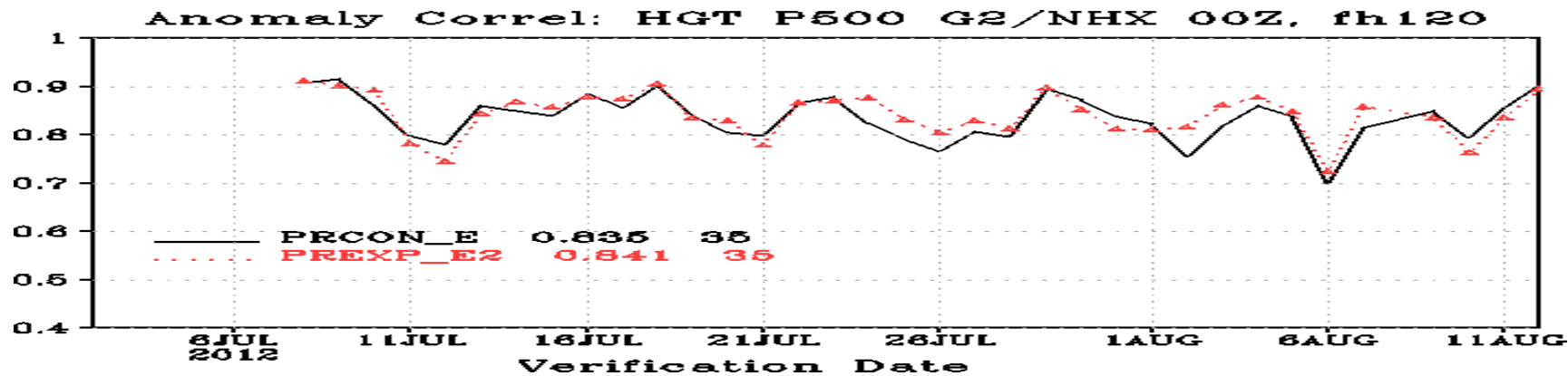


# Results



- The result from individual tests (the results from both period are similar)

