GOES-R Atmospheric Motion Vectors: Assimilation in NCEP GFS

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Topic: Numerical Weather Prediction

Program: GOES-R3

GOES-R AMVs

What are they?

Estimate of wind using the GOES-R Advanced Baseline Imager (ABI) by tracking cloud and moisture gradients

What's new compared to GOES AMVs?

- ABI provides improvements in quality of the target
- GOES-R AMV Algorithm includes additions of nested tracking, cluster analysis to find dominate motion, and height assignment based on pixel level information of either brightness temperature or the cloud height from the GOES-R ABI Cloud Height Algorithm

How to test?

Proxy data created using SEVIRI images to simulate 4 ABI Channels will be assimilated in the NCEP GFS Hybrid Ensemble Kalman Filter Data Assimilation System

Methodology

To minimized time between research to operations for this new data type, proxy data will be tested in the current research version of NCEP GFS. Two seasons each two months in duration will assimilate the proxy GOES-R AMVs. Parallel control runs will also be completed which do not assimilate AMVs from the SEVIRI instrument.

Completed:

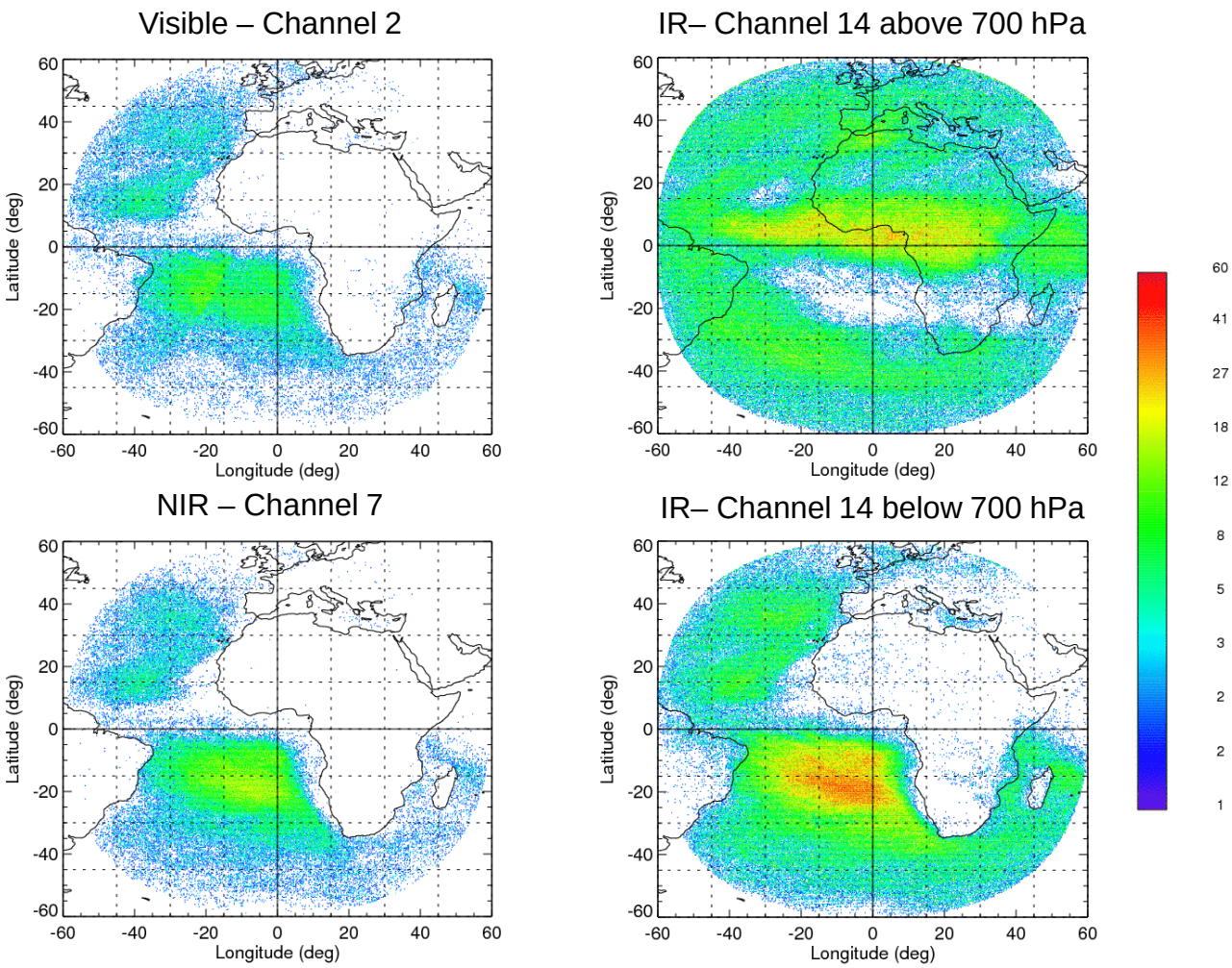
- Evaluate proxy GOES-R ABI AMVs during two short seasons using observation-background statistics
- Investigate quality control procedures

