Assimilation of GOES-R Atmospheric Motion Vectors in the NCEP Global Forecast System

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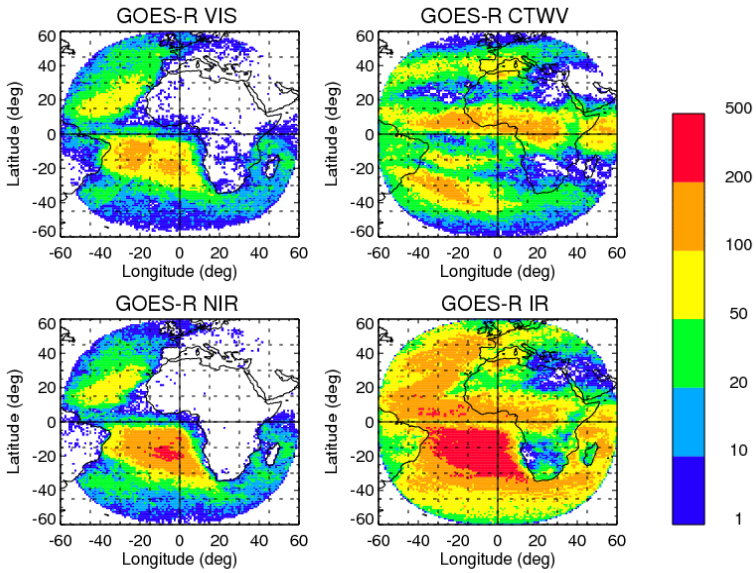
Purpose:

Evaluate proxy AMVs for GOES-R Advanced Baseline Imager (ABI) within the NCEP GFS to support the successful, timely use of the new data when available.

June 2012 AMV total number in a 1ºx1º grid box



Proxy GOES-R AMV Data Uses

- Meteosat-9 & 10 SEVIRI imagery
- GOES-R ABI Nested Tracking Algorithm
- GOES-R ABI Cloud Height Algorithm

4 AMV types represent ABI Channels:

- 2 visible (VIS)
- 7 infrared (NIR)
- 8 cloud top water vapor (CTWV) – Tb height assignment
- 14 infrared (IR)

Proxy data is created on an hourly frequency. Results are shown using the 6 hour synoptic frequency data. Future work is examining best use of hourly GOES-R data in the GFS.

How to best assimilate this data? Need to consider:

Quality Control
Observation Error
Departure Check
Departure Statistics
Impact on GFS Forecast Skill

