



Atmospheric Motion Vector Impact Study Using the NCEP Global Forecast System

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And
Lars Peter Riishojgaard



Background

- May 2011 version of the NCEP GDAS/GFS
- T574L64 (operational resolution)
- Operational configuration except:
 - Conventional data QC from the operational run, not the experiment
 - No restricted data used (aircraft, ships, etc.)
- Two Seasons:
 - 15 Aug – 30 Sept 2010
 - 1 Dec 2010 – 15 Jan 2011
- Two experiments
 - Deny all AMVs (NAMV) (both seasons)
 - Deny Polar AMVs (NMOD) (Dec – Jan only)





Denied AMVs for No AMV Experiment

- MTSAT, infrared and visible below 850 hPa
- Meteosat, infrared and visible below 850 hPa
- GOES, infrared
- GOES, water vapor cloud top
- MTSAT, infrared and visible above 850 hPa
- Meteosat, infrared and visible above 850 hPa
- MODIS, infrared
- MODIS, water vapor cloud top
- MODIS, water vapor deep layer





Denied AMVs for No Polar AMV Experiment

- MODIS, infrared
- MODIS, water vapor cloud top
- MODIS, water vapor deep layer

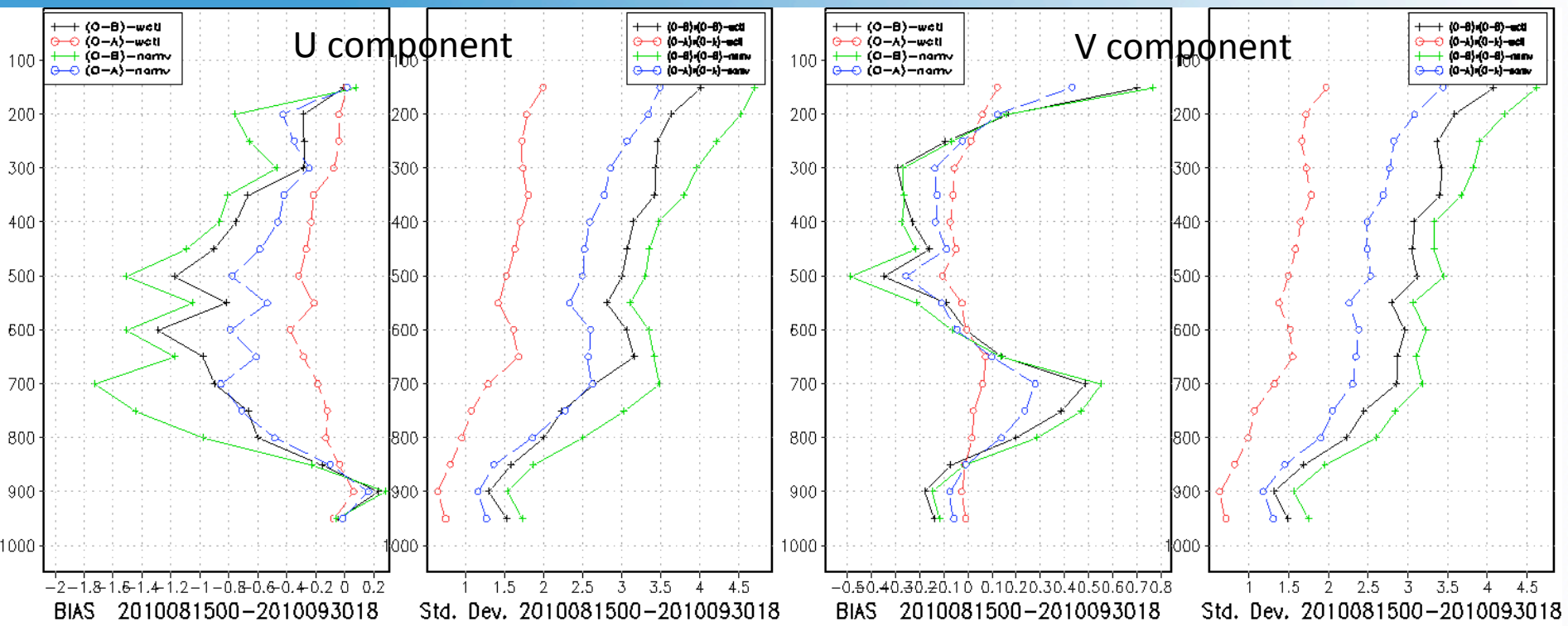


No AMV Experiment 15 Aug 2010 – 30 Sep 2010





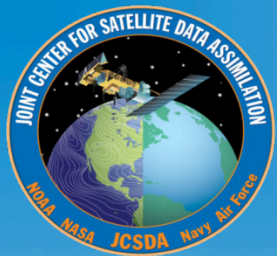
GOES infrared



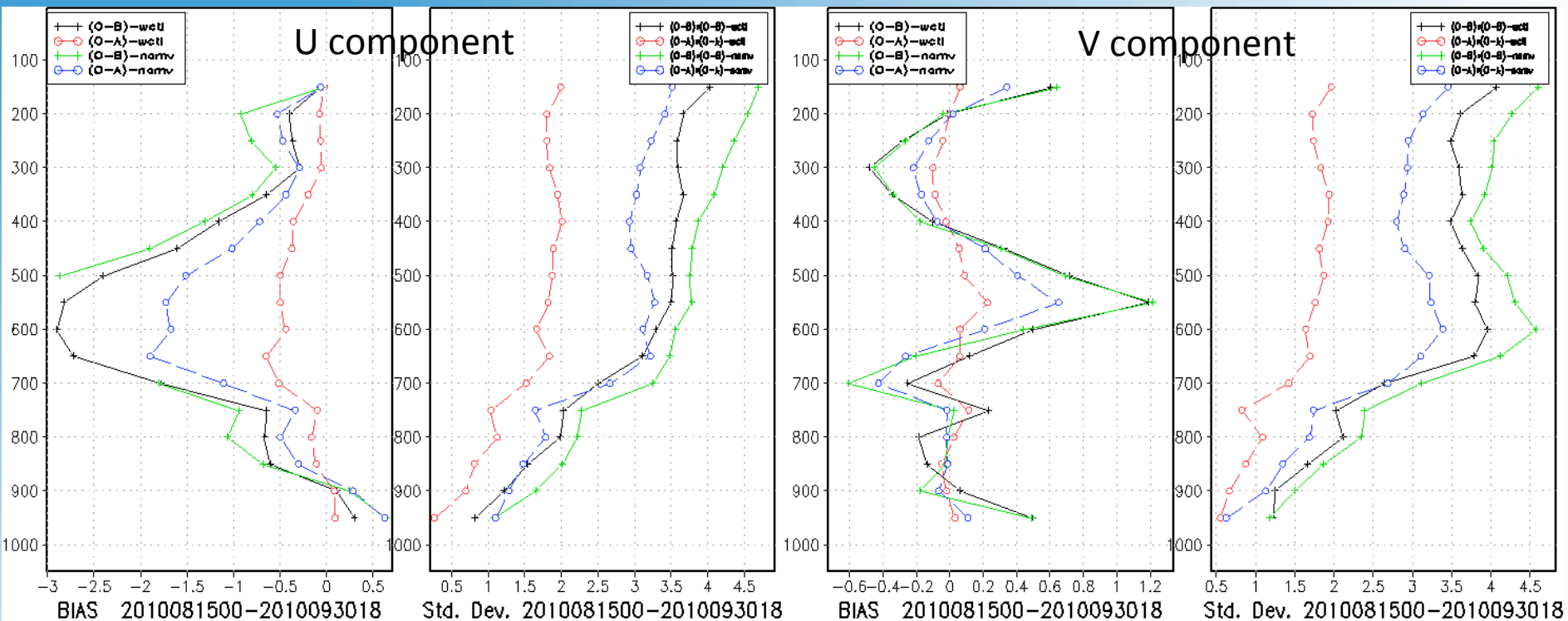
Black = Control (O-B) Red = Control (O-A)
 Green = Experiment (O-B) Blue = Experiment (O-A)

No AMV Experiment 15 Aug 2010 – 30 Sept 2010





GOES Water Vapor Cloud Top

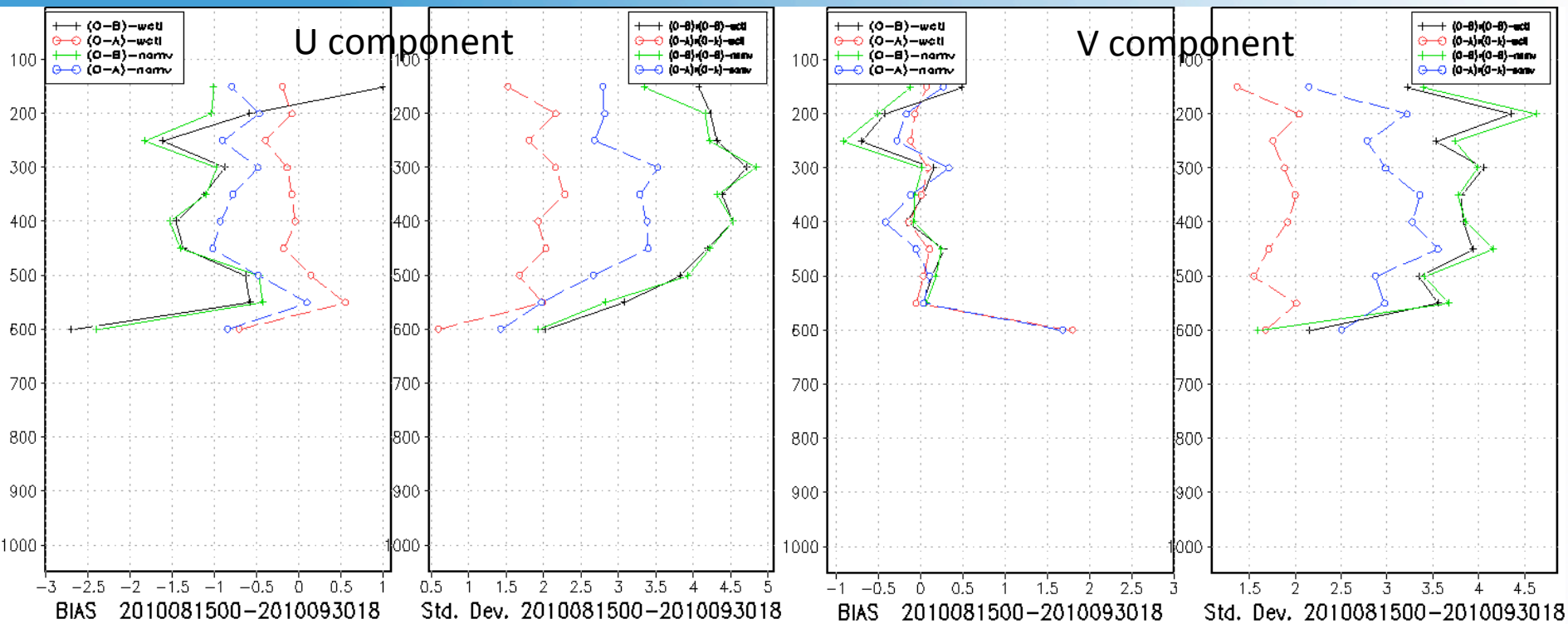


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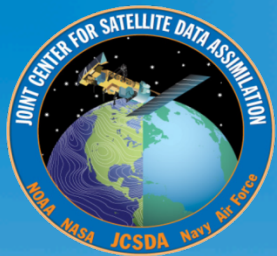


MTSAT infrared above 850 hPa

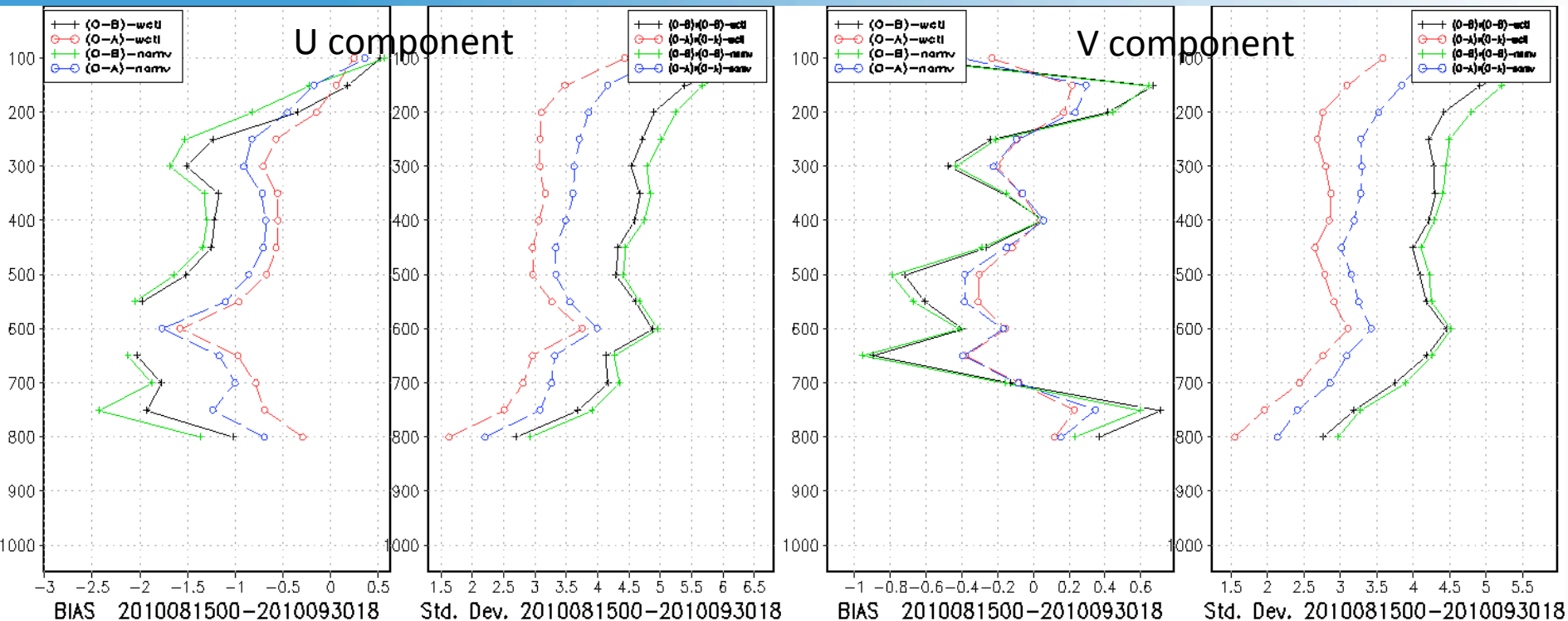


Black = Control (O-B) Red = Control (O-A)
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Meteosat-9 infrared above 850 hPa



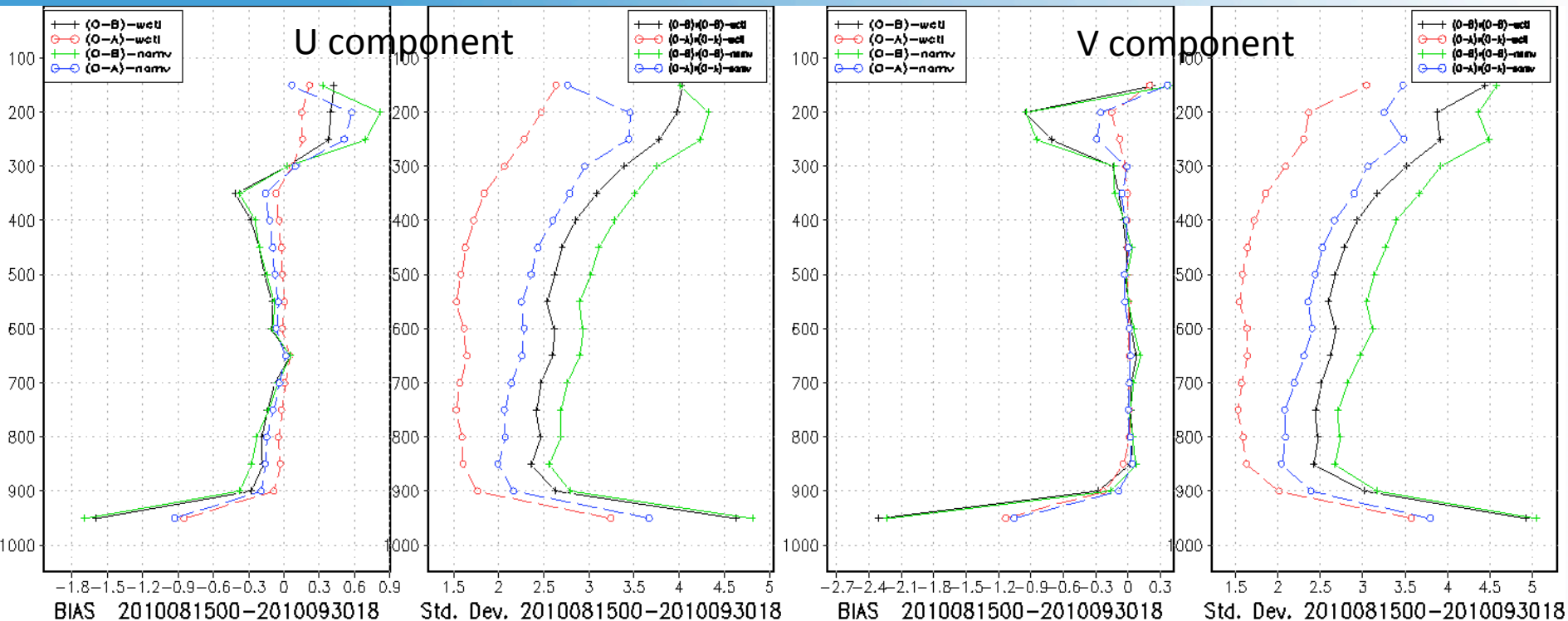
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Green = Experiment (O-B) Blue = Experiment (O-A)

No AMV Experiment 15 Aug 2010 – 30 Sept 2010



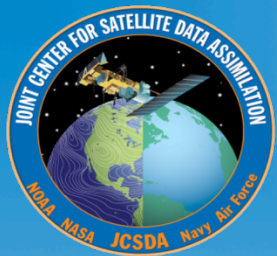


MODIS infrared

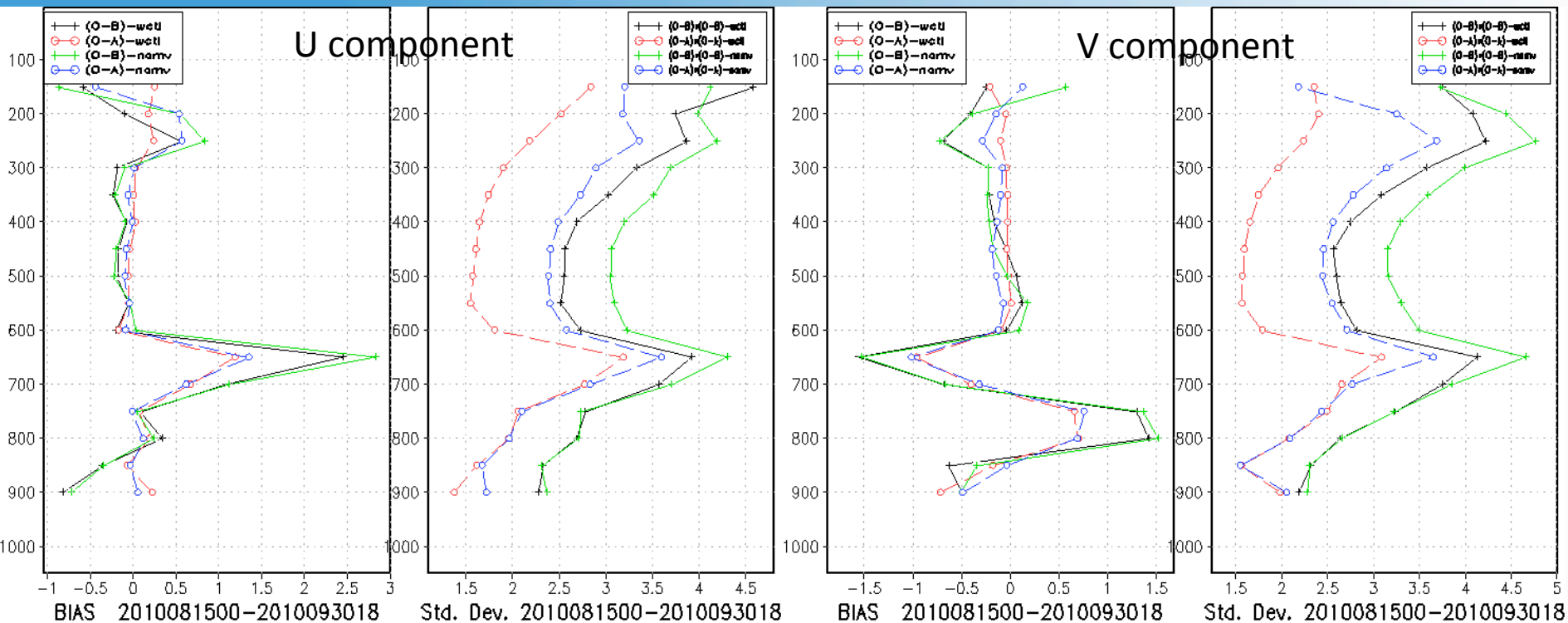


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MODIS Water Vapor Cloud Top

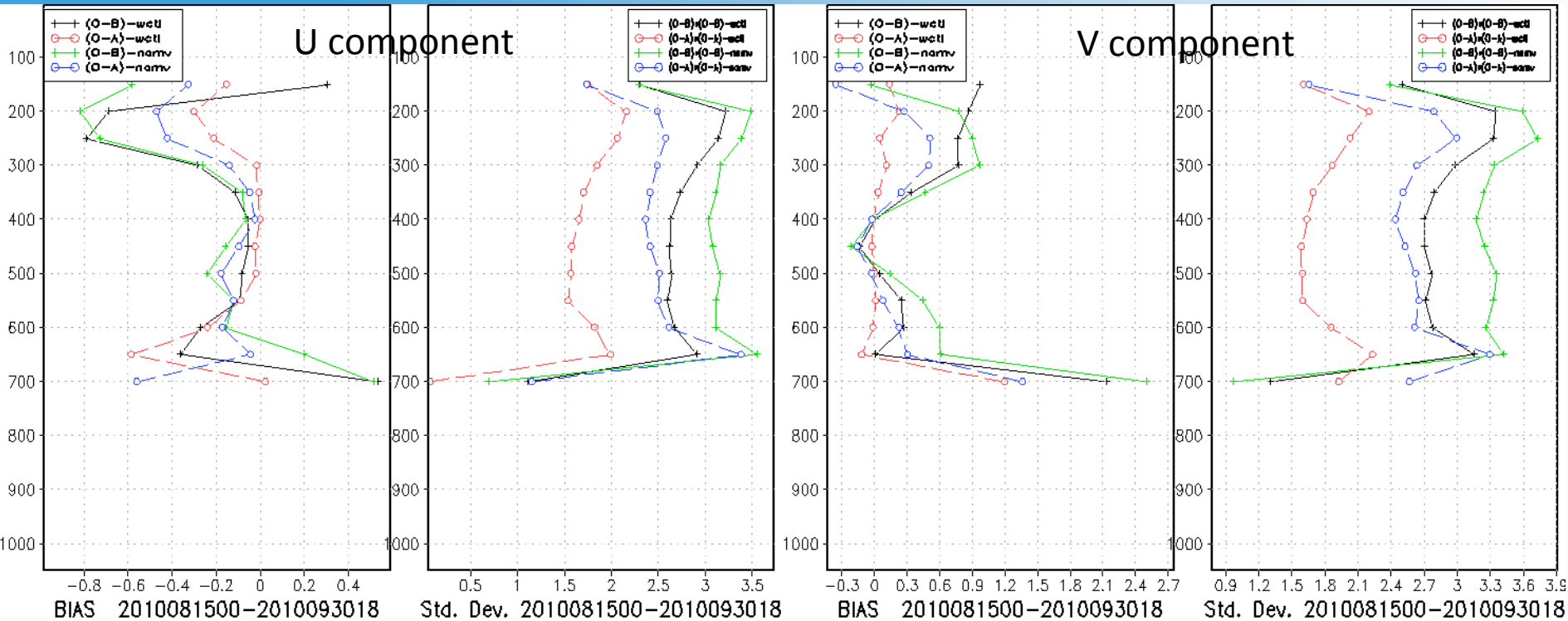


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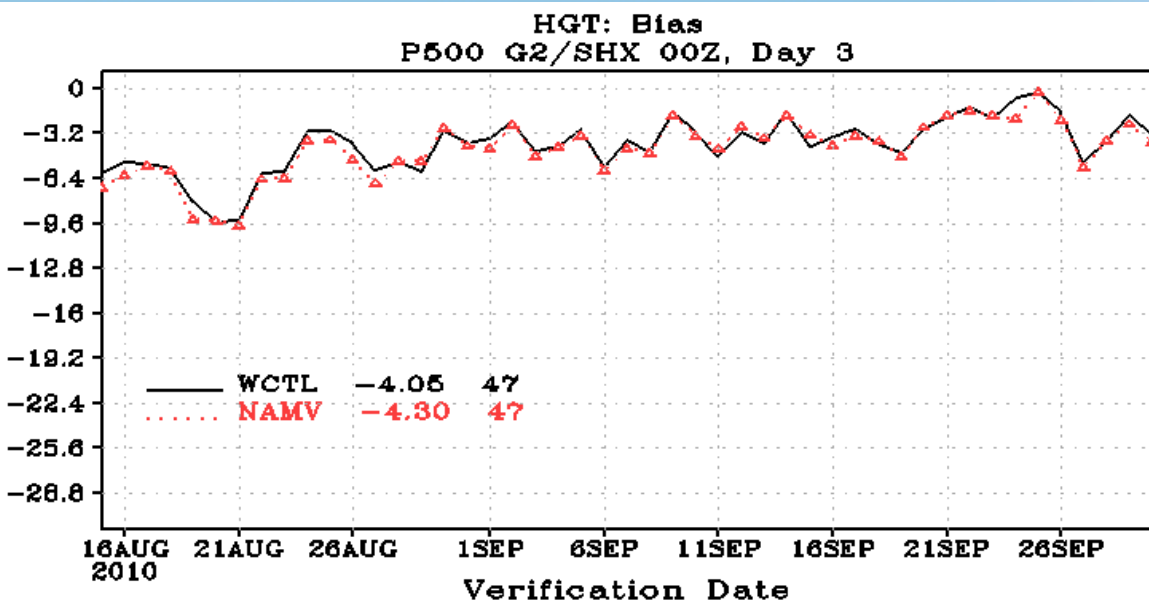
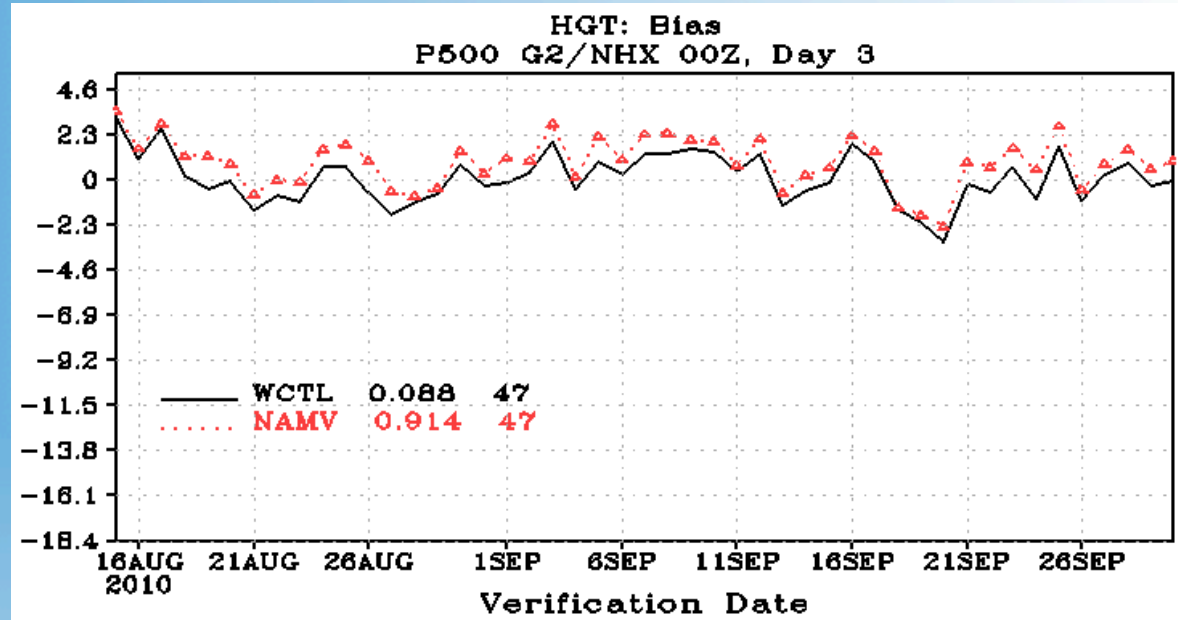


MODIS Water Vapor Deep Layer



Black = Control (O-B) Red = Control (O-A)
 Green = Experiment (O-B) Blue = Experiment (O-A)

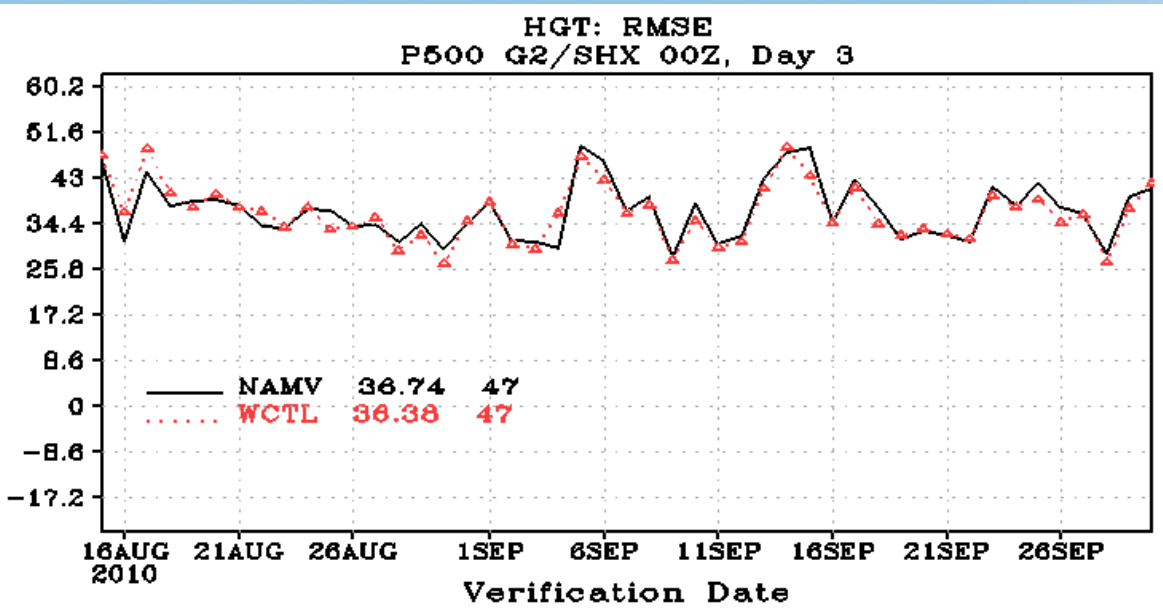
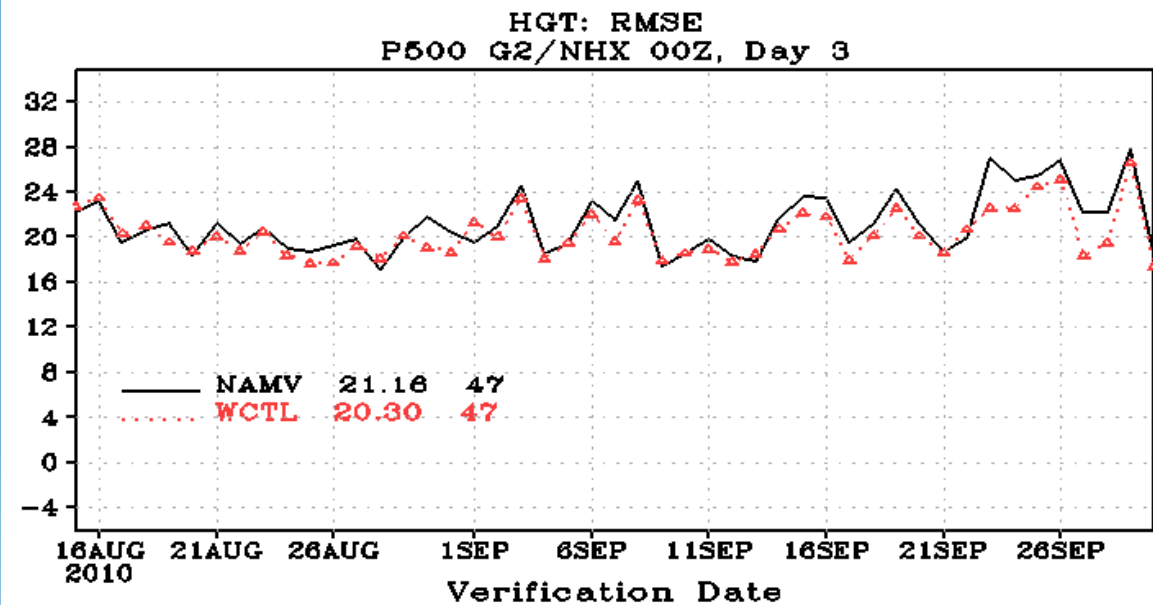




Geopotential heights - day 3
Bias time series at 500 hPa for
Northern and Southern
Hemispheres.

