Quality control of MODIS and AVHRR polar winds in the GDAS/GFS: Status and plans

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Outline

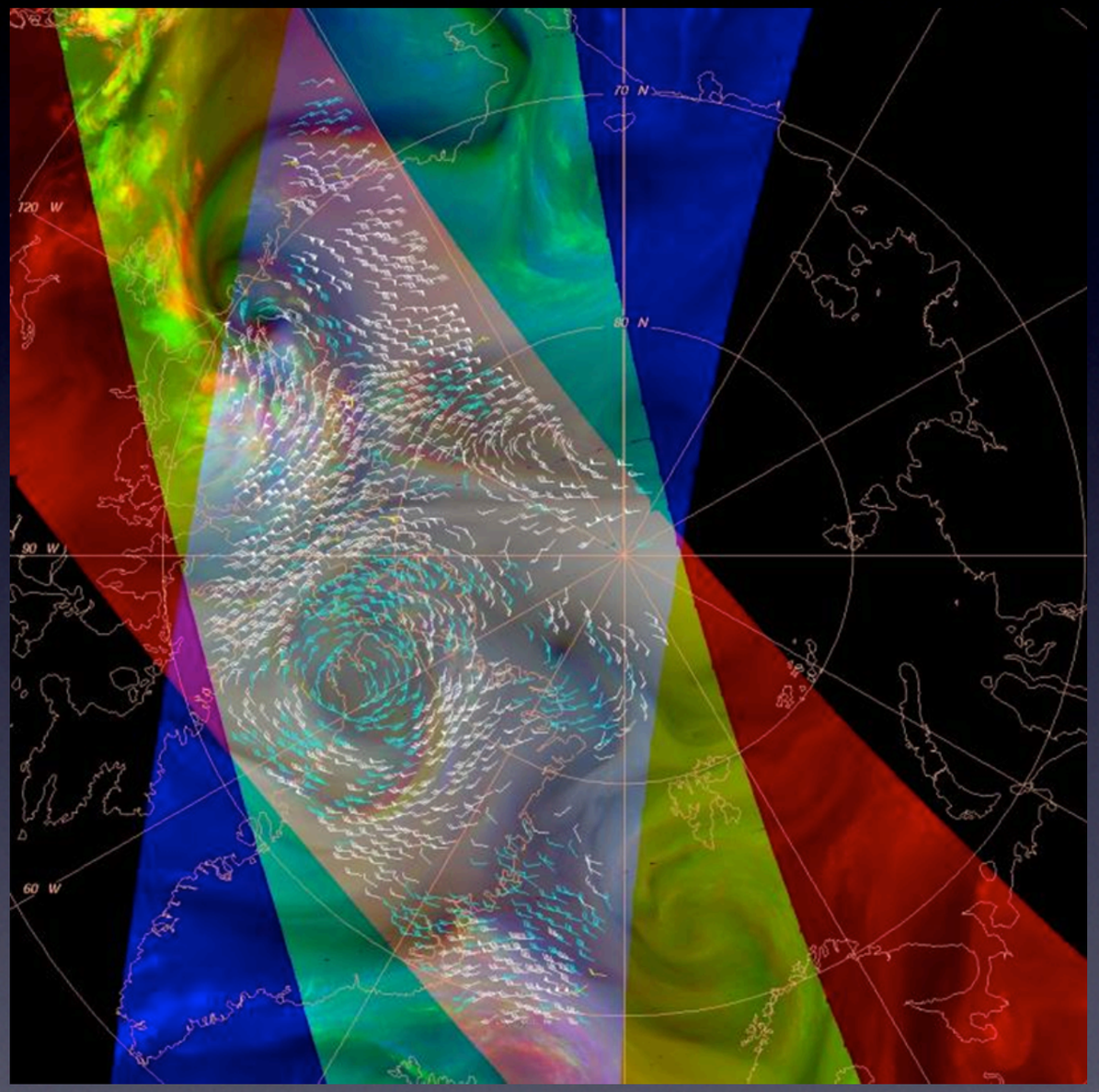
- Polar Winds
- What is the Expected Error (EE)?
- Experiments using the EE
- O-B and O-A statistics
- Forecast impact

Satellite-derived Polar Winds

Unlike geostationary satellites at lower latitudes, it is not be possible to obtain complete polar coverage at a snapshot in time with one or two polar-orbiters.