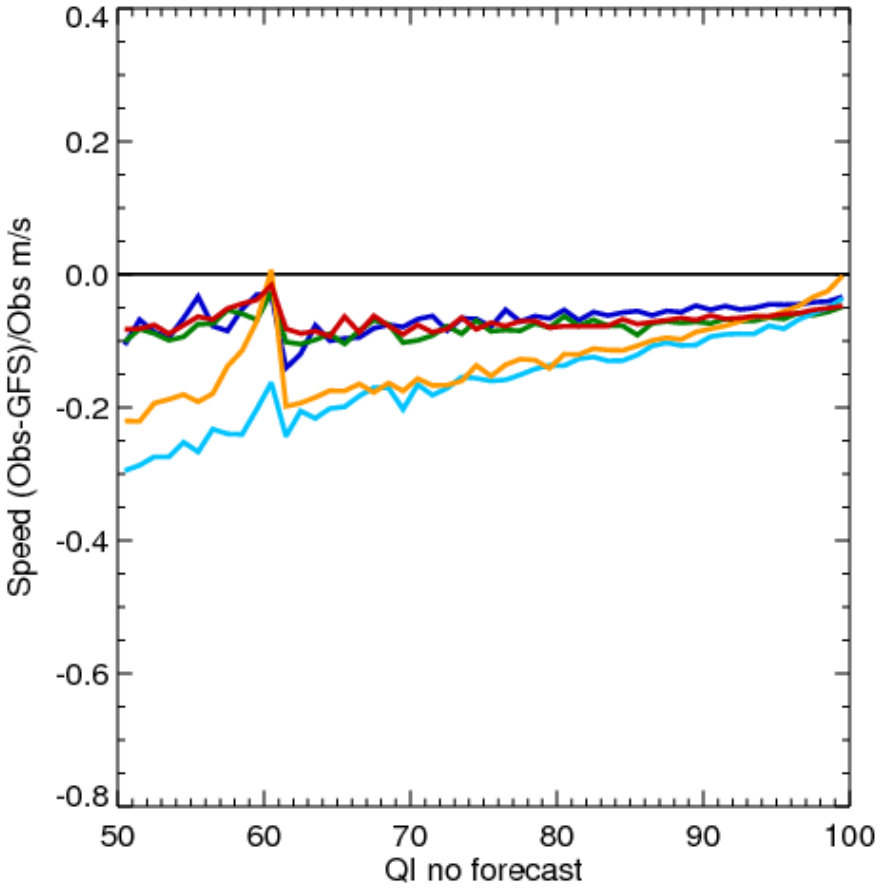
Quality Control

QI - Quality Indicator without the forecast component
Used QIFN > 80

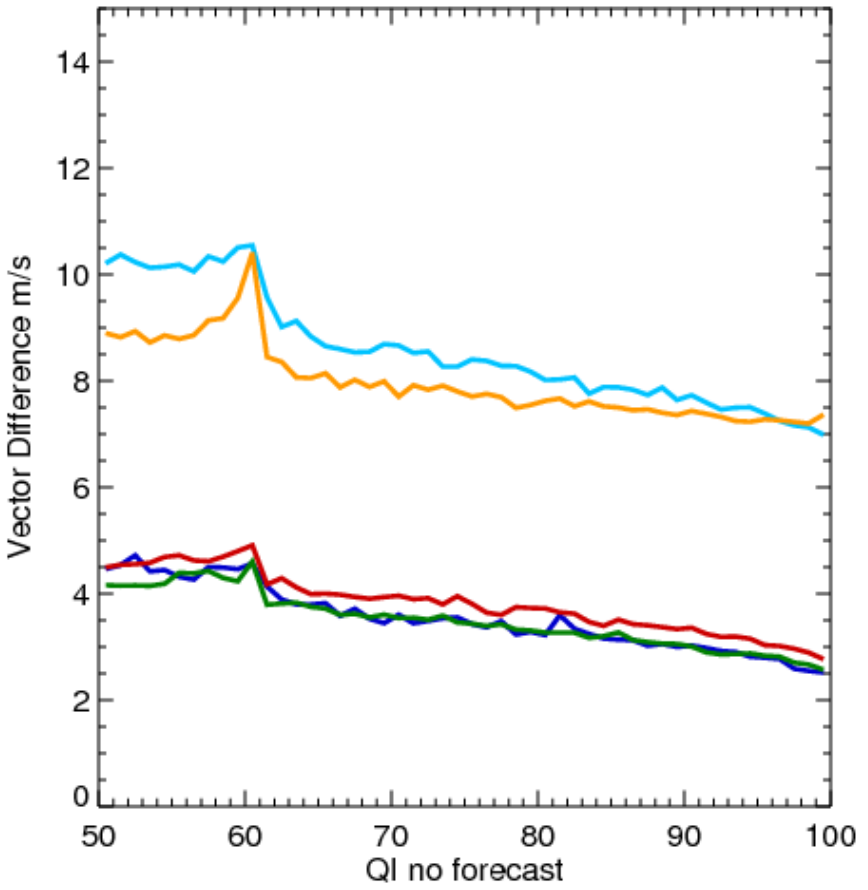
June 2012 – All data

VIS
NIR
CTWV
IR Below 700hPa
IR Above 700hPa

Mean Normalized Speed departure



RMSE of the Vector Difference



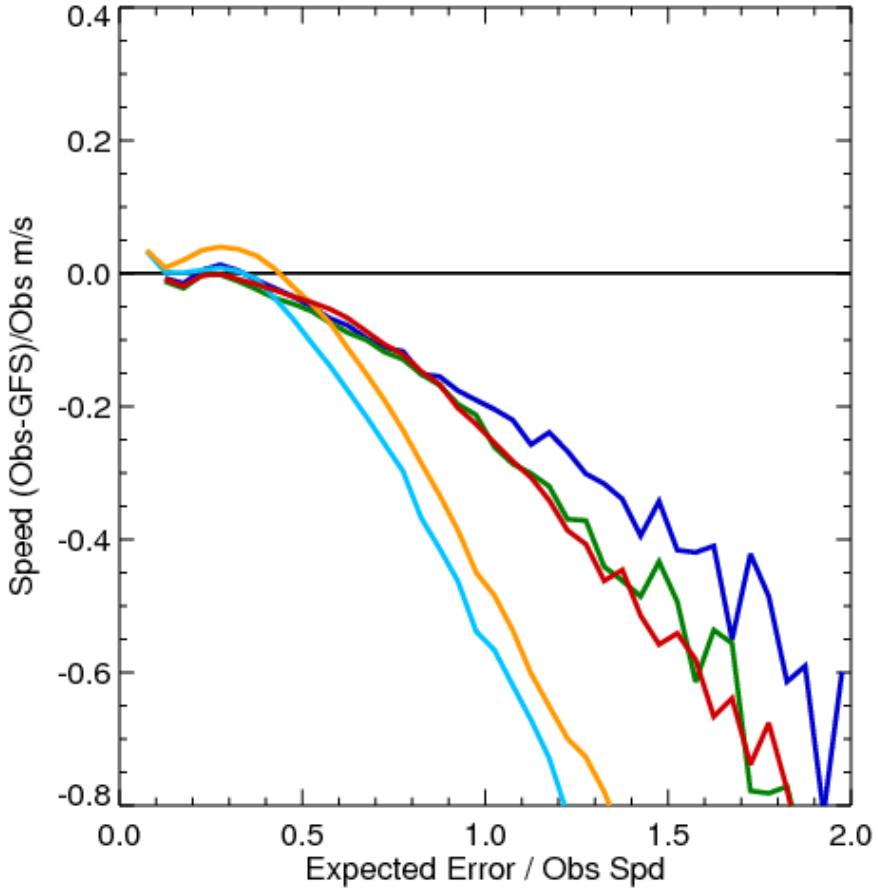
Quality Control

NEE – Normalized Expected Error
Used NEE < 0.9

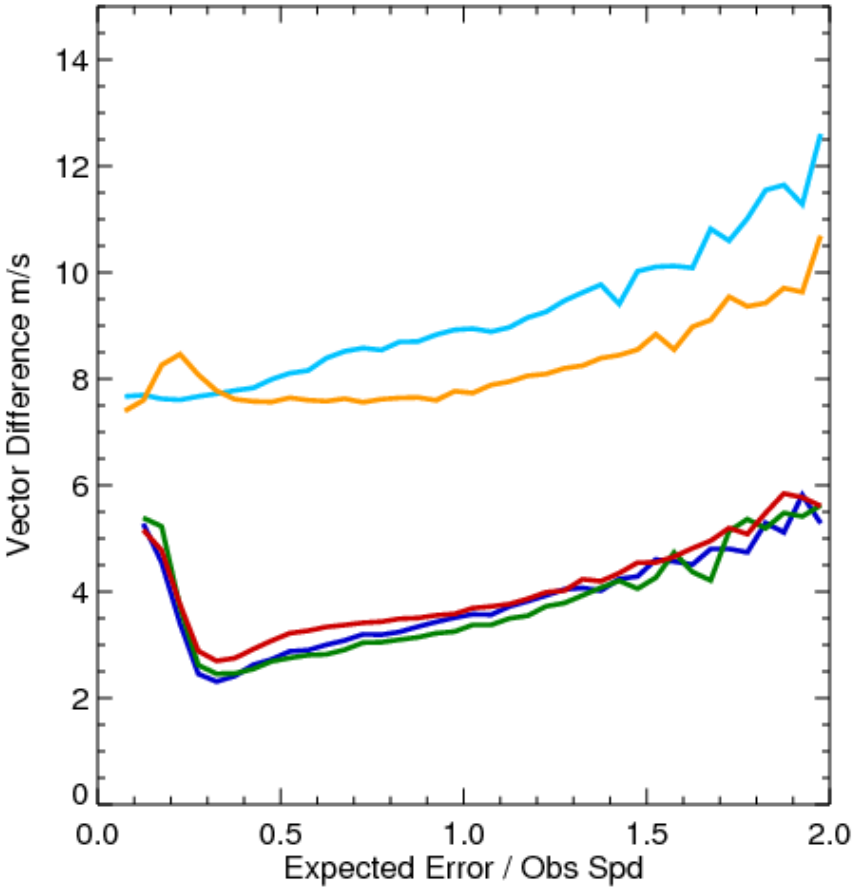
June 2012 – All data

VIS
NIR
CTWV
IR Below 700hPa
IR Above 700hPa

Mean Normalized Speed departure



RMSE of the Vector Difference

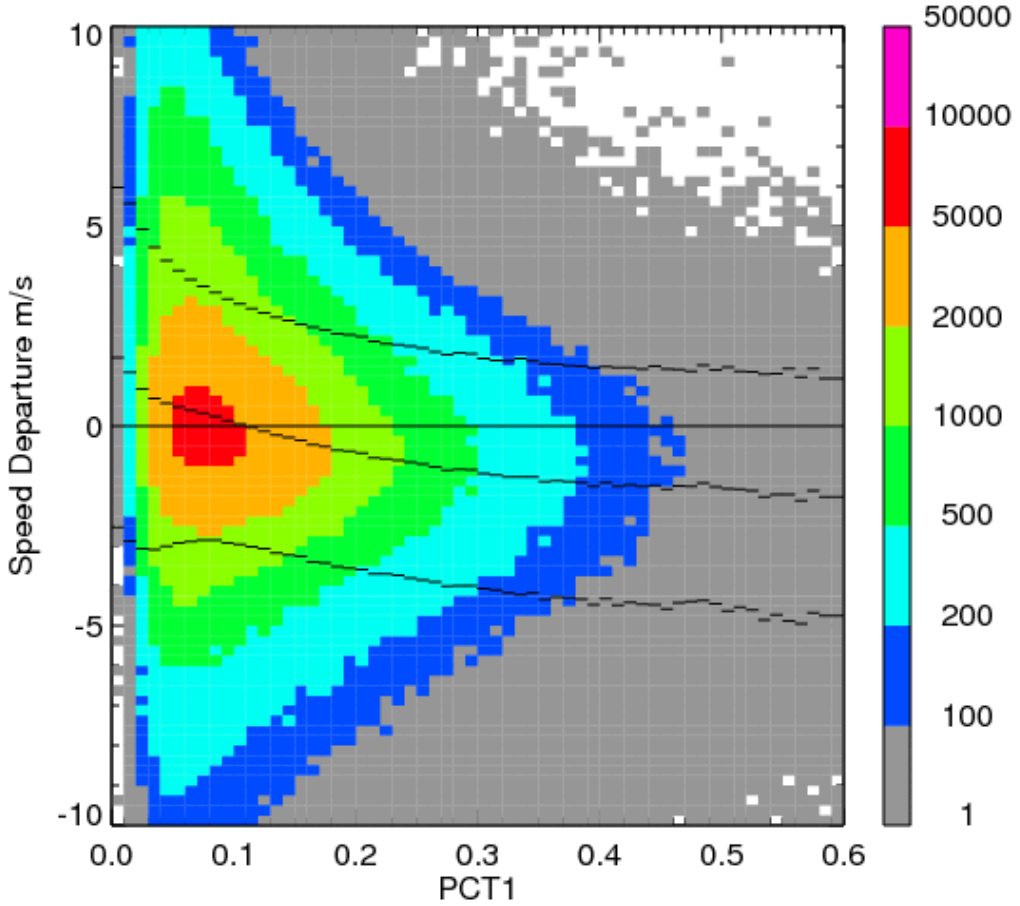


Quality Control

PCT1 – Cluster standard deviation / distance traveled
Used 0.04< PCT1 <0.5

June 2012 – IR data

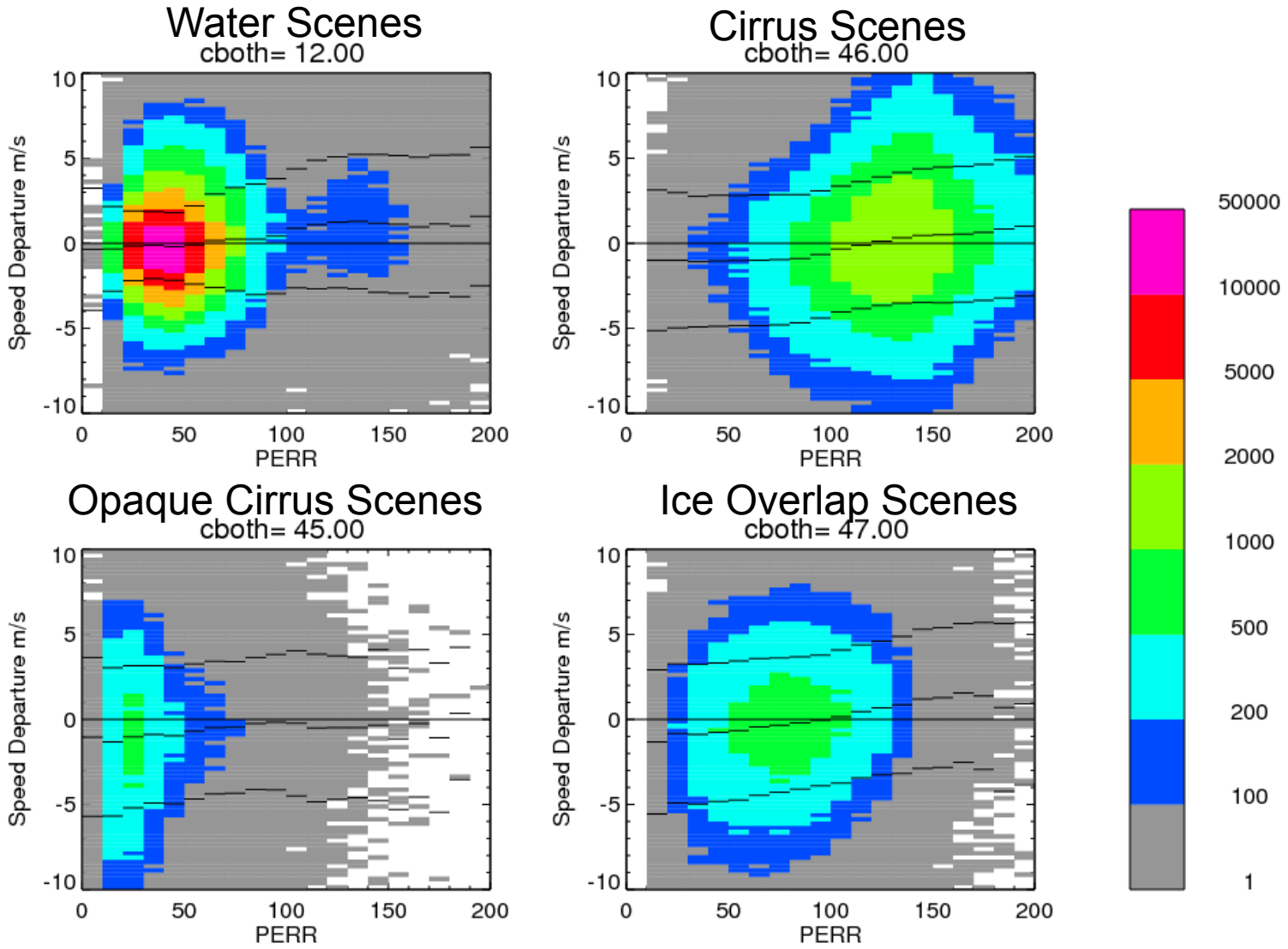
Speed departure Obs – GFS Background (m/s)
Black lines mark mean and standard deviation for each pct1 bin along the x axis



Quality Control

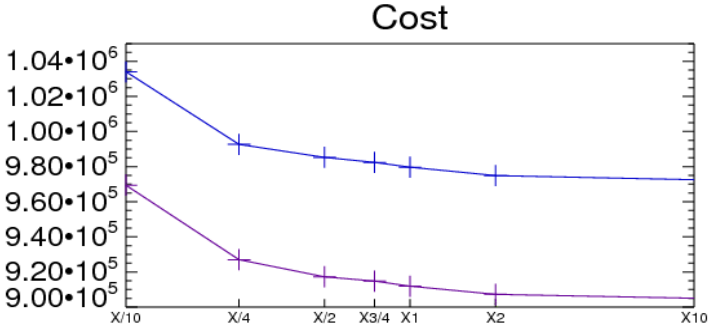
June 2012 – IR data

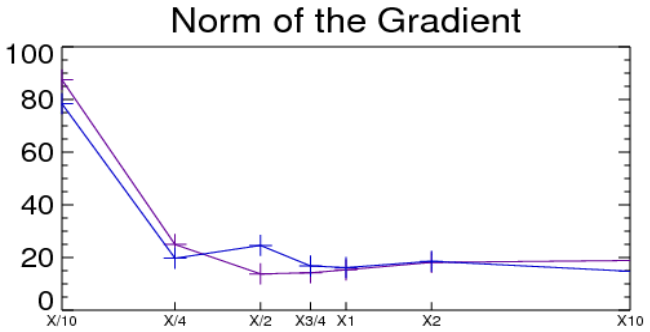
PERR – Cluster median of the measure of uncertainty in cloud top height (hPa)
Did not use this parameter.

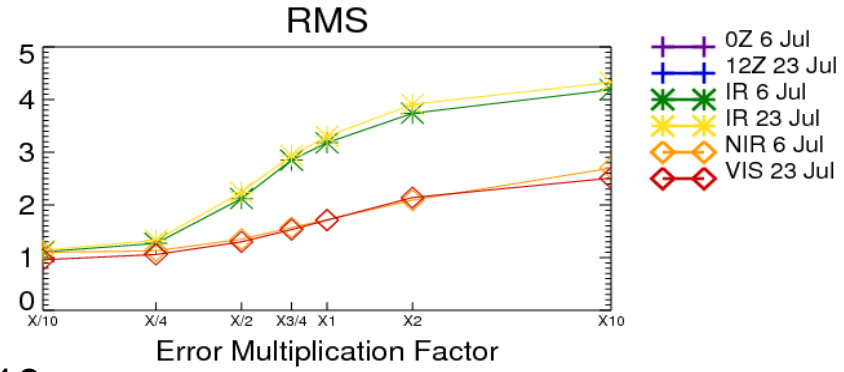


Observation Error

Analysis response to varying the GOES-R AMV observation error through a range of multipliers to the current GOES AMV error settings.