Positive = WCTL closer to zero





Geopotential heights, day 3, RMSE time series at 500 hPa for Northern and Southern Hemispheres.

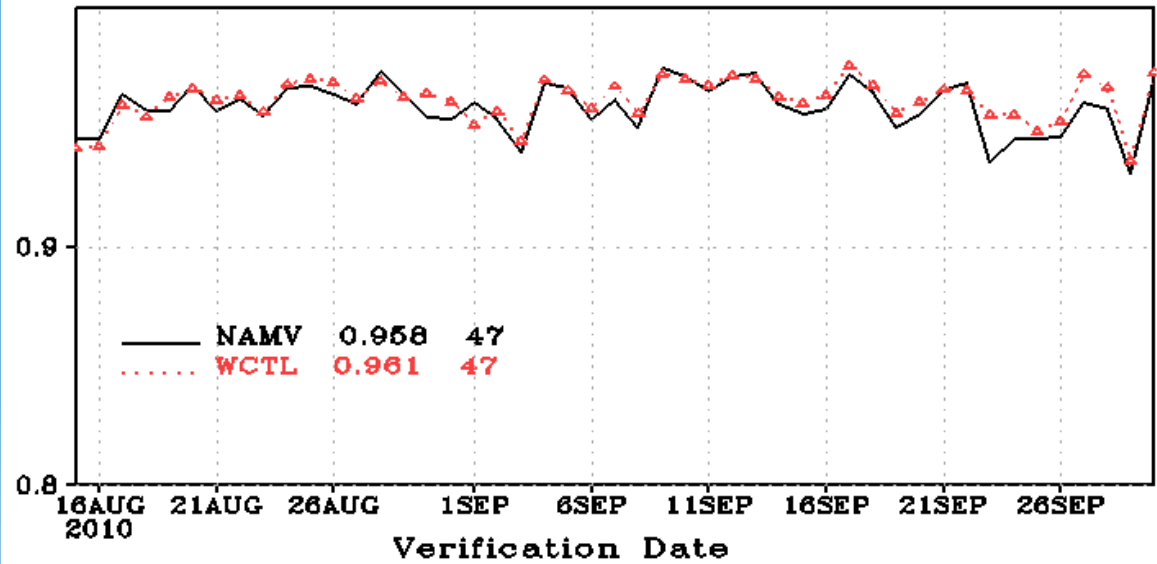
Positive = WCTL < NAMV

No AMV Experiment 15 Aug 2010 – 30 Sept 2010

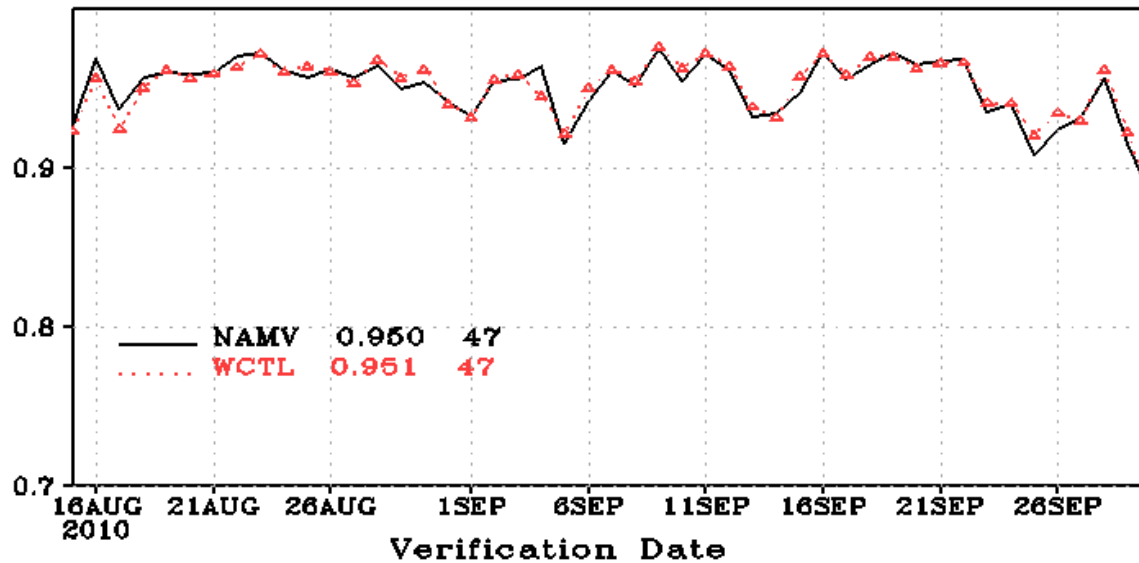




Anomaly Correl: HGT P500 G2/NHX 00Z, Day 3



Anomaly Correl: HGT P500 G2/SHX 00Z, Day 3

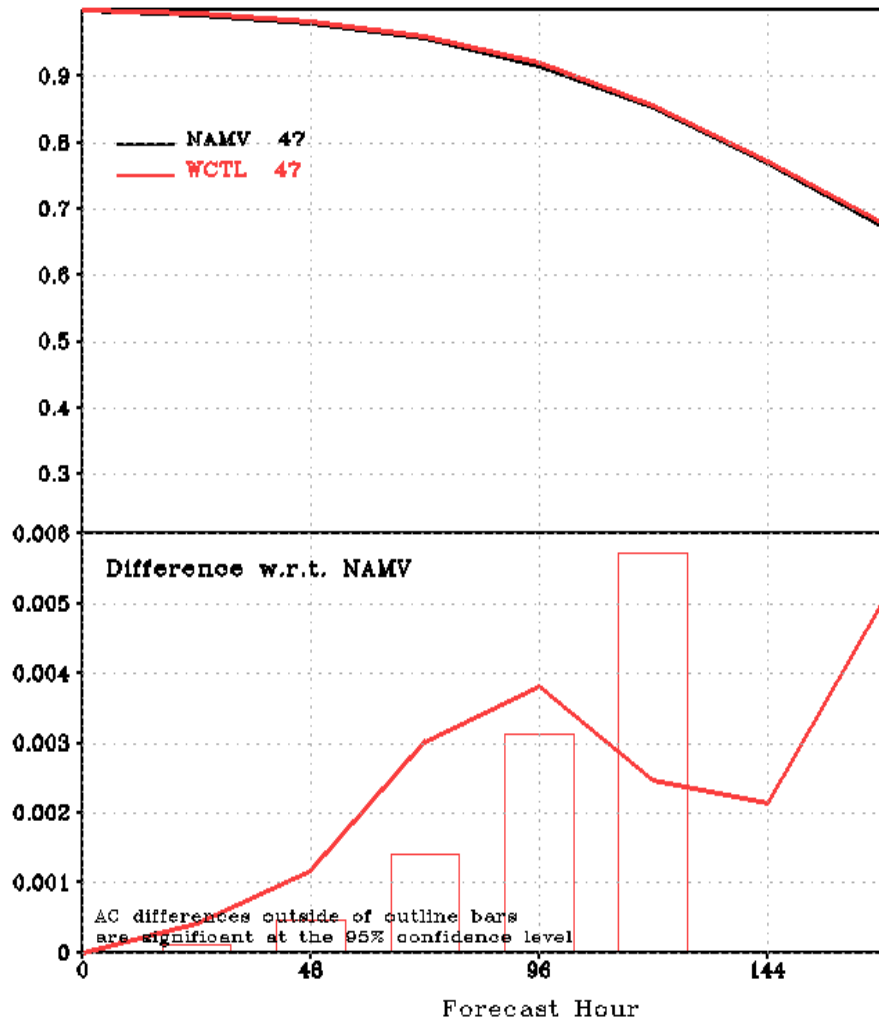


Geopotential heights anomaly correlation time series at 500 hPa for Northern and Southern Hemispheres.

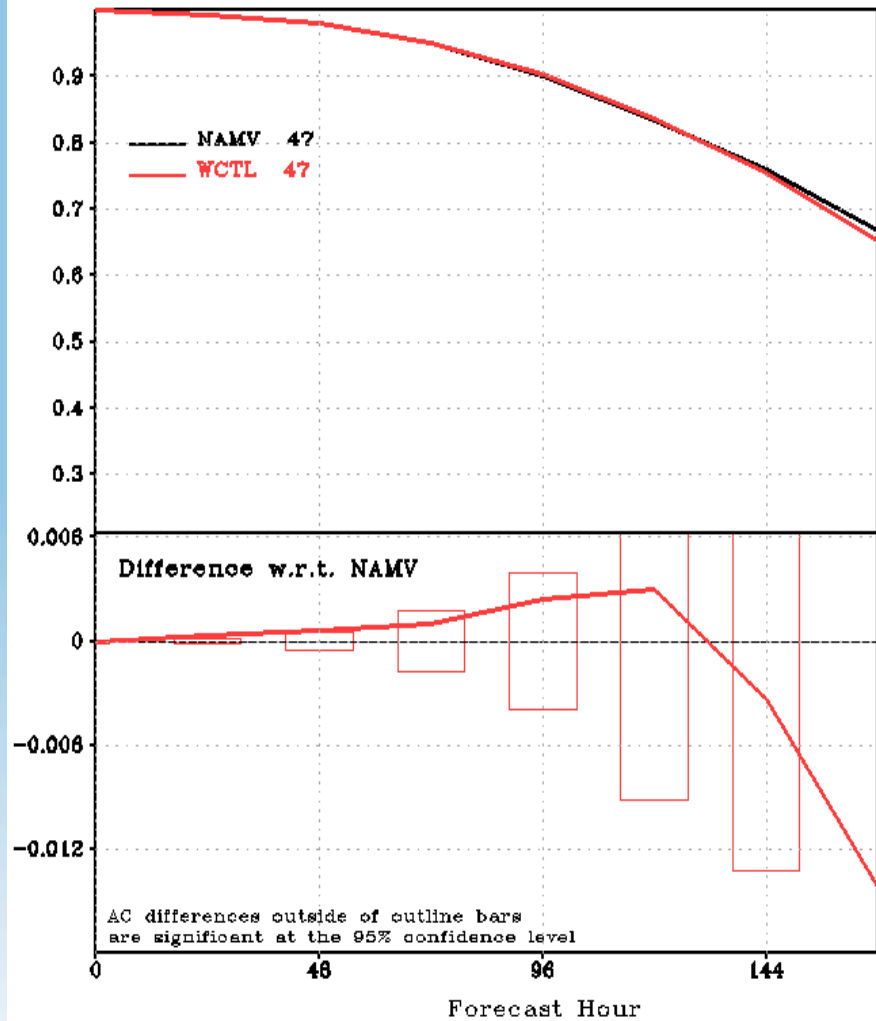




AC: HGT P500 Q2/NHX 00Z, 20100815-20100930

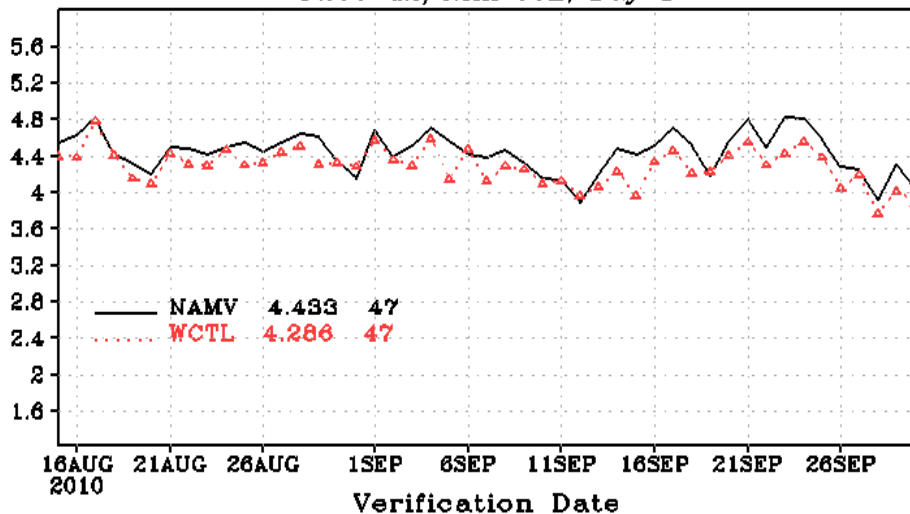


AC: HGT P500 Q2/SHX 00Z, 20100815-20100930

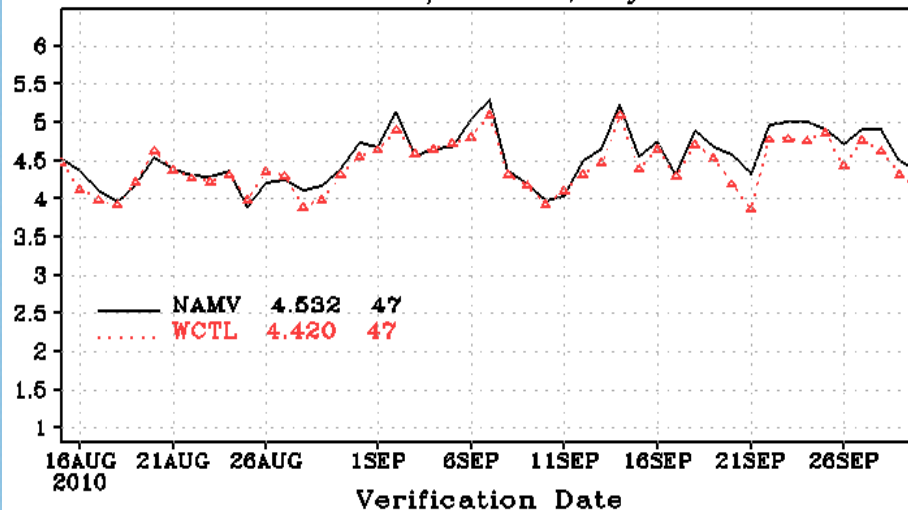




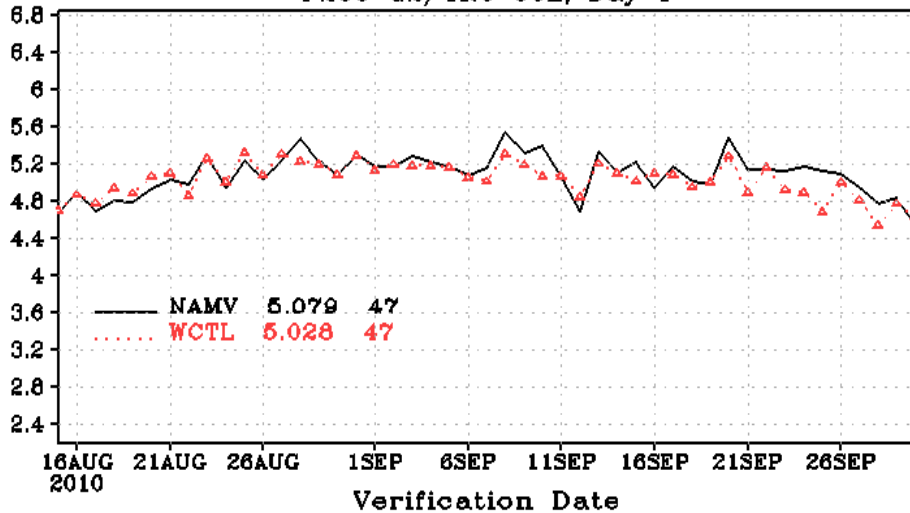
WIND: RMSE
P200 G2/NHX 00Z, Day 1



WIND: RMSE
P200 G2/SHX 00Z, Day 1



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



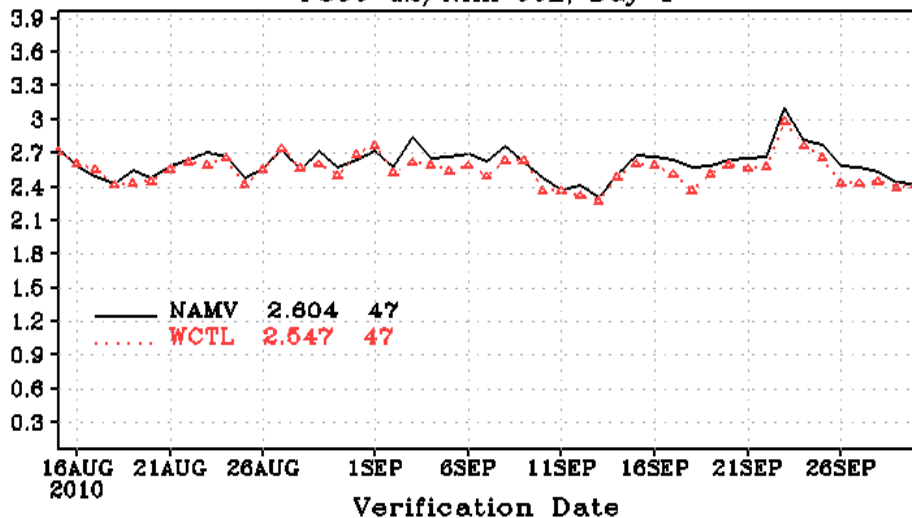
Wind Speed RMSE Day 1 time series at 200 hPa for the Northern and Southern Hemisphere and Tropical region.

Positive = WCTL < NAMV

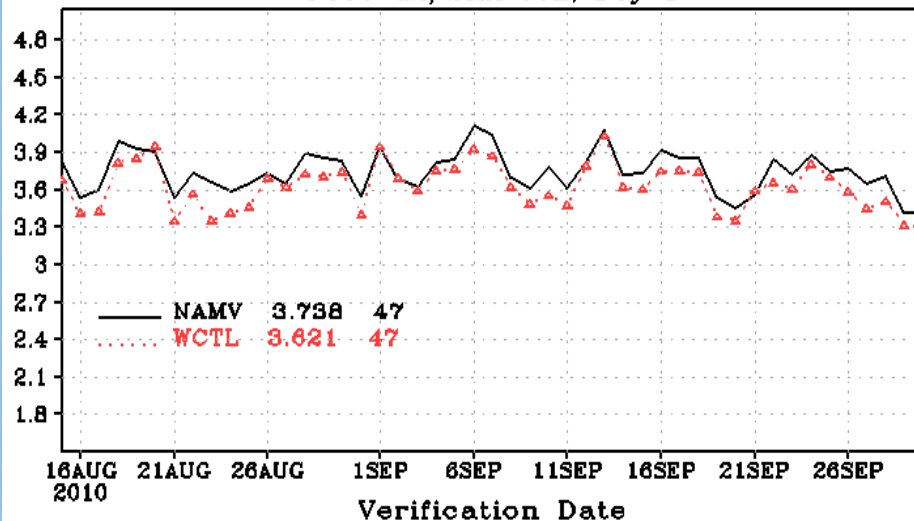




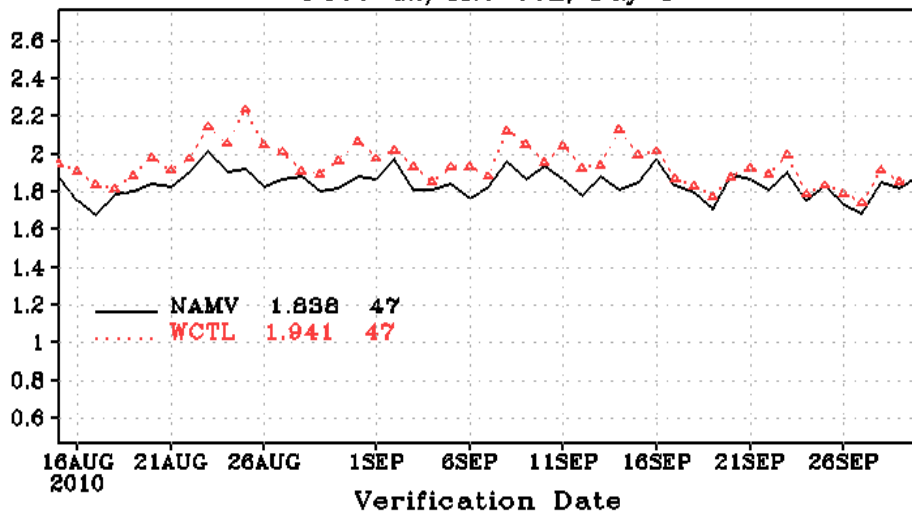
WIND: RMSE
P850 G2/NHX 00Z, Day 1



WIND: RMSE
P850 G2/SHX 00Z, Day 1



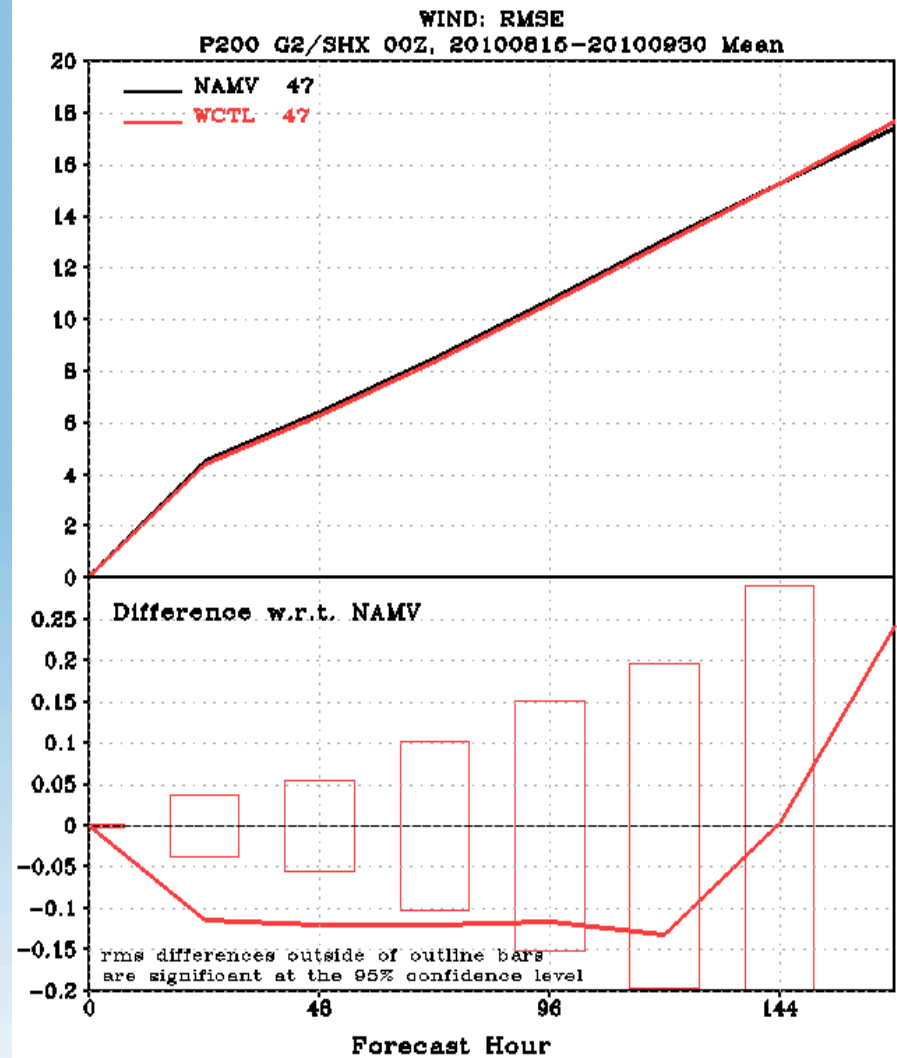
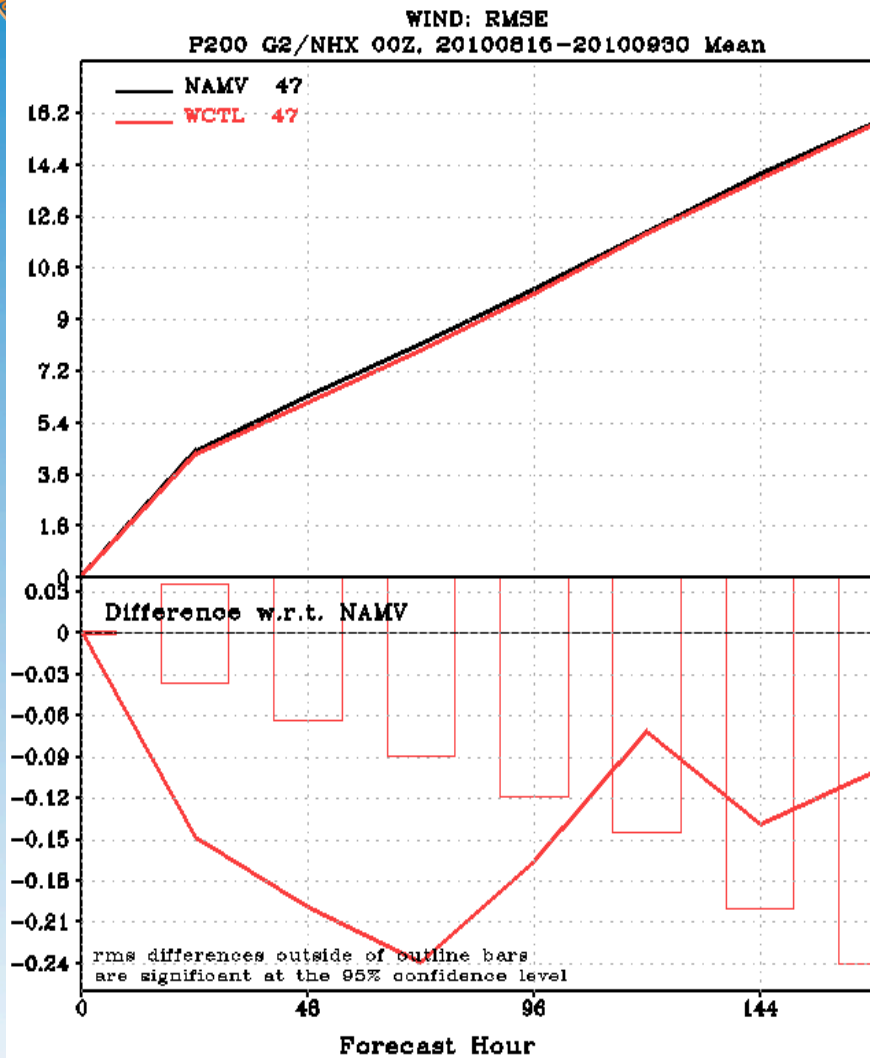
WIND: RMSE
P850 G2/TRO 00Z, Day 1