Begun:

- Assimilate AMVs for two seasonal runs to determine impact on the assimilated state and forecast skill
- Optimize observation error specification

Proxy GOES-R AMV Data

Location of assimilated AMVs from 15 May – 30 June, 2012.
Color indicates number of data in a ¼°x ¼° grid box

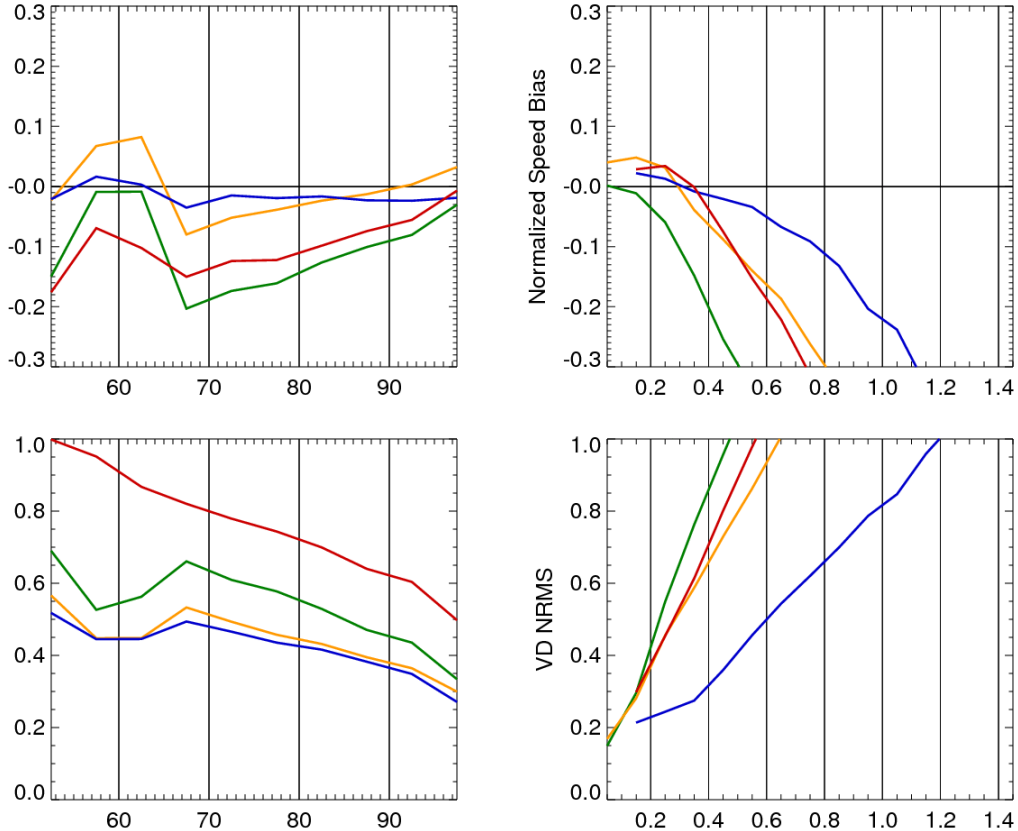


Quality Control

Observation-GFS Background (OMB) wind statistics Dec 2011, Channel 14 IR AMV QI without forecast component and normalized EE are both good predictors of OMB and have been used as quality control metrics.