Winds must be derived for areas that are covered by three successive orbits

The gray area is the overlap between three orbits.



Three overlapping Aqua MODIS passes, with WV and IR winds superimposed. The white wind barbs are above 400 hPa, cyan are 400 to 700 hPa, and yellow are below 700 hPa.

Expected Error

Least square regression is used to compute the RMSE (ms^{-1}) from the EE components as compared to co-located RAOBs.

EE Components:	[Terra NH cloud drift]
• Five QI values	[-0.1 to -2.8]
• Wind speed	[+0.1]
• Wind shear	[+0.03]
• Temperature shear	[-0.01]
• Pressure level	[-0.003]
• Constant	[+8.4]

MODIS Polar Winds QC

Thinning criteria

Within 50 hPa of the tropopause
Within 200 hPa of the surface, if over land

Current

qcU* = qcV = 7 ms^{-1}

$(O\text{-}B)_U$ > qcU OR

$(O\text{-}B)_V$ > qcV

Proposed

EERAT: EE Ratio

EEWOE: Assign EE as Wind Observation Error

* Special case:

qcU = qcV = (ObsSpd + 15)/3

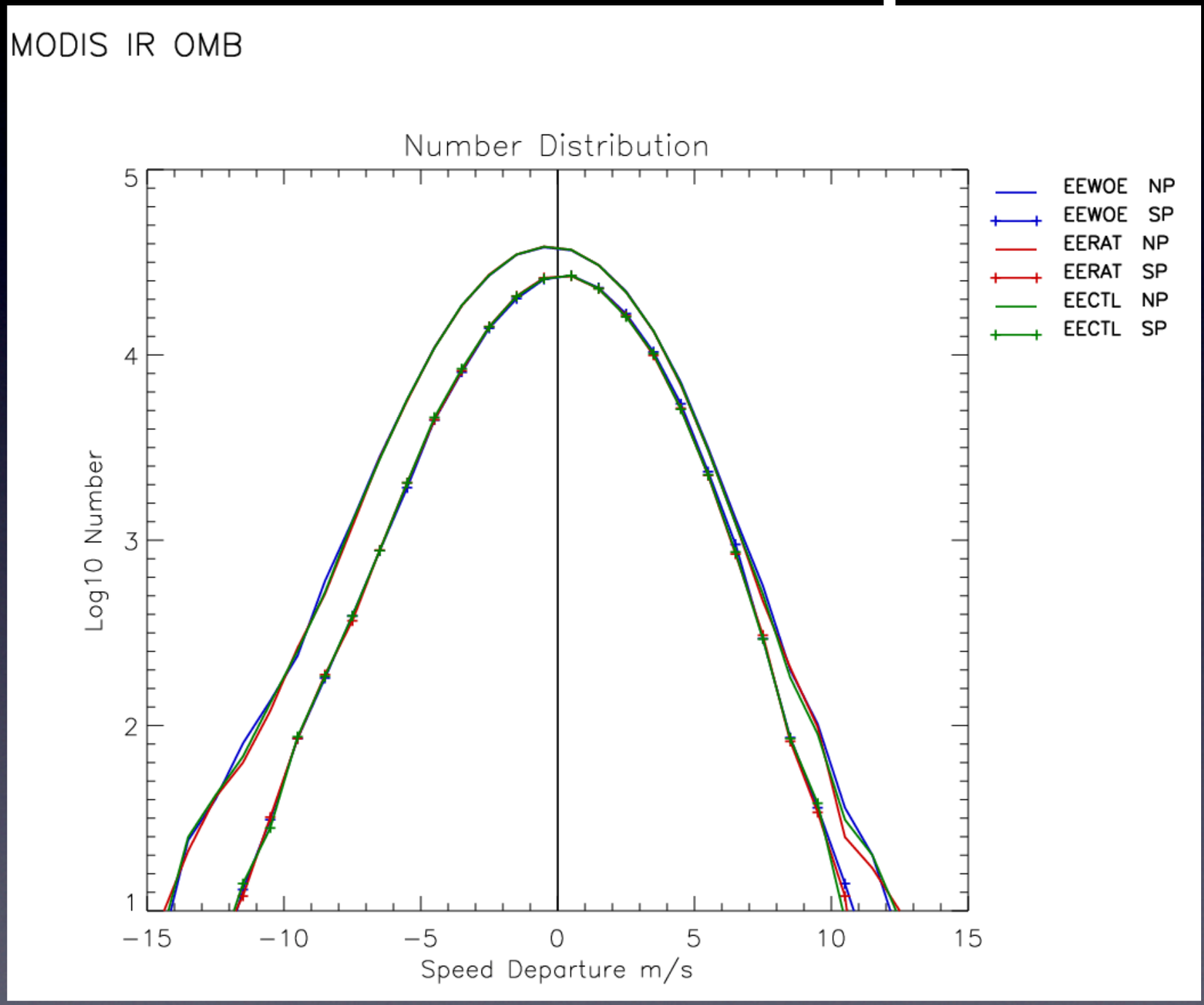
(IR wind within 200 hPa of surface OR WV wind below 400 hPa) AND