## 1. Results from assimilation of Meteosat cloud top winds

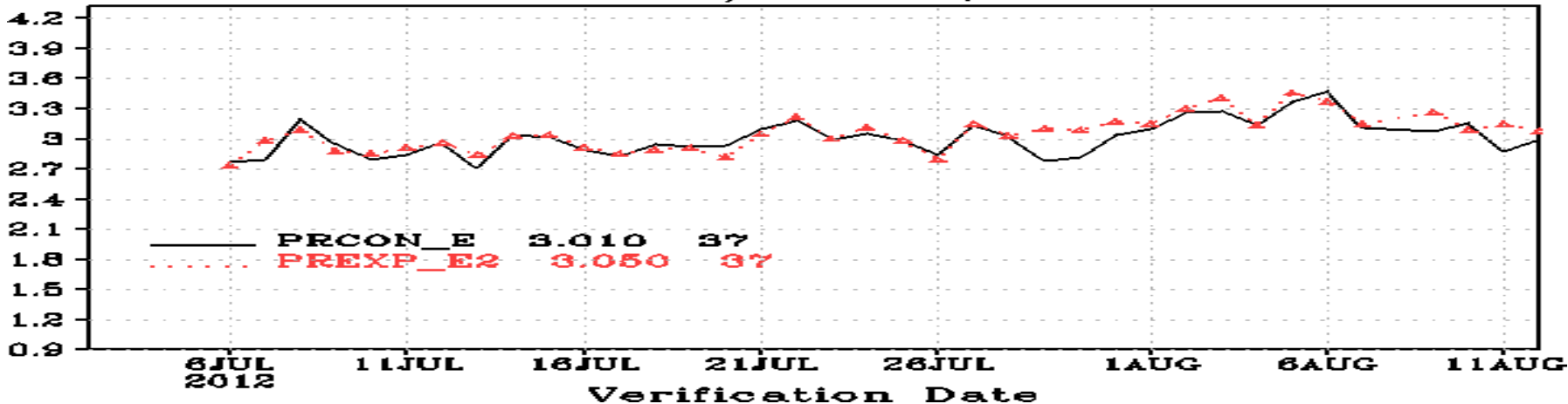




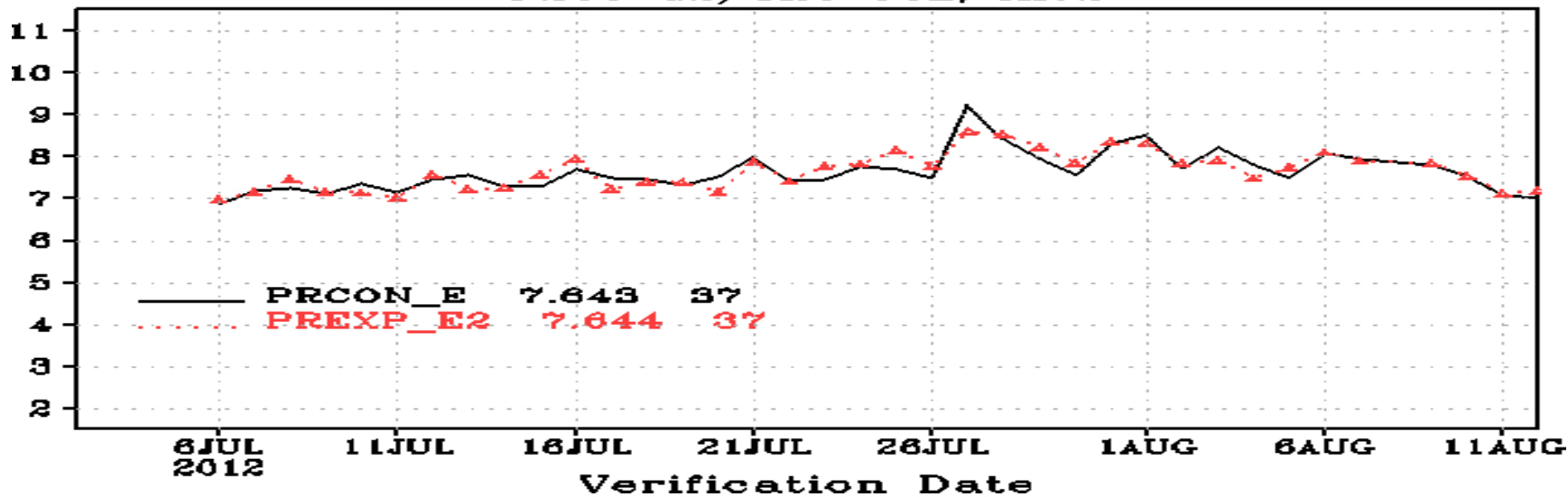
# Results



**WIND: RMSE**  
**P850 G2/TRO 00Z, fh72**



**WIND: RMSE**  
**P200 G2/TRO 00Z, fh72**

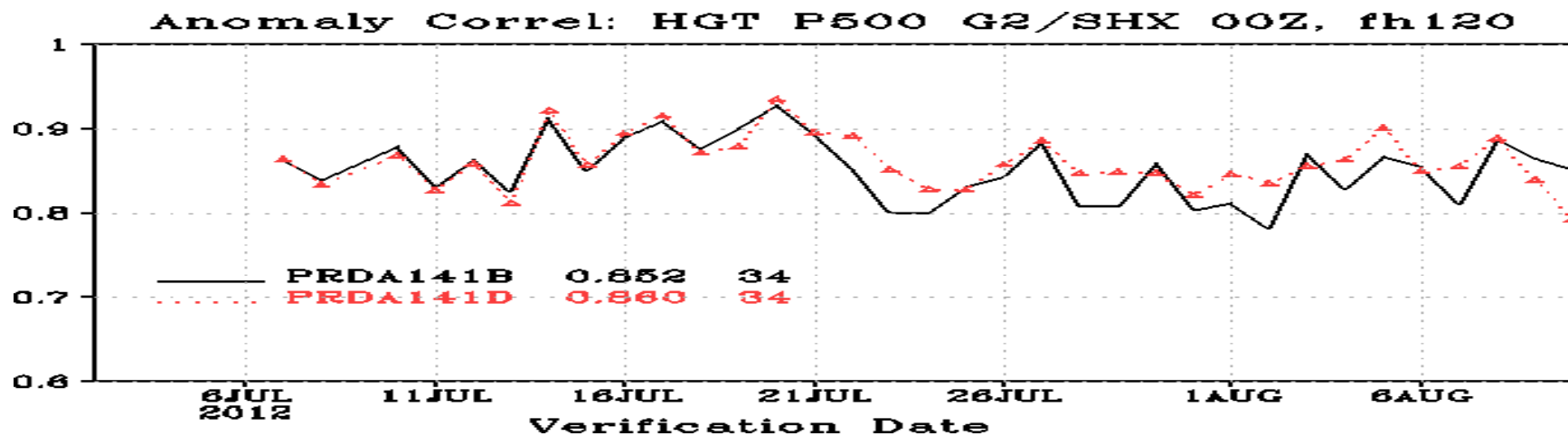
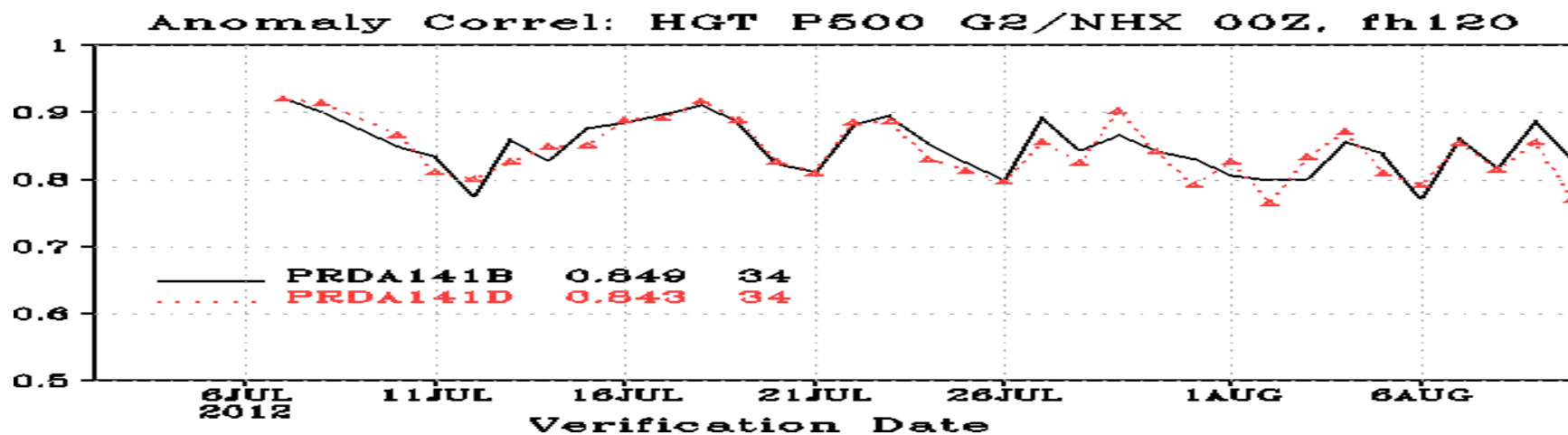




# Results

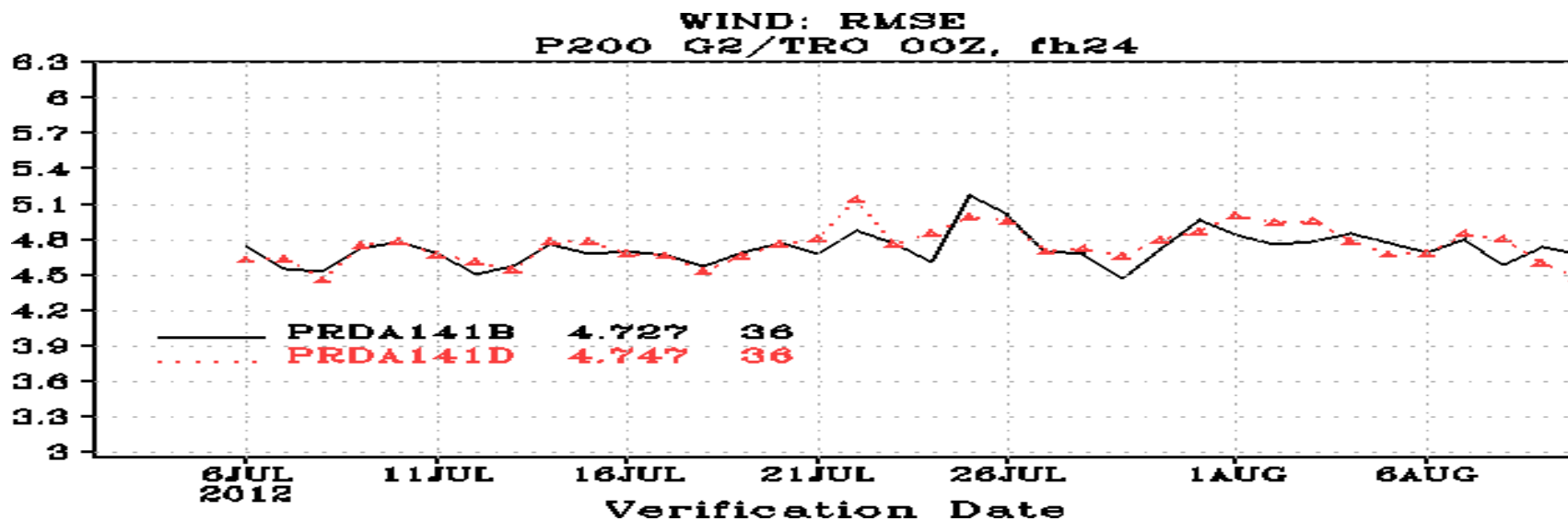
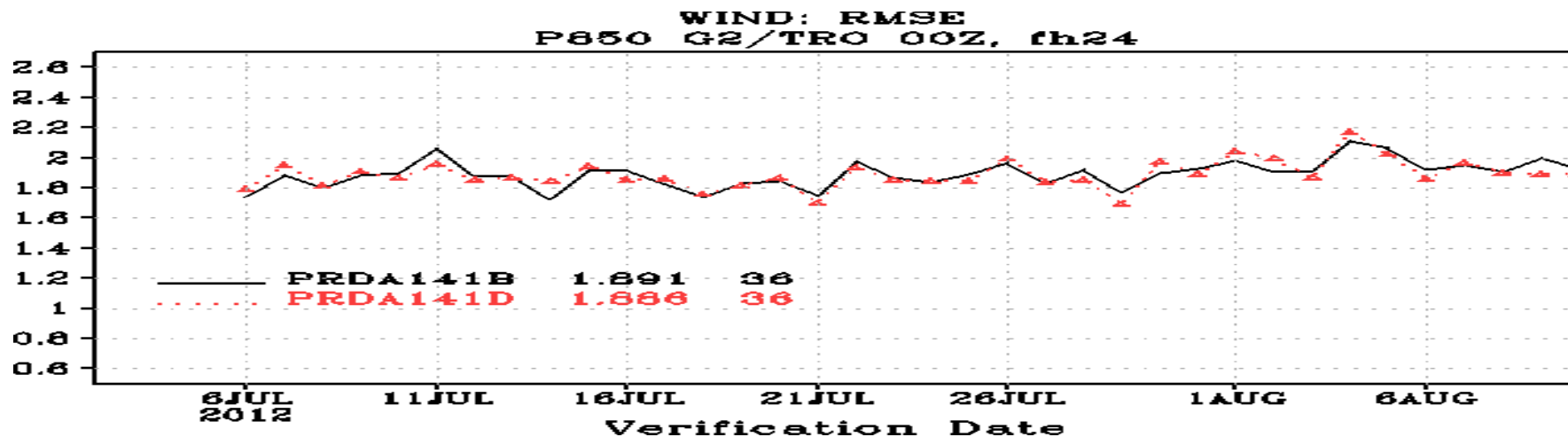