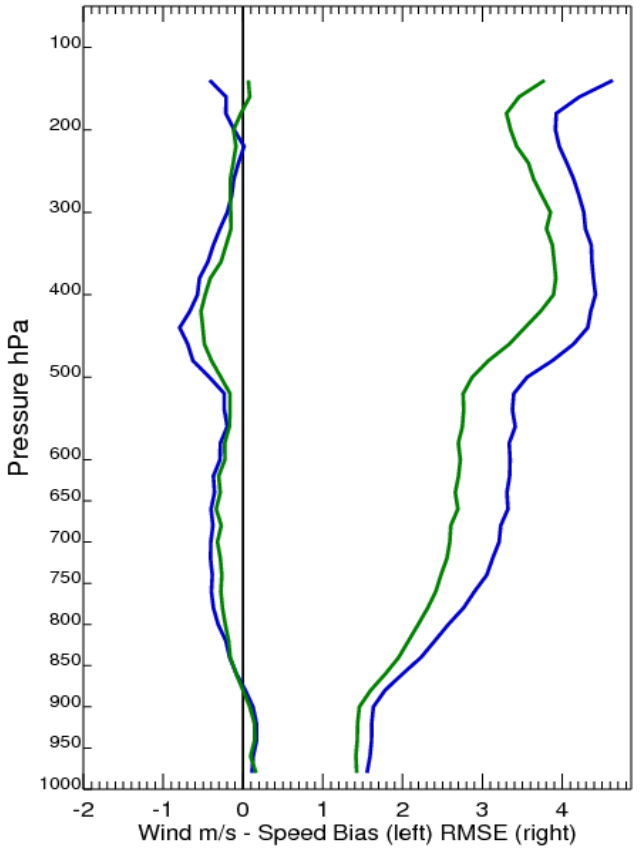
Error/10

Error*10

Original Error

Fit to obs (GFS Analysis – AMV)

Speed Bias (left) Vector Difference RMSE (right)

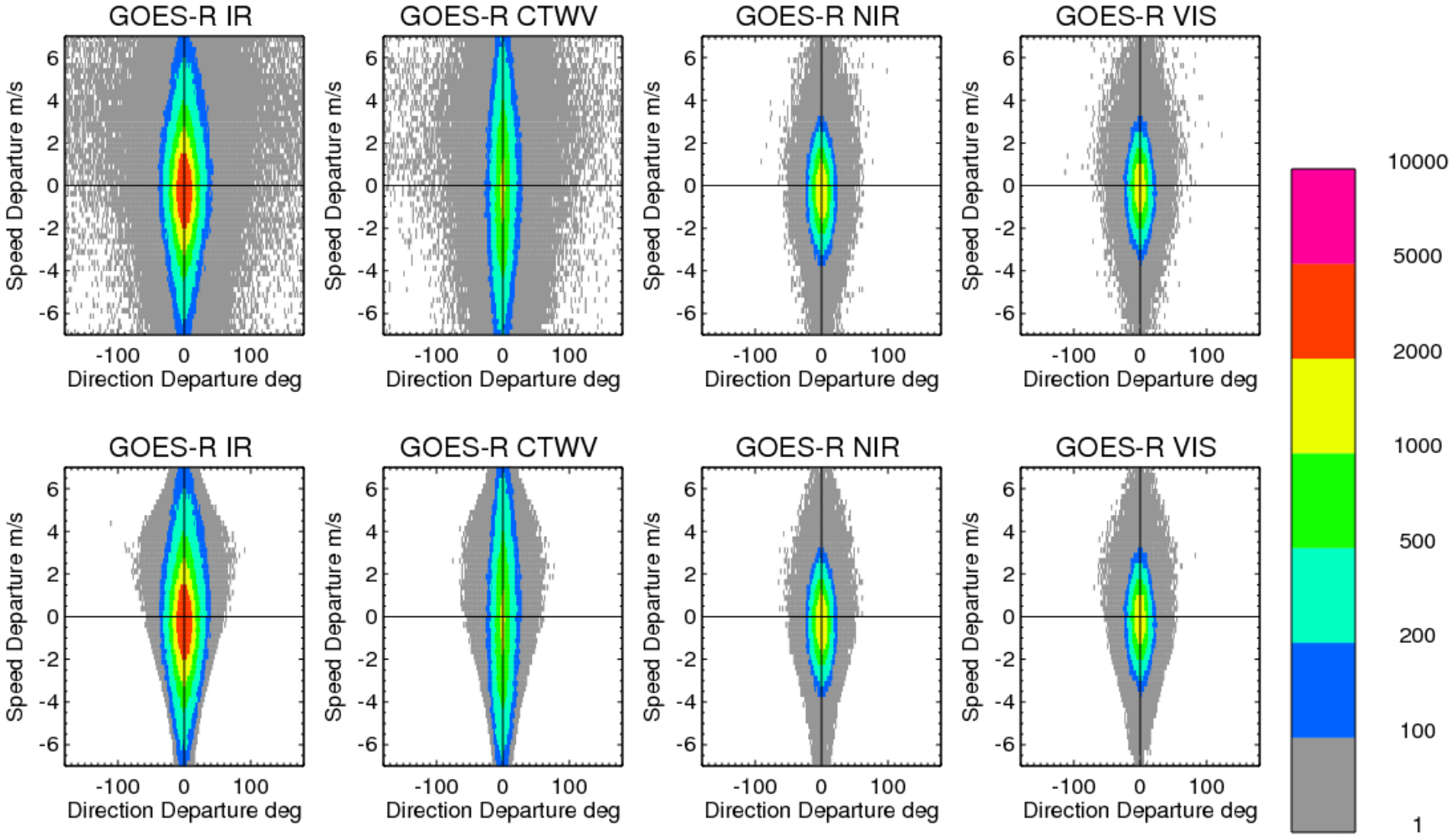


Blue – Original GOES Error
Green – 75% GOES Error

Log Normal Vector Departure Check

$$\text{SQRT}[\ (U_{AMV} - U_{GFS})^2 + (V_{AMV} - V_{GFS})^2\ ]\ /\ \text{LOG}(\text{Speed}_{AMV}) < 3$$

Top row: after QC before departure check



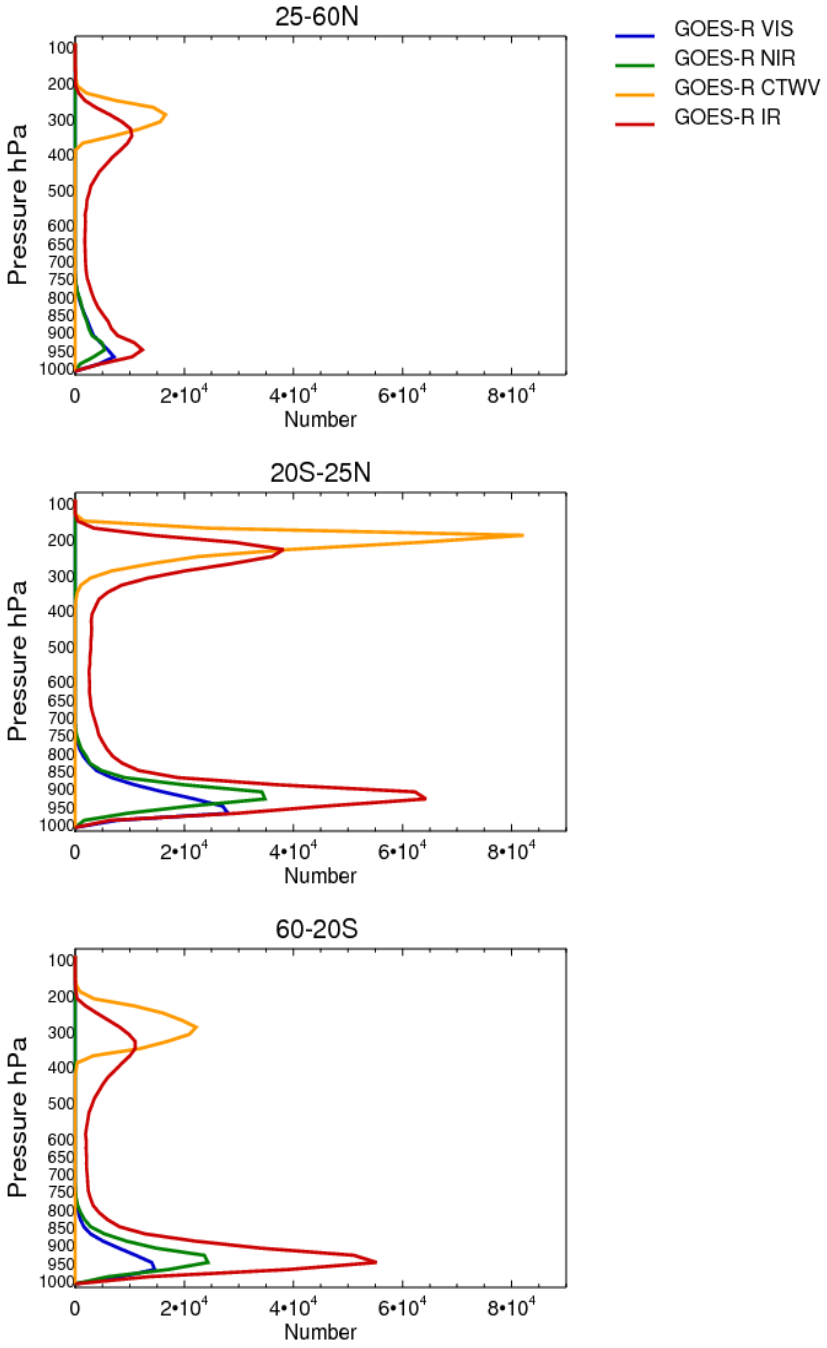
Bottom row: after QC and departure check

Data Count – June 2012

Percent removed due to QC, Departure Check, and GSI checks.

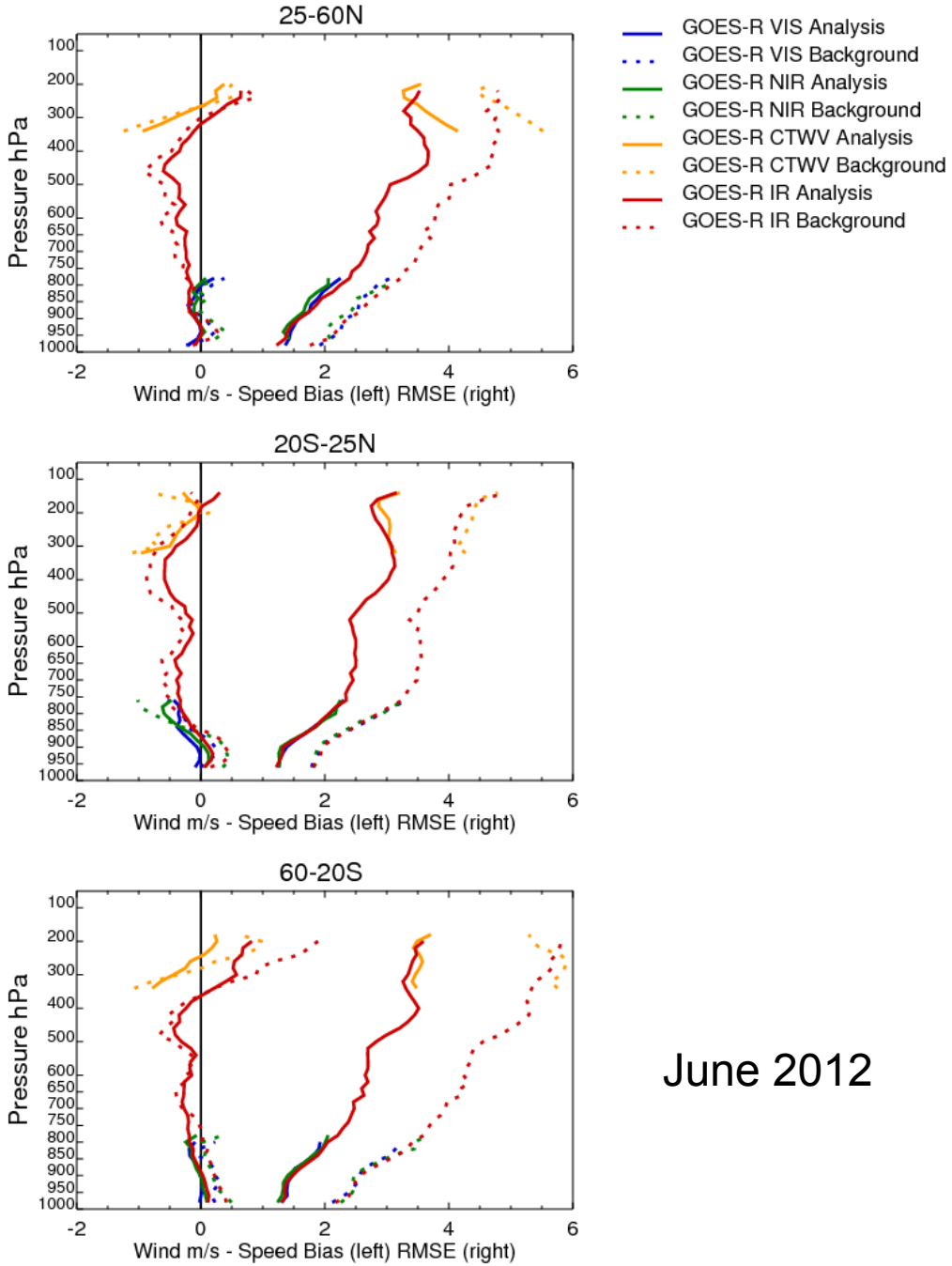
Condition	Visible	Near IR	CTWV	IR	
QI > 80	16	17	26	26	
+ NEE<0.9	3	2	3	2	
+ 0.04<**PCT1**<0.5				7	
+ LNVD < 3	1	1	14	7	
Rejected by GSI	10	3	0.2	2	
% Used	70	77	58	56	