(GuessSpd +15)/3 < qcU

Experiments

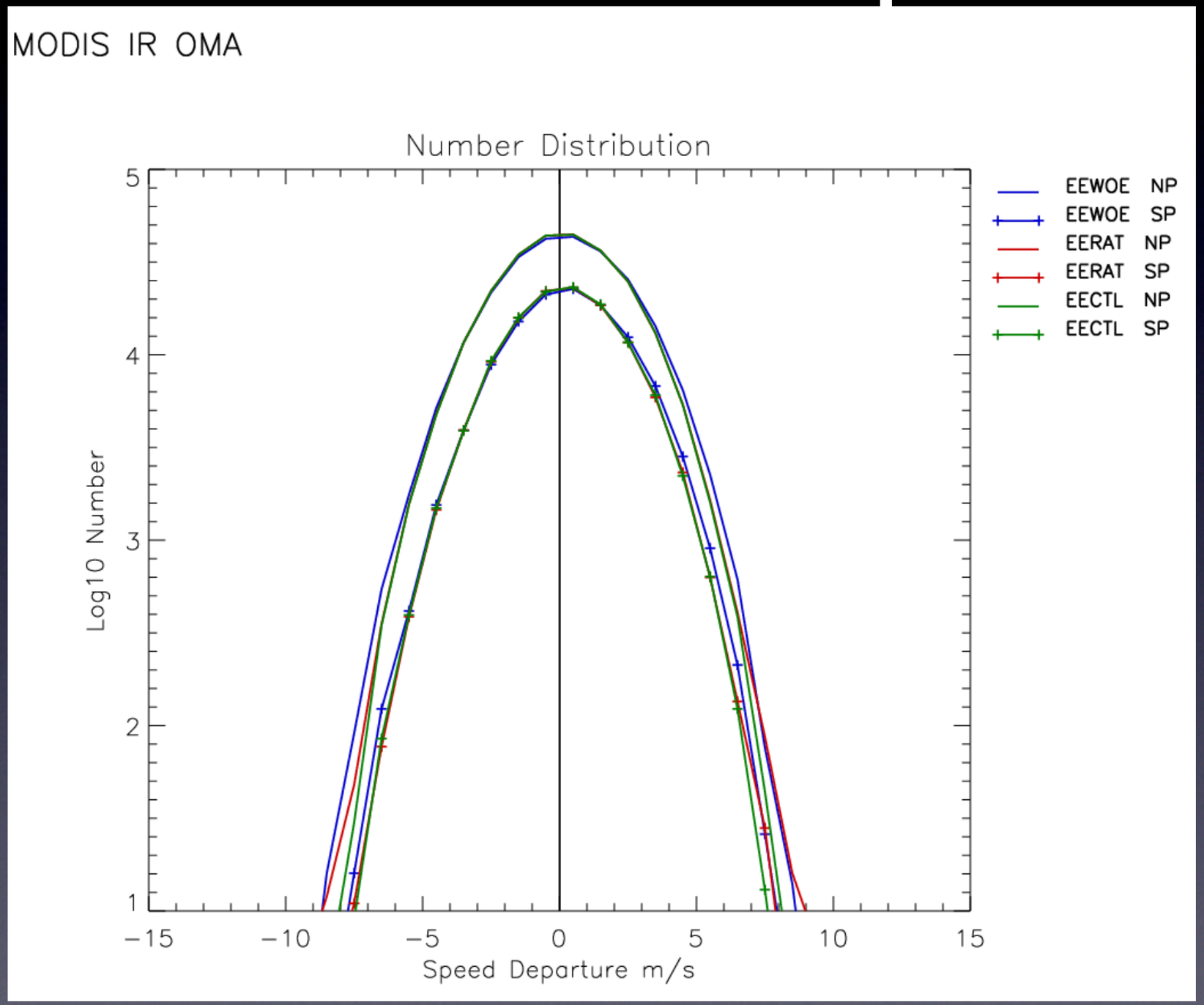
- Running hybrid GDAS/GFS on S4
- January – February 2012
  1. EEWOE: Observation error set to EE (min. of 3 ms^{-1})
  2. EERAT: EE/Obs_spd > 1.3367 (EE Ratio)
- O-B and O-A statistics based on 2-18 January 2012 for IR-only winds (Water vapor winds are similar)
- Forecast impact of EERAT based on 35 forecasts from mid-January to late February 2012