## 2. The results from assimilation of GOES hourly winds





# Results

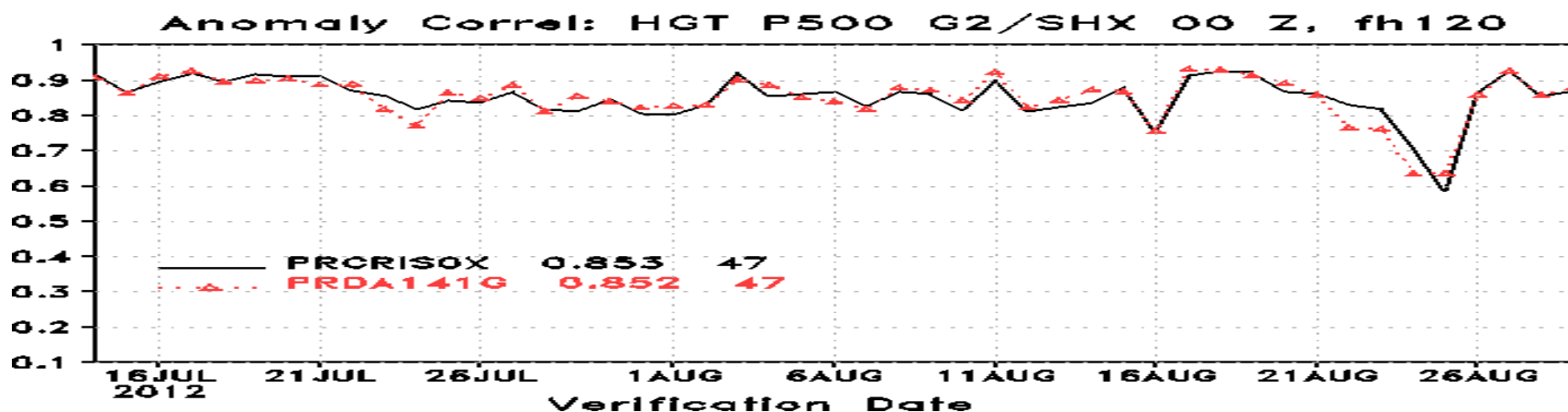
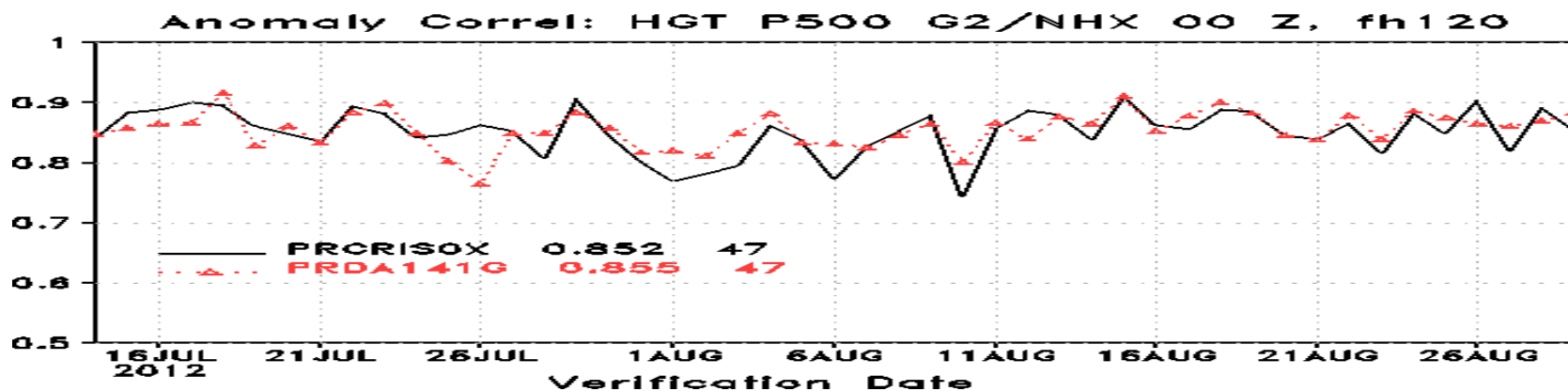


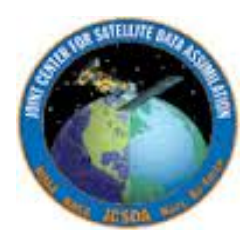


# Results



- 2. The results from assimilation of both Meteosat, GOES hourly winds, and JMA profiler winds, include bug fix