Normalized Speed Bias

Normalized Vector Difference NRMS



Quality Indicator (QI) no forecast component

Normalized Expected Error EE / Speed OBS

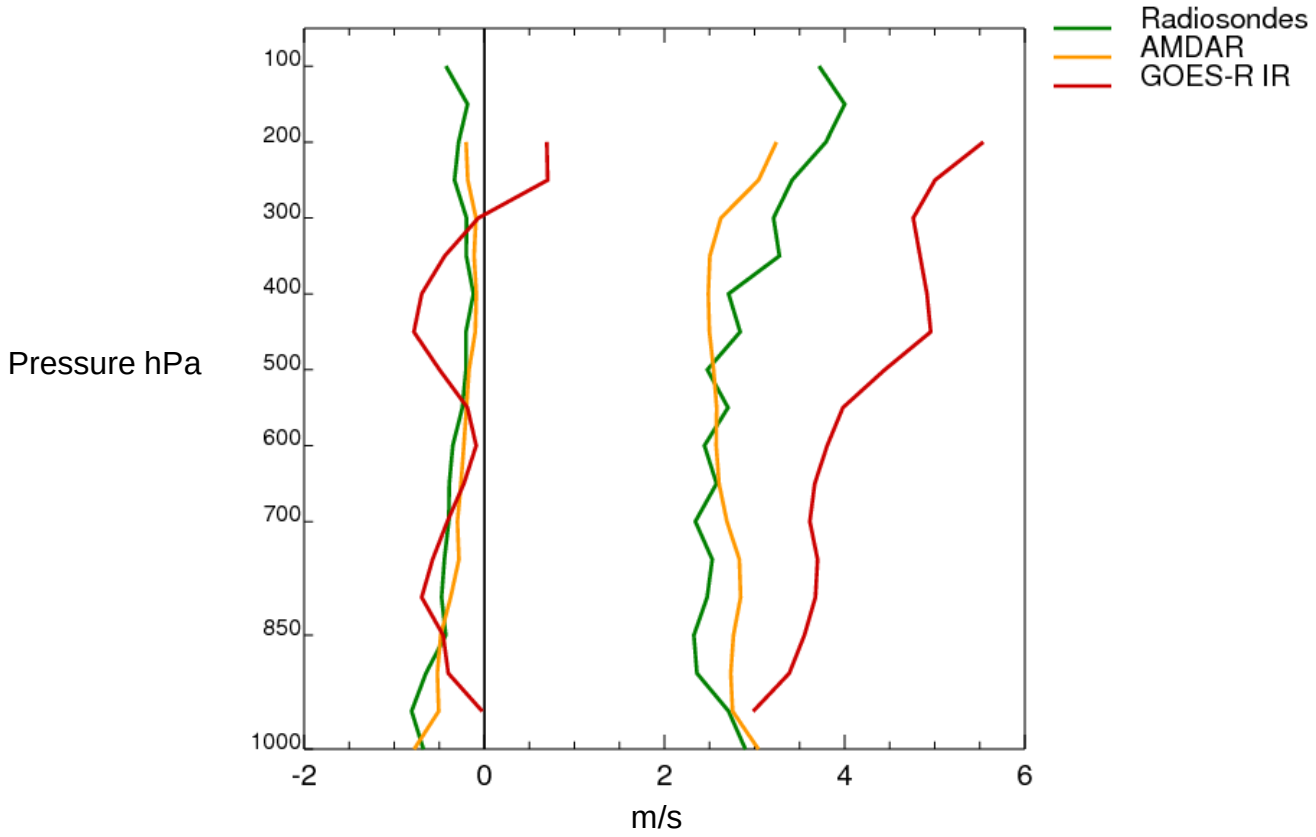
Low AMVs below 750 hPa – Blue

Mid-Upper Level AMVs above 750 hPa:
Tropics ITCZ 15S-5N – Red
SH – Yellow
NH - Green

Normalized Speed Bias =
(Speed OBS-Speed GFS) / Speed OBS
Vector Difference =
SQRT $[(UOBS-UGFS)^2 + (VOBS-VGFS)^2]$

Fit to Observations

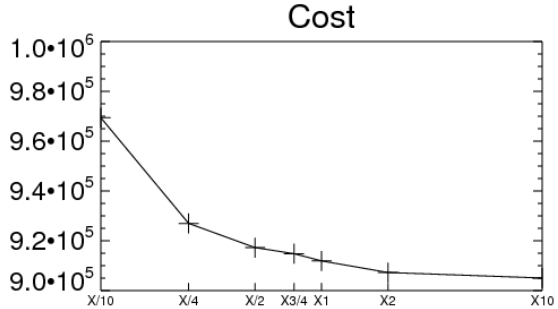
Comparing the analysis state to the assimilated observations has revealed a need to change the specified observation error due to the error's impact on the influence of the observation on the final analysis state. Below is a comparison of the GOES-R IR AMVs to radiosondes and AMDAR aircraft data within the region 35-45N and 5W-45E, an area with reasonable data count for all three data types. A wind vector RMSE similar to the radiosondes for the GOES-R AMVs is desirable.