MODIS IR Winds Speed O-B



2 – 18 January 2012

MODIS IR Winds Speed O-A



2 – 18 January 2012

MODIS IR Winds

Background	Speed Departure	
	Bias	Std Dev
EEWOE NP	-0.35	2.70
EEWOE SP	0.15	2.48
EERAT NP	-0.36	2.67
EERAT SP	0.10	2.47
EECTL NP	-0.36	2.68
EECTL SP	0.09	2.47

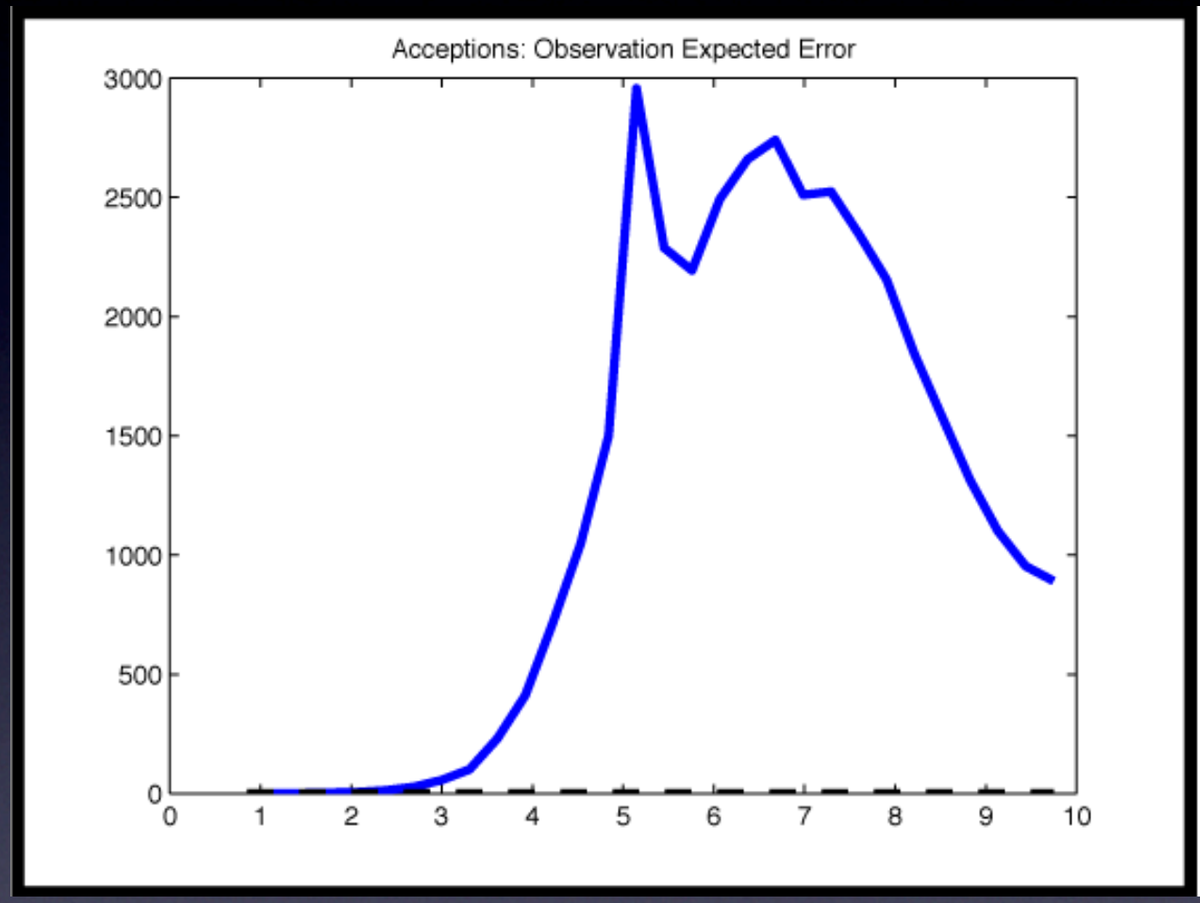
Analysis	Speed Departure	
	Bias	Std Dev
EEWOE NP	0.13	2.20
EEWOE SP	0.29	2.03
EERAT NP	0.08	2.12
EERAT SP	0.20	1.96
EECTL NP	0.08	2.11
EECTL SP	0.20	1.96