Data Count and Fit to Obs
as a function of Pressure for 3 regions



Fit to obs (GFS – AMV)

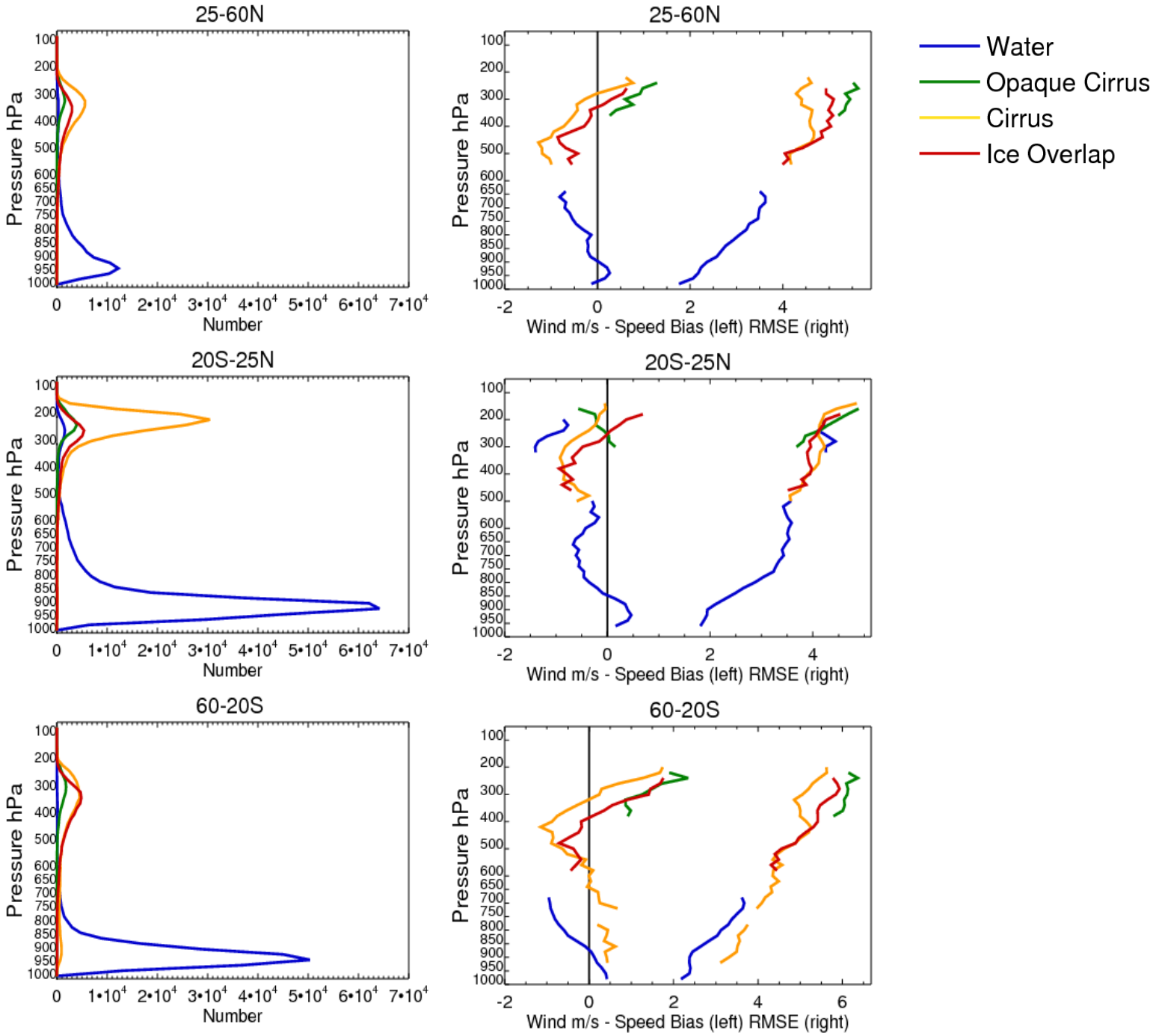
Speed Bias (left) Vector Difference RMSE (right)



June 2012

Data Count and Fit to Obs IR AMVs

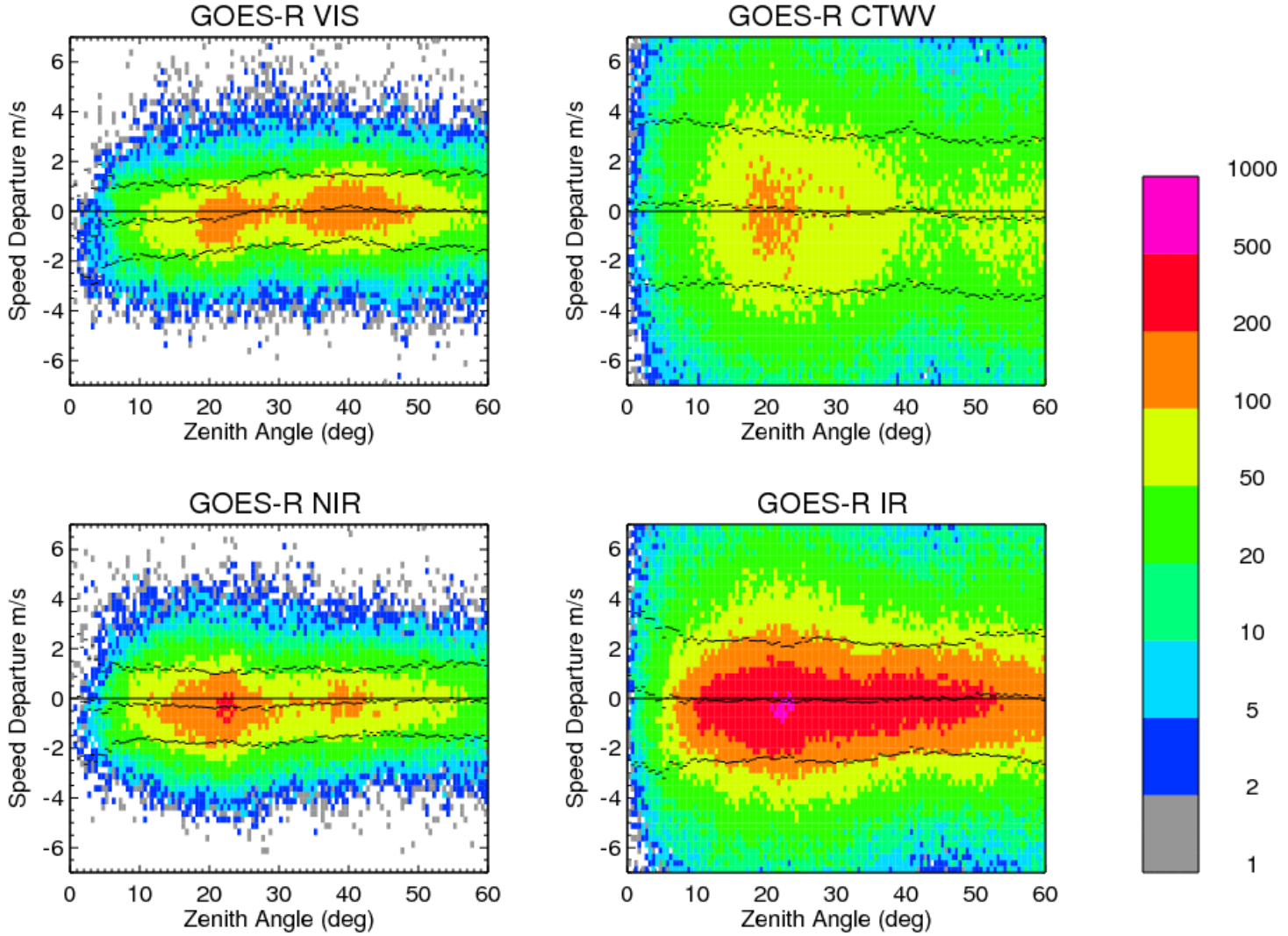
as a function of Pressure for 3 regions divided into dominant cloud type in target box



Speed departure as a function of Zenith Angle

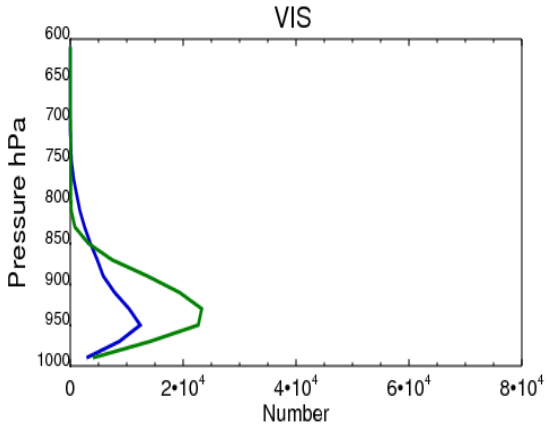
20S-25N June 2012

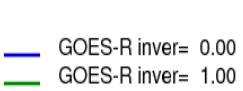
AMV speed – GFS Background speed

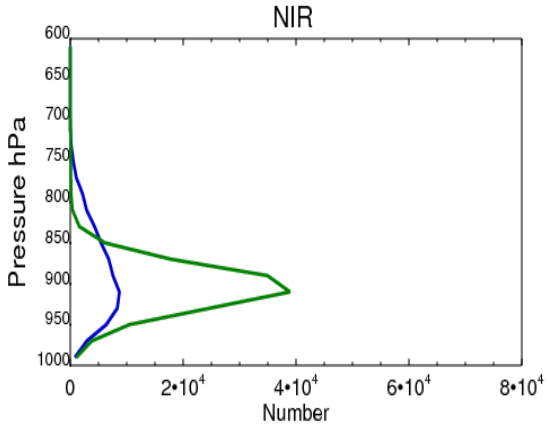


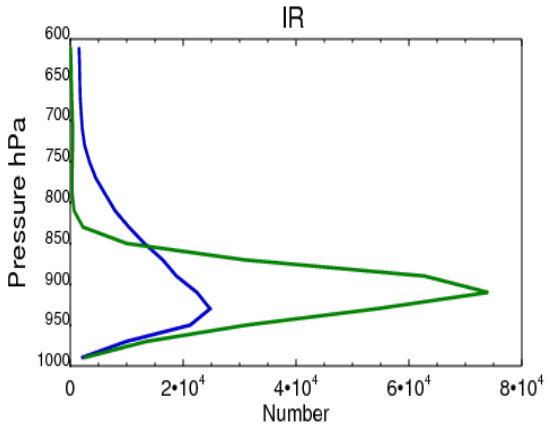
Data Count and Fit to Obs

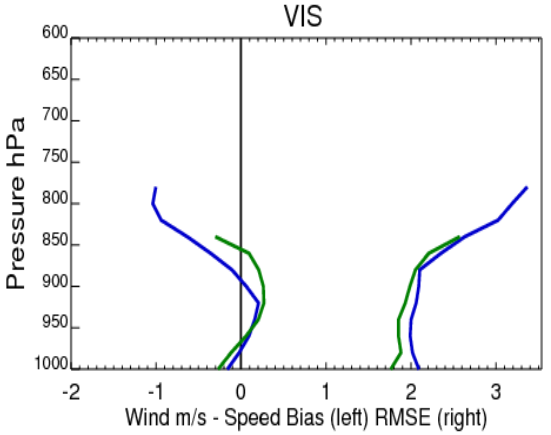
30S-30N Ocean AMVs June 2012. Blue – no inversion, Green – with inversion