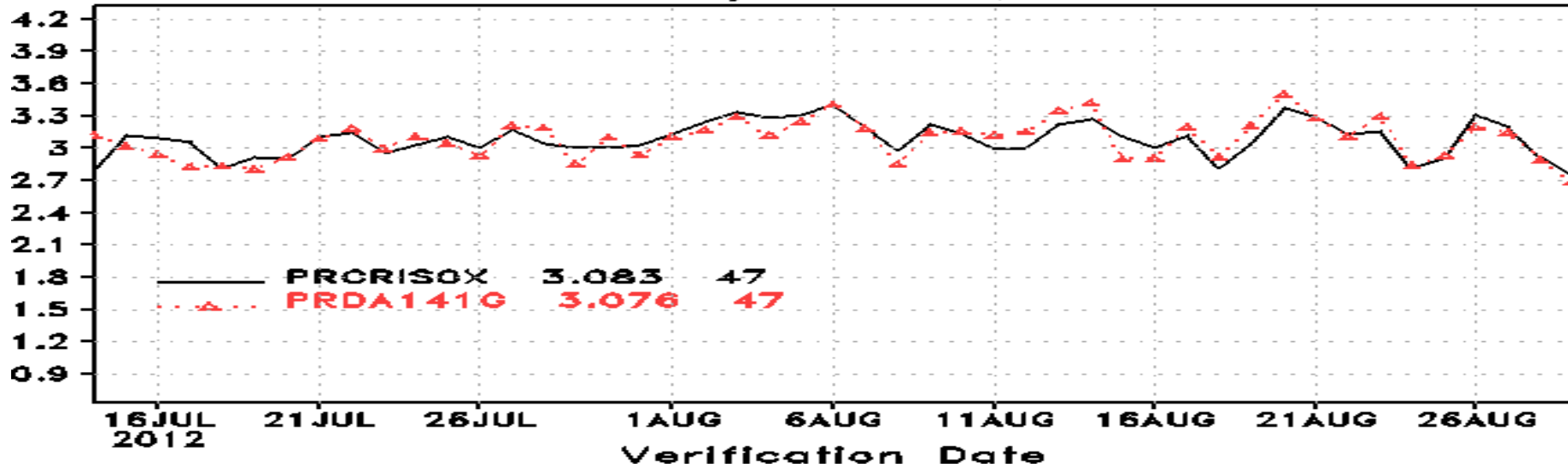




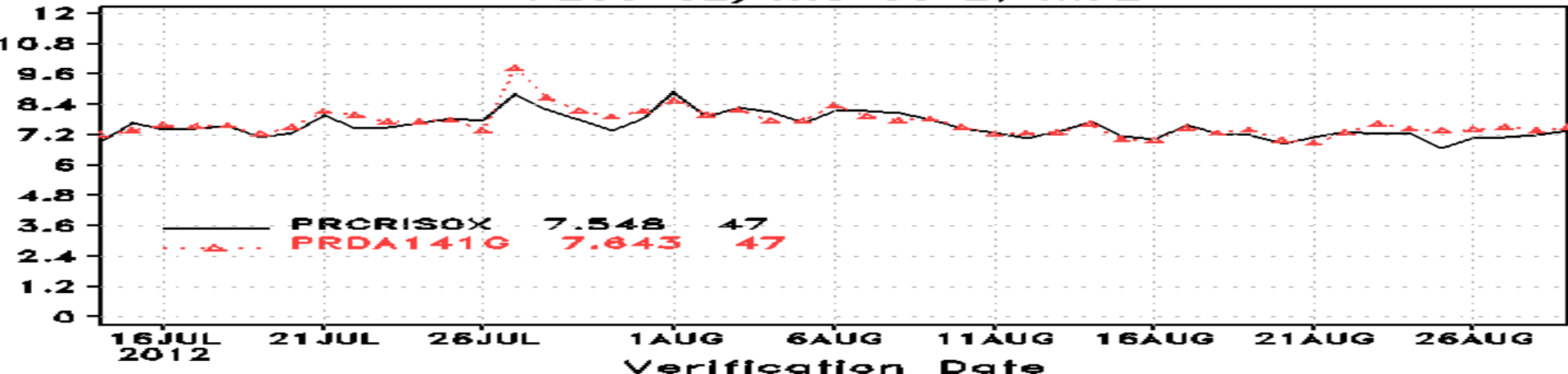
# Results



WIND: RMSE  
P850 G2/TRO 00 Z, 1h72



WIND: RMSE  
P200 G2/TRO 00 Z, 1h72



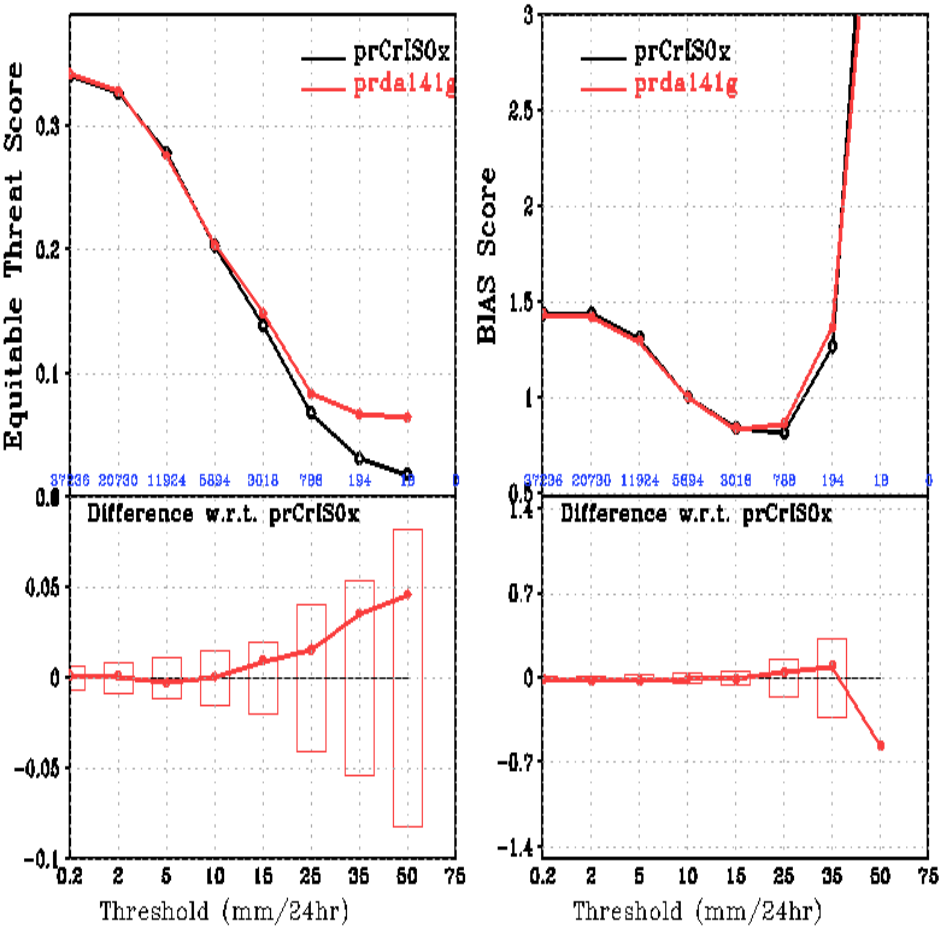




# Results

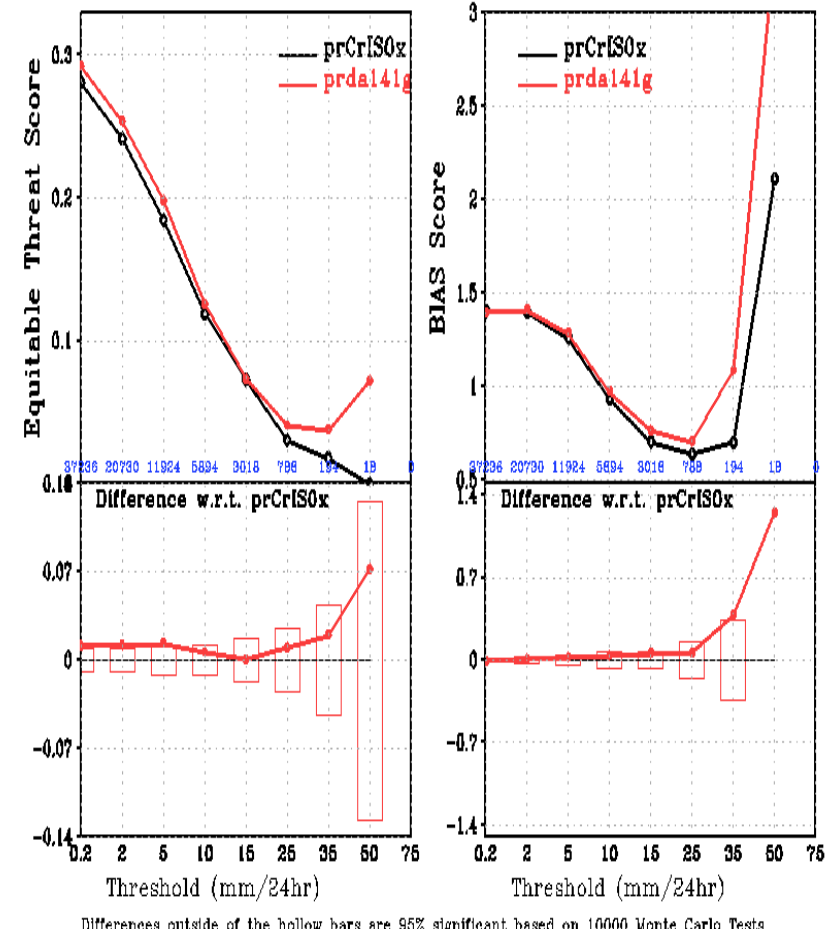


CONUS Precip Skill Scores, f12-f36, 14jul2012-29aug2012 00Z Cycle



Differences outside of the hollow bars are 95% significant based on 10000 Monte Carlo Tests

CONUS Precip Skill Scores, f60-f84, 14jul2012-29aug2012 00Z Cycle