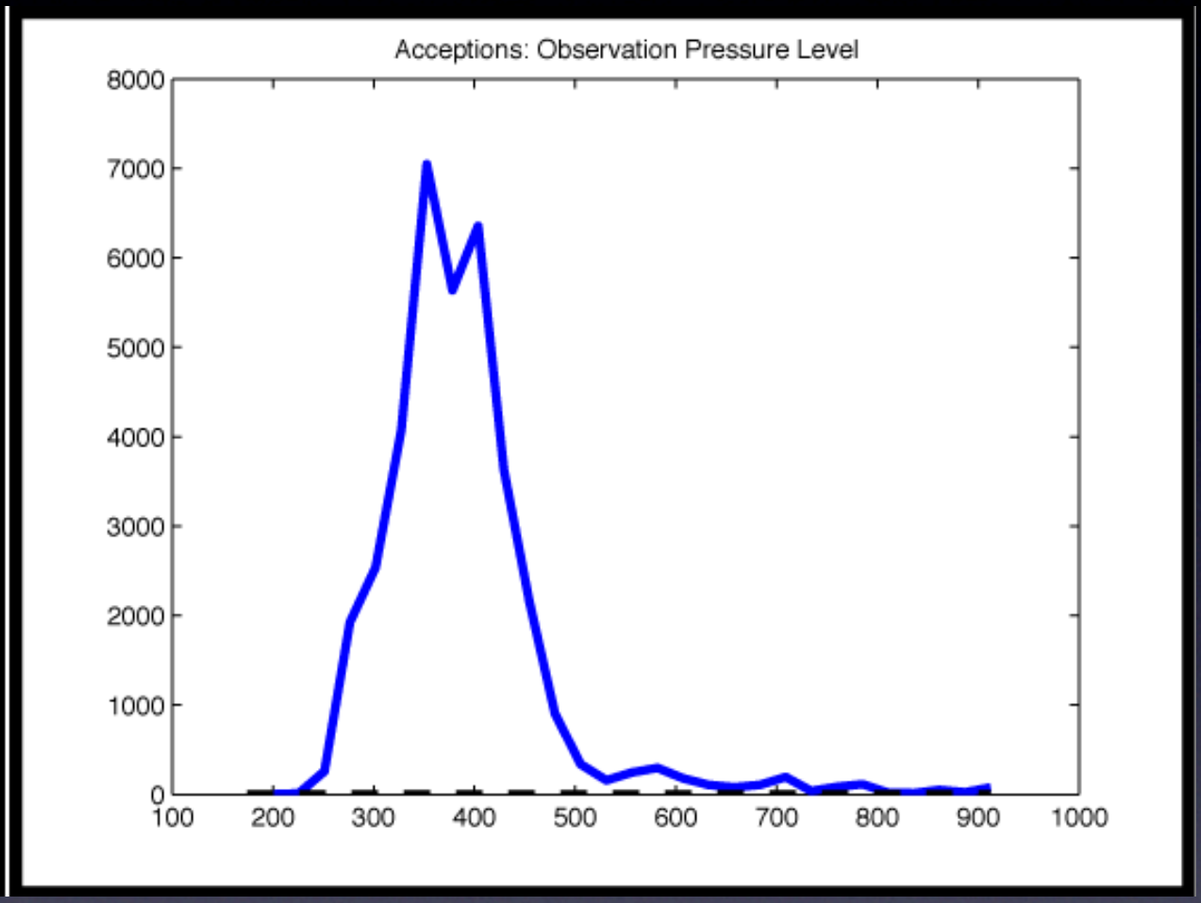
Difference Histogram

- Create histograms (EE, vector height, etc.) for the accepted winds in the experiment and control.
- Subtract the control from the experiment: Difference Histogram
  - Above zero line: the experiment is allowing more observations of that type
  - Below zero line: the experiment is rejecting more observations of that type.
- 172 analysis periods
- 3 million accepted observations and 250,000 rejected observations from both the experiment and control.
  - Experiment has 36,000 (1%) more accepted observations than the control.

Difference Histogram

Accepted Observations (EERAT – Control)