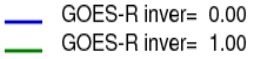


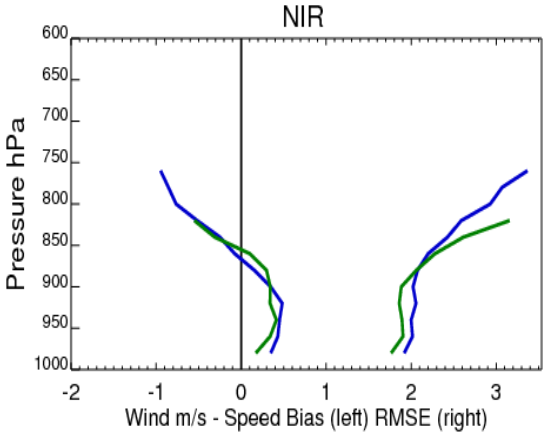




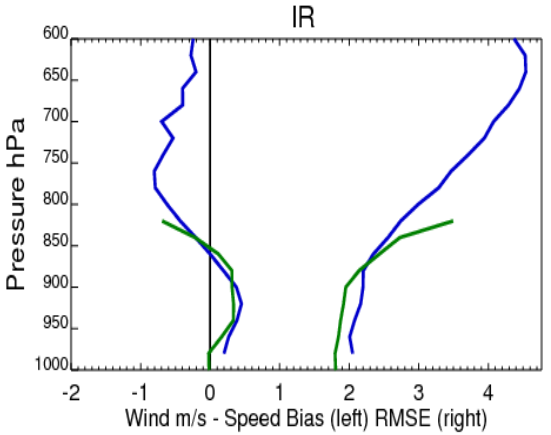








GFS Background - AMV



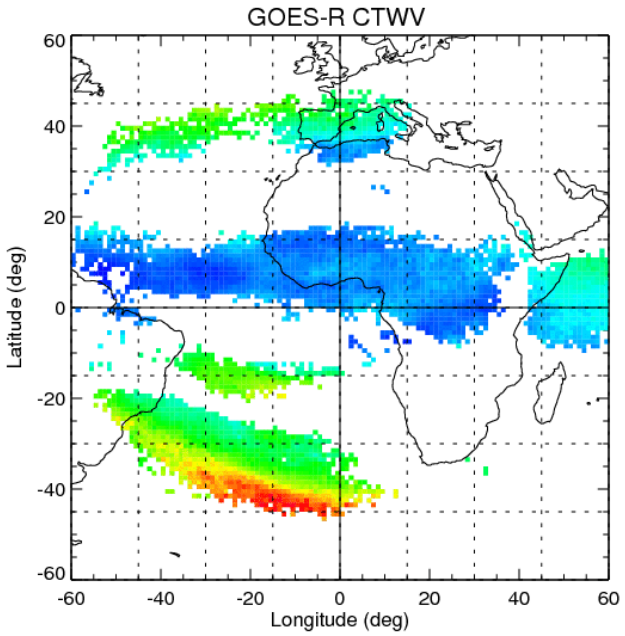
1x1 deg grid box average from 100-700hPa for June 2012

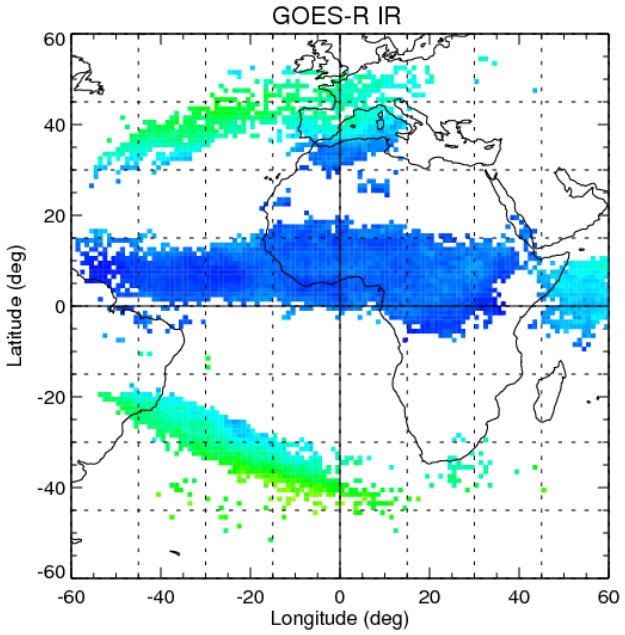
GFS Speed (m/s)

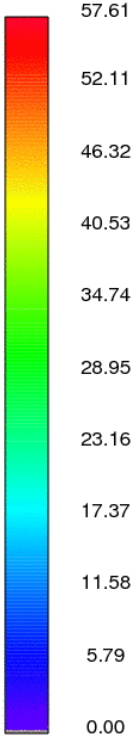
AMV-GFS Speed/ AMV Speed

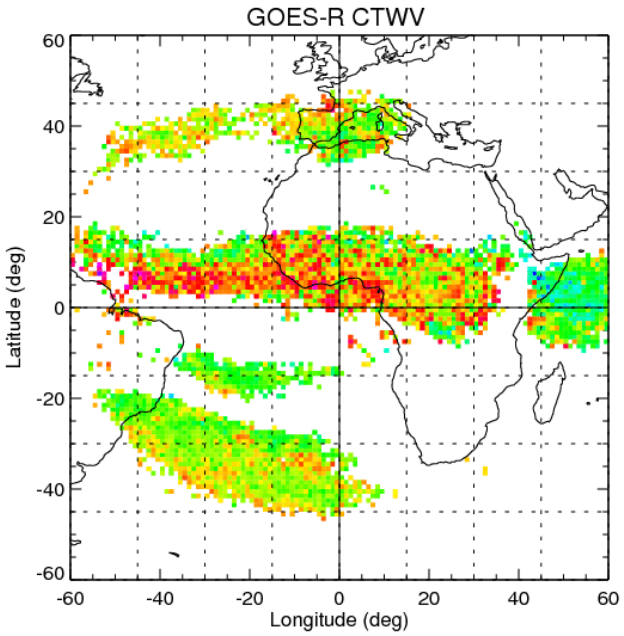
CTWV

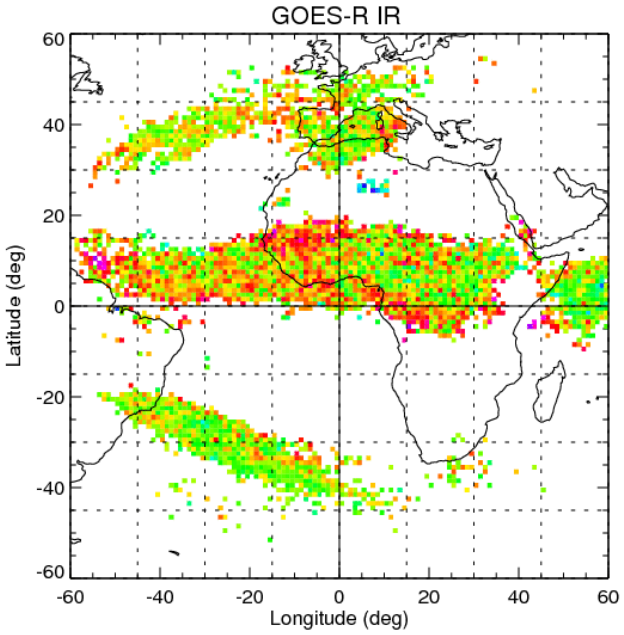
IR

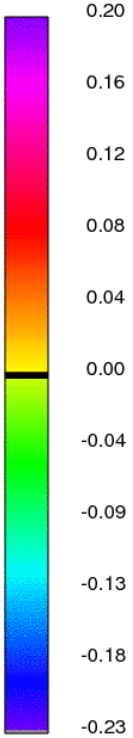








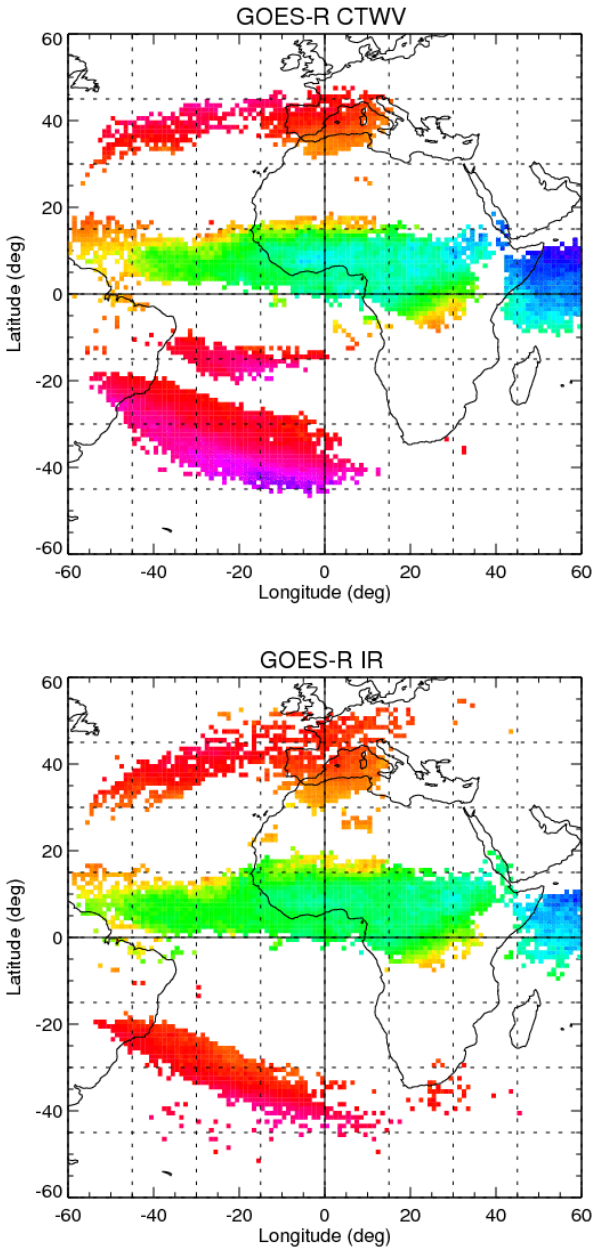




1x1 deg grid box average from 100-700hPa for June 2012

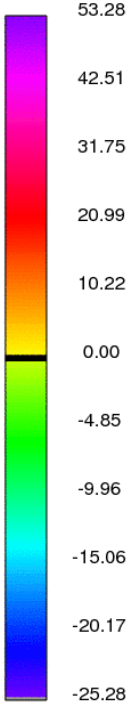
GFS U Comp (m/s)