Differences outside of the hollow bars are 95% significant based on 10000 Monte Carlo Tests



# Results



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- Assimilation of GOES hourly and Meteosat winds, JMA profiler winds has little impacts on conventional observation fits, most noticeable impacts for observation fits for satellite winds

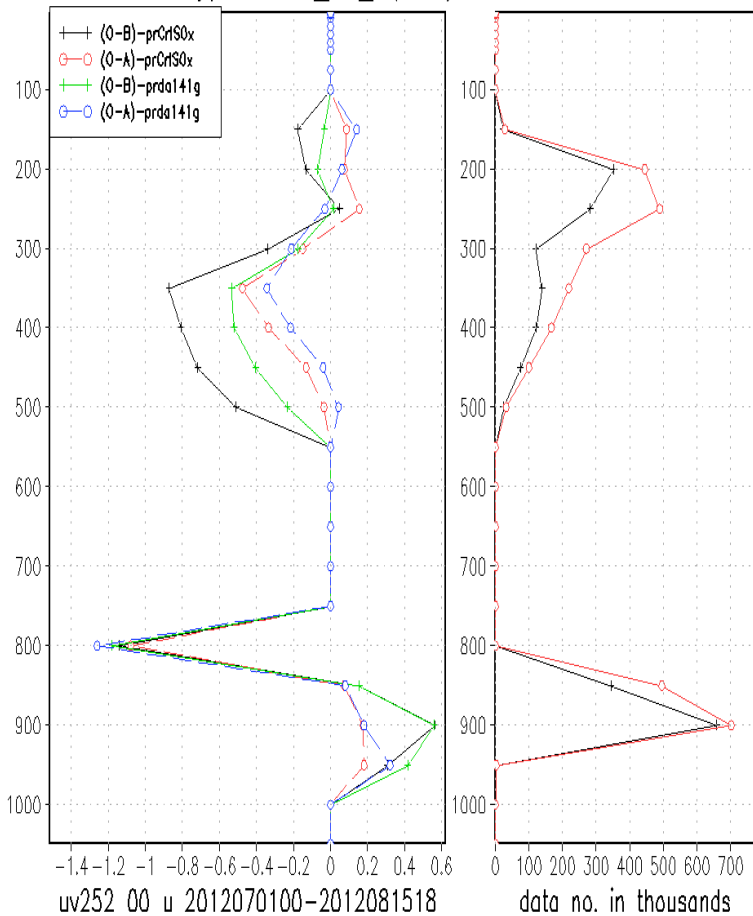


# Results

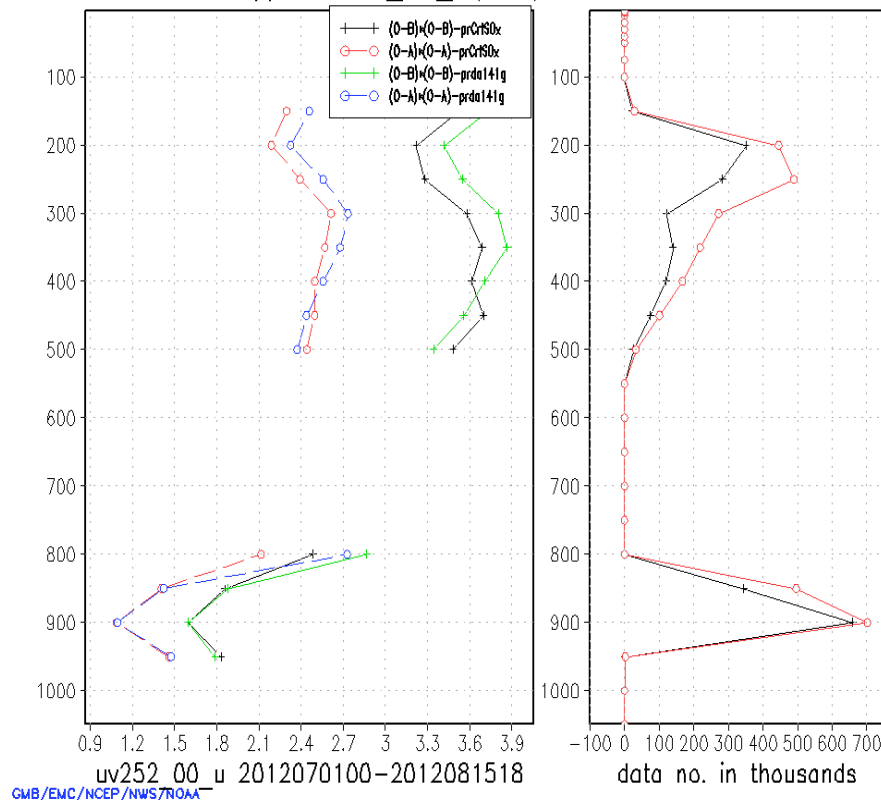


- 1. JMA satellite winds  
IR winds

Observation type:uv252\_00\_u(bias)