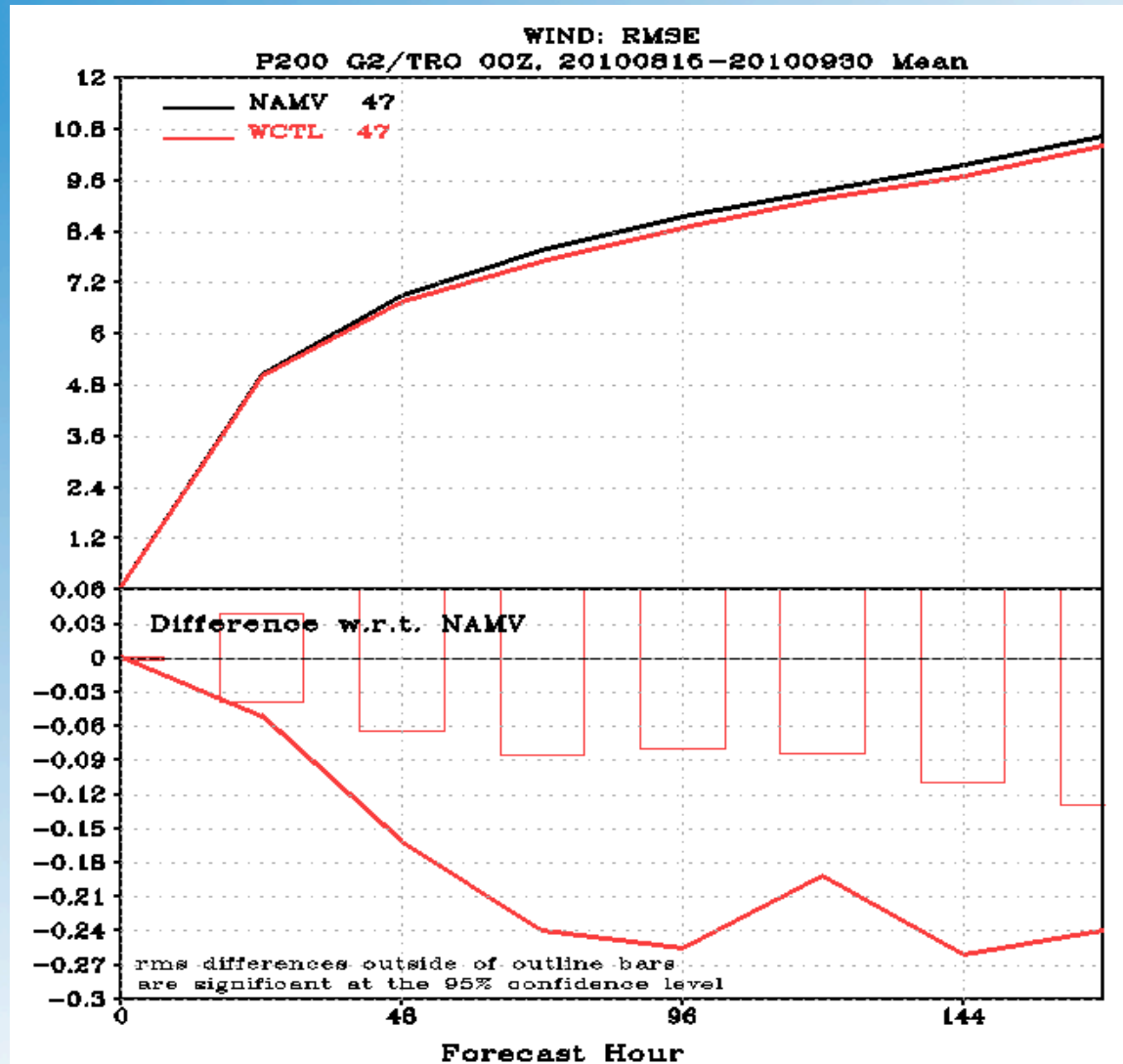


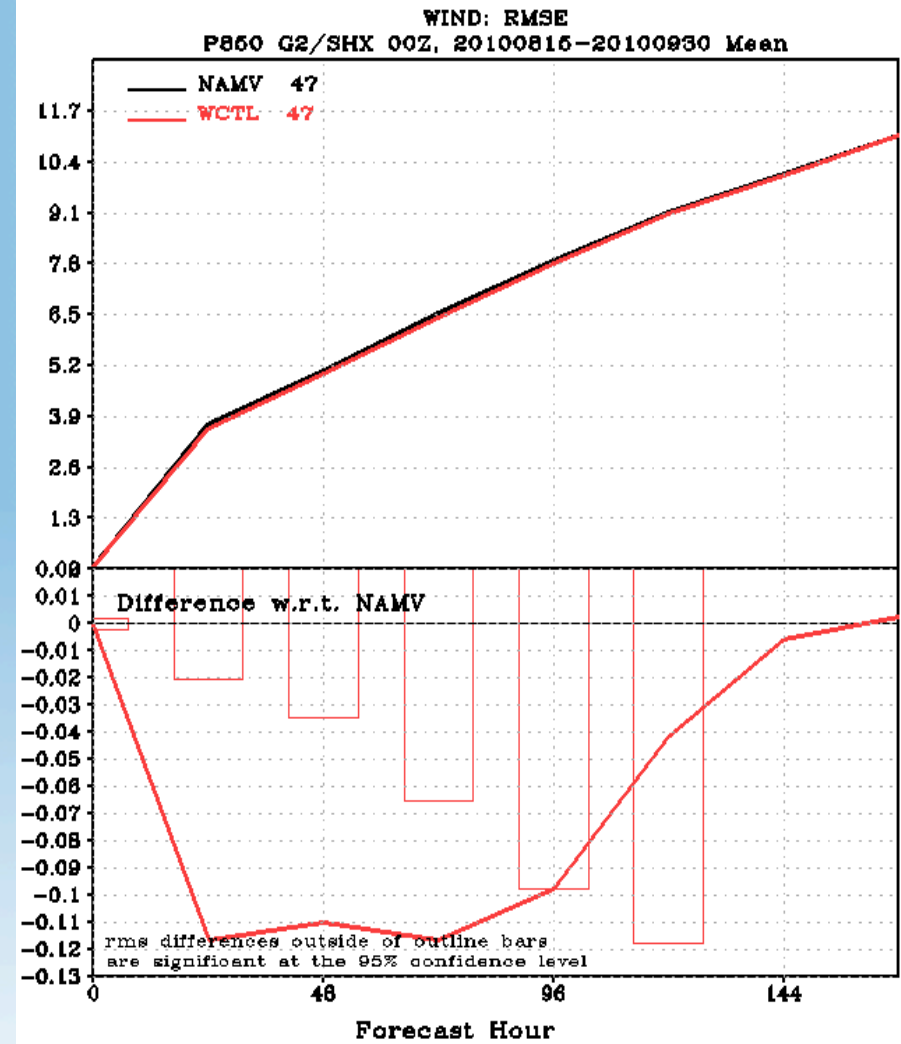
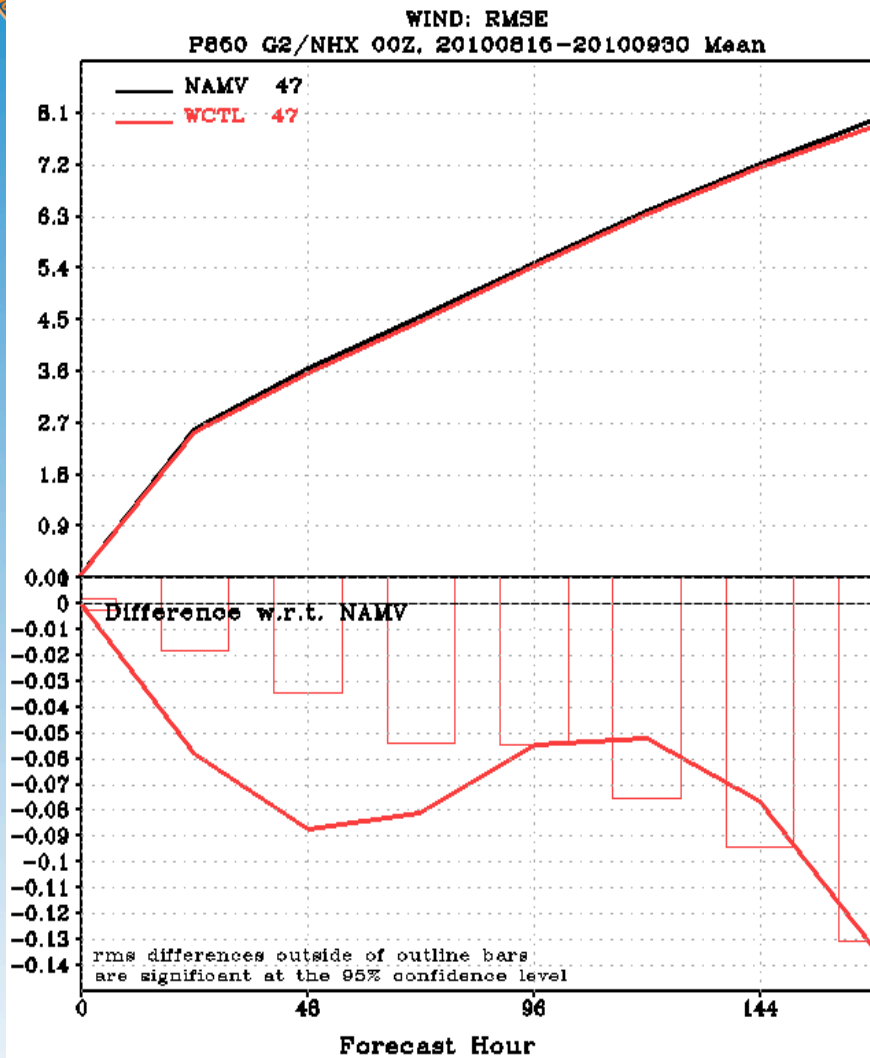
Wind Speed RMSE, Day 1, time series at 850 hPa for the Northern and Southern Hemisphere and Tropical region.

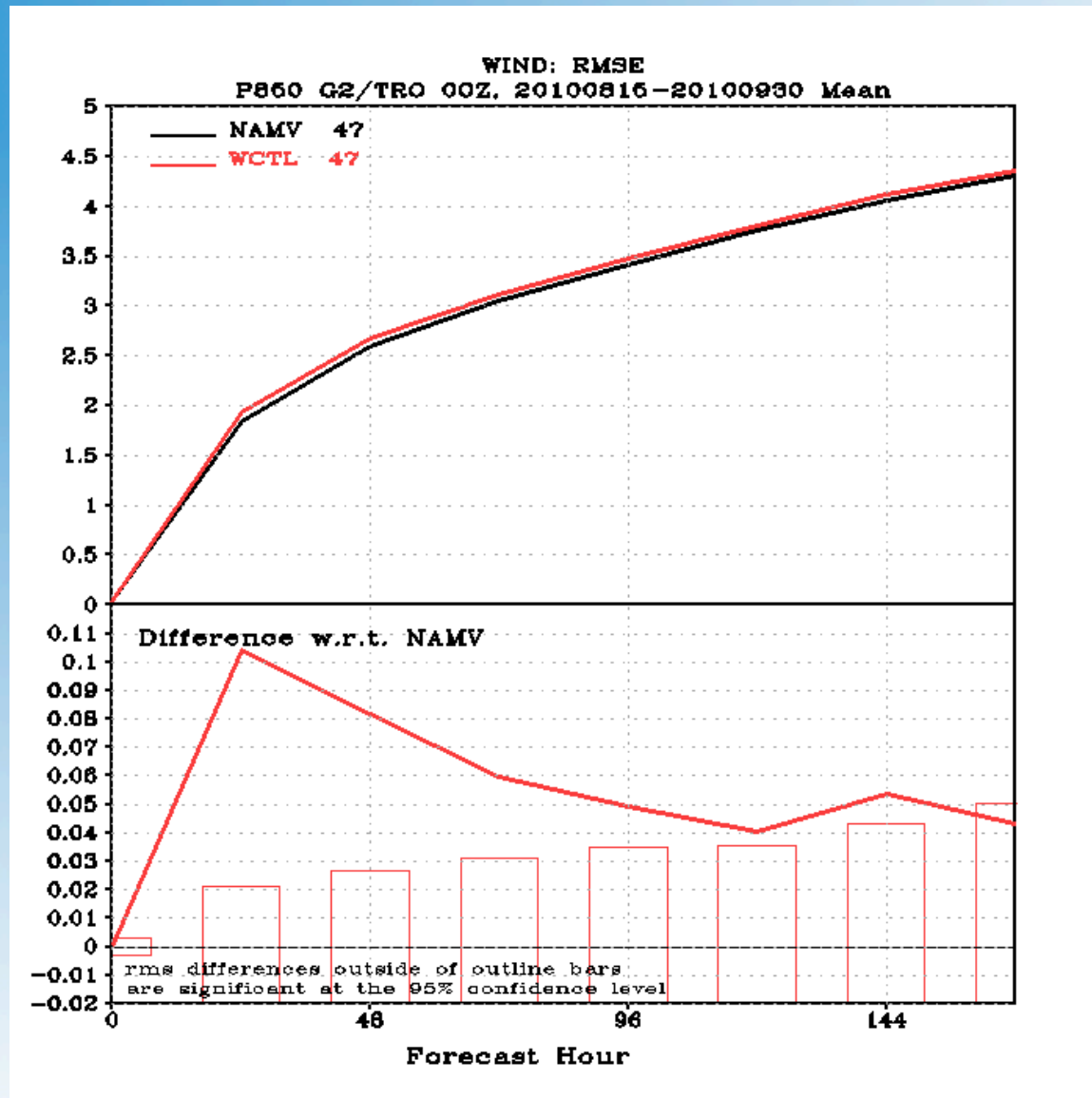
Positive = WCTL < NAMV

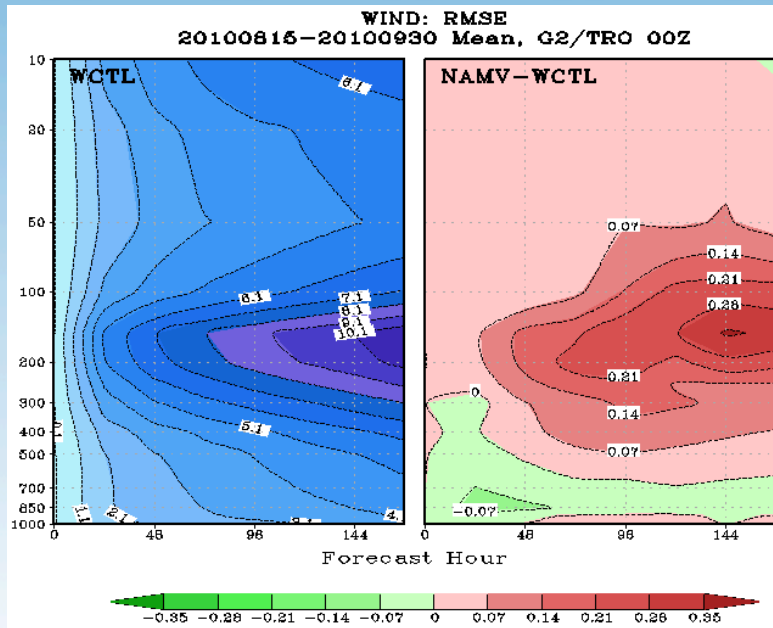
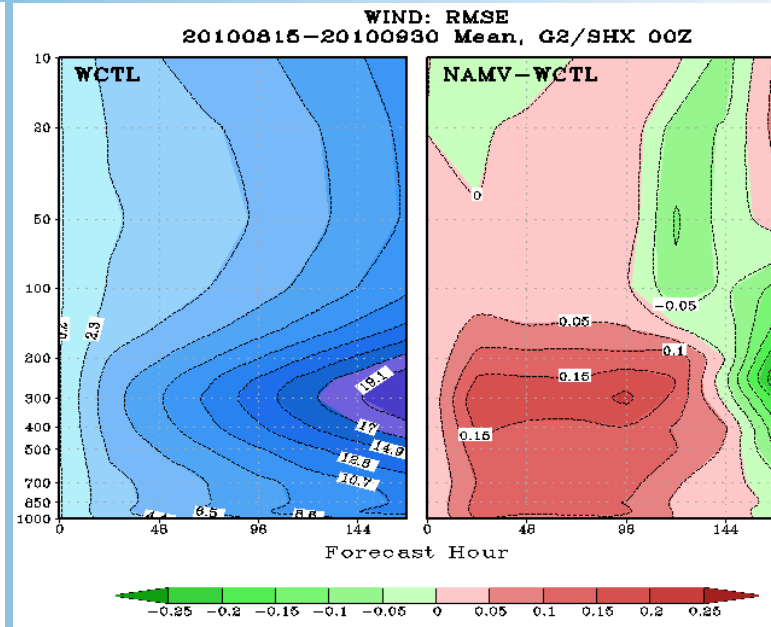
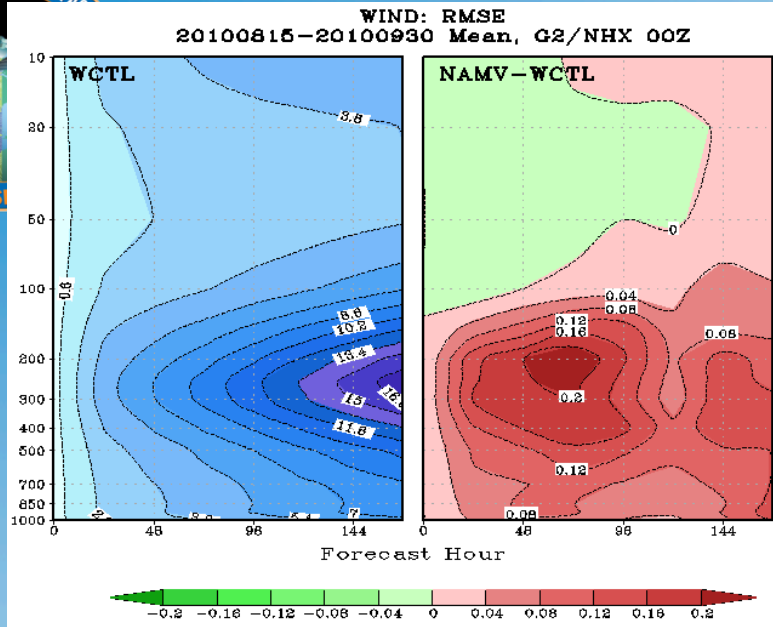








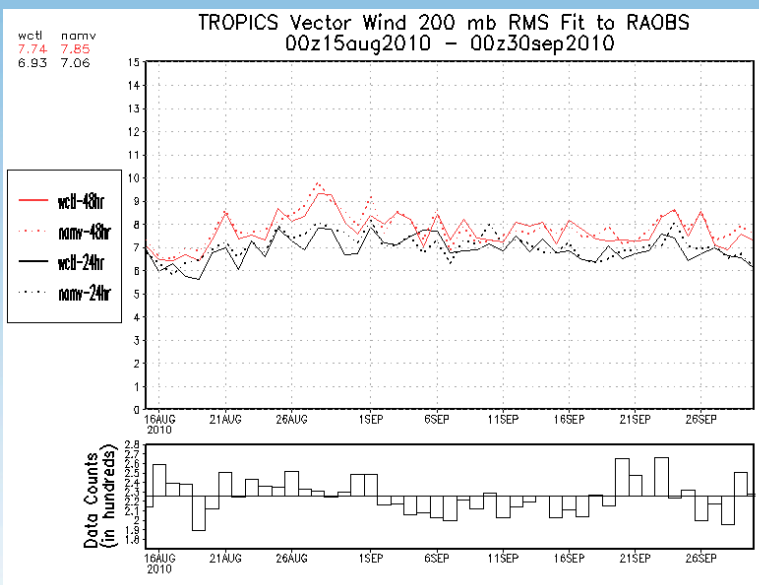
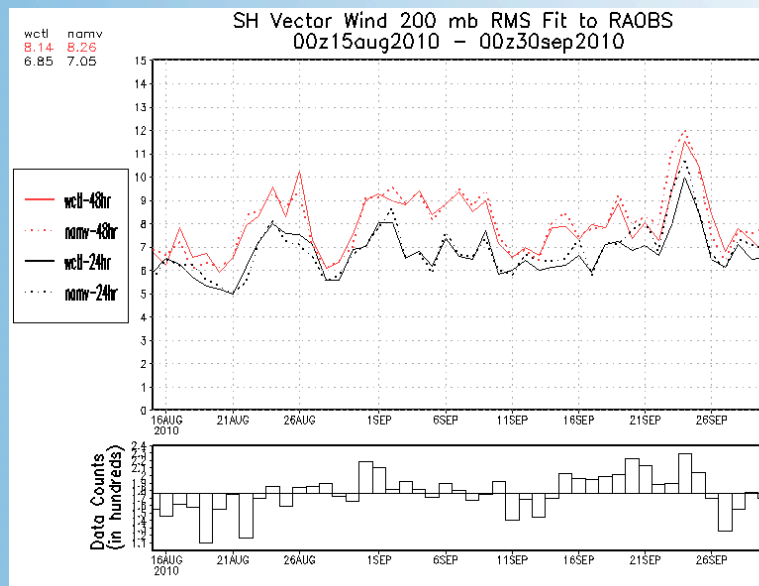
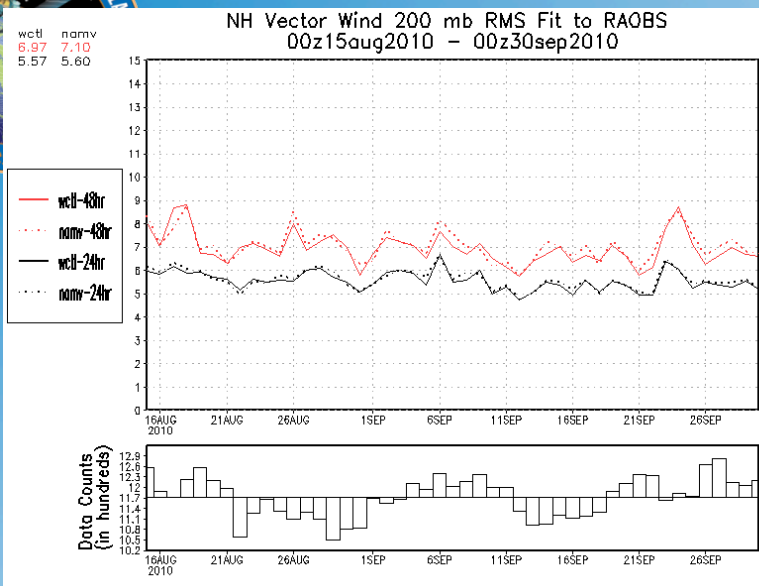
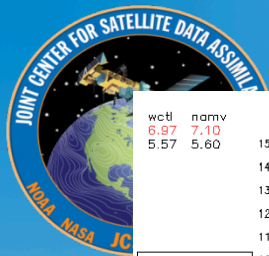




Vertical profile vs forecast time of wind speed RMSE for the Northern and Southern Hemispheres and Tropical Region.

Left panel is average wind speed from the control. Right panel is difference of experiment - control.

Red = Improvement
Green = Degredation

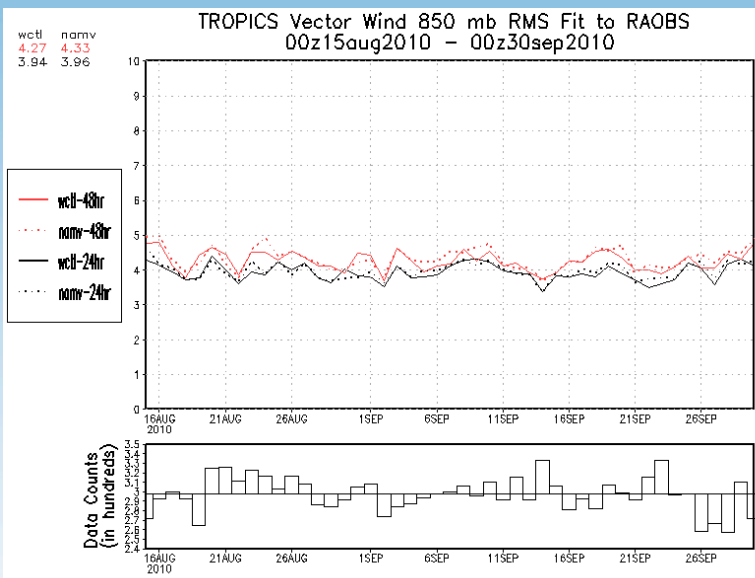
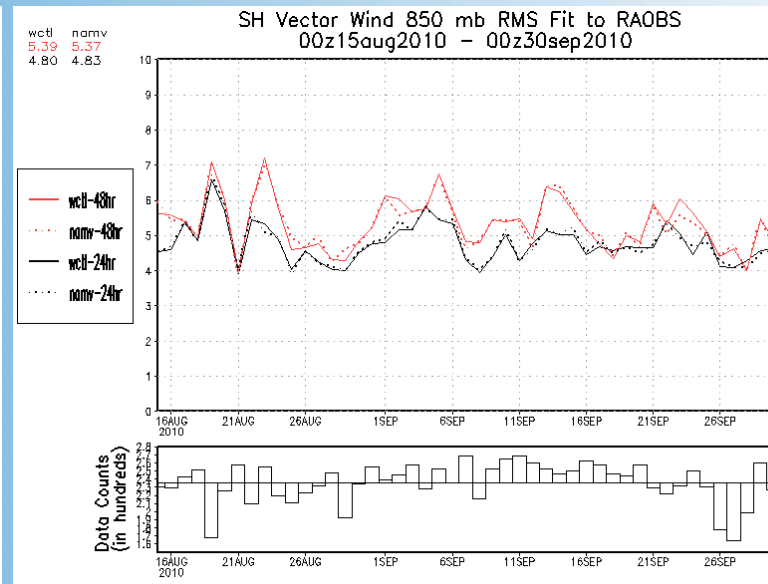
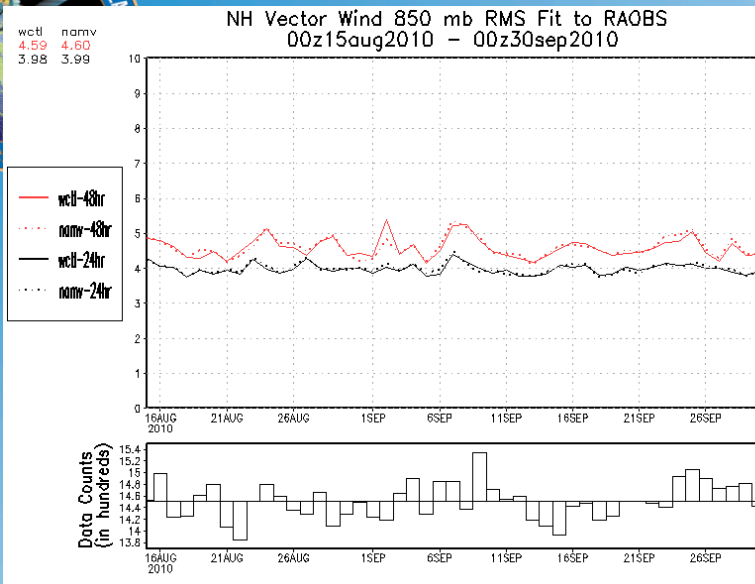
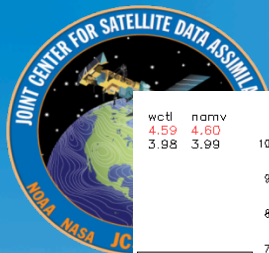


24 and 48 hour time series of Vector Wind RMS fit to Rawinsondes at 200 hPa for the Northern and Southern Hemispheres and Tropical Region.

Solid lines are the control
 Dashed lines are the experiment

Red = 48 hr. statistics
 Black = 24 hr. statistics





24 and 48 hour time series of Vector Wind RMS fit to Rawinsondes at 850 hPa for the Northern and Southern Hemispheres and Tropical Region.

Solid lines are the control
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Summary

15 Aug 2010 – 30 Sep 2010

- Slow bias for U prominent for Geostationary AMVs
- AC scores are generally neutral (not shown)
- 500 hPa height bias/RMS generally positive
- 200 hPa vector wind RMSE wrt own analysis:
 - Mostly positive and significant
- 850 hPa vector wind RMSE wrt own analysis:
 - positive at mid-latitudes but negative in the tropics
- 200 hPa 24 & 48 hr. fit to rawinsondes:
 - Positive for NH, SH, TR.
- 850 hPa 24 & 48 hr. fit to rawinsondes:
 - Mostly neutral

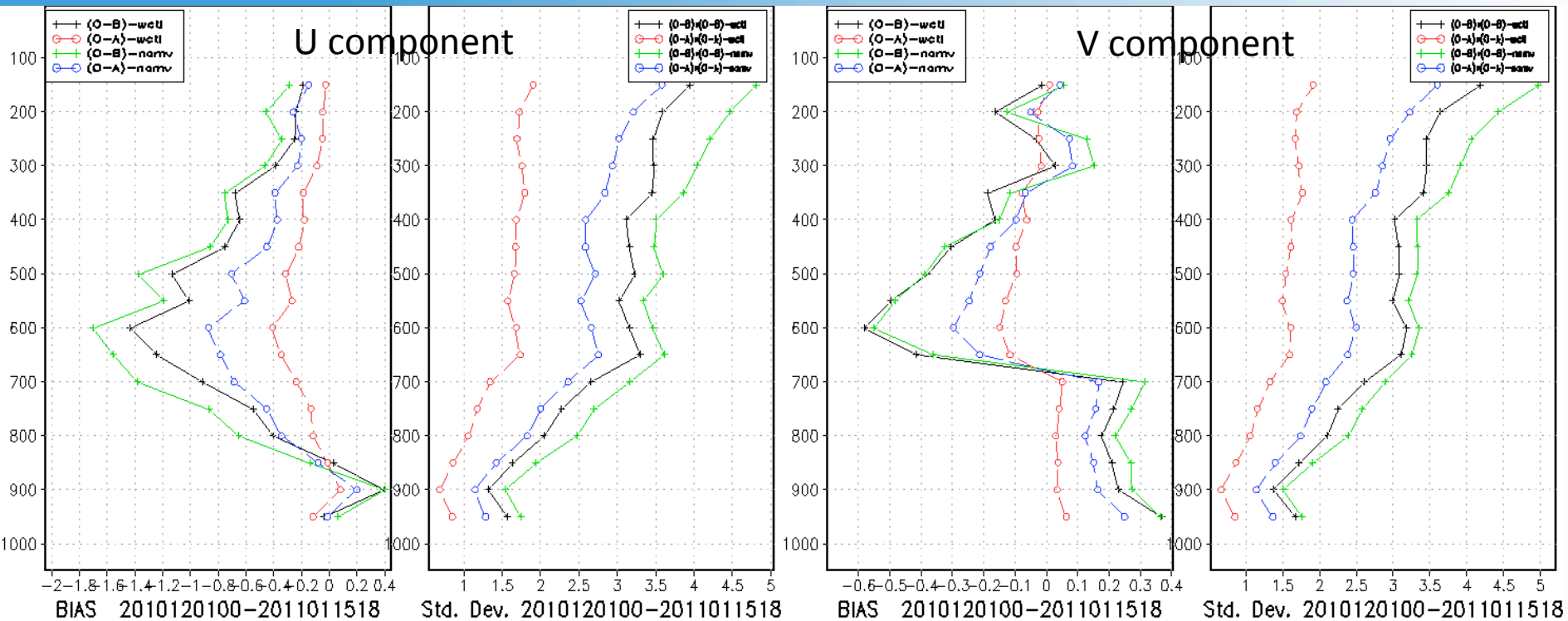




No AMV Experiment 1 Dec 2010 – 15 Jan 2010



GOES infrared

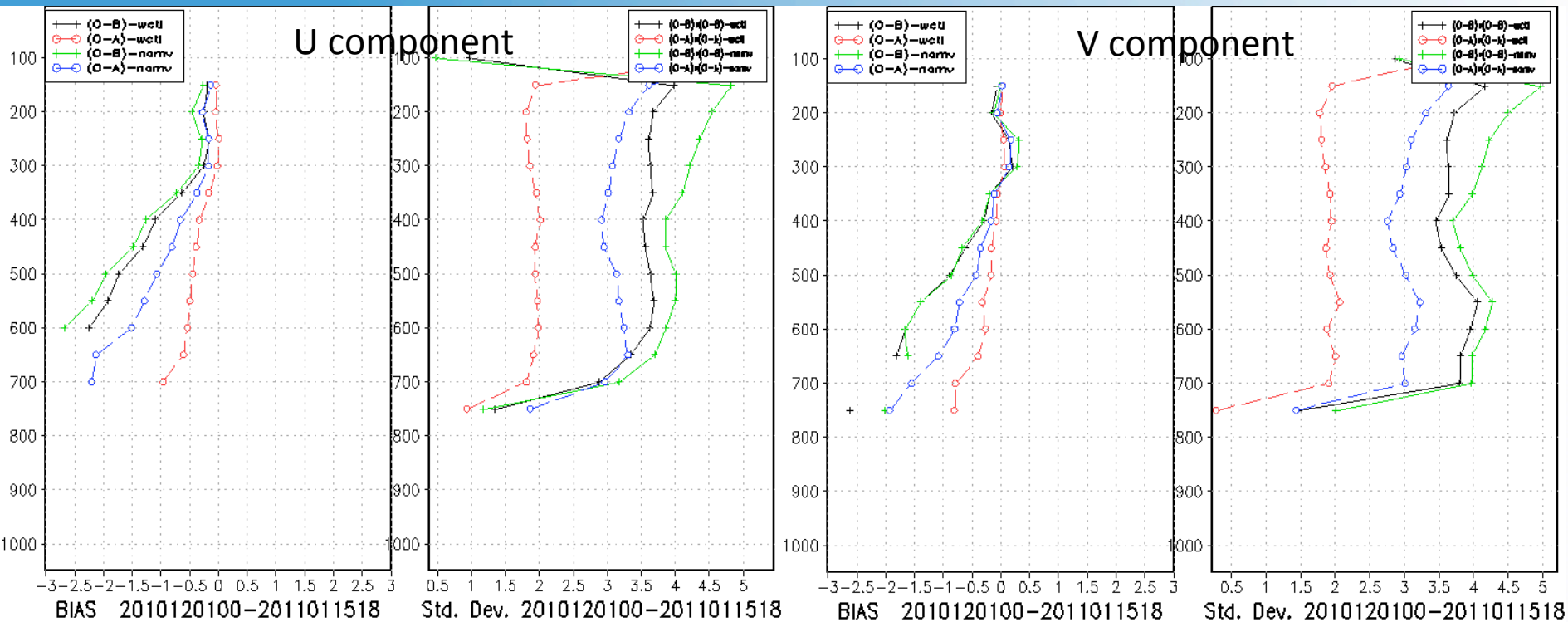


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GOES Water Vapor Cloud Top

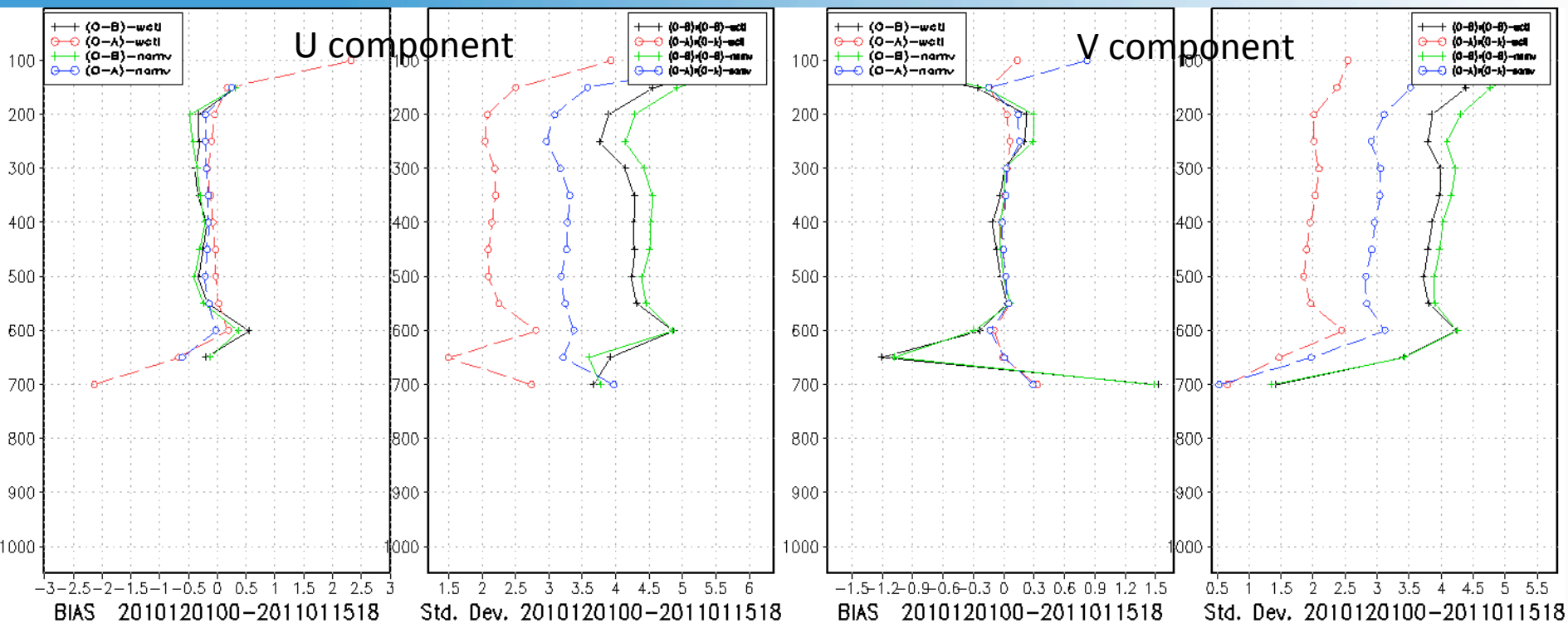


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MTSAT infrared above 850 hPa