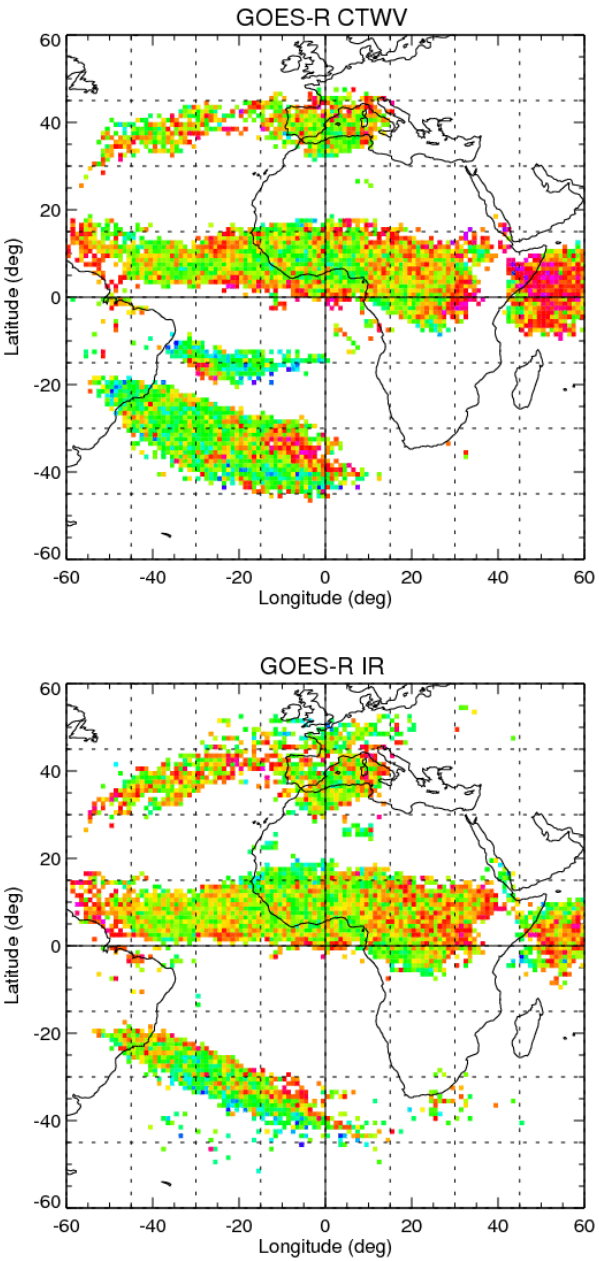
AMV-GFS U Comp (m/s)

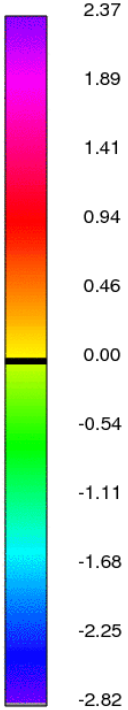


CTWV

IR



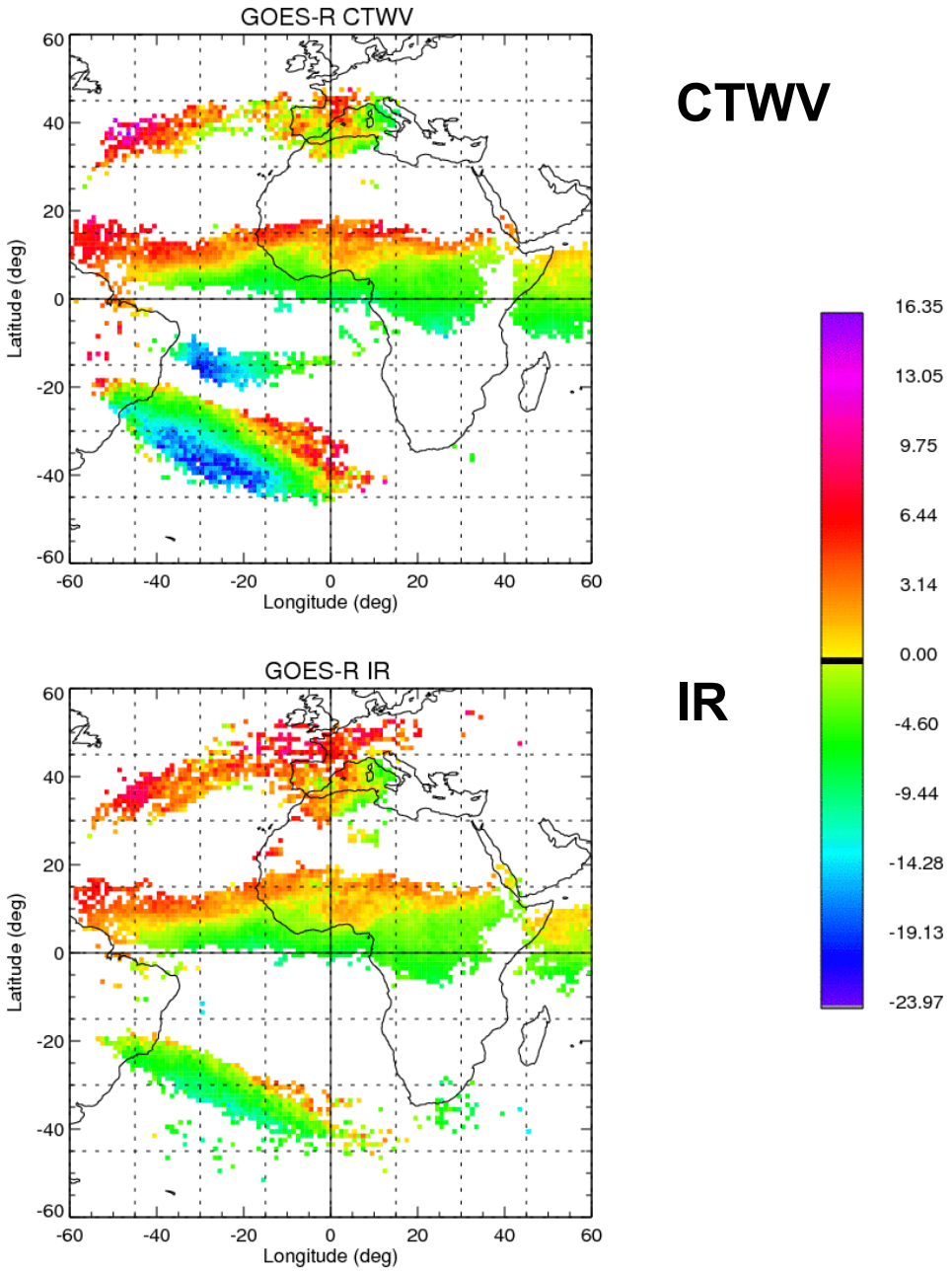




1x1 deg grid box average from 100-700hPa for June 2012

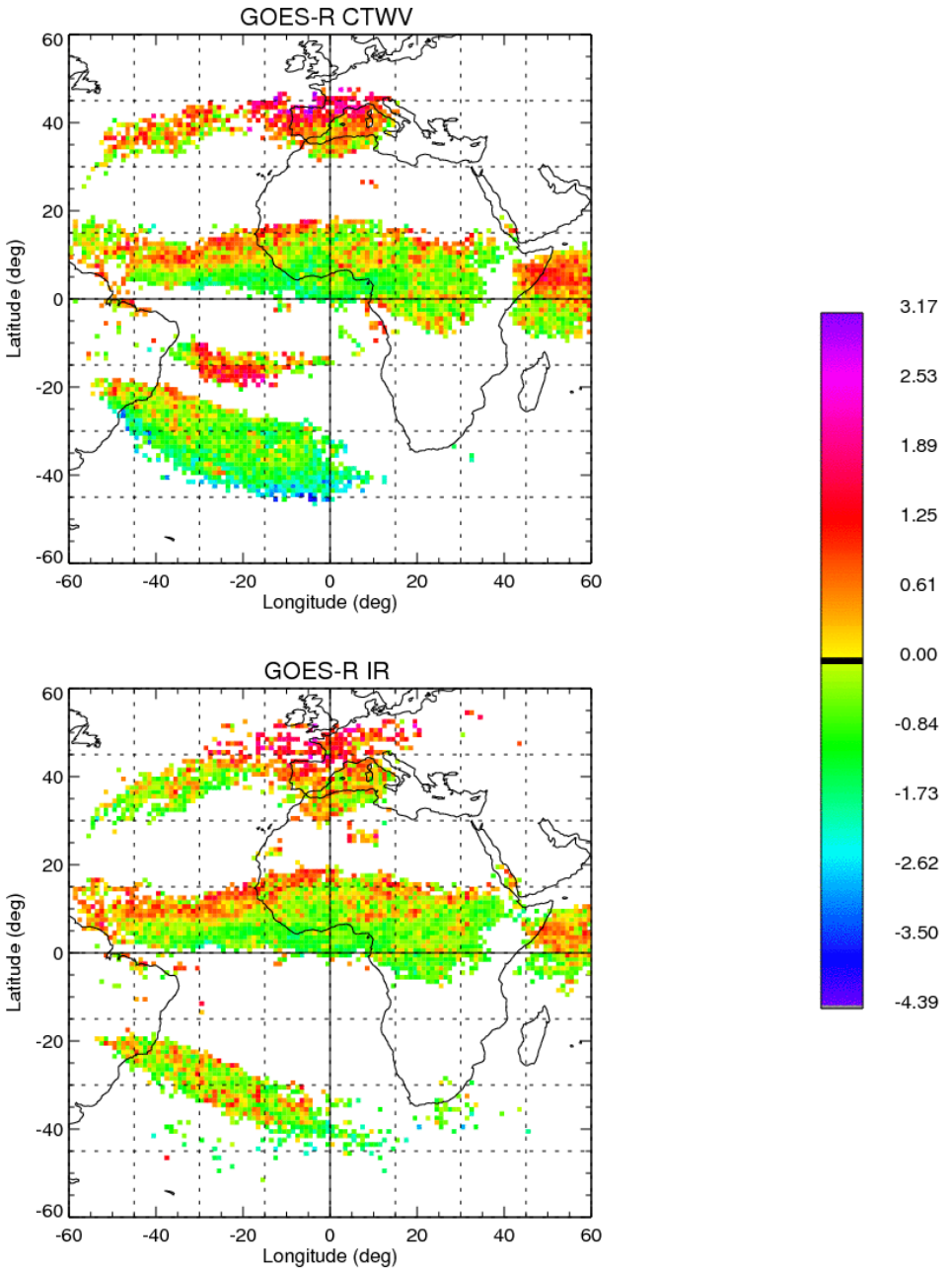
GFS V Comp (m/s)

AMV-GFS V Comp (m/s)