Observation type:uv252\_00\_u(rms)



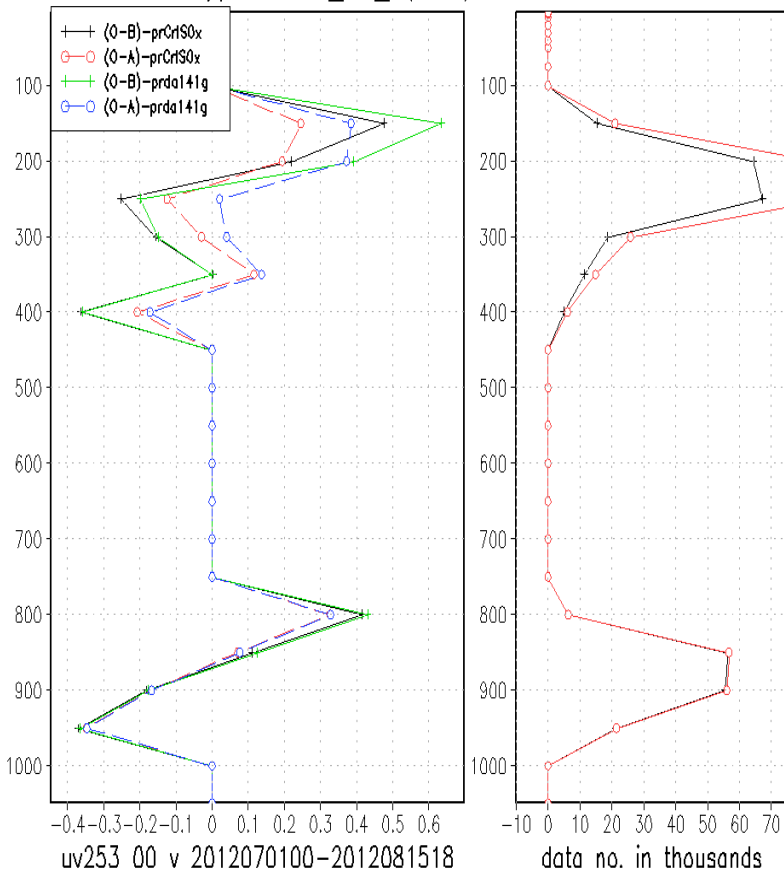


# Results

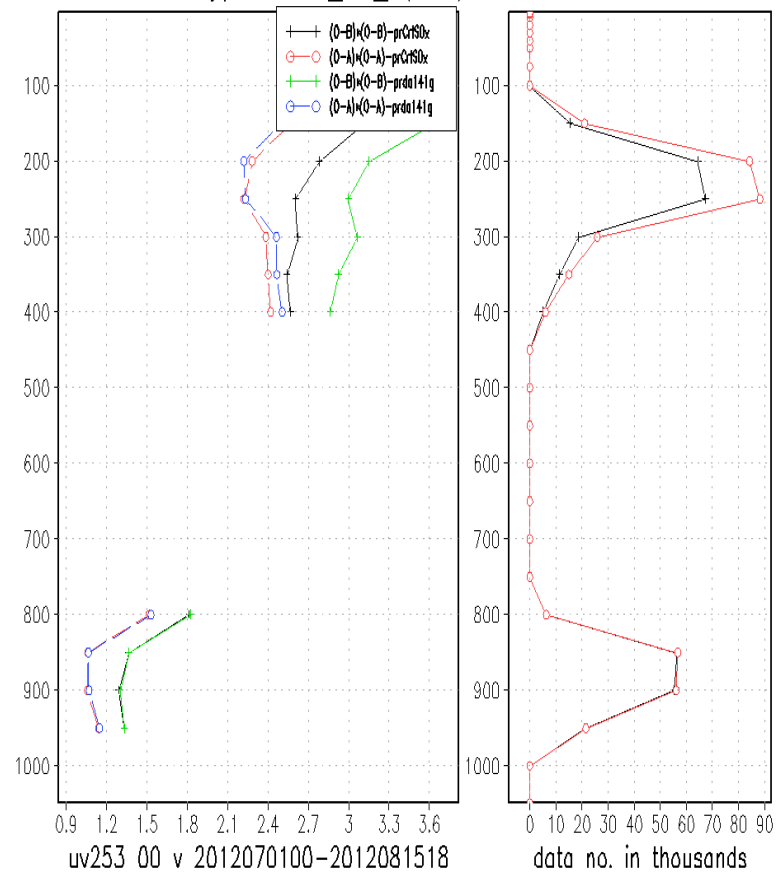


## 2. Meteosat satellite winds IR winds

Observation type:uv253\_00\_v(bias)



Observation type:uv253\_00\_v(rms)