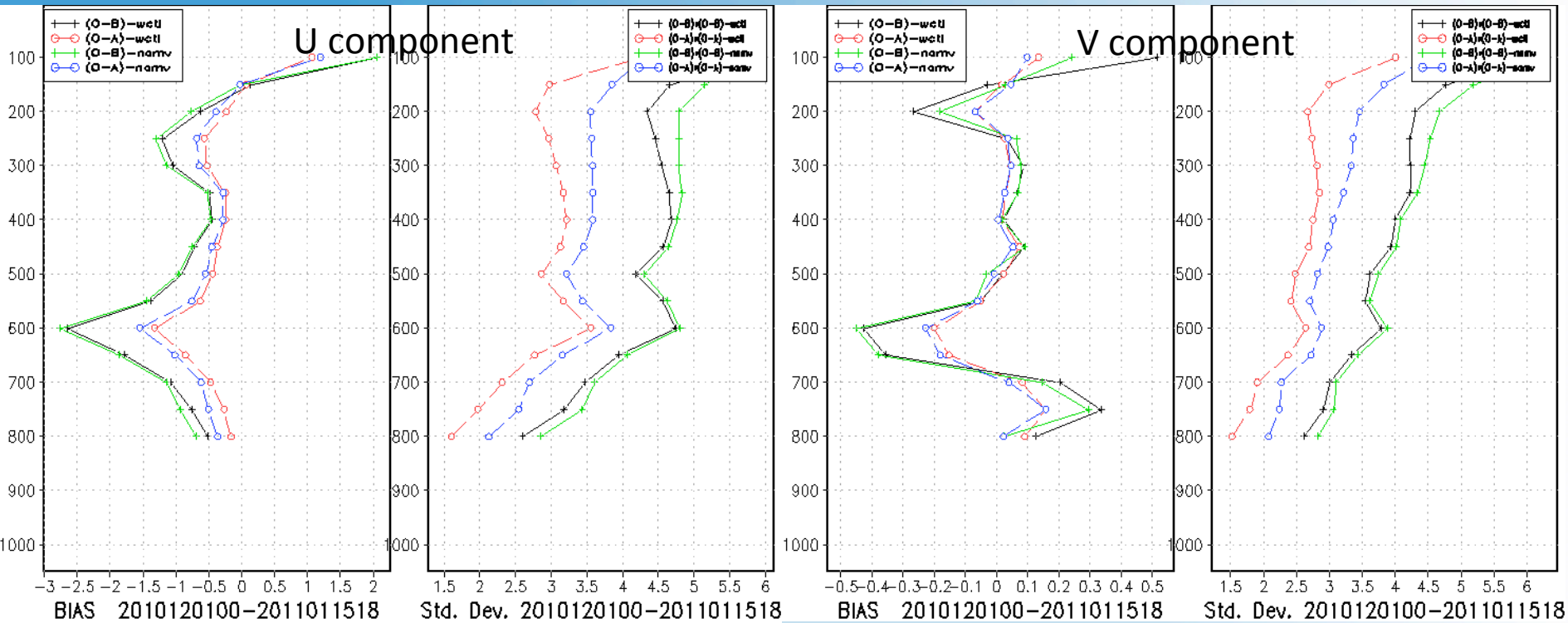


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Meteosat-9 infrared above 850 hPa

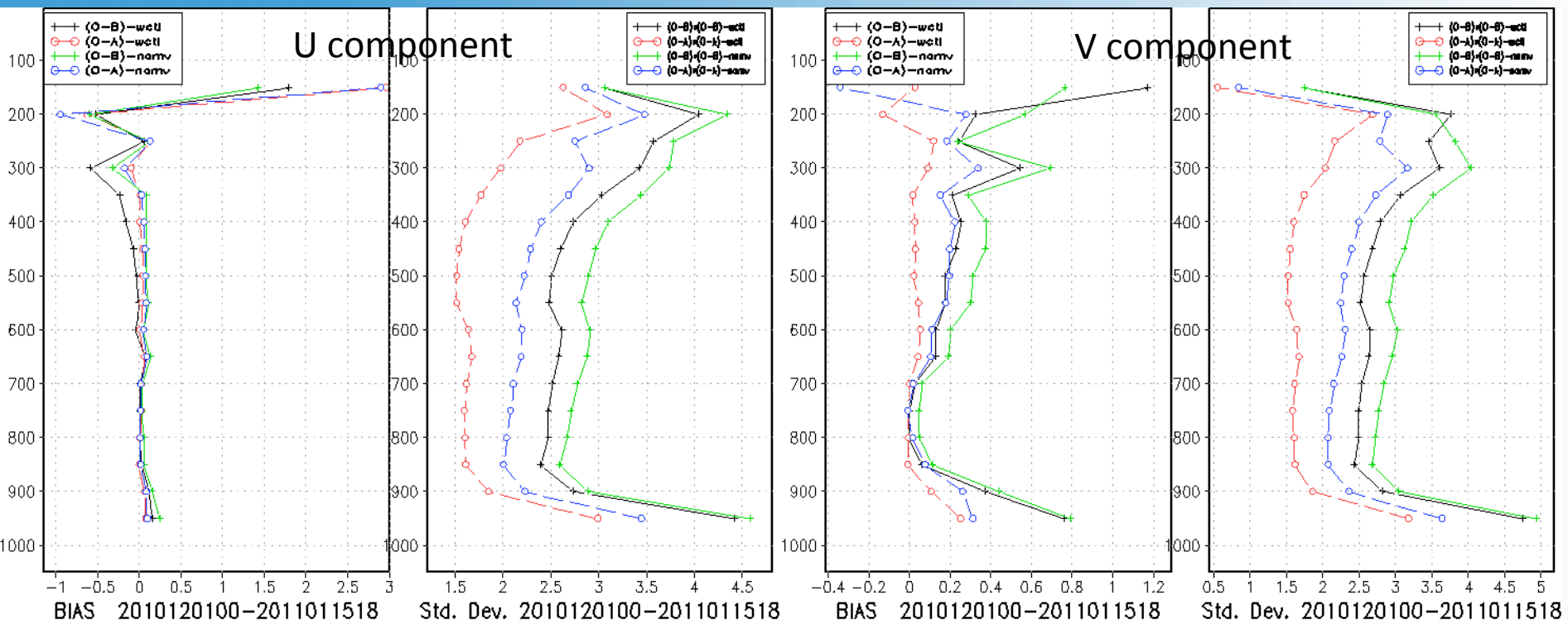


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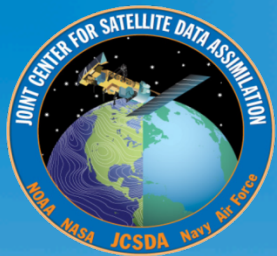


MODIS infrared

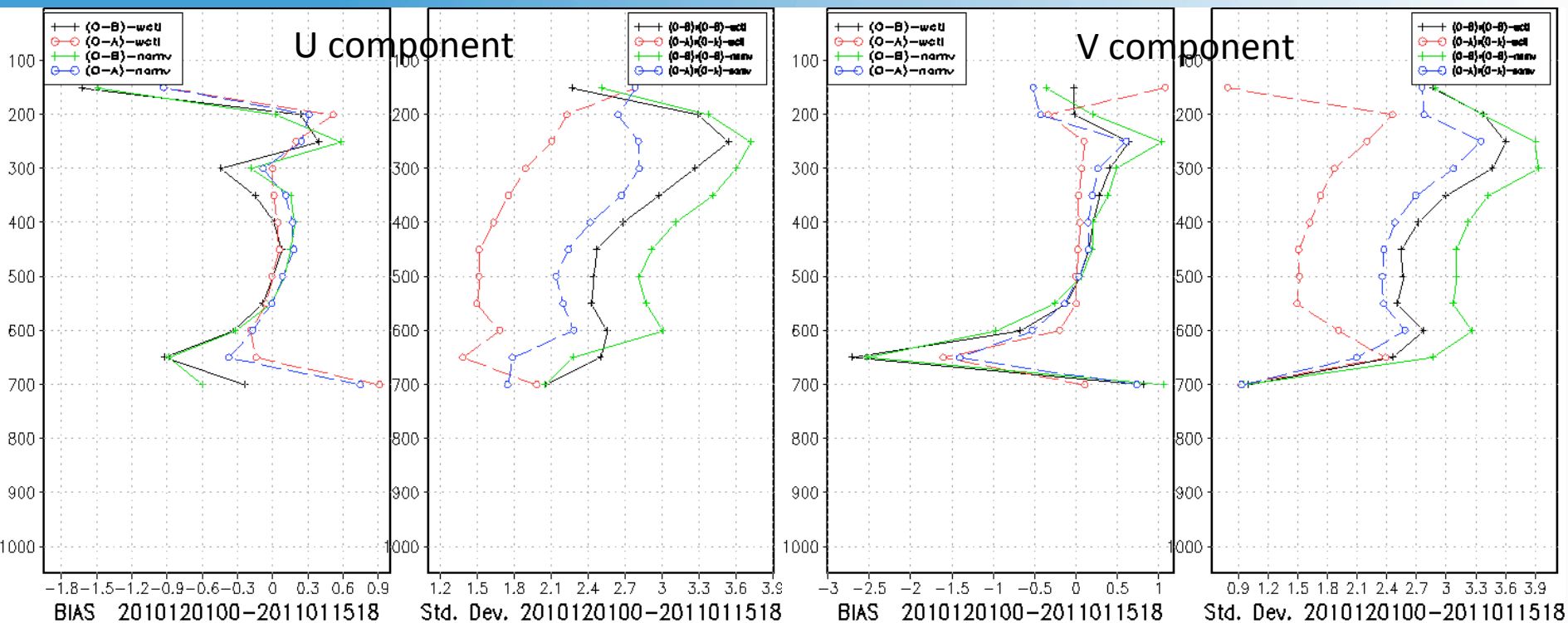


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MODIS Water Vapor Cloud Top

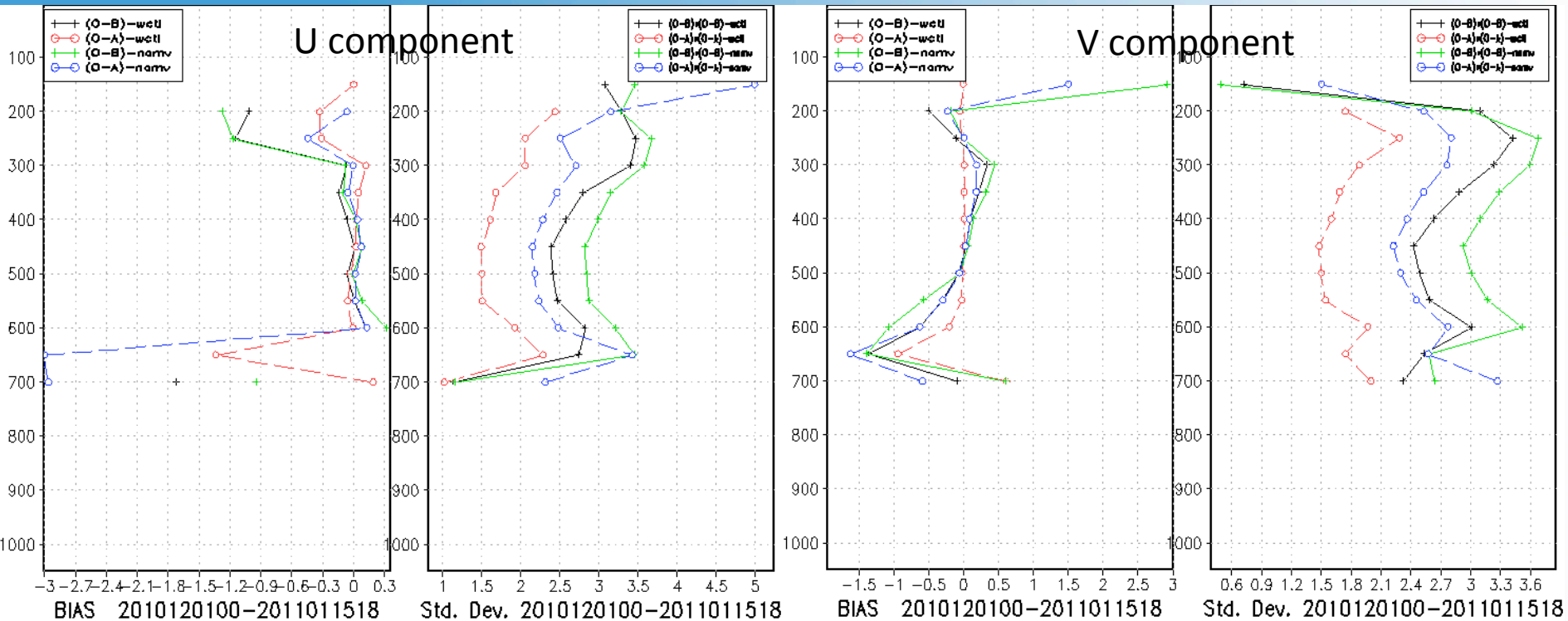


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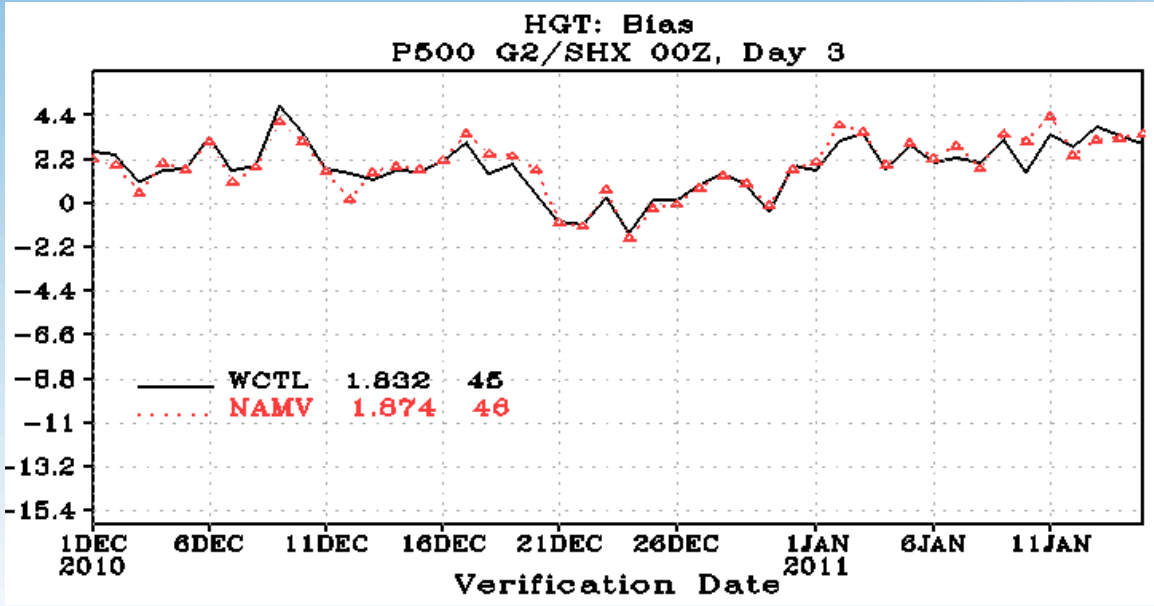
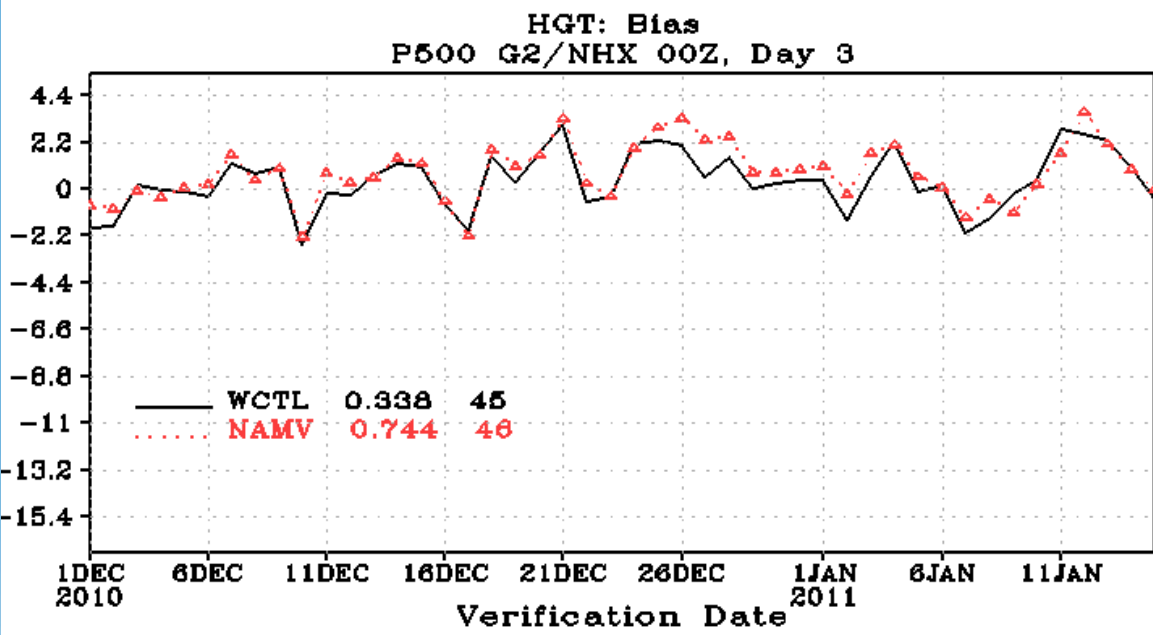
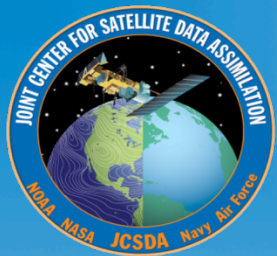


MODIS Water Vapor Deep Layer



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 Green = Experiment (O-B) Blue = Experiment (O-A)



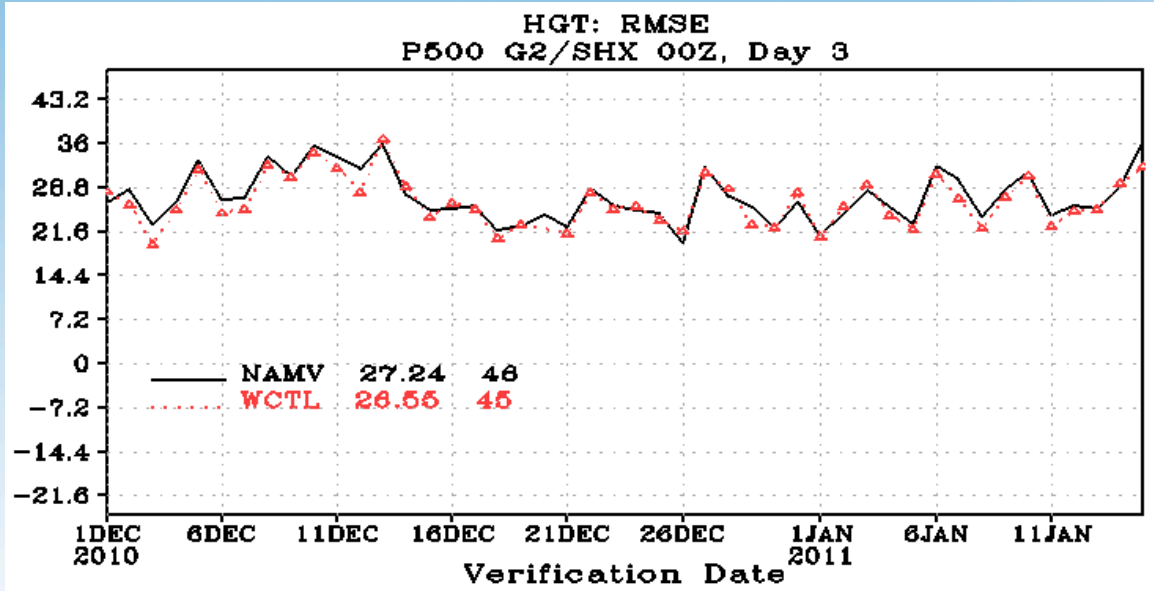
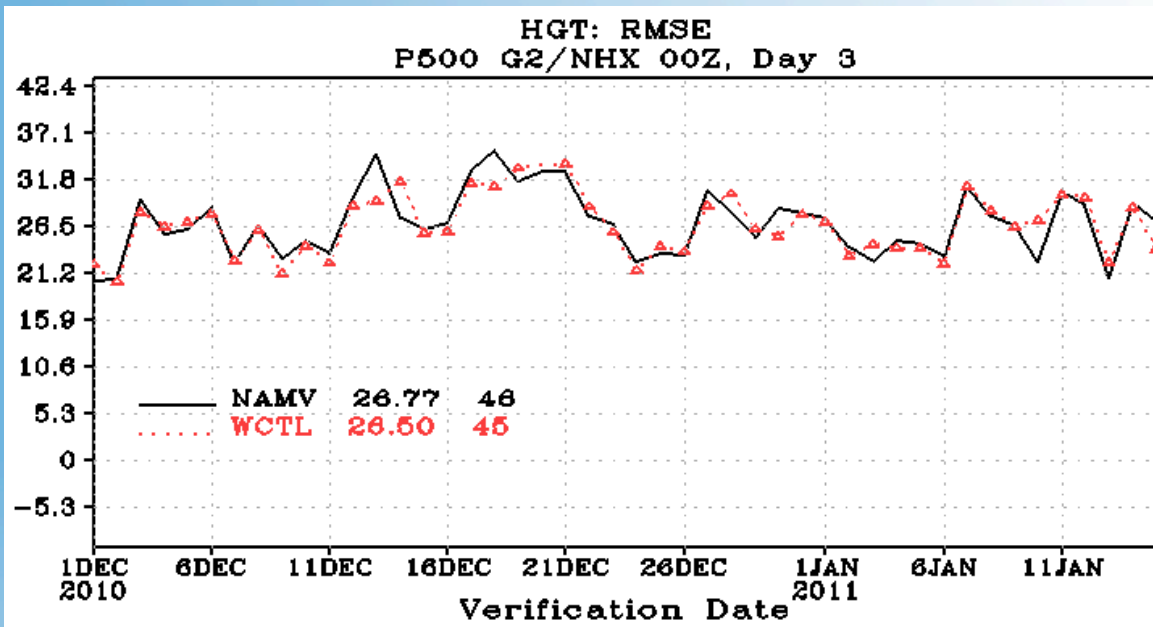


Geopotential heights, day 3,
Bias time series at 500 hPa for
Northern and Southern
Hemispheres.

Positive = WCTL

No AMV Experiment 1 Dec 2010 – 31 Jan 2011



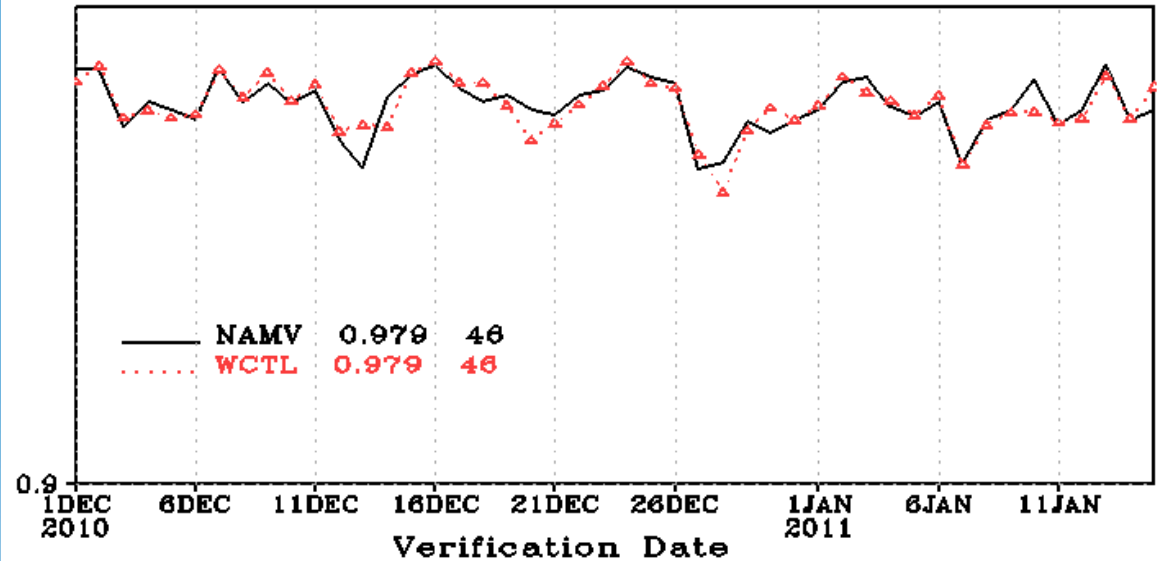


Geopotential heights, day 3, RMSE time series at 500 hPa for Northern and Southern Hemispheres.