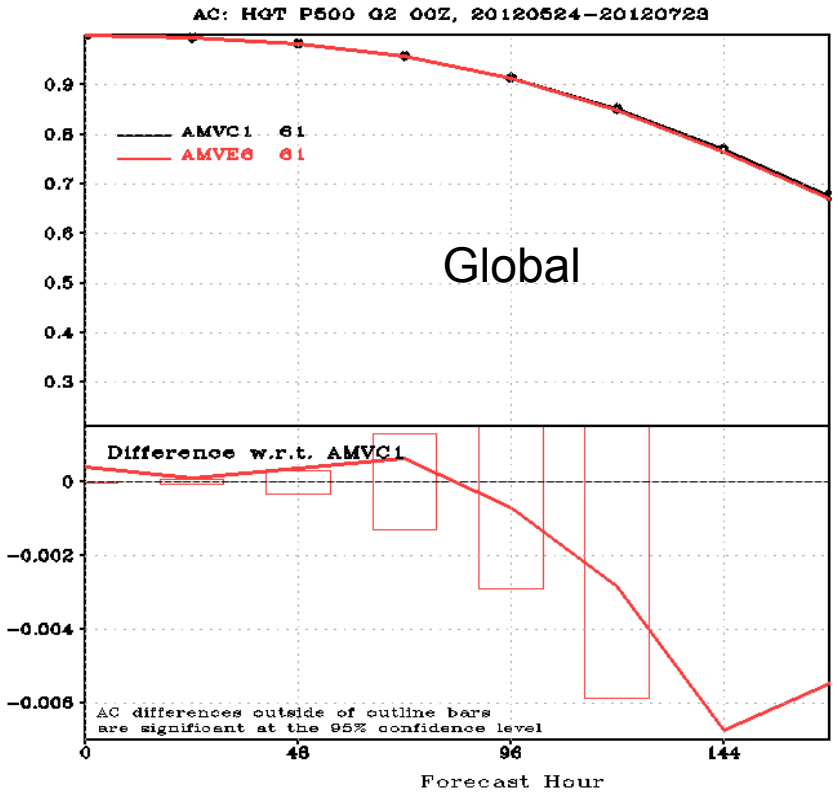
CTWV

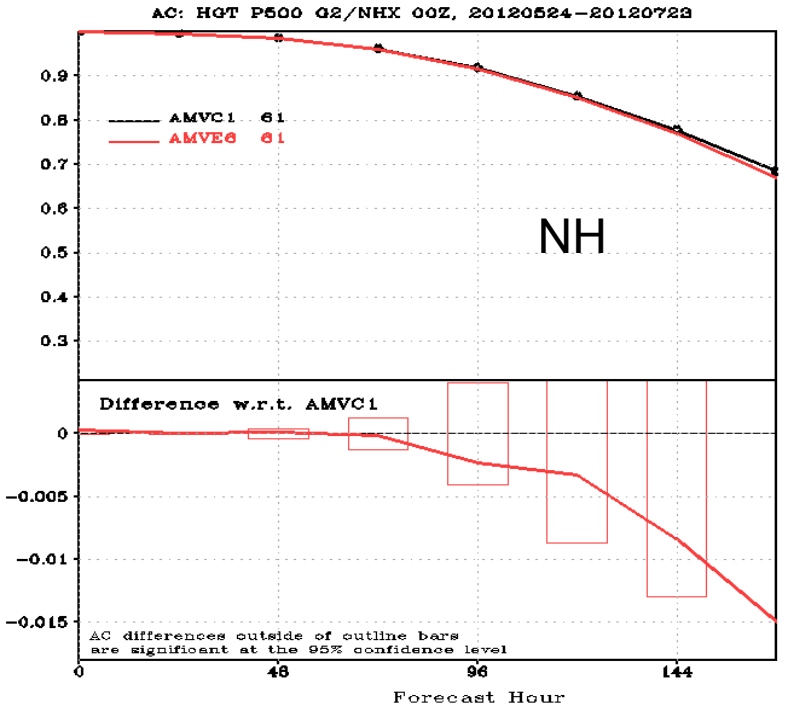
IR

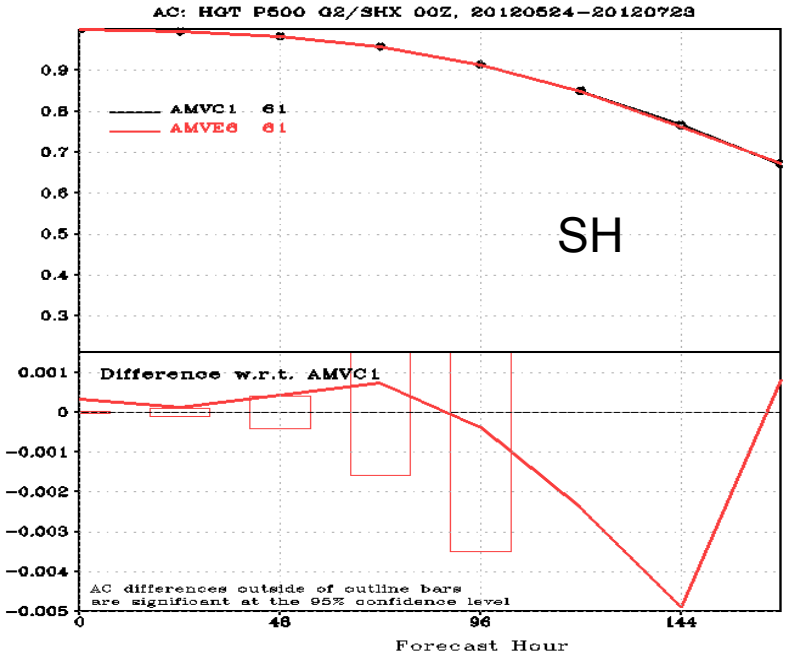


Forecast Skill Impact

500 hPa Height Anomaly Correlation Coefficient
Die-off curves



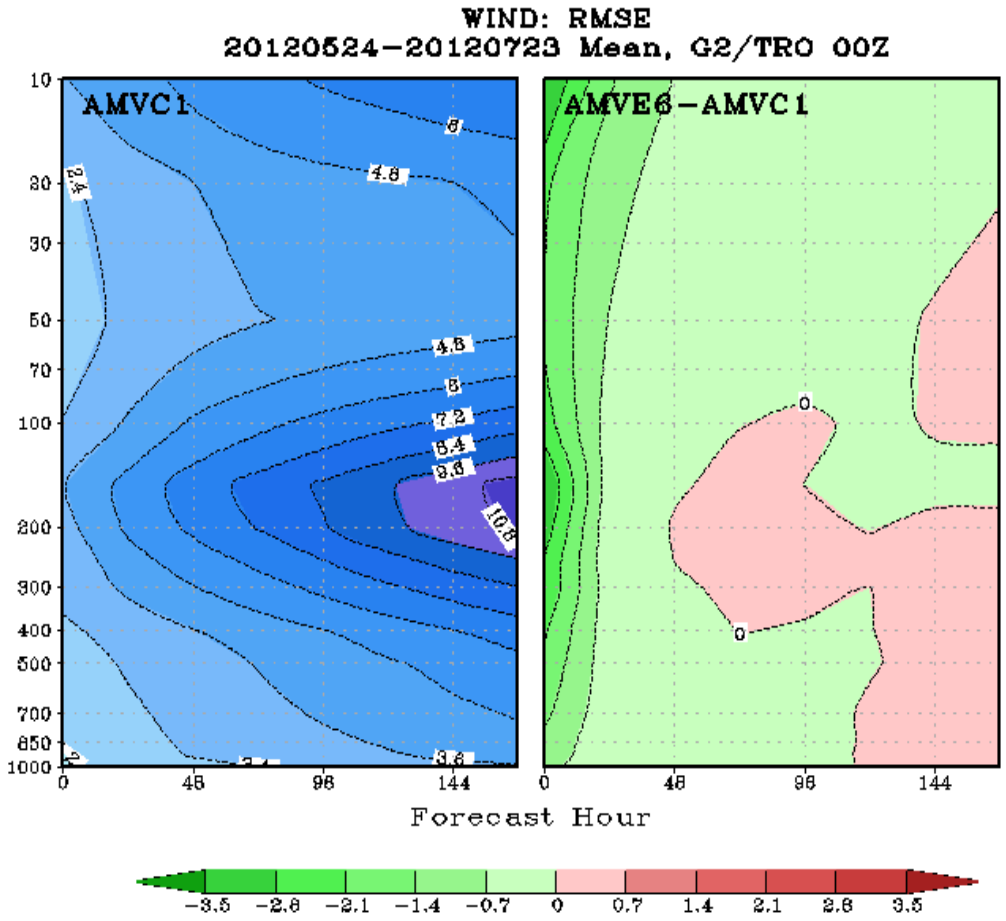


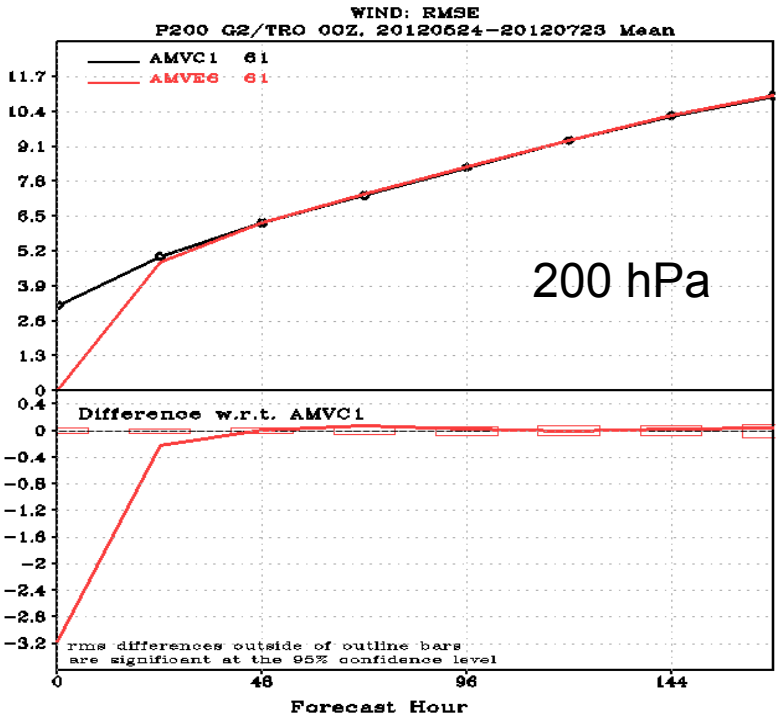


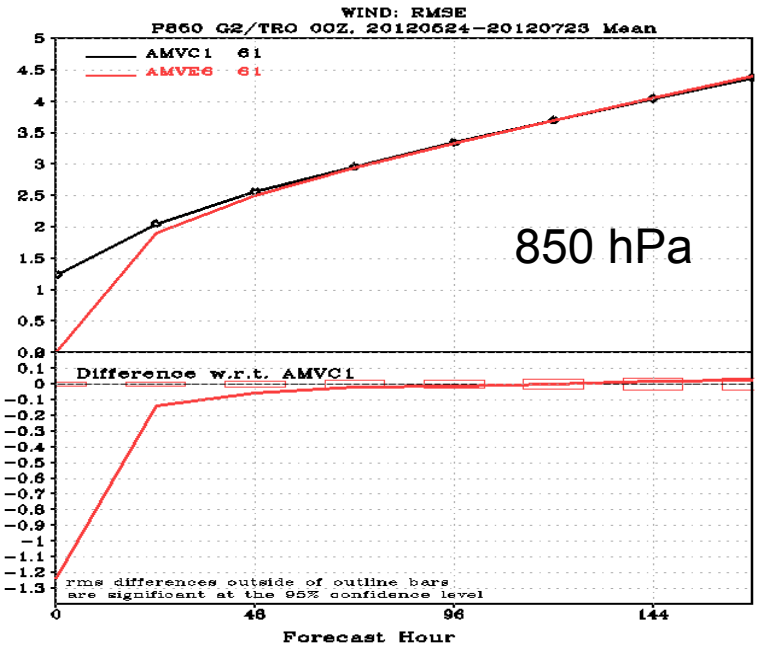
24 May – 23 July, 2014
AMVE6 – GFS simulation using GOES-R AMVs
AMVC1 – GFS simulation using no AMVs from SEVIRI