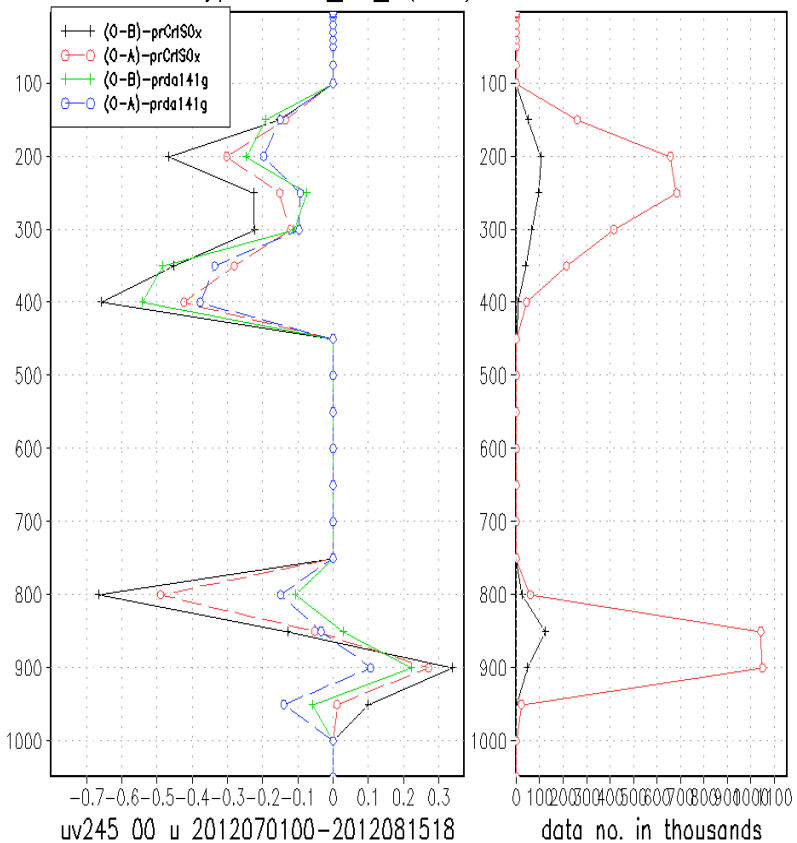


# Results

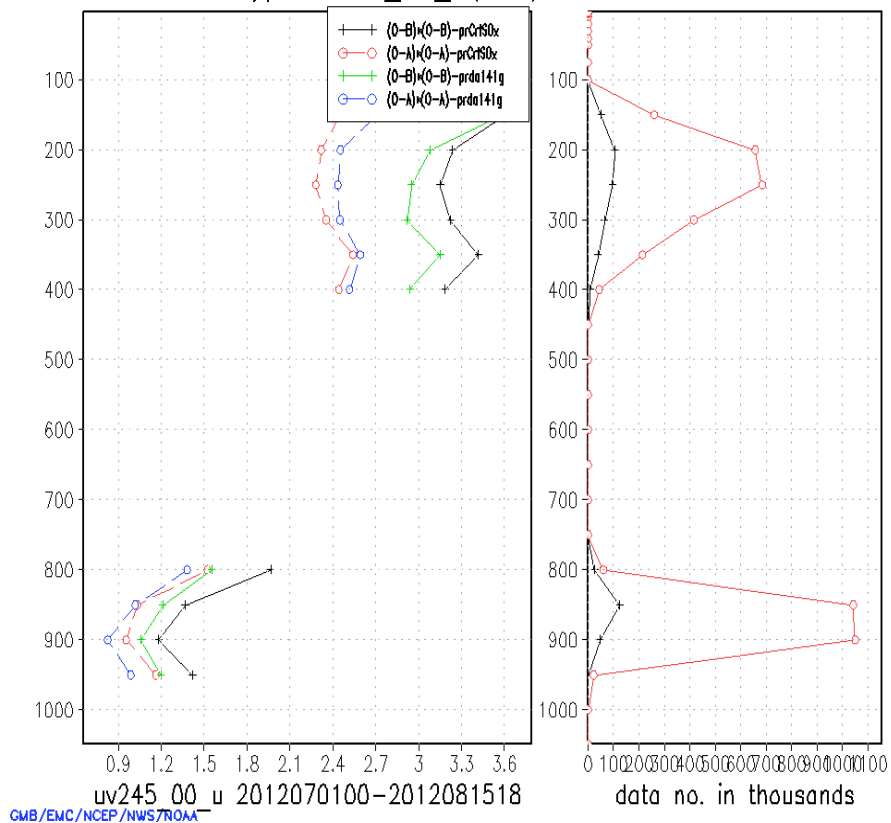


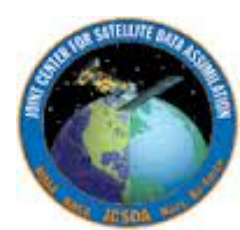
## 3. GOES winds IR winds

Observation type:uv245\_00\_u(bias)



Observation type:uv245\_00\_u(rms)