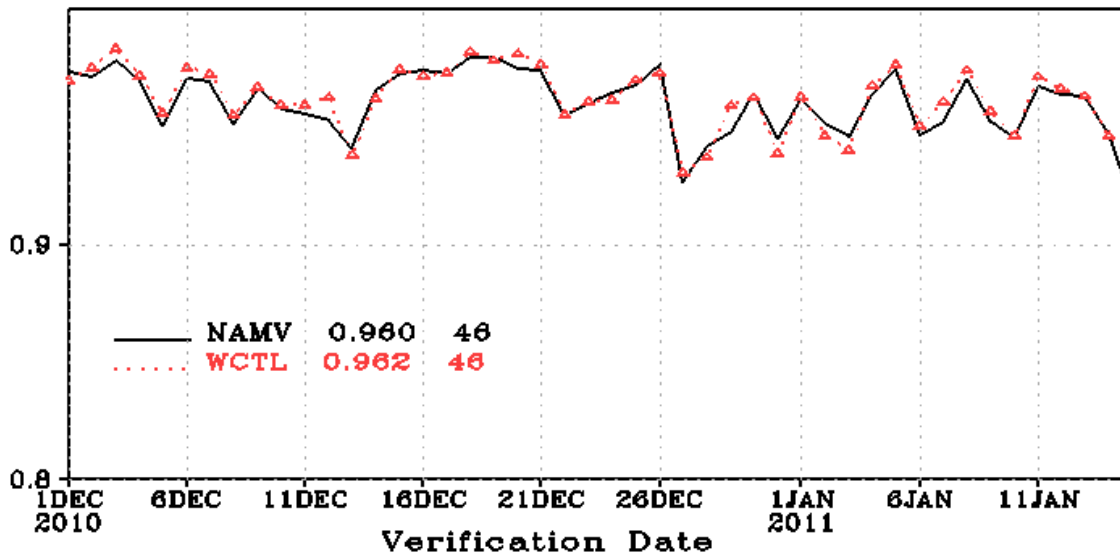




Anomaly Correl: HGT P500 G2/NHX 00Z, Day 3



Anomaly Correl: HGT P500 G2/SHX 00Z, Day 3



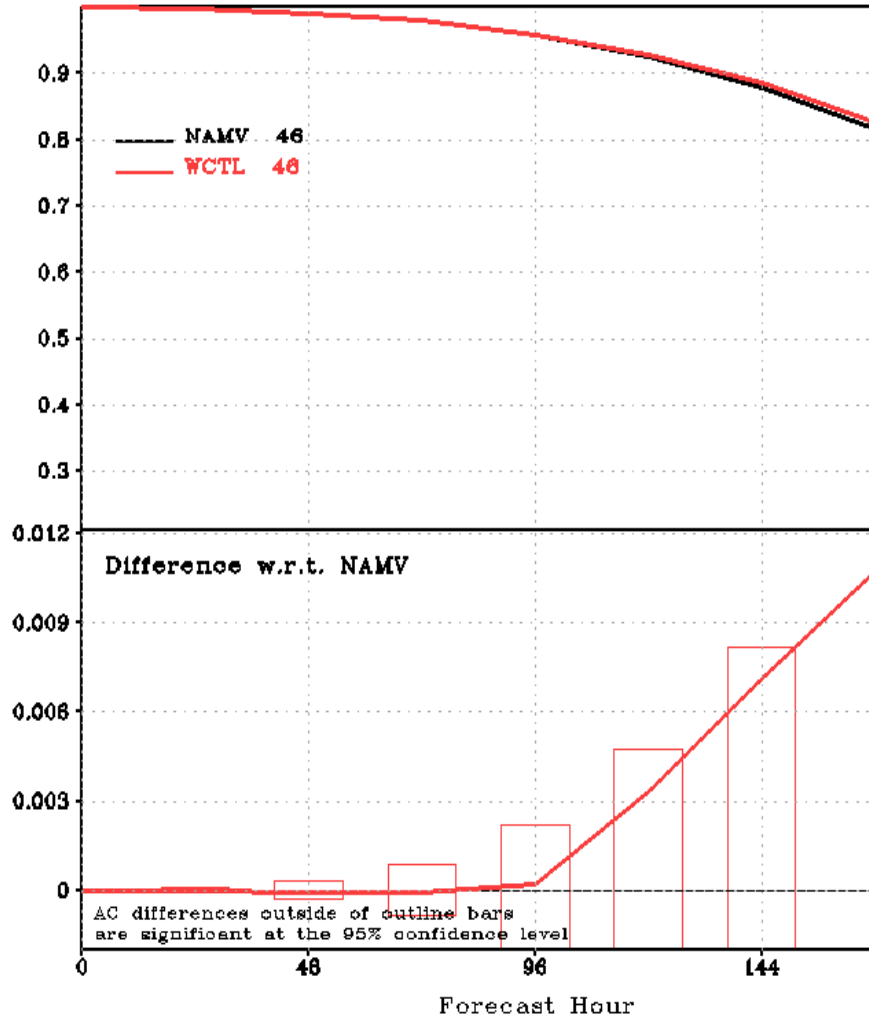
Geopotential heights anomaly correlation time series at 500 hPa for Northern and Southern Hemispheres.

Positive = WCTL closer to zero

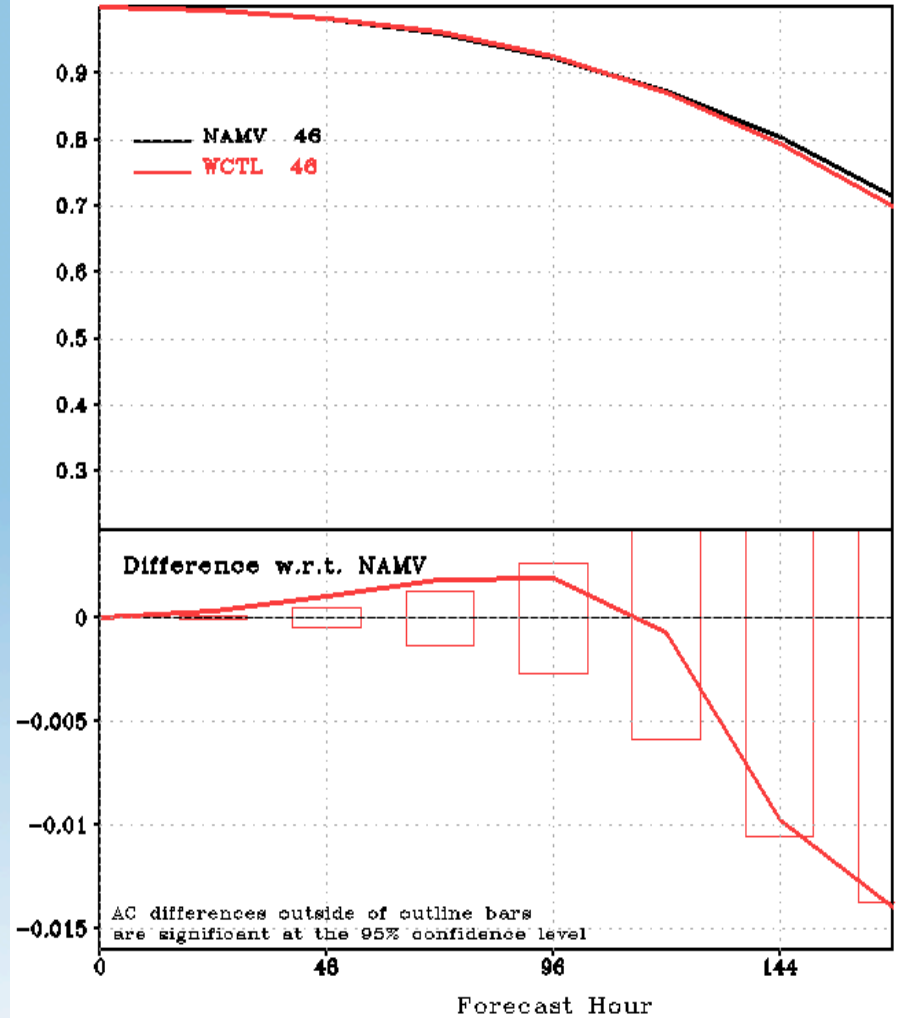




AC: HGT P500 Q2/NHX 00Z, 20101201-20110115

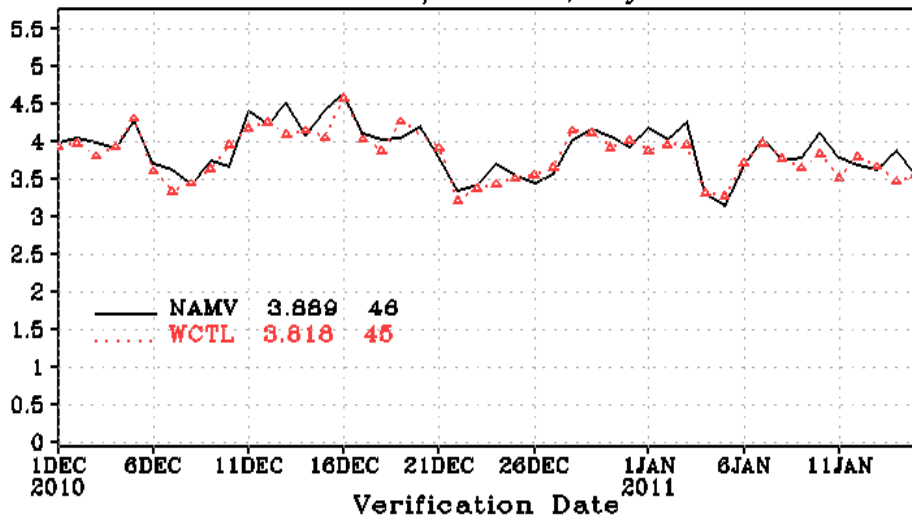


AC: HGT P500 Q2/SHX 00Z, 20101201-20110115

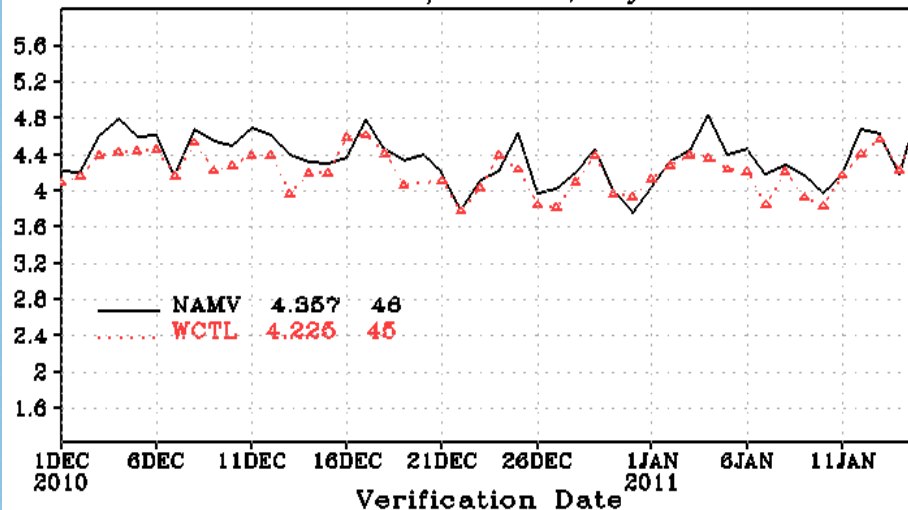




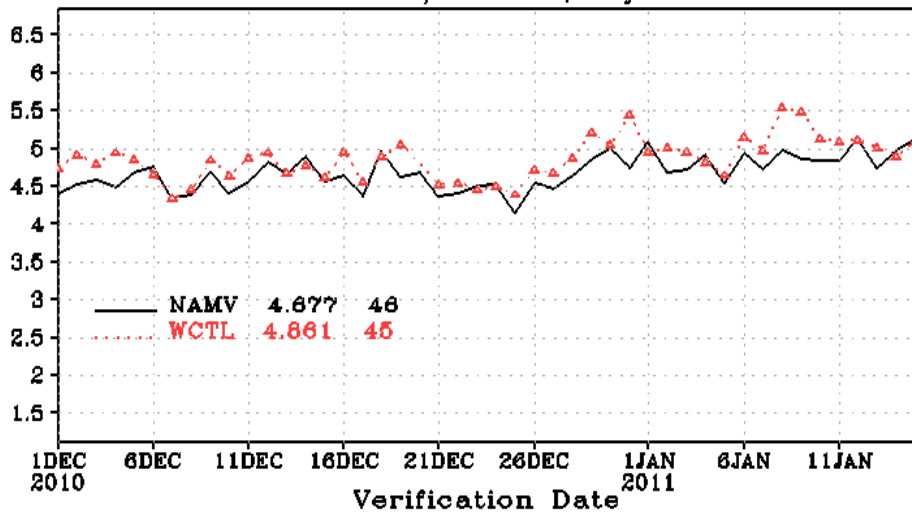
WIND: RMSE
P200 G2/NHX 00Z, Day 1



WIND: RMSE
P200 G2/SHX 00Z, Day 1



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



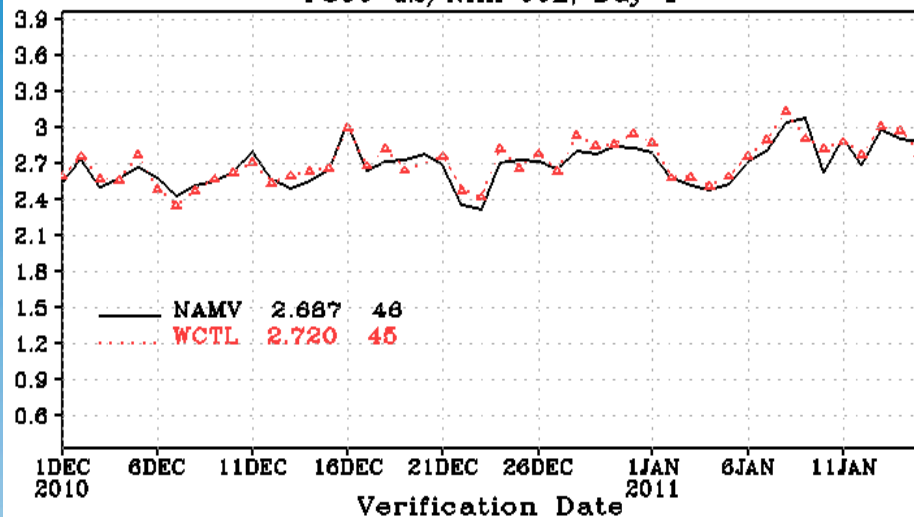
Wind Speed Root Mean Square Error, Day 1, time series at 200 hPa for the Northern and Southern Hemisphere and Tropical region.

Positive = WCTL < NAMV

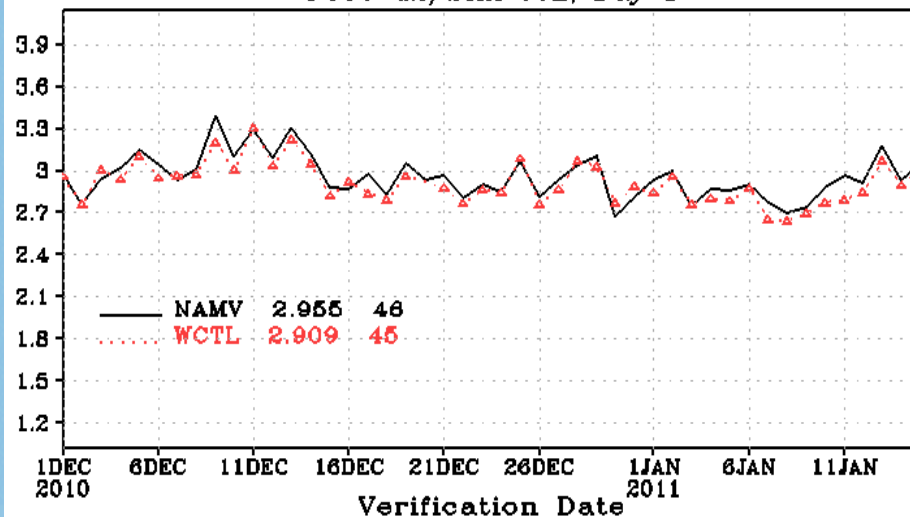




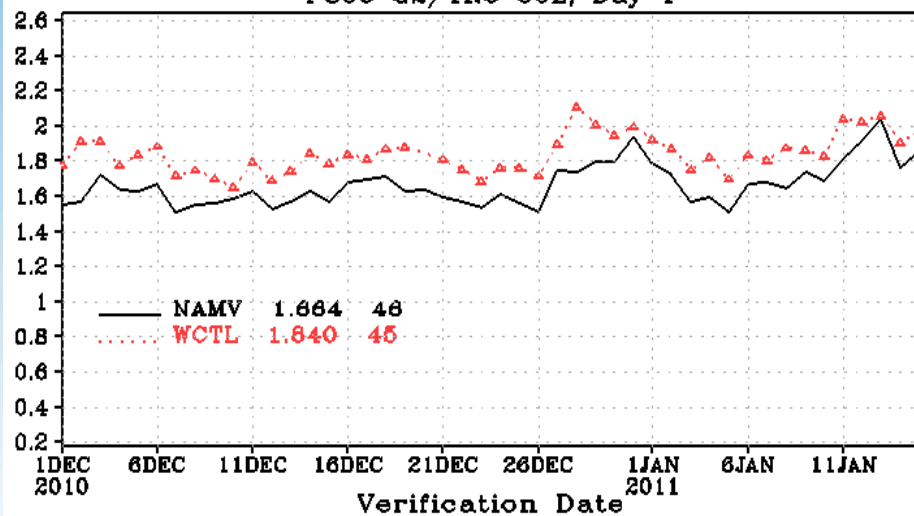
WIND: RMSE
P850 G2/NHX 00Z, Day 1



WIND: RMSE
P850 G2/SHX 00Z, Day 1



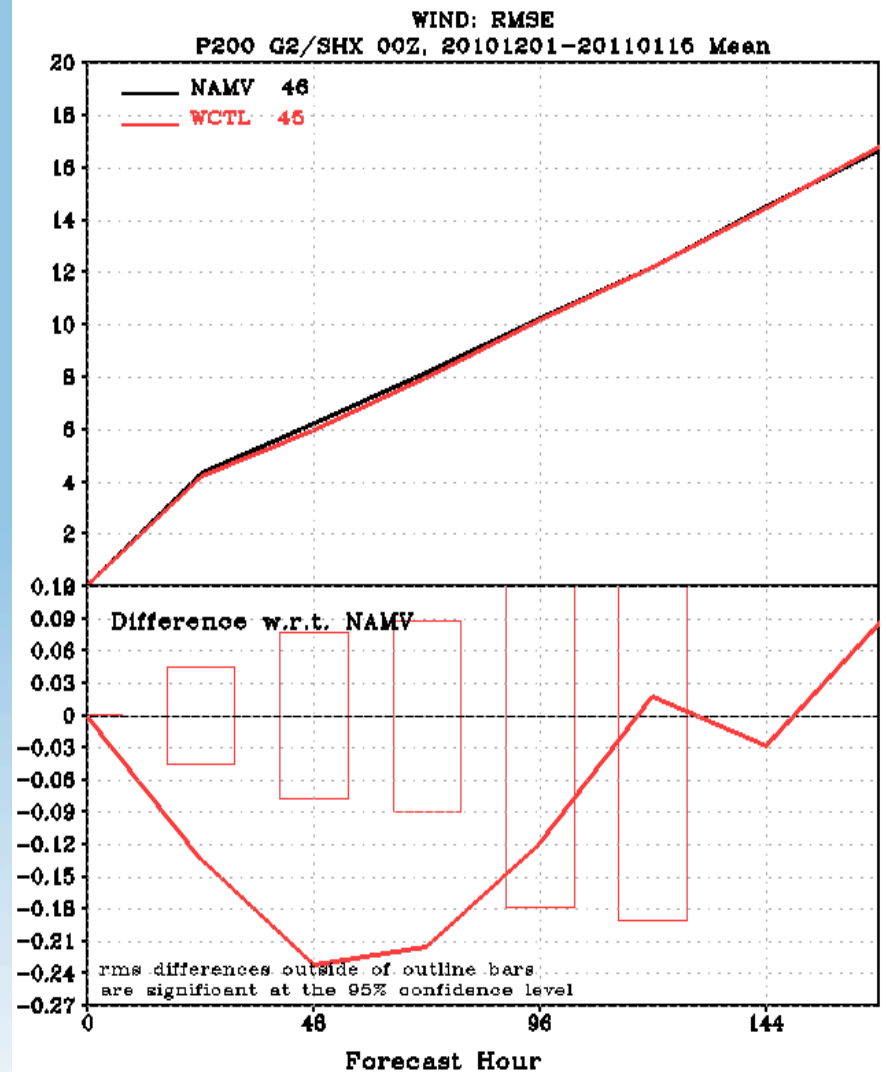
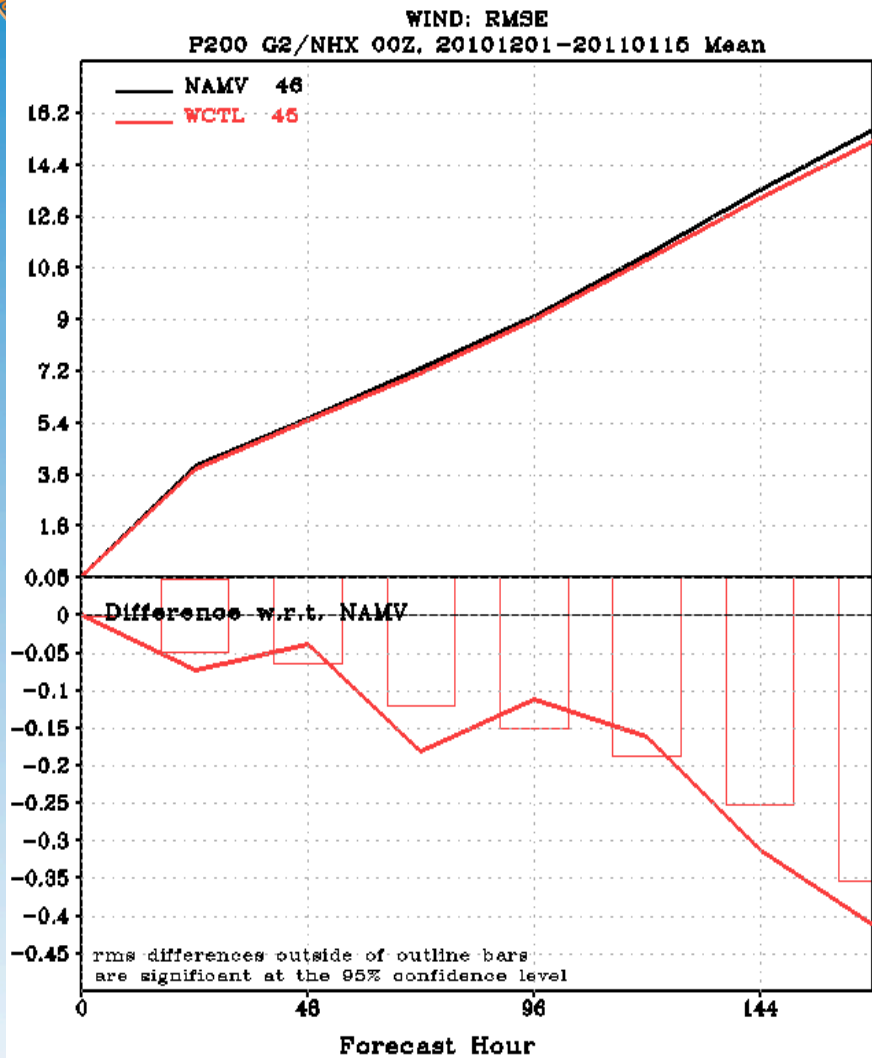
WIND: RMSE
P850 G2/TRO 00Z, Day 1

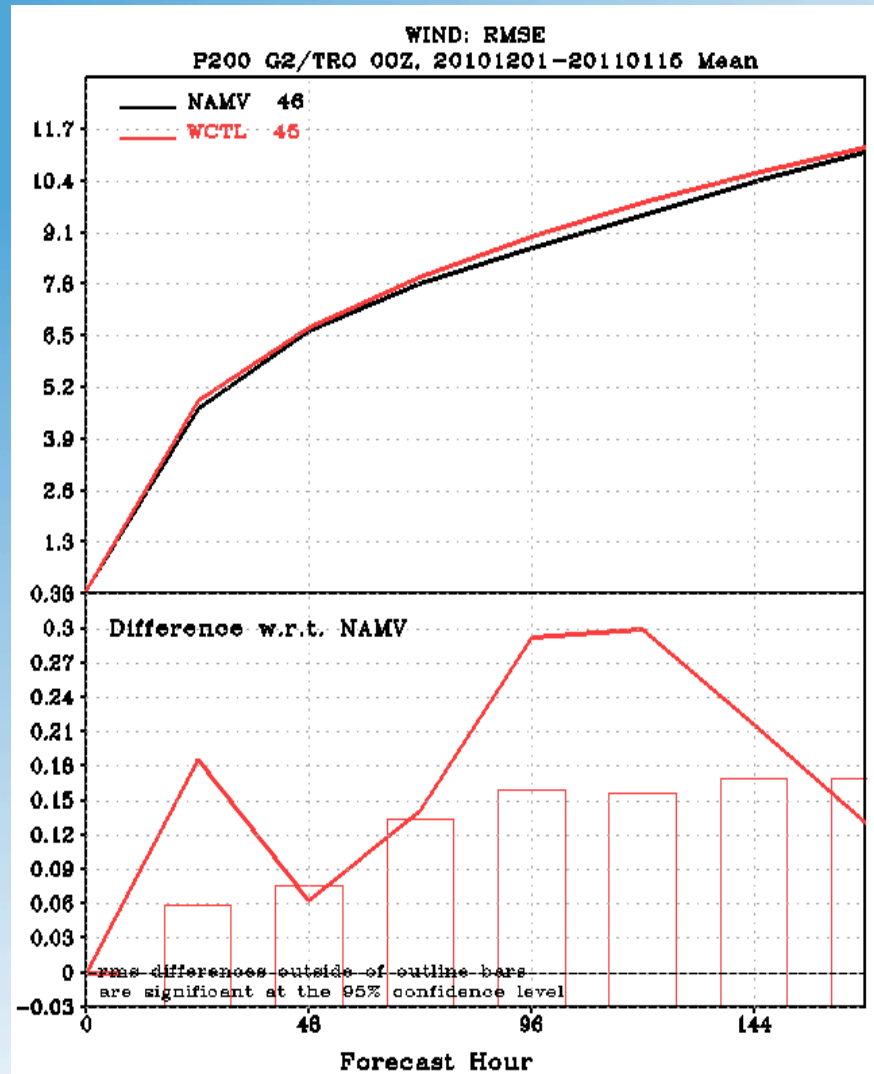


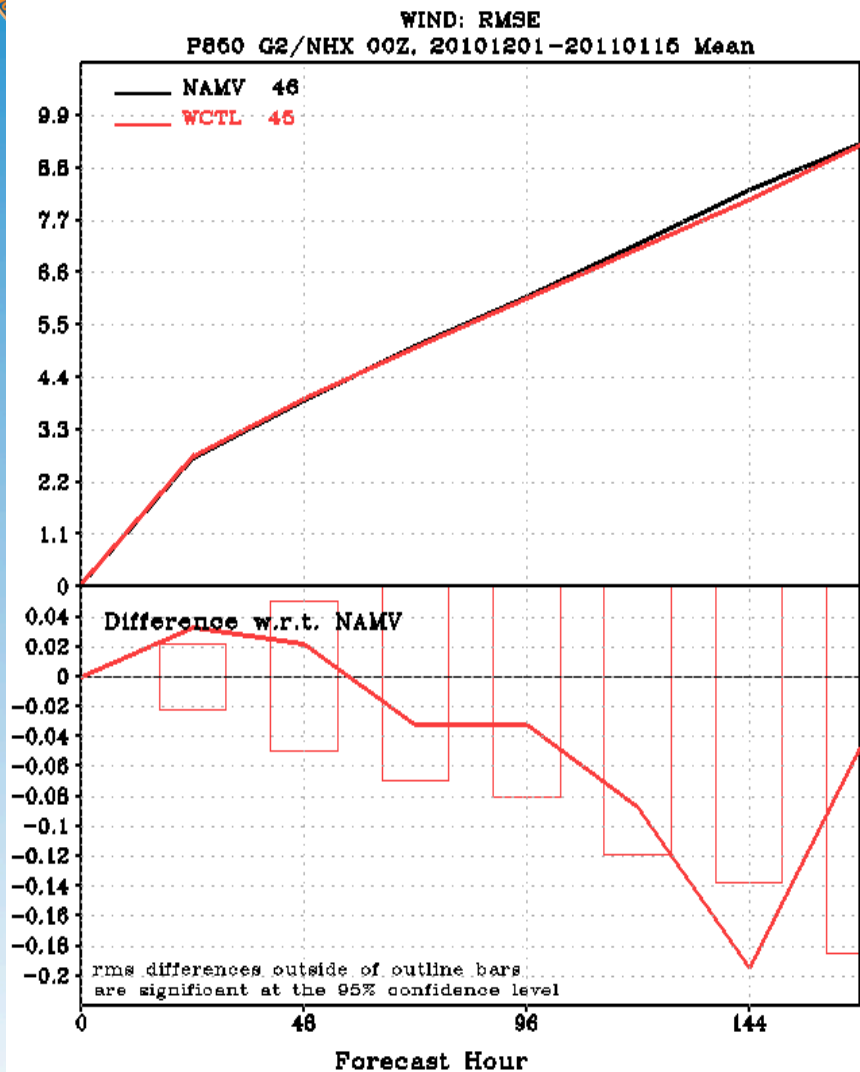
Wind Speed Root Mean Square Error, Day 1, time series at 850 hPa for the Northern and Southern Hemisphere and Tropical region.