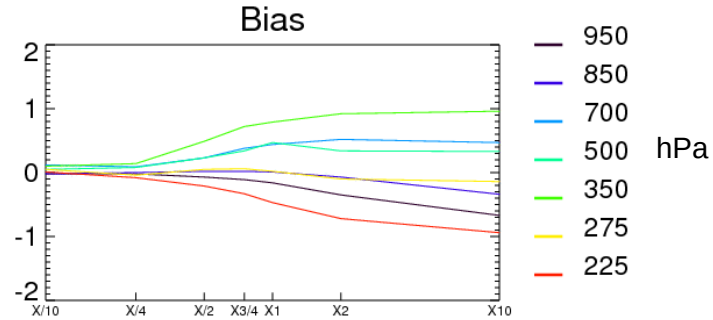


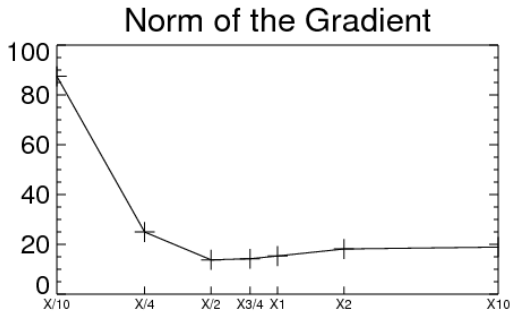
Analysis – Observation Speed bias (left) and Wind Vector RMSE (right)
35-45N & 5W-45E

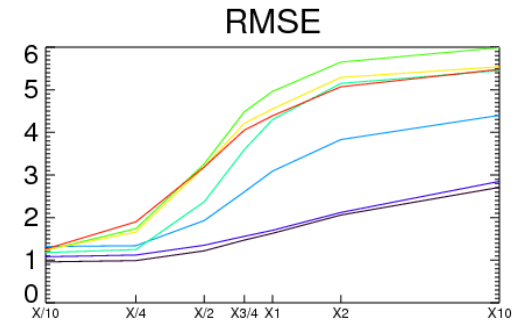
Error Tuning

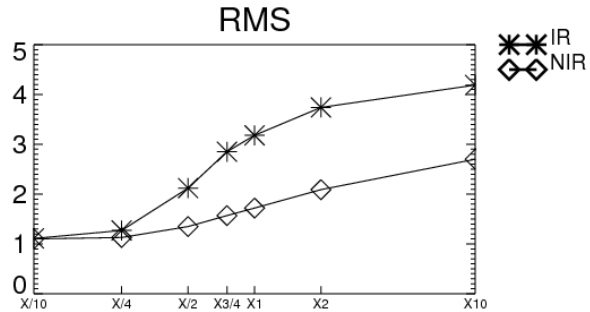
By multiplying the observation error by a range of factors and completing one analysis cycle, optimal settings for the observation error may be revealed. Below are analysis metrics for 7 cases of observation error multiplied from a range of 0.1 to 10. The curvature of the lines indicate a factor of 0.5 for upper level AMVs may be optimal.



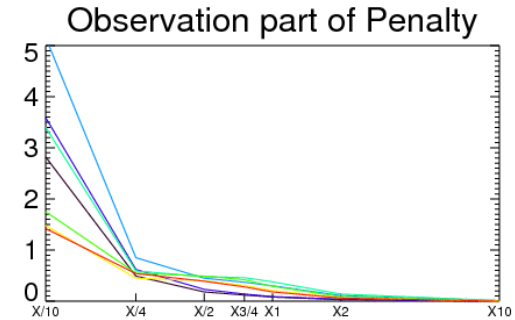








For all levels



For individual vertical levels

Path to Operations

- Undergo peer review of GFS software modifications needed to assimilate GOES-R AMVs.

- Maintain close interaction with NCEP EMC to determine when GOES-R AMVs are a candidate for use in operations.

Future Plans

- First of two seasonal GFS runs with and without GOES-R proxy AMVs has completed with support from JCSDA. Analysis is underway.
- Optimal GOES-R AMV observation error will be determined from tuning tests
- Begin second season simulation with input obtained through BUFR format, if ready.
- Continue to review QC choices while monitoring the performance of the GOES-R proxy AMVs in the GFS