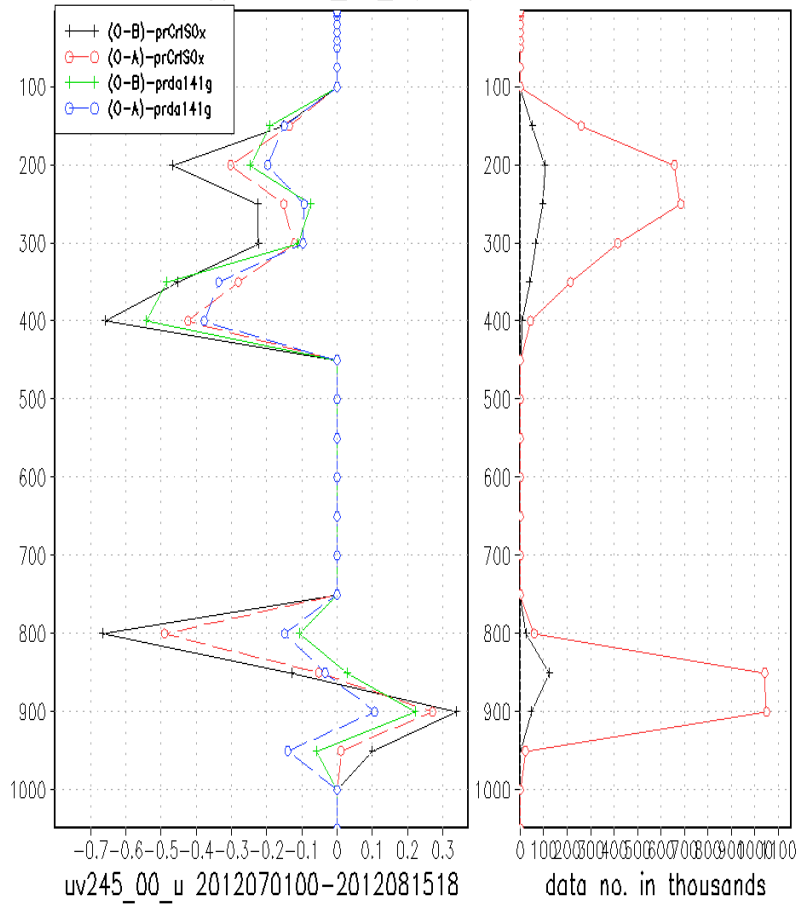


# Results

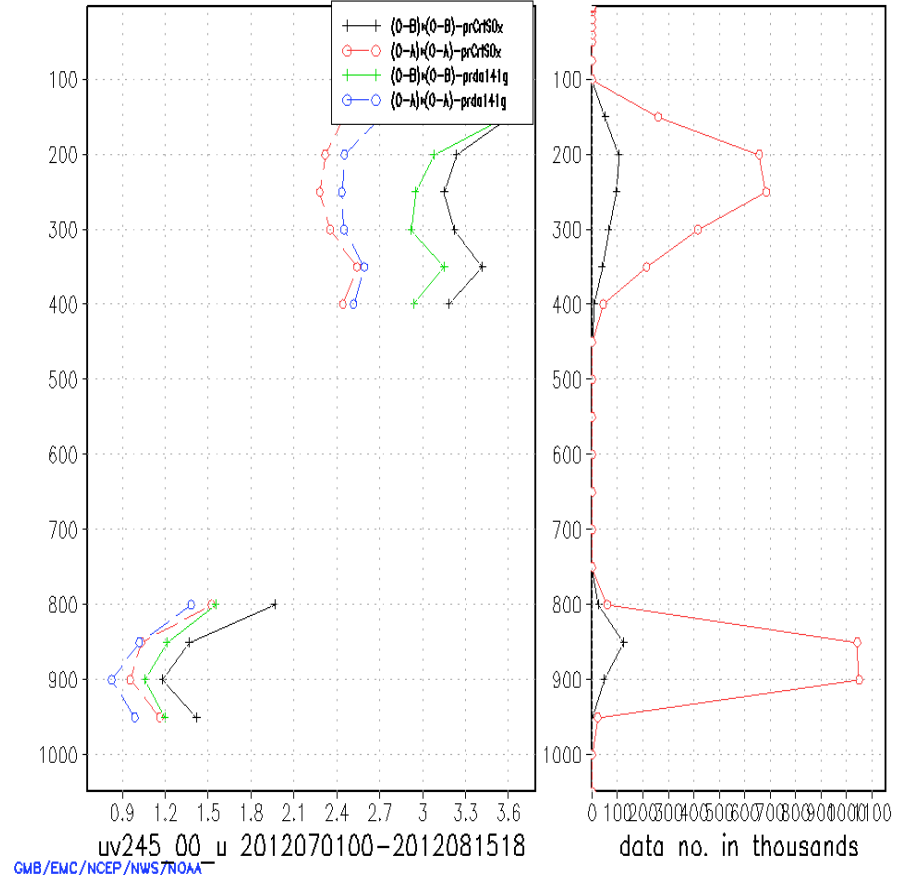


## 3. GOES winds, IR winds

Observation type:uv245\_00\_u(bias)



Observation type:uv245\_00\_u(rms)



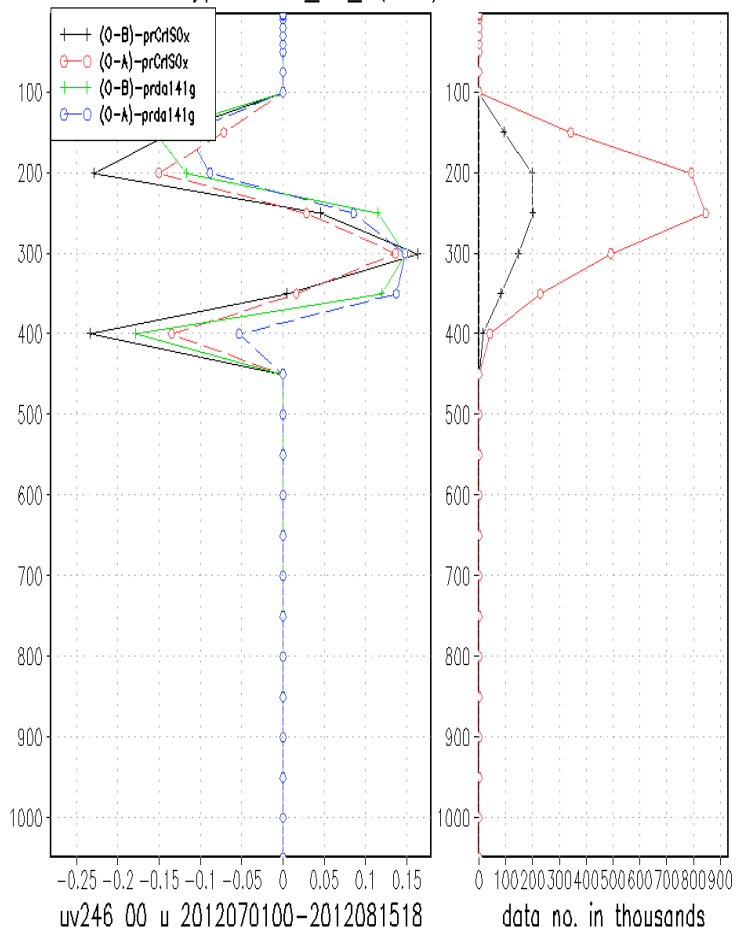


# Results

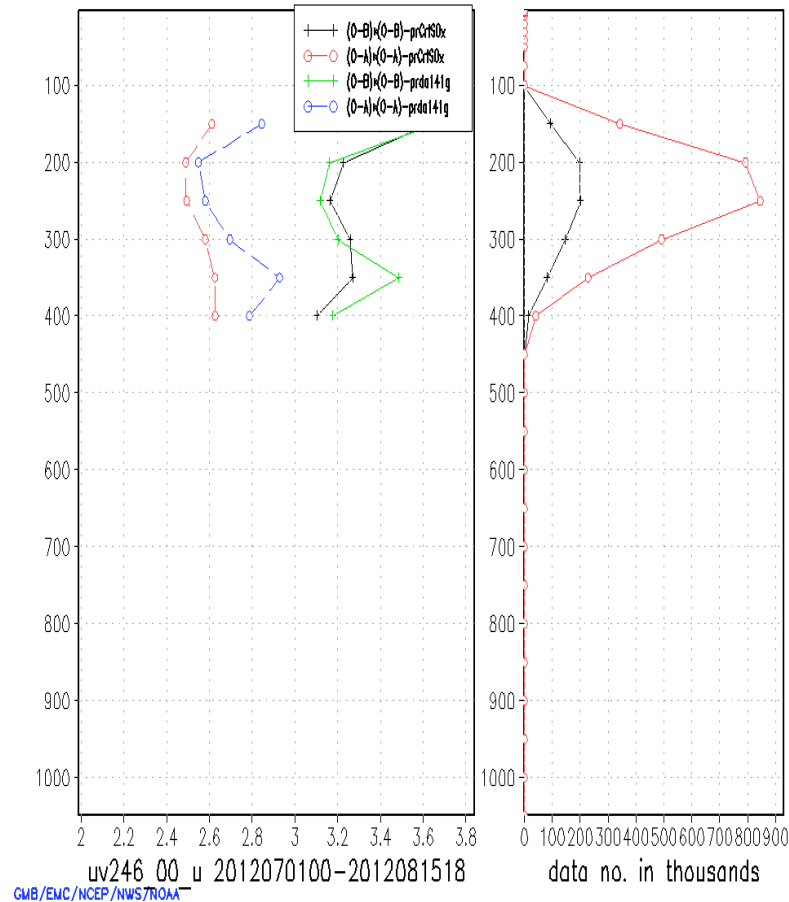


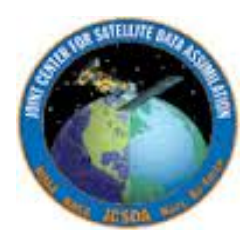
## WV winds

Observation type:uv246\_00\_u(bias)



Observation type:uv246\_00\_u(rms)





# Summary



- **The O-B statistics characteristics were studied for GOES hourly IR, WV cloud top winds and Meteosat WV cloud top winds.**
- **Based on these studies, the observation errors and quality control schemes were defined to assimilate these winds**
- **The forecast impacts for individual product assimilation were neutral toward slight positive over both hemispheres and neutral over tropical region.**





# Summary



- **The forecast impacts from adding all winds into system were mixing, neutral toward positive at both hemisphere and low level at tropical region, slight negative at higher level tropical region, neural towards positive for precipitation forecast.**
- **Assimilation of these winds improve most satellite winds observation fits except Meteosat IR winds, O-B for U component is larger**



# Next Steps

- **Continue working on improve usage of GOES hourly winds in GSI system**
- **Working on assimilation of GOES short wave and visible satellite winds produced from GOES-R algorithm.**
- **Evaluation of 4-D thinning algorithm applied on EUMETSAT hourly winds**