Positive = WCTL < NAMV

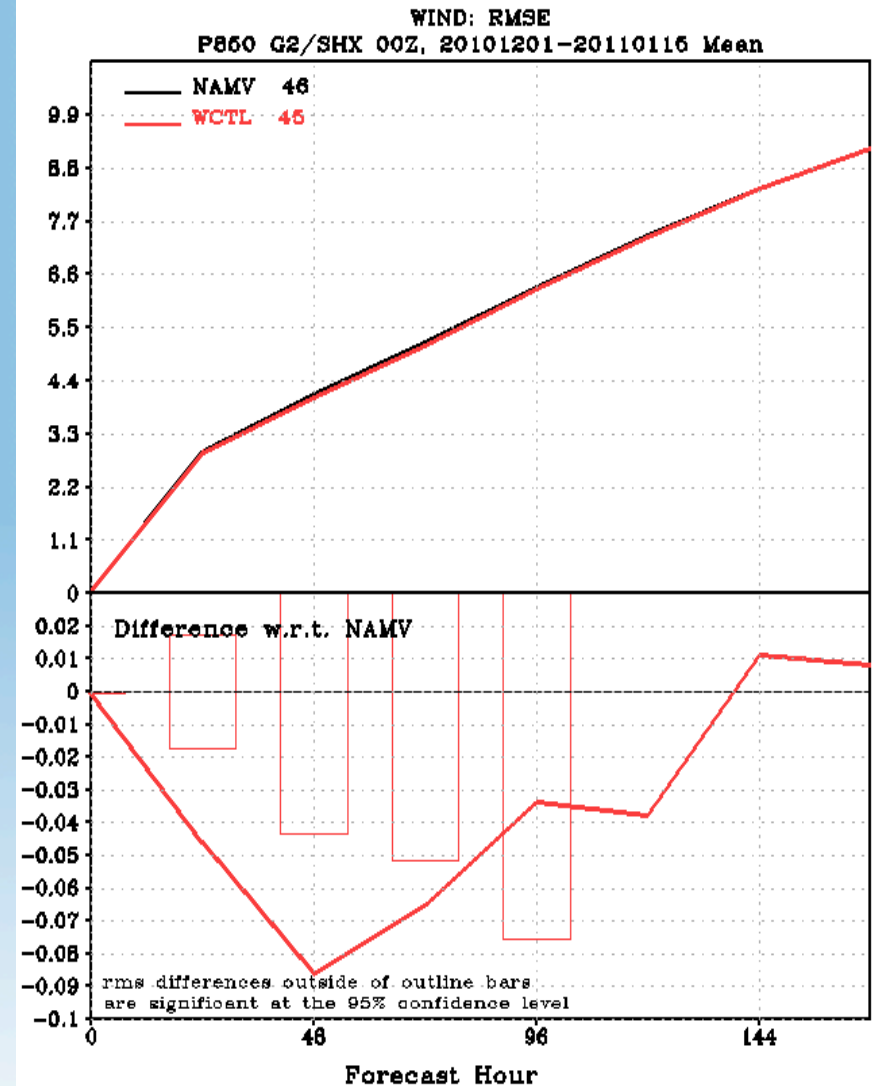


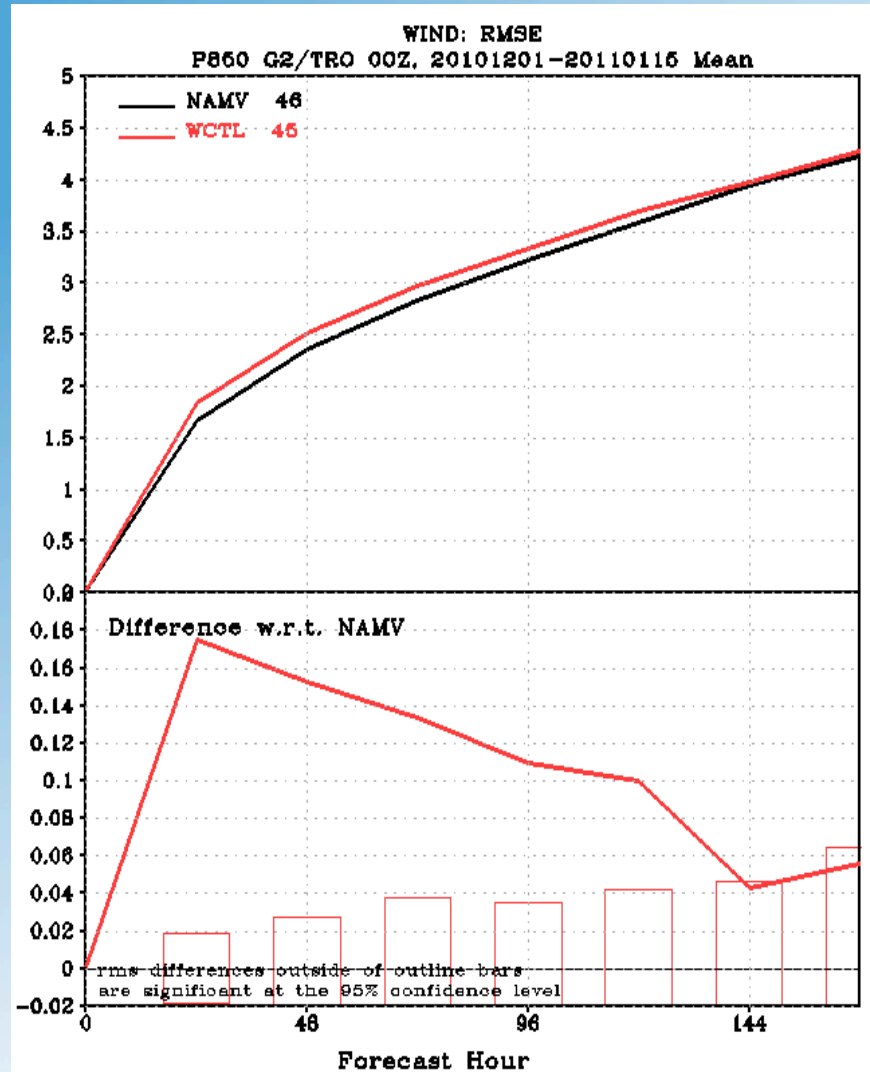


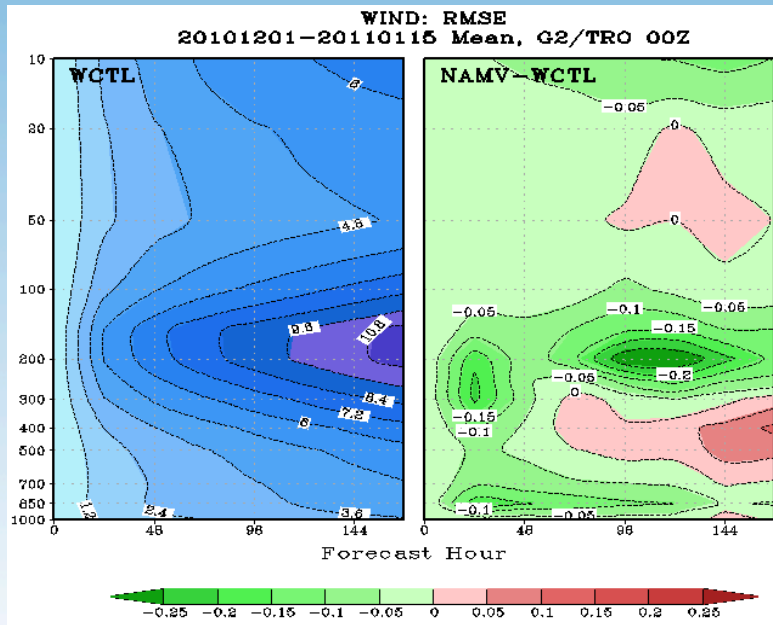
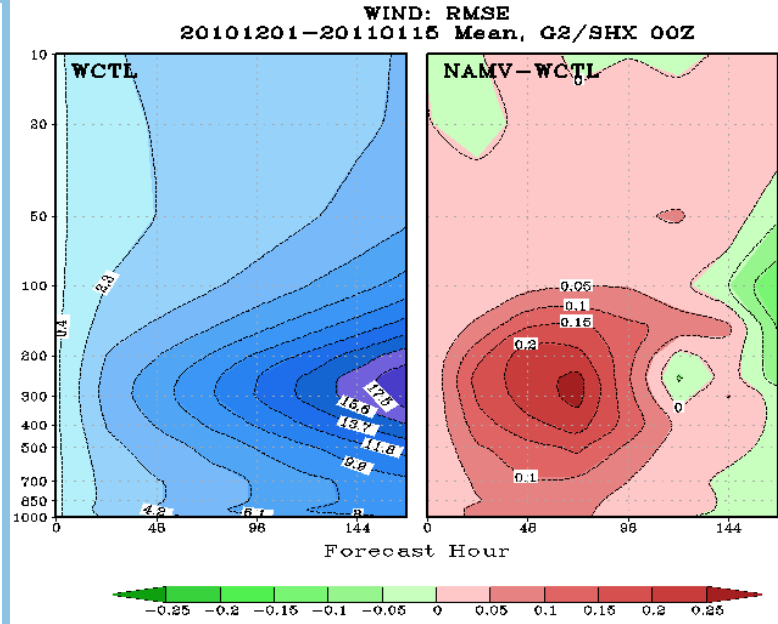
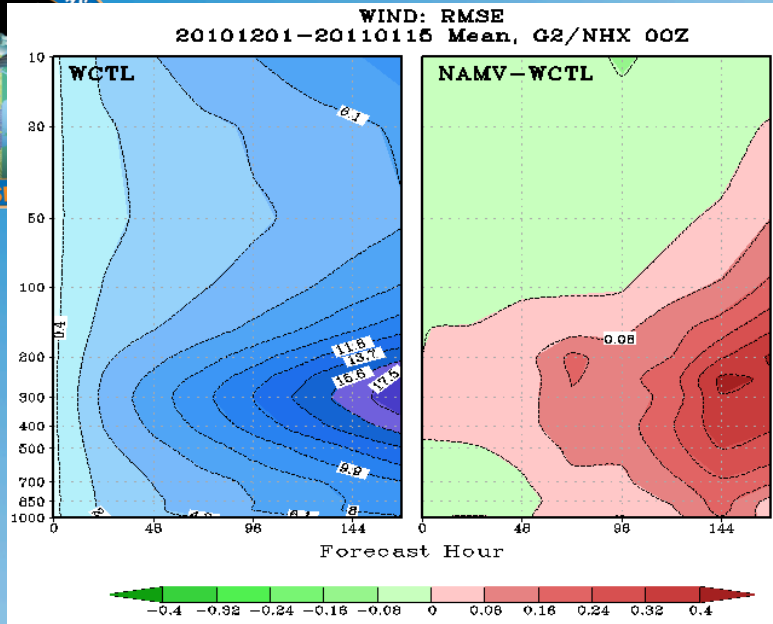
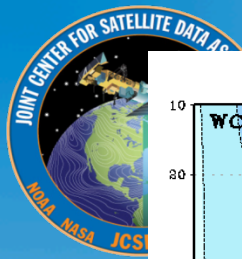




No AMV Experiment 1 Dec 2010 – 31 Jan 2011





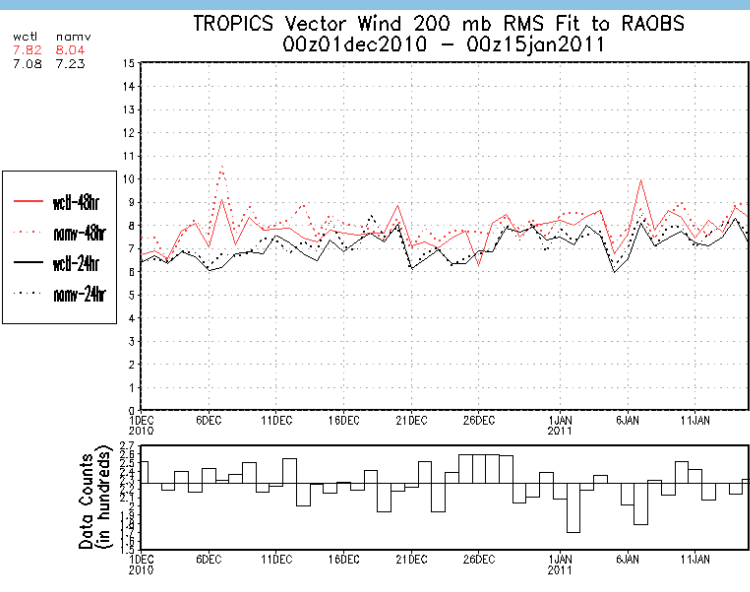
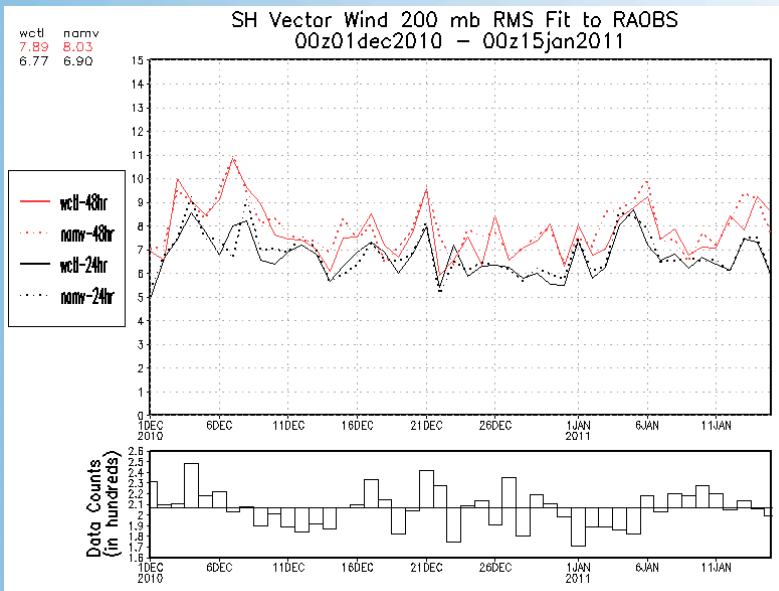
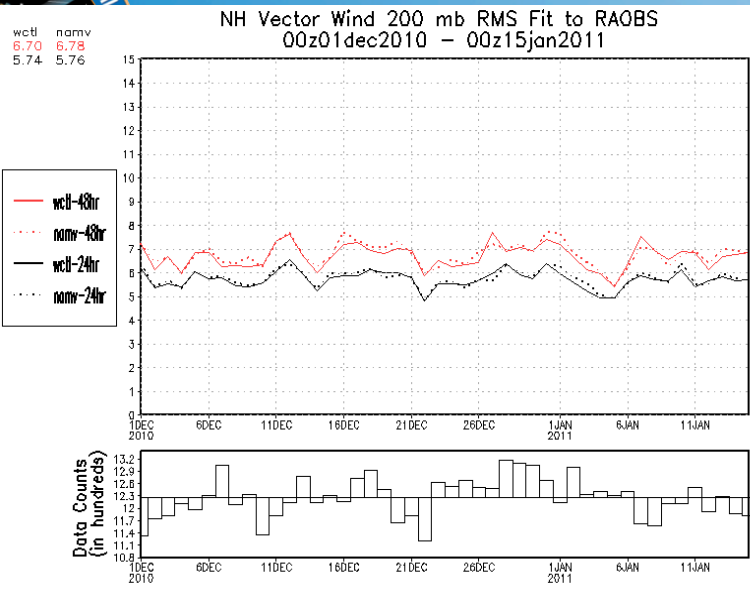
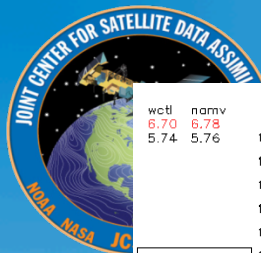


Vertical profile vs forecast time of wind speed RMSE for the Northern and Southern Hemispheres and Tropical Region.

Left panel is average wind speed from the control. Right panel is difference of experiment - control.

Red = Improvement
Green = Degredation

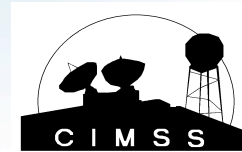


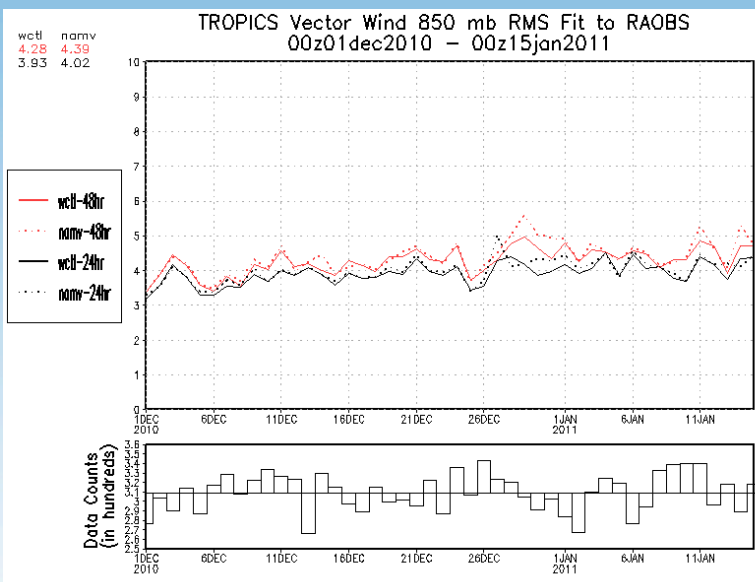
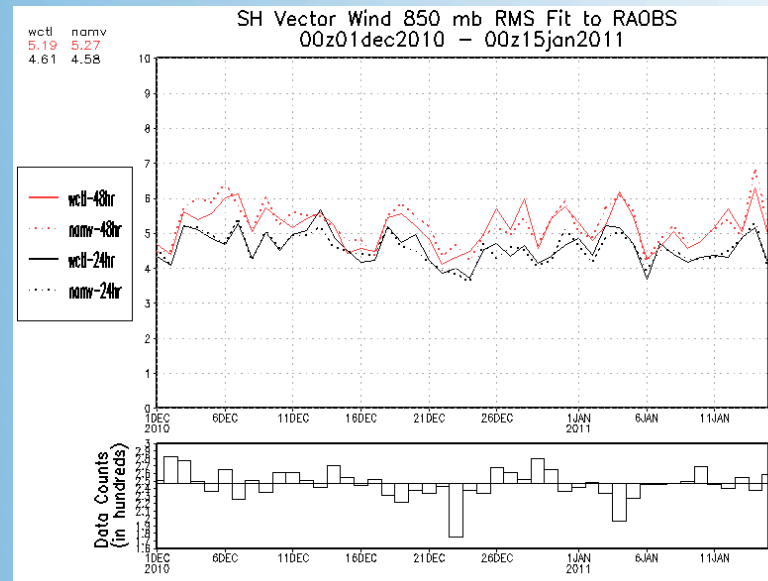
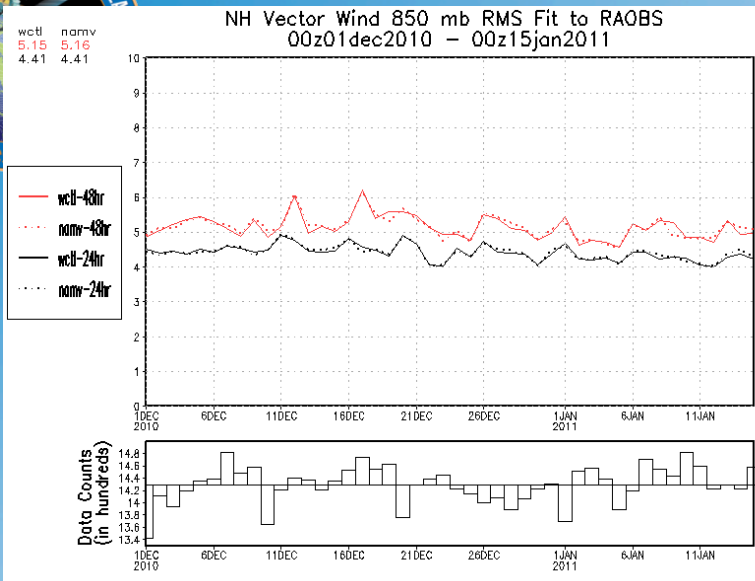
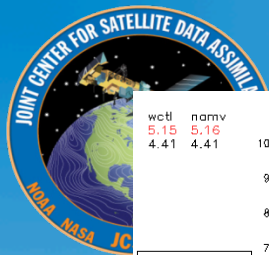


24 and 48 hour time series of Vector Wind RMS fit to Rawinsondes at 200 hPa for the Northern and Southern Hemispheres and Tropical Region.

Solid lines are the control
 Dashed lines are the experiment

Red = 48 hr. statistics
 Black = 24 hr. statistics

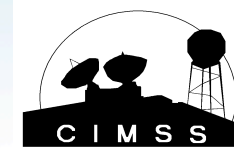




24 and 48 hour time series of Vector Wind RMS fit to Rawinsondes at 850 hPa for the Northern and Southern Hemispheres and Tropical Region.

Solid lines are the control
Dashed lines are the experiment

Red = 48 hr. statistics
Black = 24 hr. statistics





Summary

1 Dec 2010 – 15 Jan 2011

- Slow bias for U for GOES AMVs, others are closer to zero
- AC scores: (not shown)
 - NH positive but not significant
 - SH short term positive, long term negative
- 500 hPa height bias/RMS generally positive
- 200 hPa vector wind RMSE wrt own analysis:
 - Mostly positive and significant at mid latitudes
 - Negative and significant in tropics
- 850 hPa vector wind RMSE wrt own analysis:
 - Positive to neutral at mid-latitudes
 - Negative in the tropics
- 200 hPa 24 & 48 hr. fit to rawinsondes:
 - Neutral for NH
 - Positive for SH, TR
- 850 hPa 24 & 48 hr. fit to rawinsondes:
 - Neutral for NH
 - Positive for SH, TR



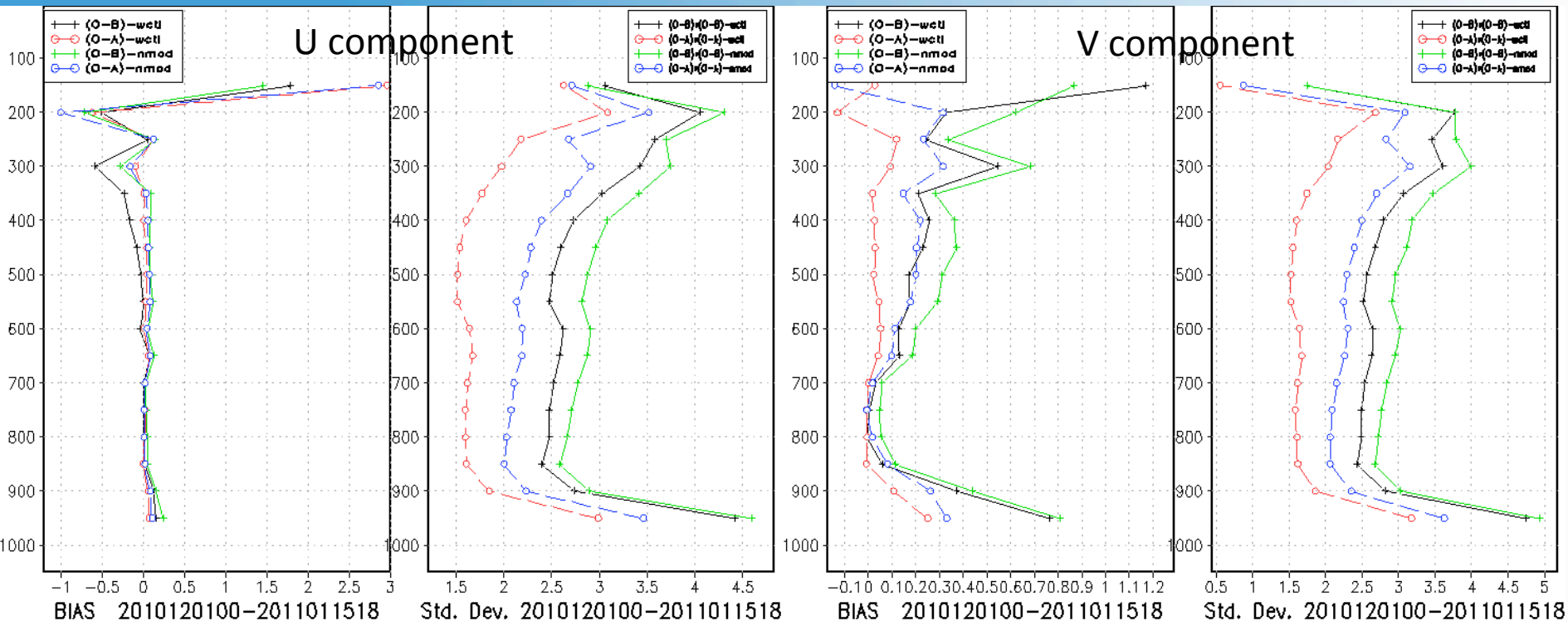


No Polar AMV Experiment 1 Dec 2010 – 15 Jan 2011



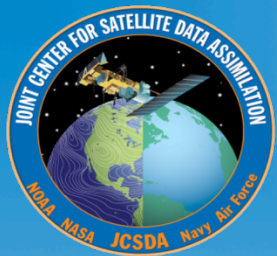


MODIS infrared

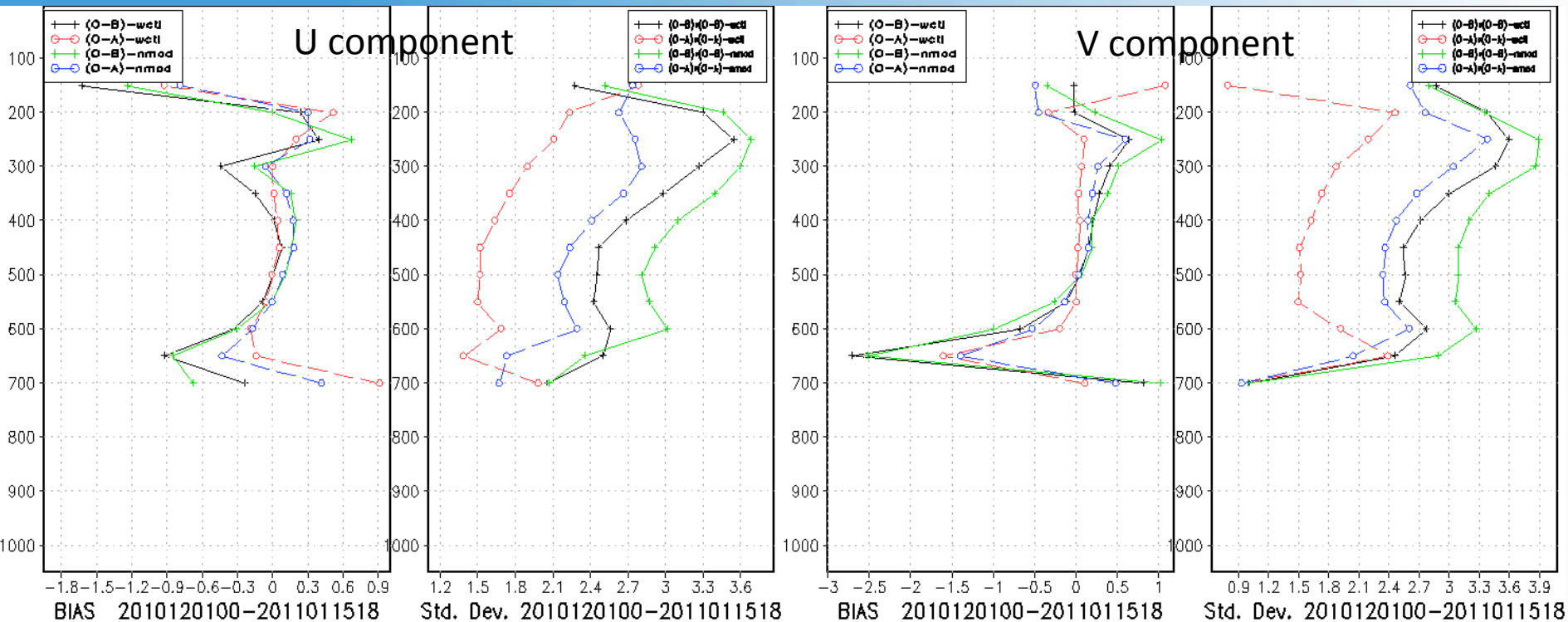


Black = Control (O-B) Red = Control (O-A)
 Green = Experiment (O-B) Blue = Experiment (O-A)





MODIS Water Vapor Cloud Top

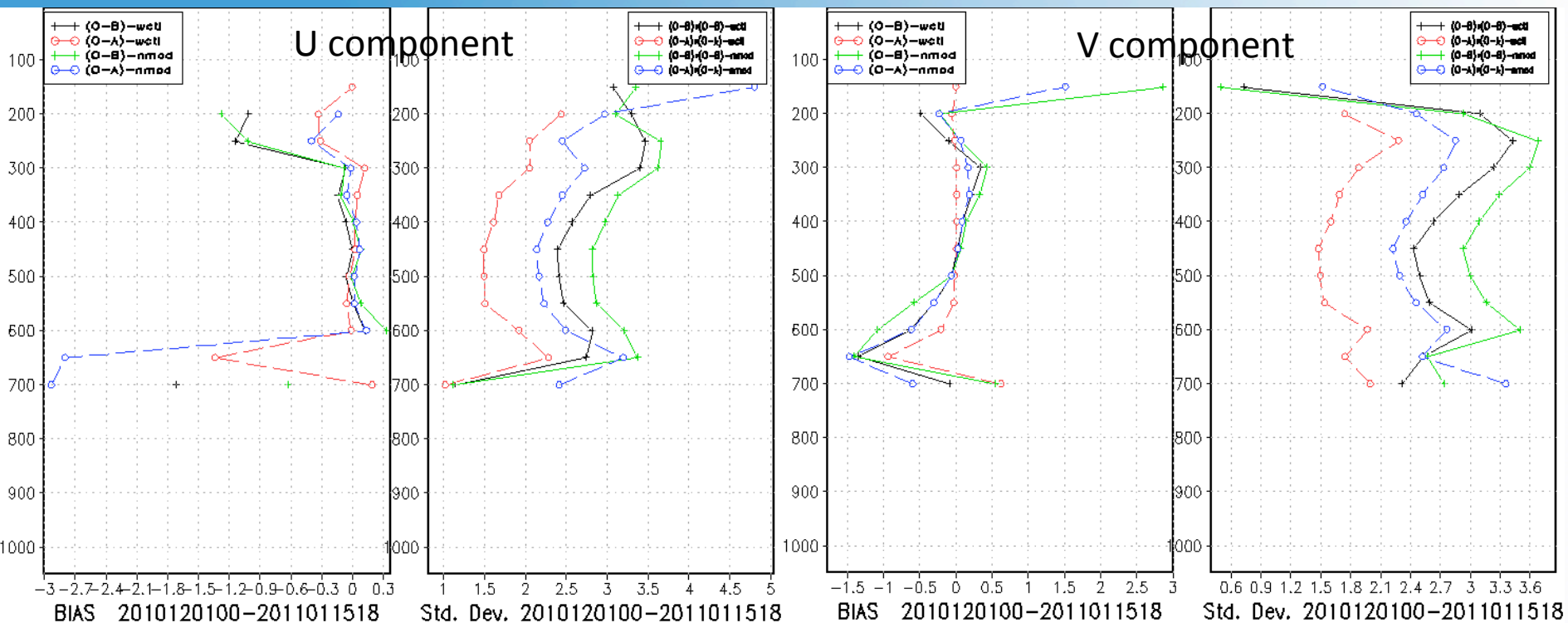


Black = Control (O-B) Red = Control (O-A)
 Green = Experiment (O-B) Blue = Experiment (O-A)



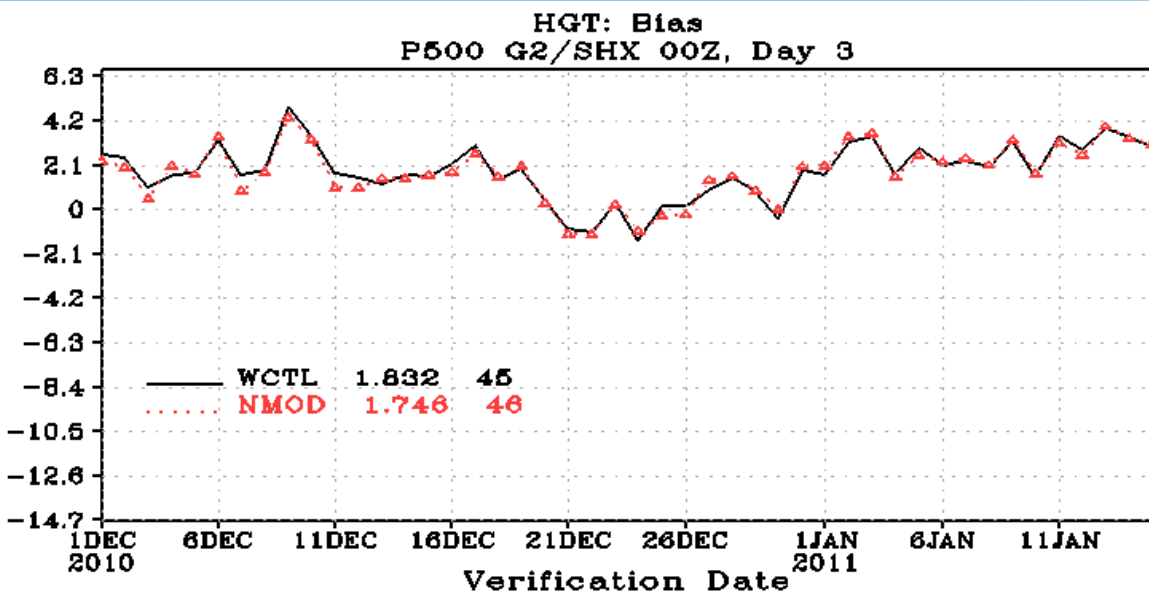
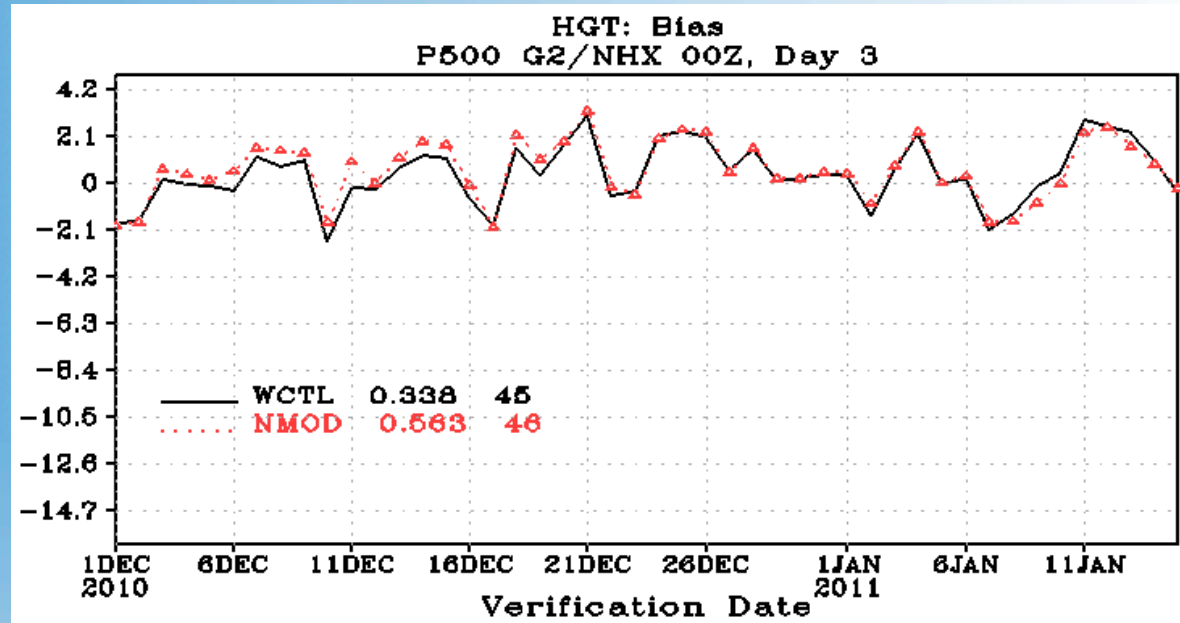