Forecast Skill Impact

Tropical Wind RMSE

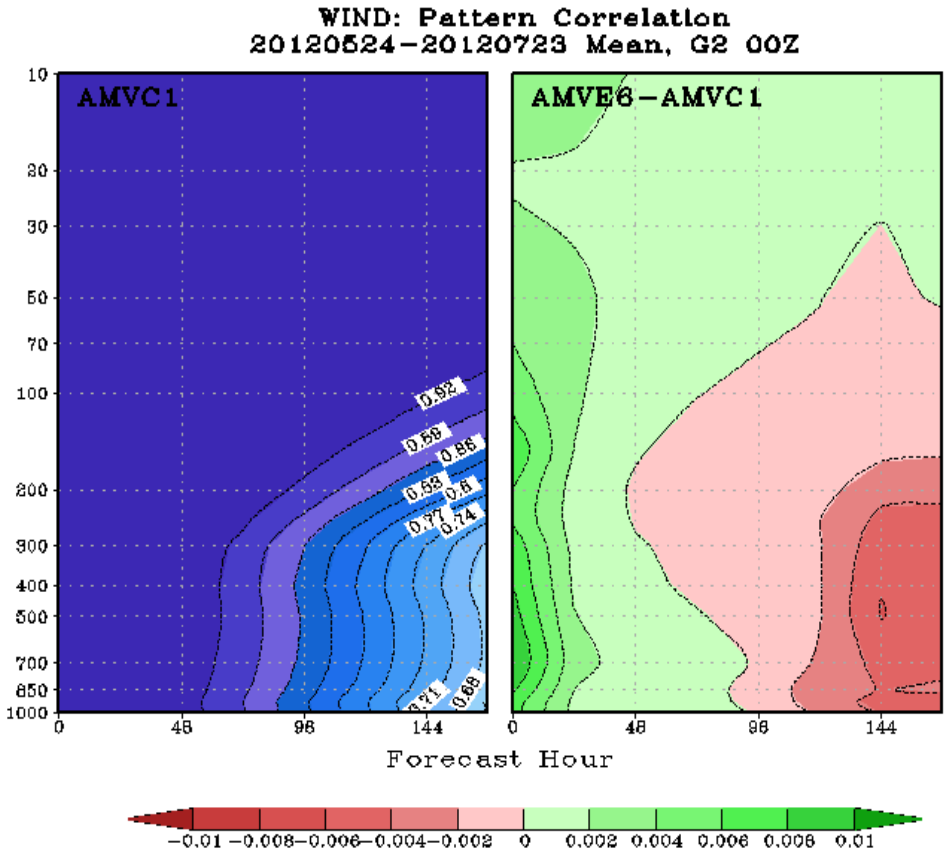


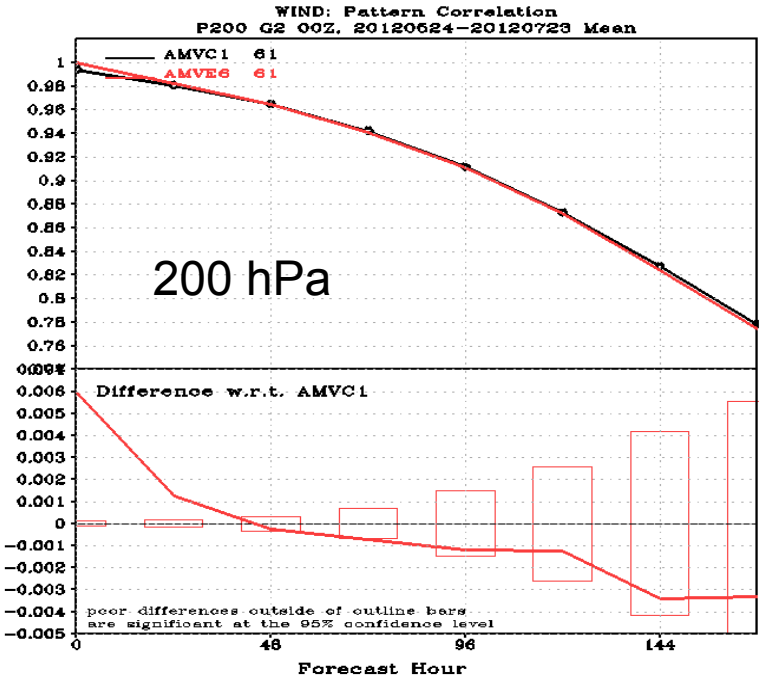


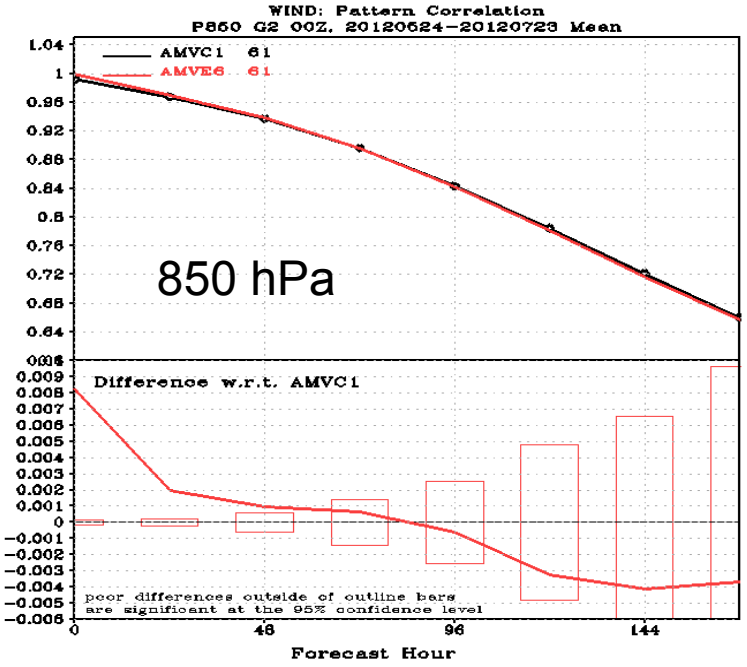


Forecast Skill Impact

Global Wind Pattern Correlation



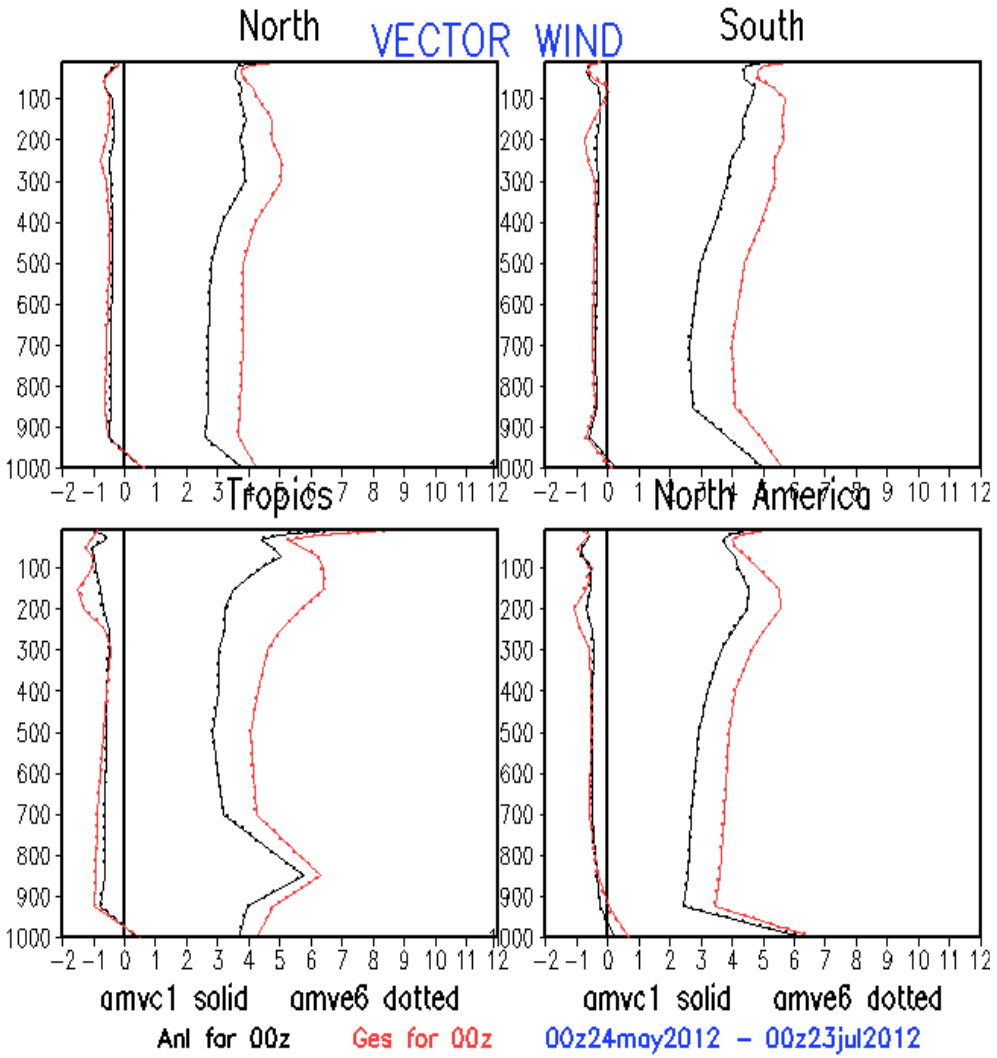




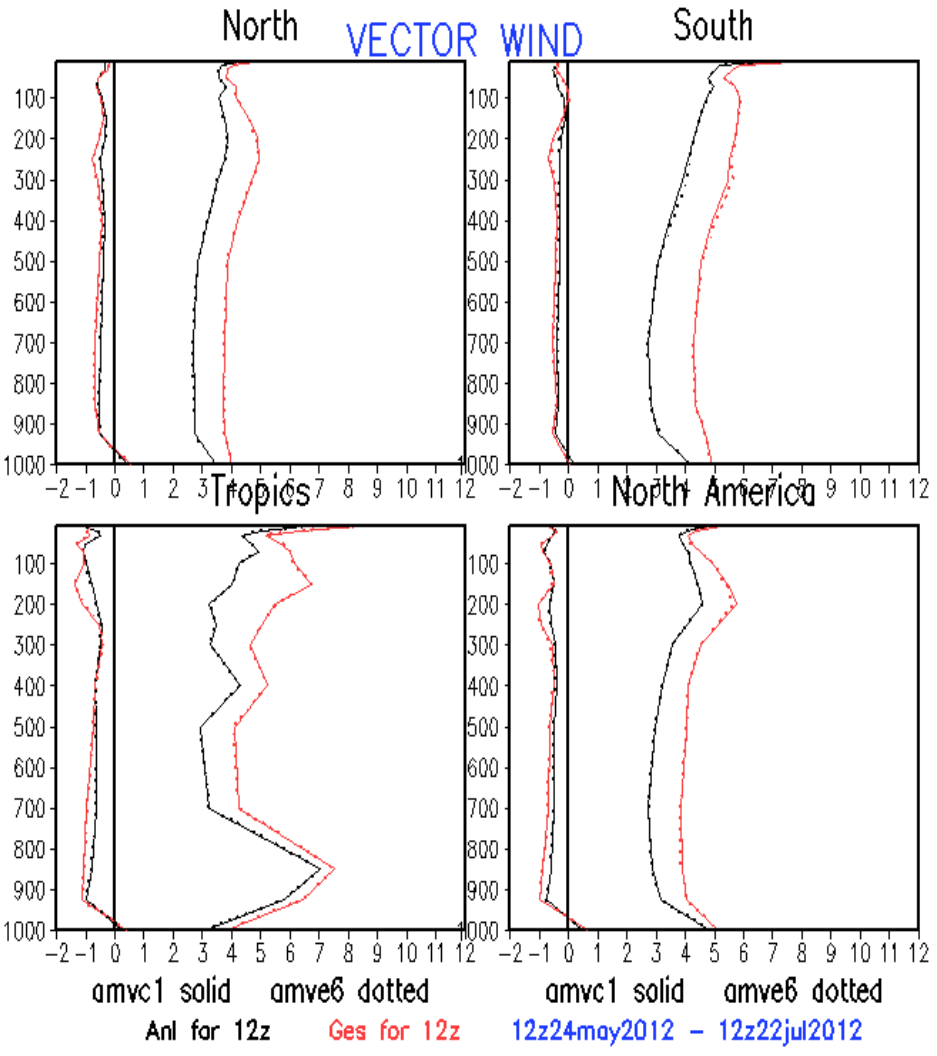
Radiosonde Fit to Obs

Solid – AMVC1 no SEVIRI AMVs
Dots – AMVE6 GOES-R AMVs

0Z



12Z



Summary

Selected Quality Control Settings
QIFN < 80
EE/Ob Speed < 0.9
0.04 < PCT1 < 0.5

Reduced Observation Error for synoptic frequency data by 25%

Applied Log Normal Vector Departure Check

Forecast Skill Impact is neutral to slightly positive in the Southern Hemisphere.

Next: Examine impact of hourly GOES-R AMV data with consideration given to observation error settings and use of off synoptic time data.