MODIS Water Vapor Deep Layer



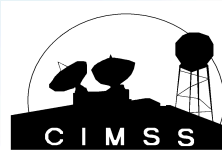
Black = Control (O-B) Red = Control (O-A)
 Green = Experiment (O-B) Blue = Experiment (O-A)

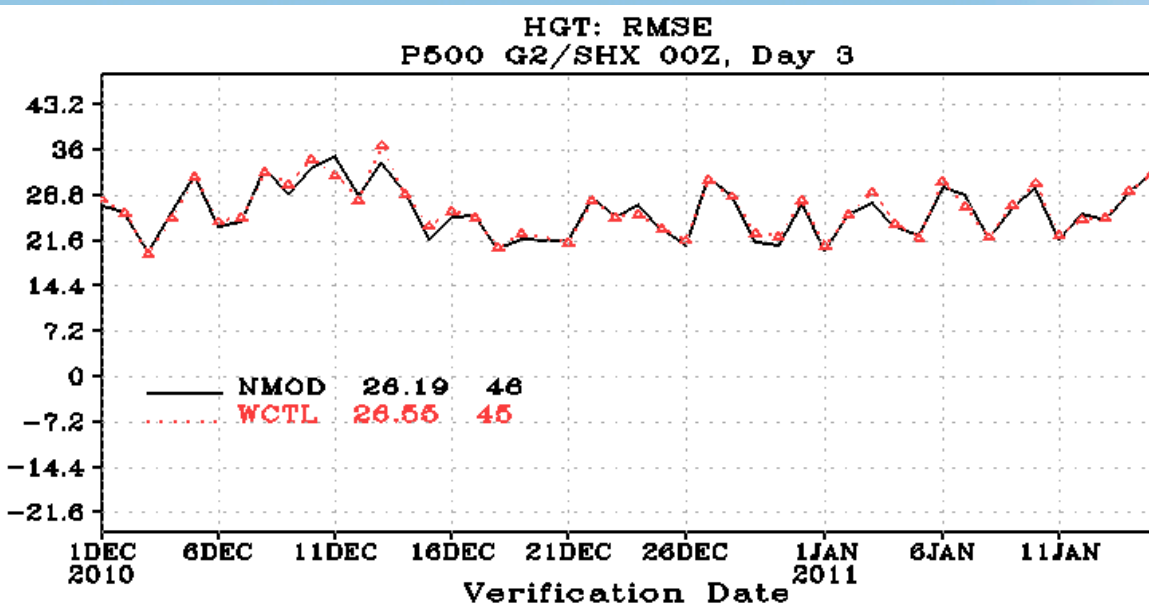
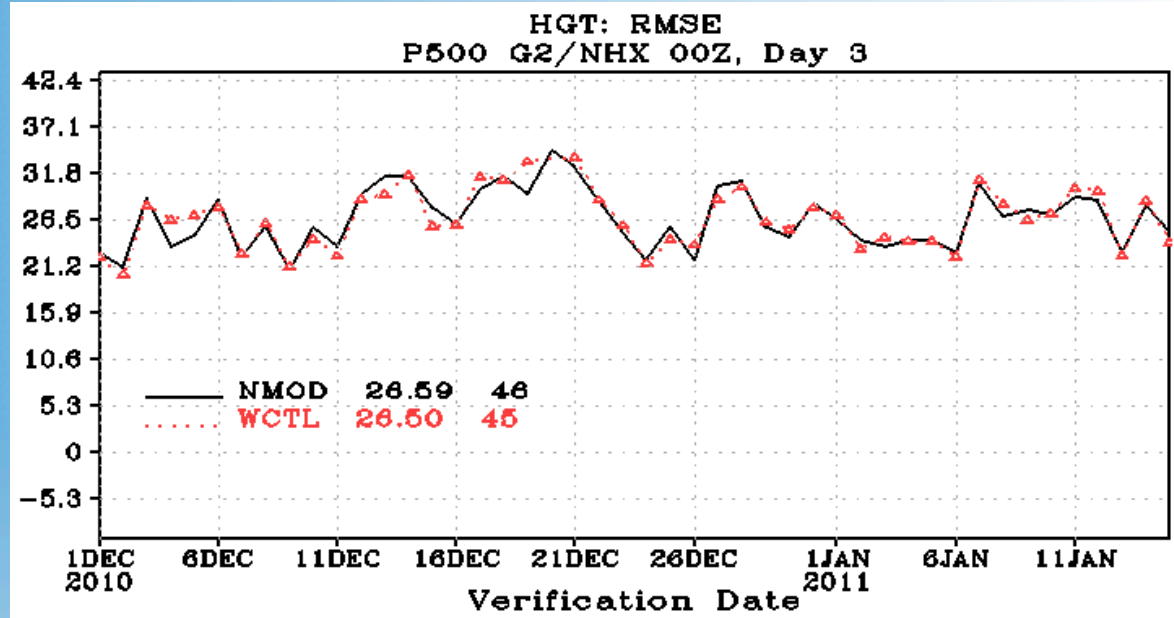




Geopotential heights - day 3
Bias time series at 500 hPa for
Northern and Southern
Hemispheres.

Positive = WCTL closer to zero





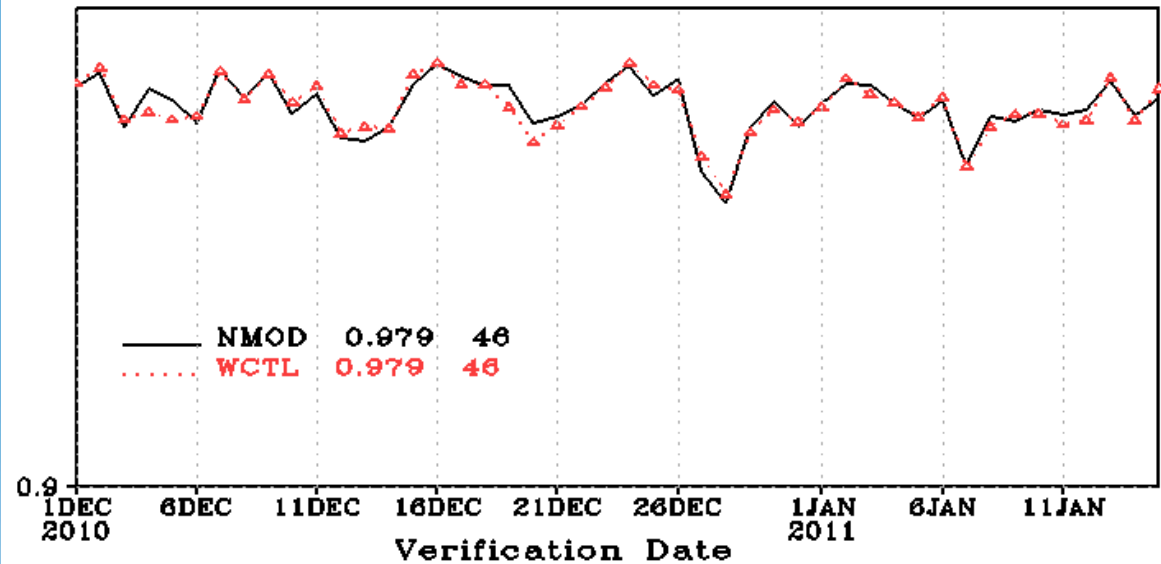
Geopotential heights, day 3,
RMSE time series at 500 hPa for
Northern and Southern
Hemispheres.

Positive = WCTL < NAMV

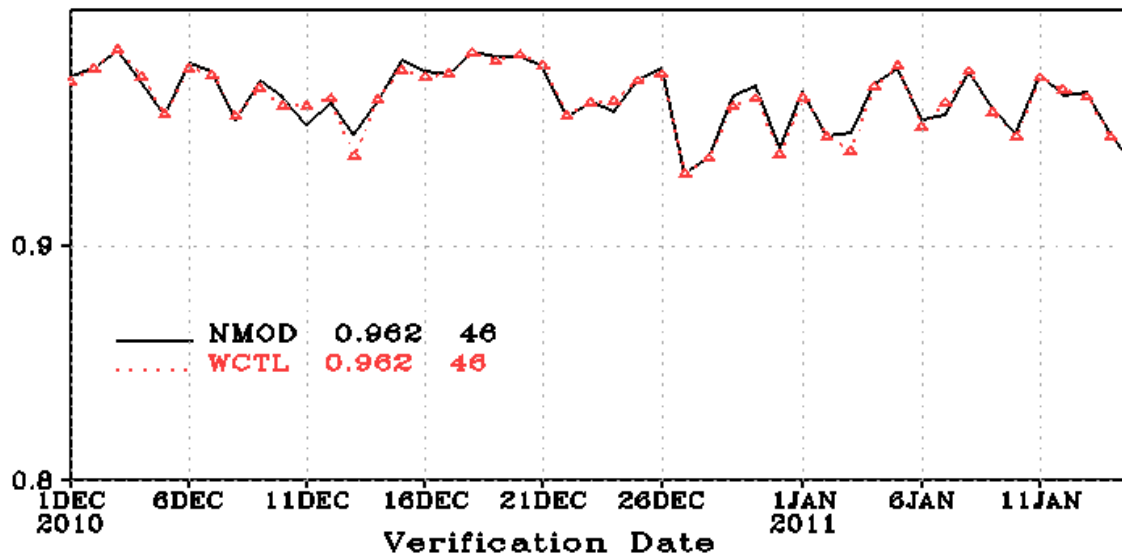




Anomaly Correl: HGT P500 G2/NHX 00Z, Day 3



Anomaly Correl: HGT P500 G2/SHX 00Z, Day 3

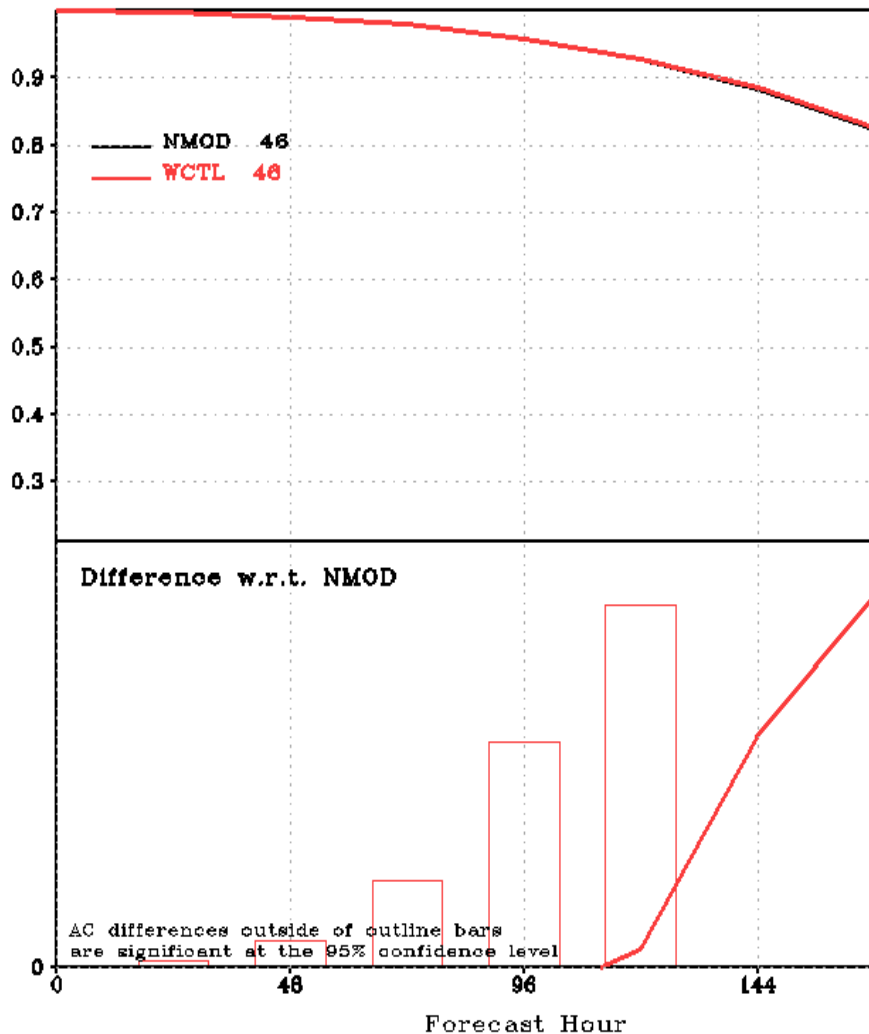


Geopotential heights anomaly correlation time series at 500 hPa for Northern and Southern Hemispheres.

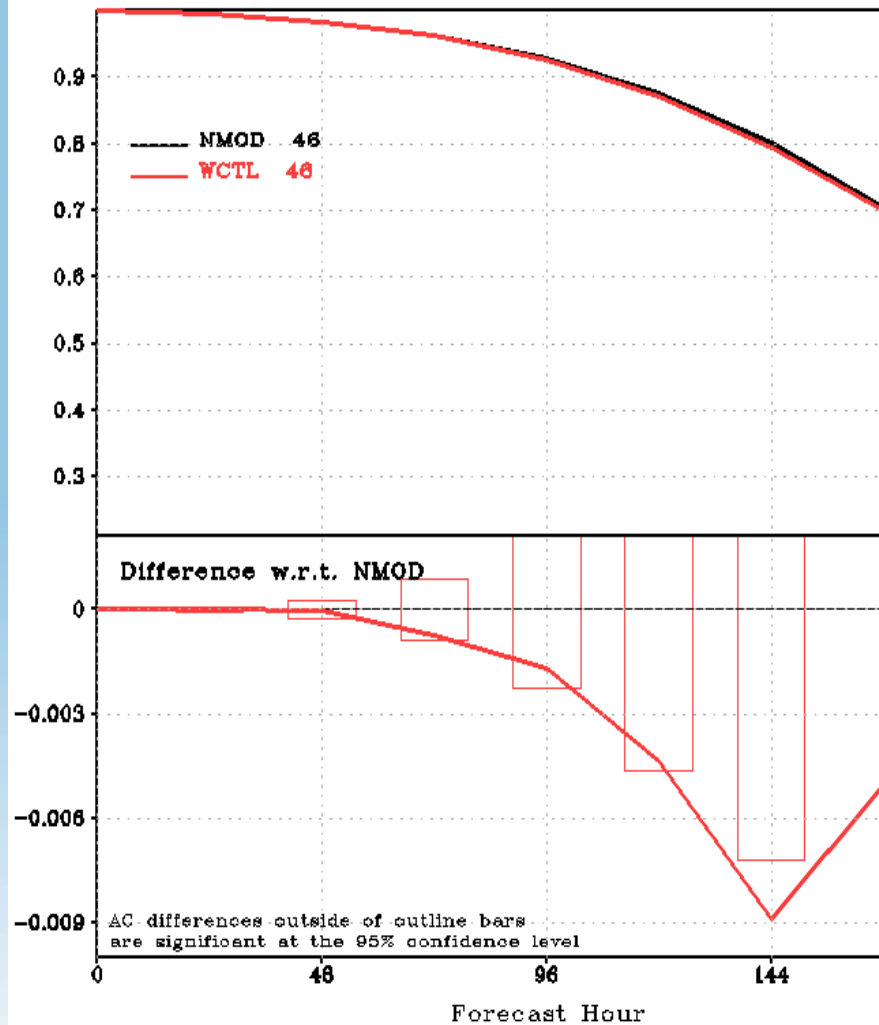




AC: HGT P500 Q2/NHX 00Z, 20101201-20110115

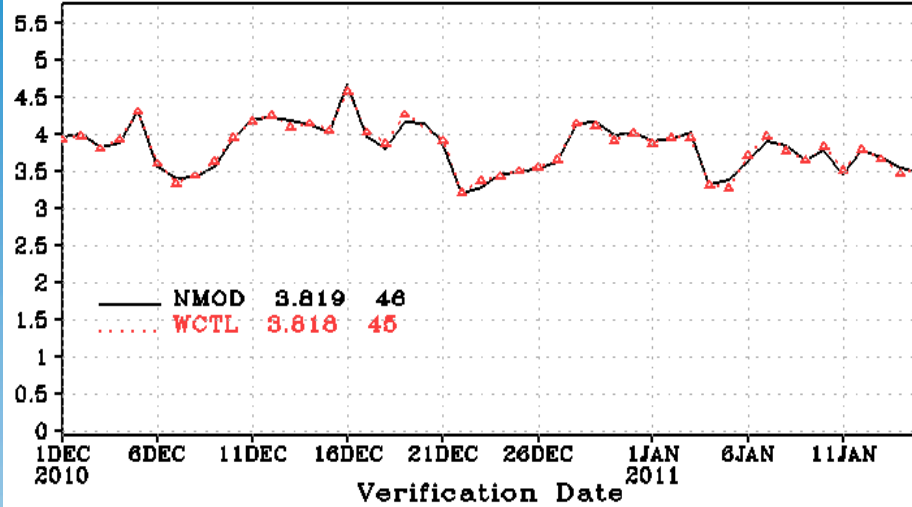


AC: HGT P500 Q2/SHX 00Z, 20101201-20110115

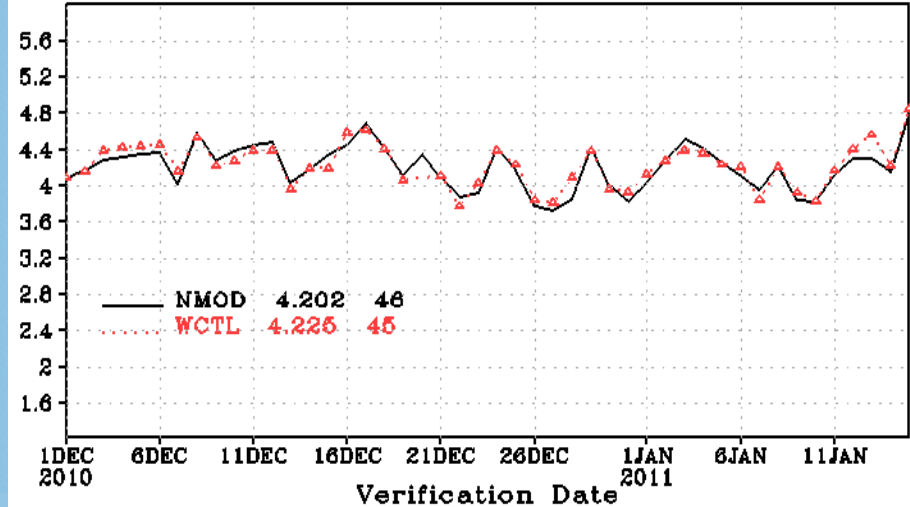




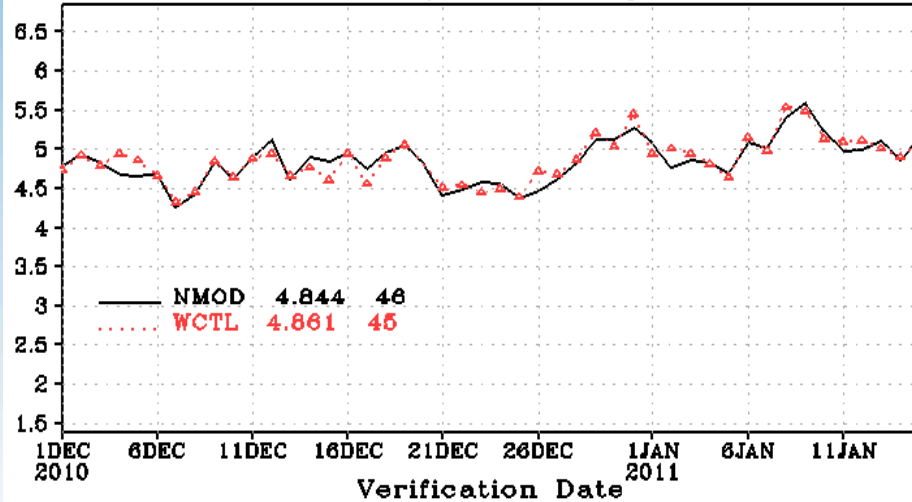
WIND: RMSE
P200 G2/NHX 00Z, Day 1



WIND: RMSE
P200 G2/SHX 00Z, Day 1



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



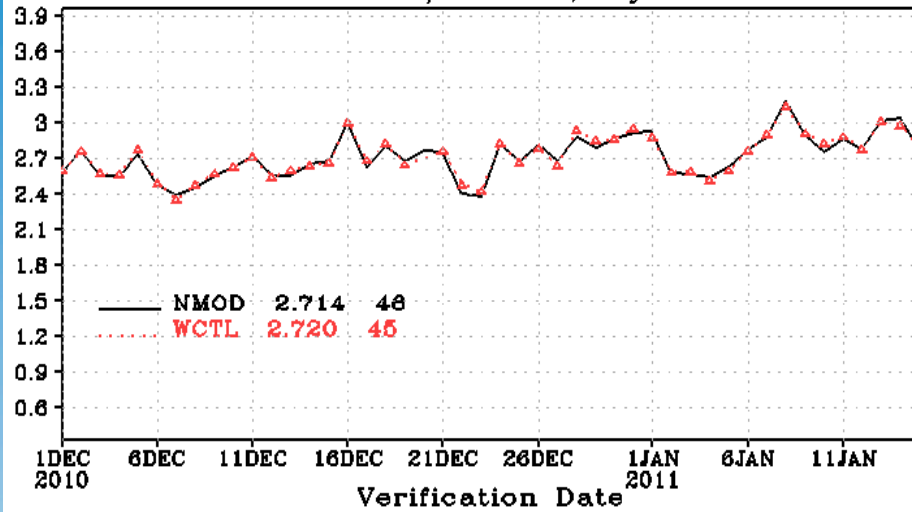
Wind Speed Root Mean Square Error, Day 1, time series at 200 hPa for the Northern and Southern Hemisphere and Tropical region.

Positive = WCTL < NAMV

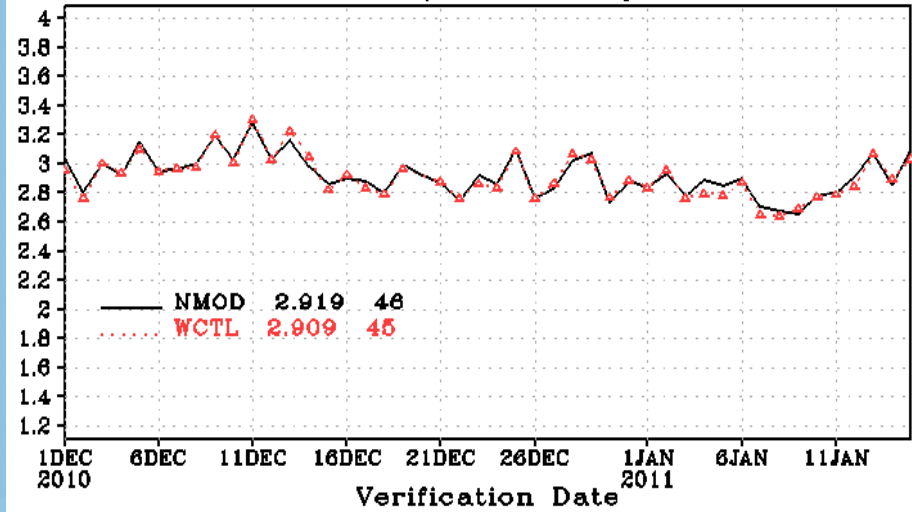




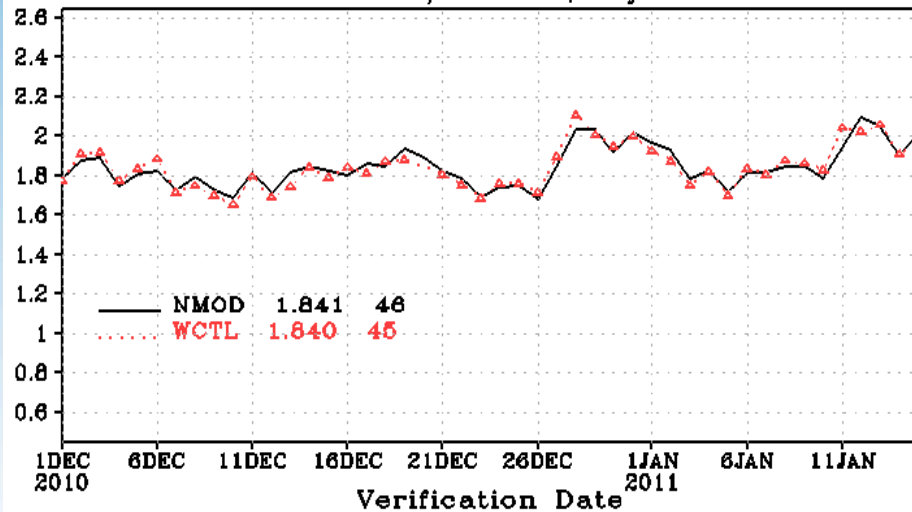
WIND: RMSE
P850 G2/NHX 00Z, Day 1



WIND: RMSE
P850 G2/SHX 00Z, Day 1



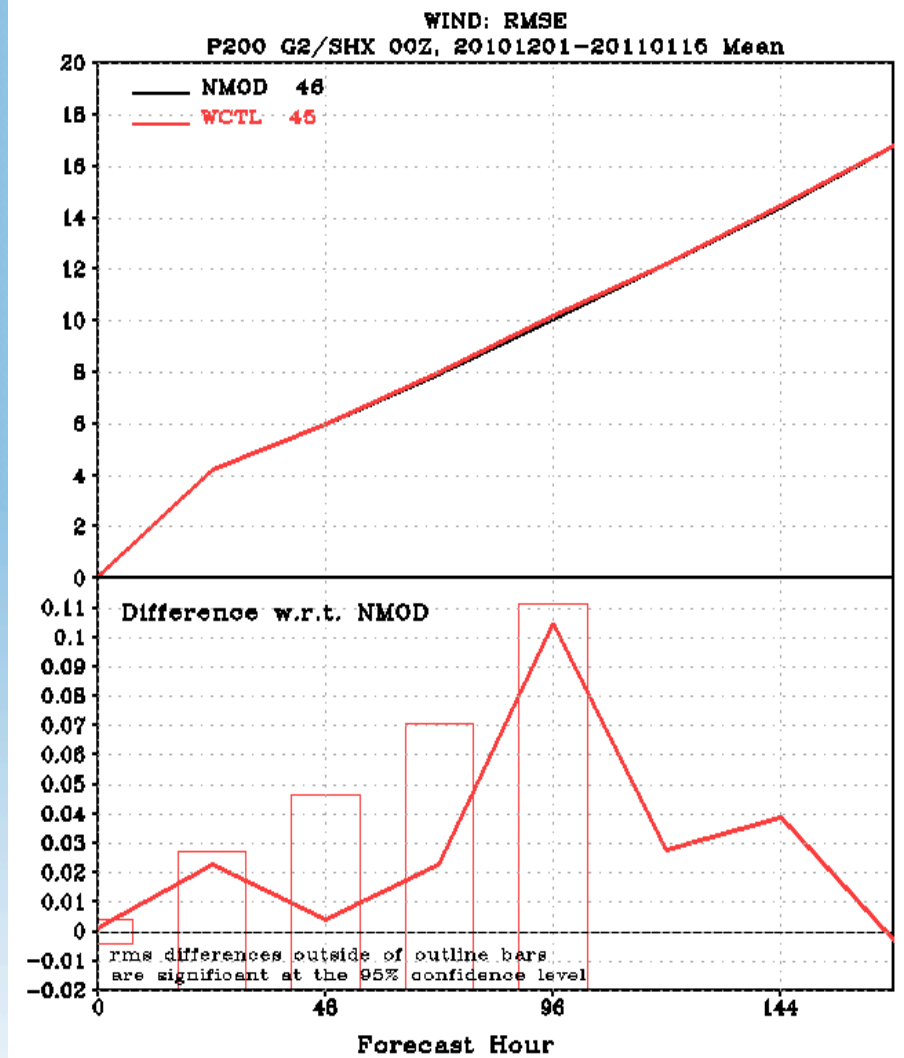
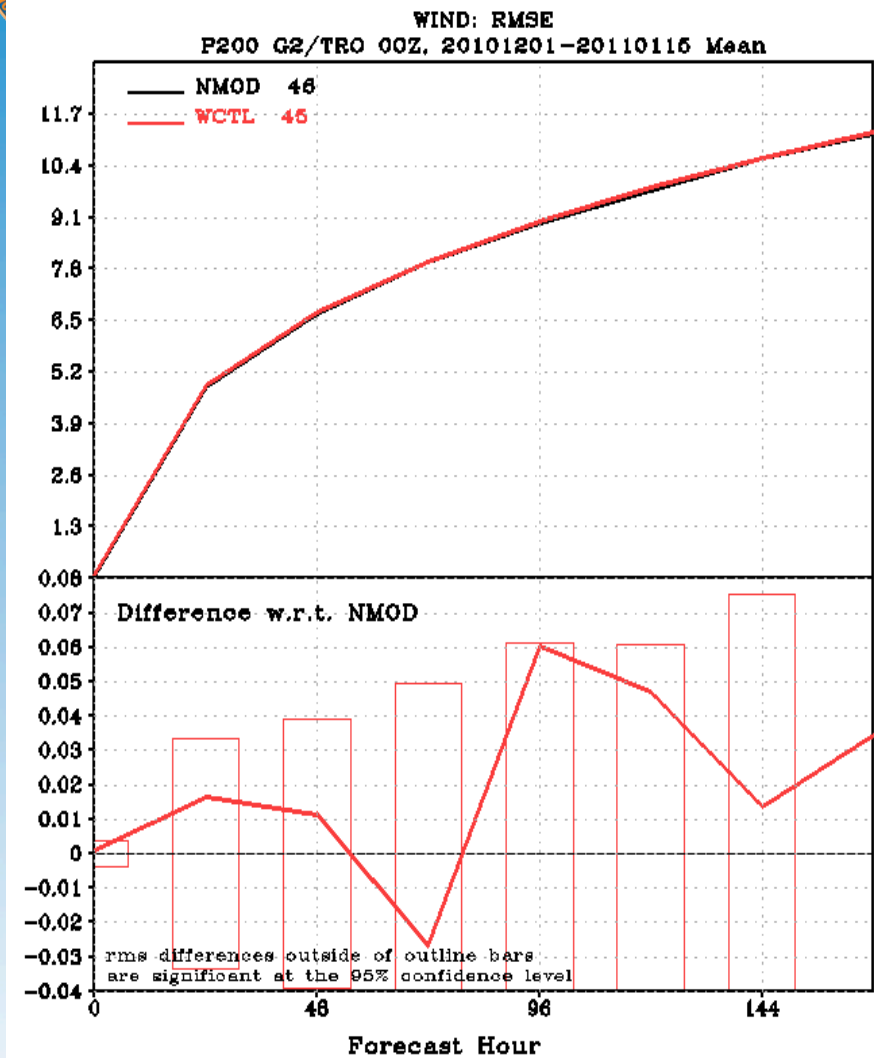
WIND: RMSE
P850 G2/TRO 00Z, Day 1

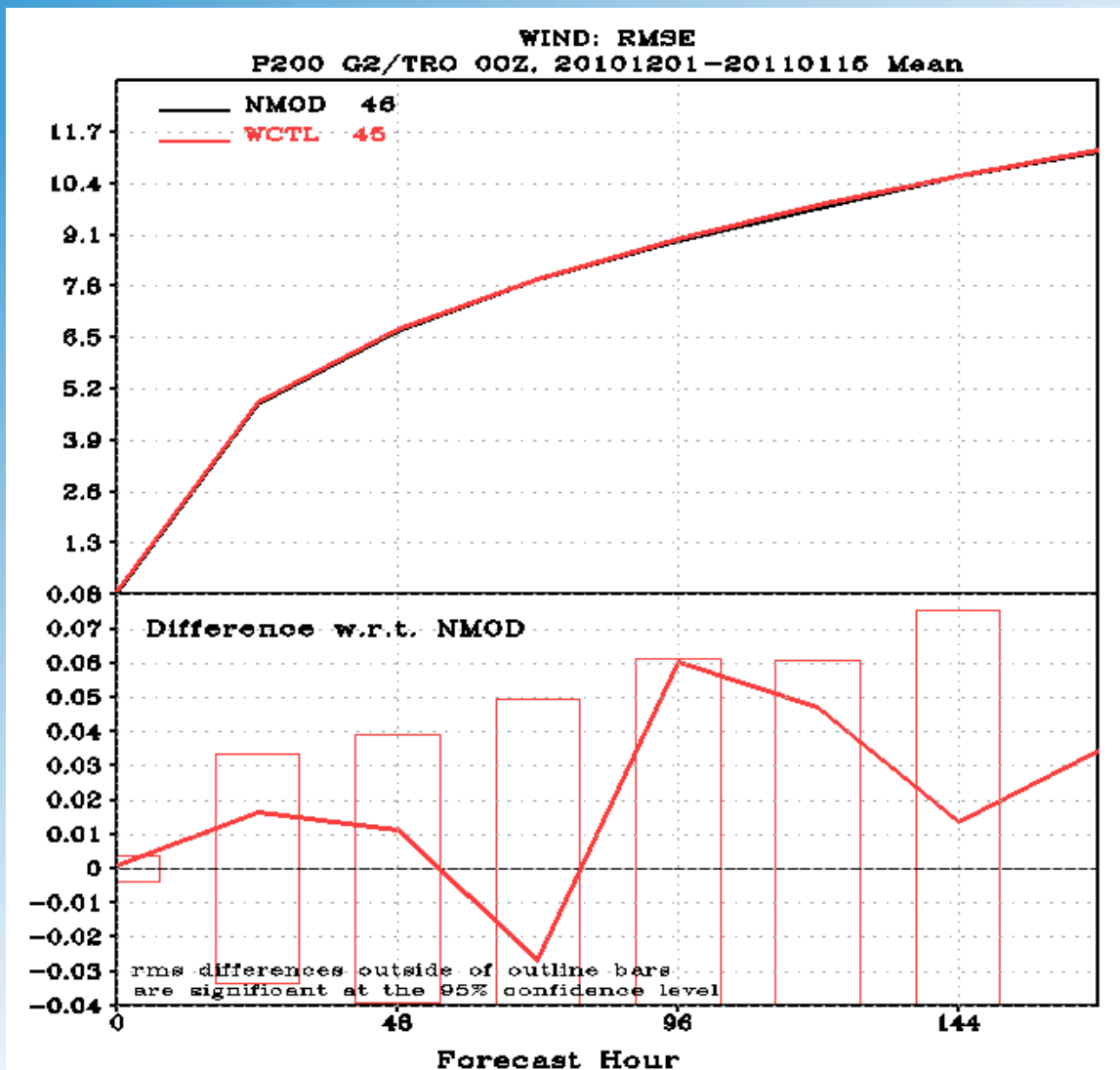


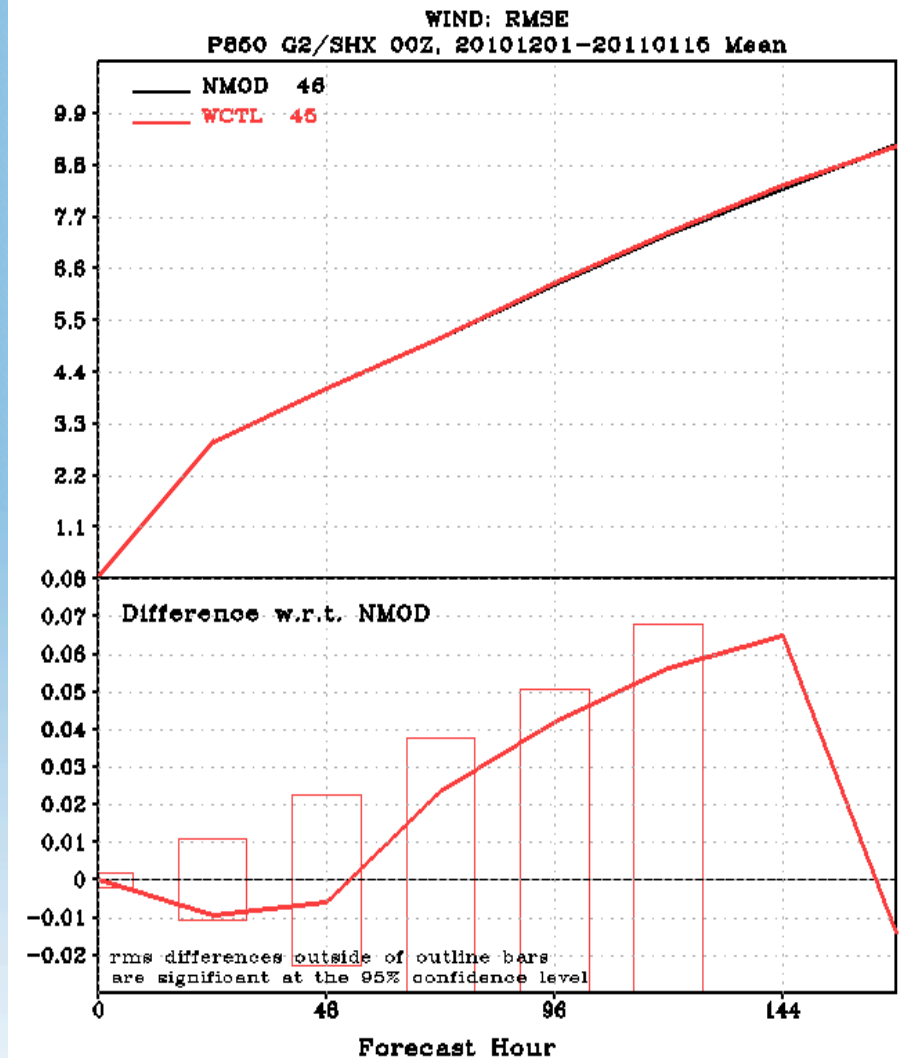
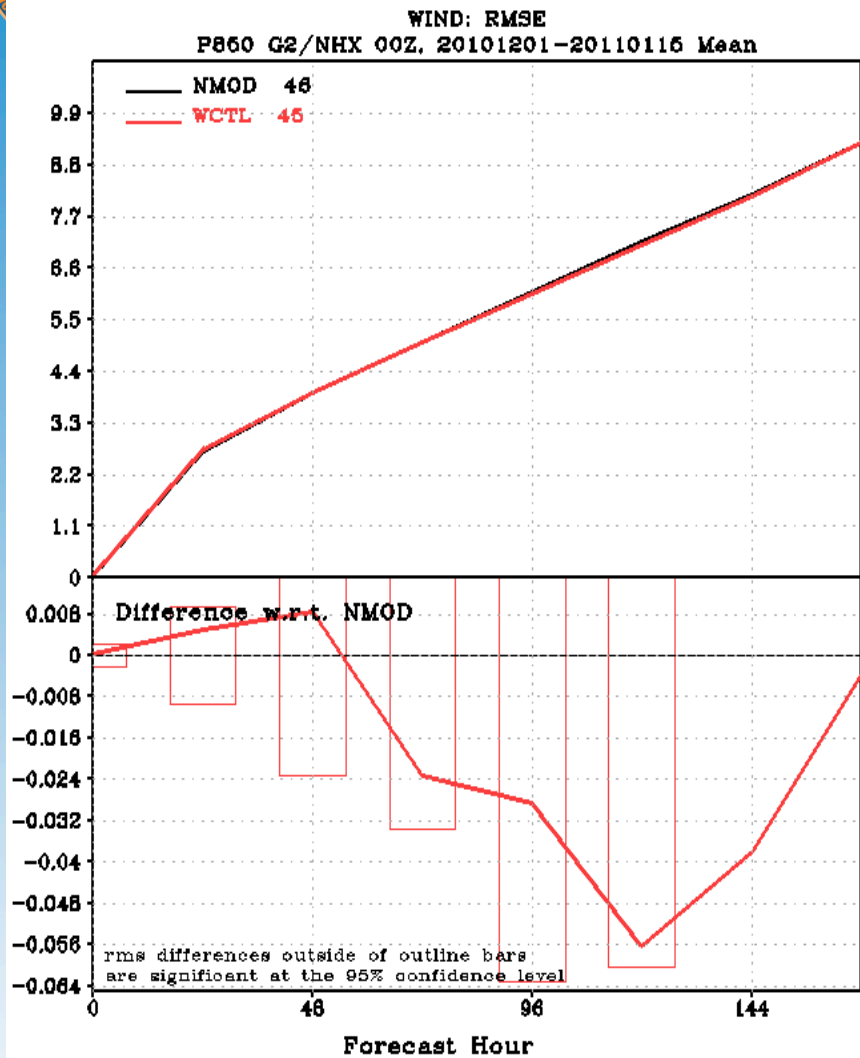
Wind Speed Root Mean Square Error, Day 1, time series at 850 hPa for the Northern and Southern Hemisphere and Tropical region.

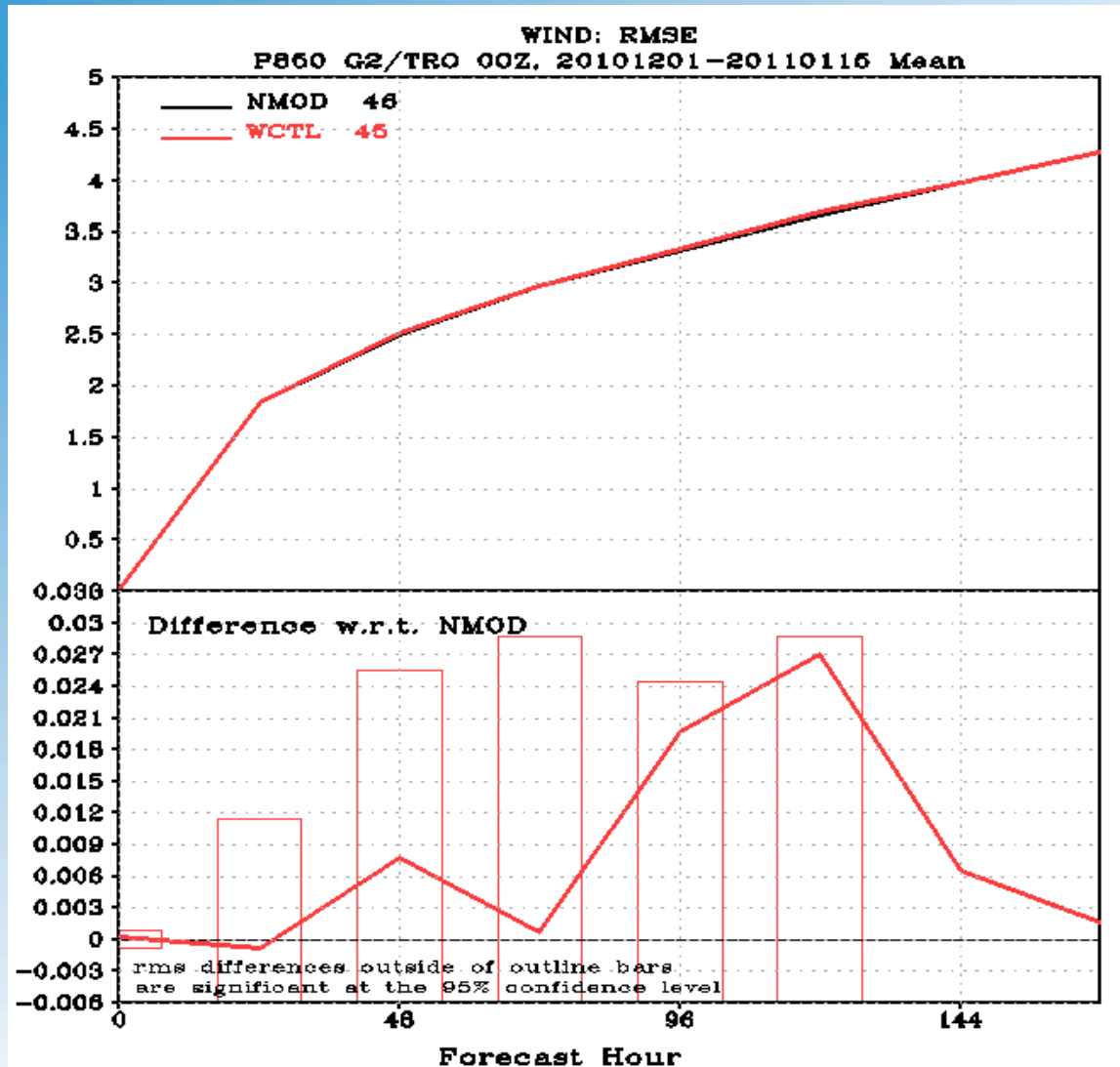
Positive = WCTL < NAMV

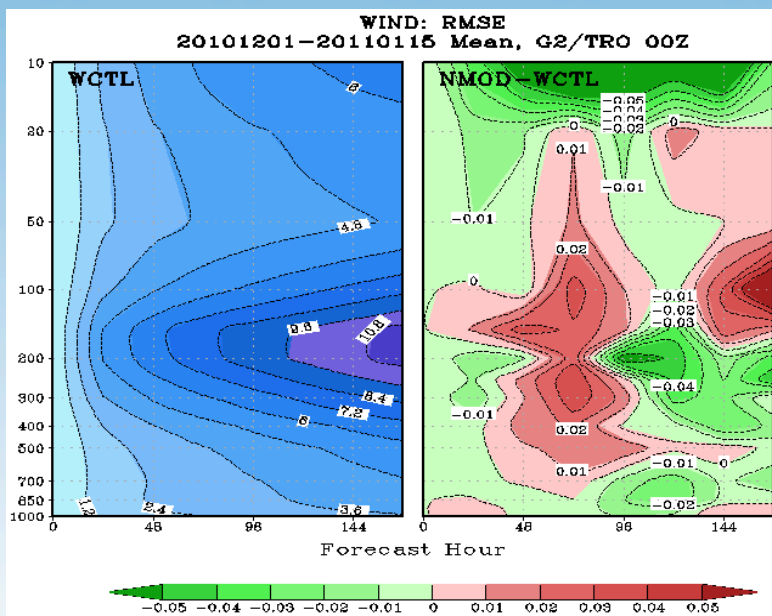
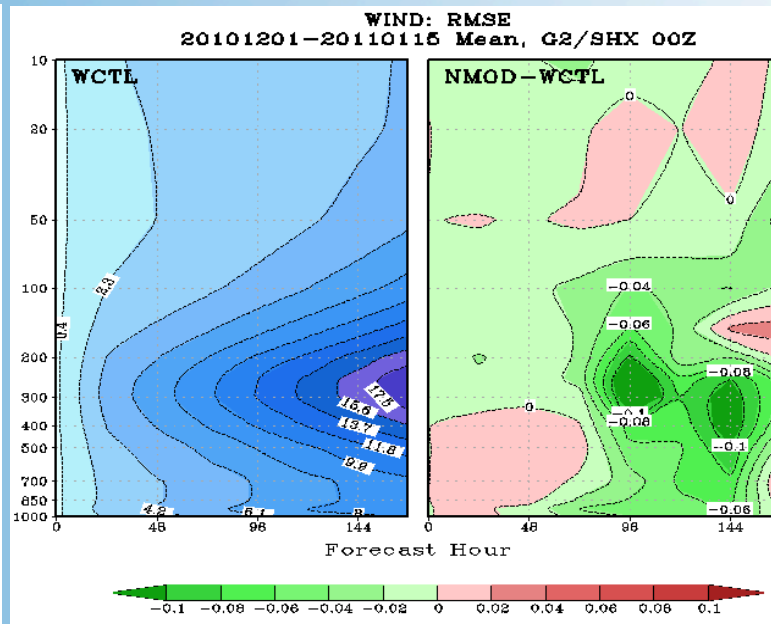
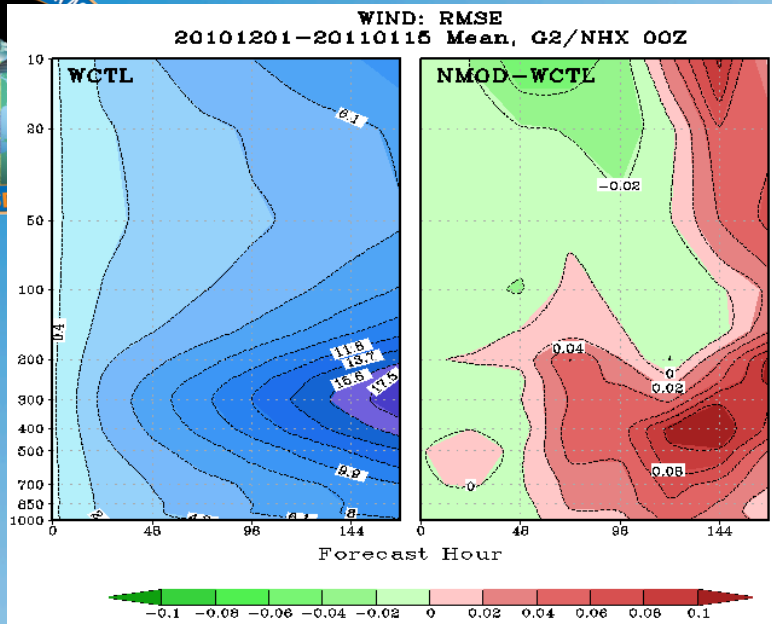
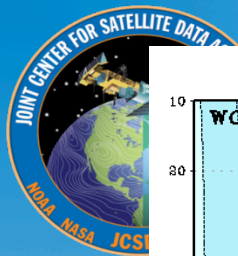








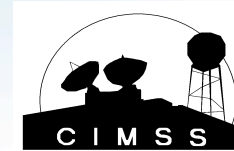


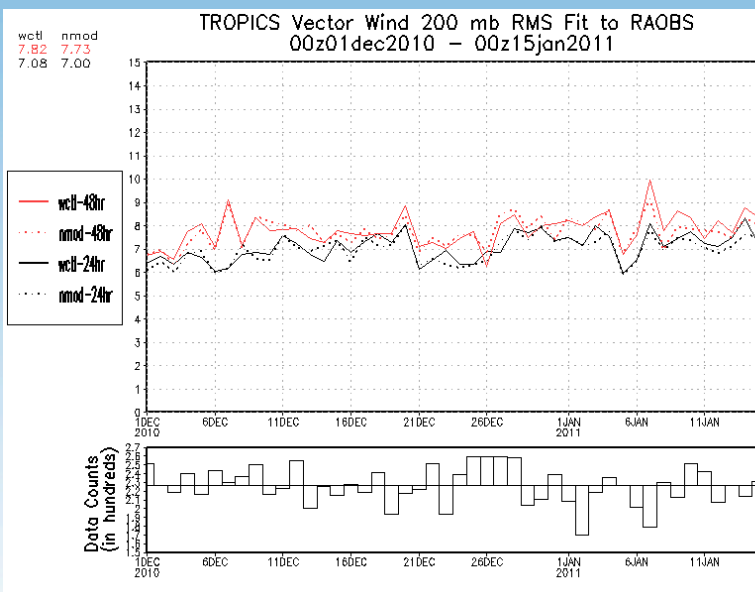
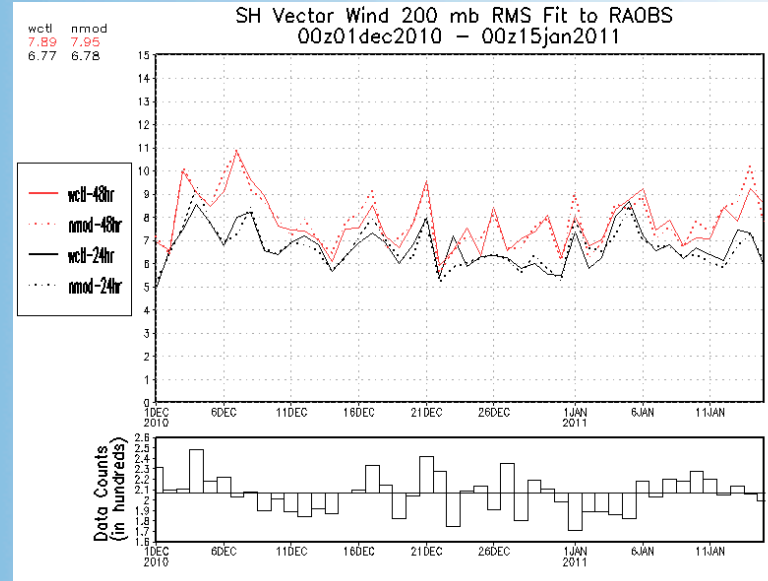
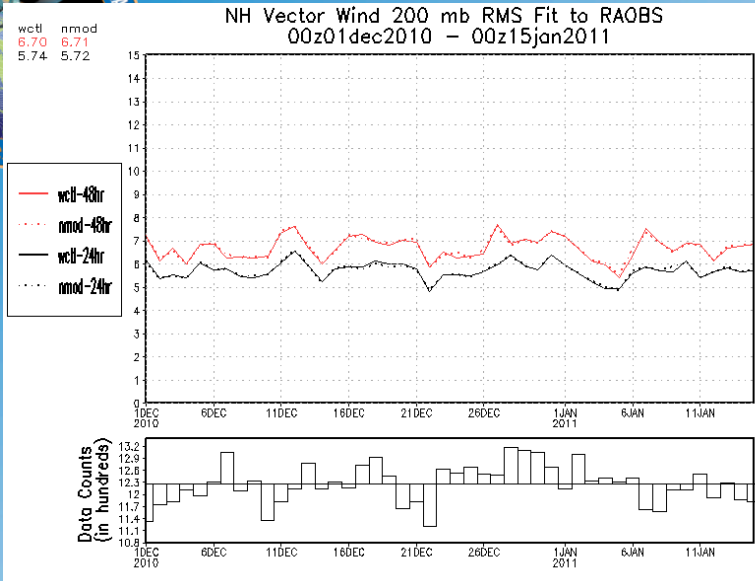
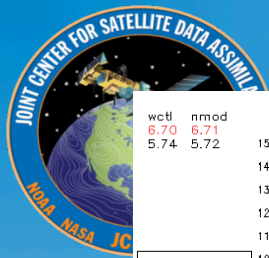


Vertical profile vs forecast time of wind speed RMSE for the Northern and Southern Hemispheres and Tropical Region.

Left panel is average wind speed from the control. Right panel is difference of experiment - control.

Red = Improvement
Green = Degredation

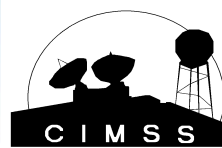


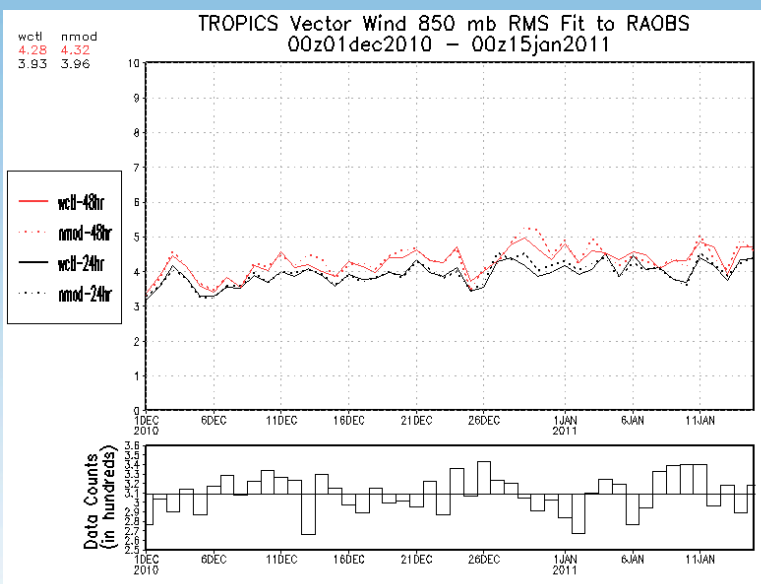
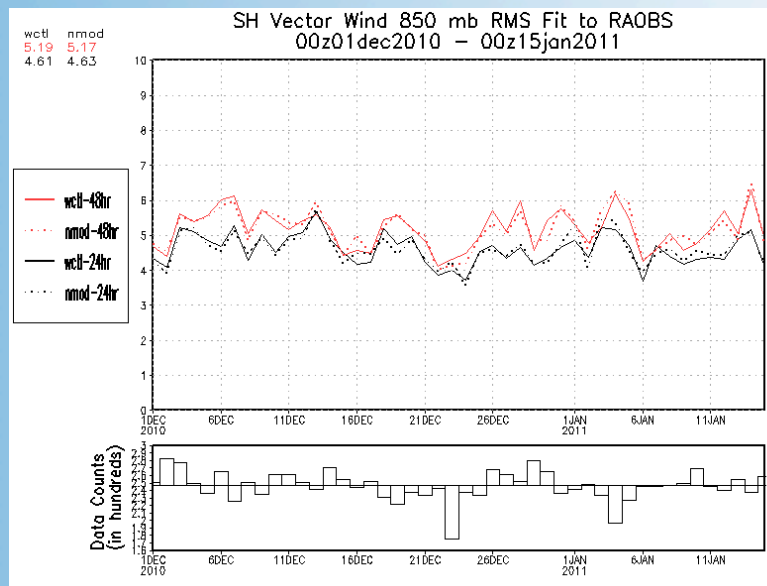
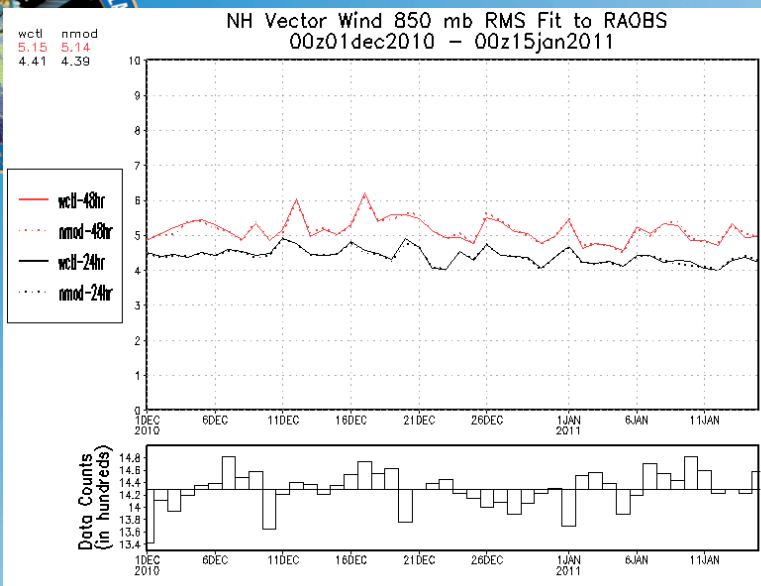
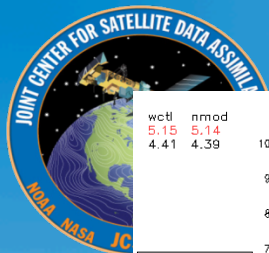


24 and 48 hour time series of Vector Wind RMS fit to Rawinsondes at 200 hPa for the Northern and Southern Hemispheres and Tropical Region.

Solid lines are the control
 Dashed lines are the experiment

Red = 48 hr. statistics
 Black = 24 hr. statistics





24 and 48 hour time series of Vector Wind RMS fit to Rawinsondes at 850 hPa for the Northern and Southern Hemispheres and Tropical Region.

Solid lines are the control
Dashed lines are the experiment

Red = 48 hr. statistics
Black = 24 hr. statistics





Summary

1 Dec 2010 – 15 Jan 2011

- 500 hPa AC Scores: (not shown)
 - NH Positive (not significant)
 - SH Negative (not significant)
- 500 hPa Bias is positive
- 500 hPa RMS
 - NH Positive
 - SH Negative
- 200 hPa vector wind RMSE wrt own analysis:
 - Mostly positive (not significant) at mid latitudes and tropics
- 850 hPa vector wind RMSE wrt own analysis:
 - Positive NH (not significant)
 - Negative SH and tropics (not significant)
- 200 hPa 24 & 48 hr. fit to rawinsondes:
 - Neutral to positive for NH + SH
 - Negative for TR
- 850 hPa 24 & 48 hr. fit to rawinsondes:
 - Neutral for NH, SH, TR