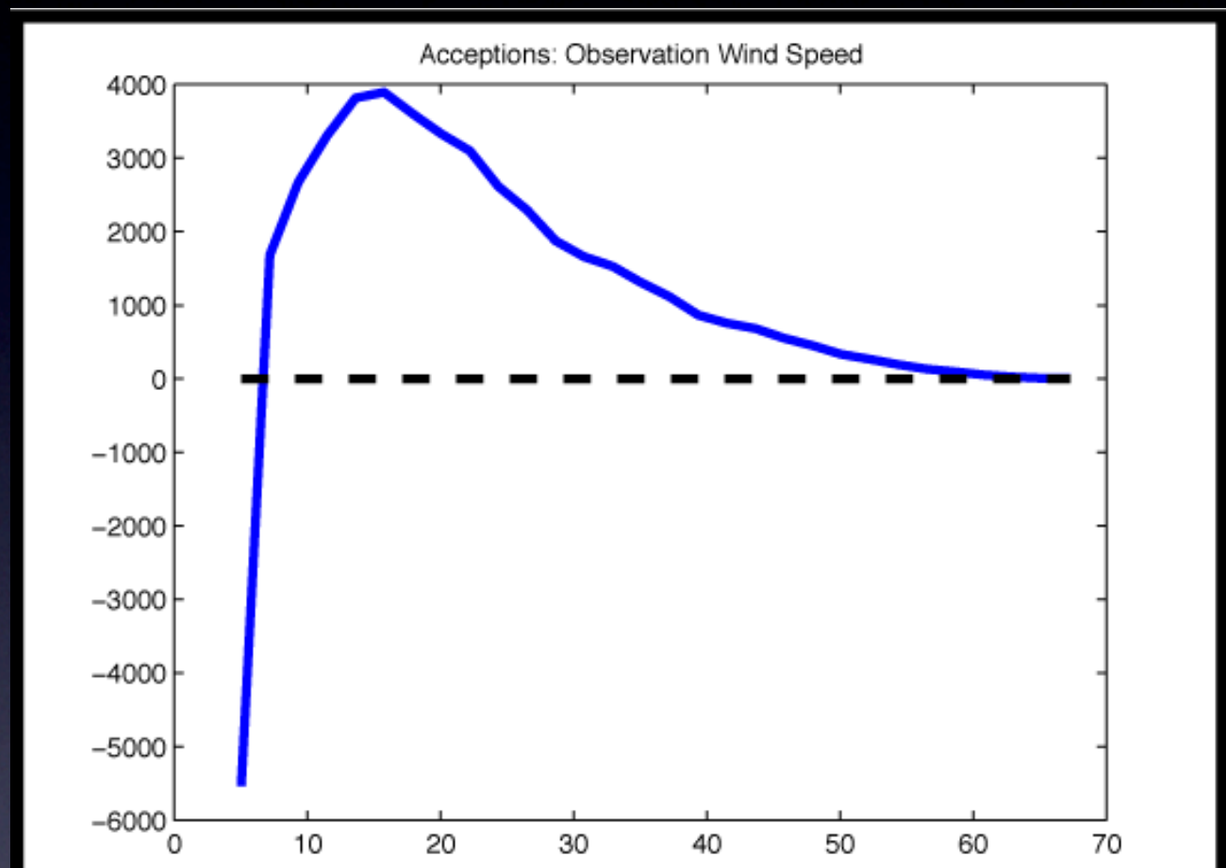


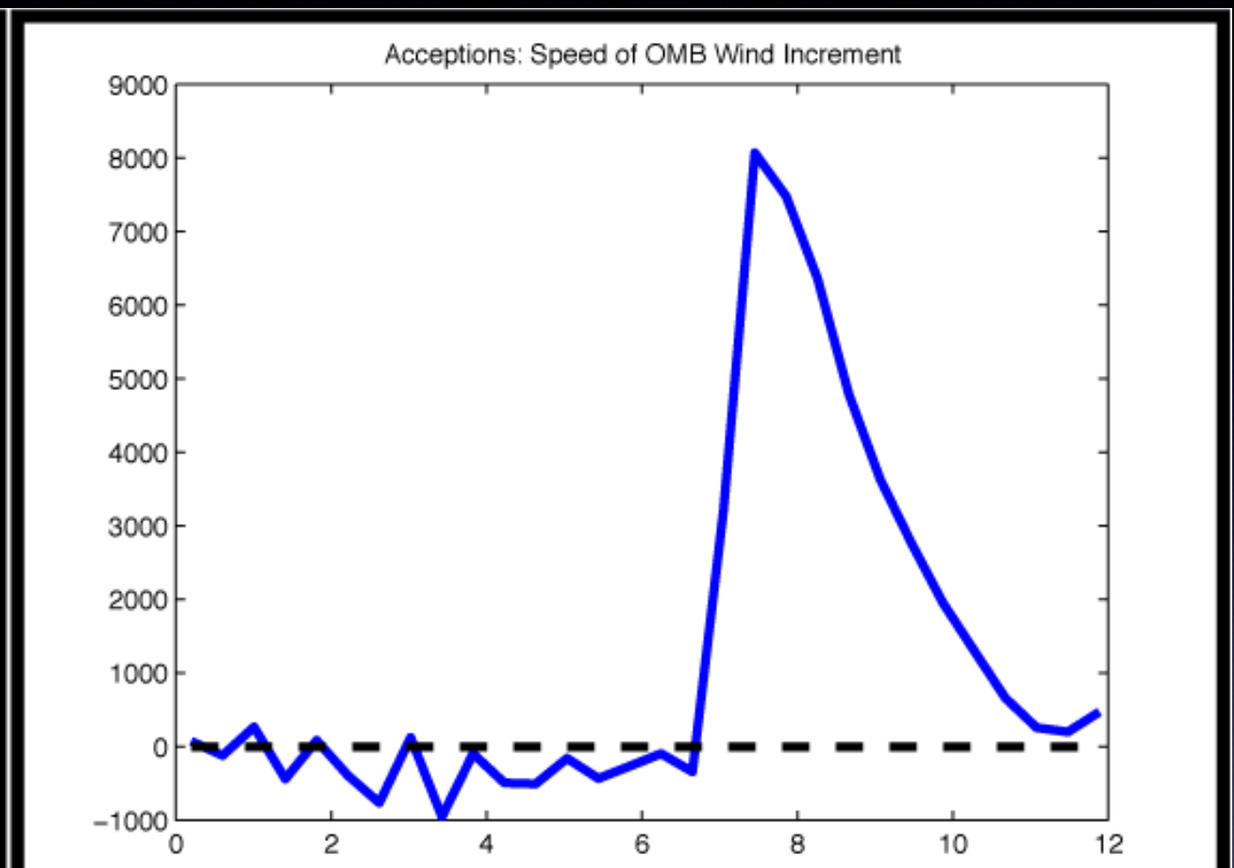
More winds are retained with EE > 5 ms^{-1}.

More winds are retained in the 250-450 hPa.

Difference Histogram

Accepted Observations (EERAT – Control)

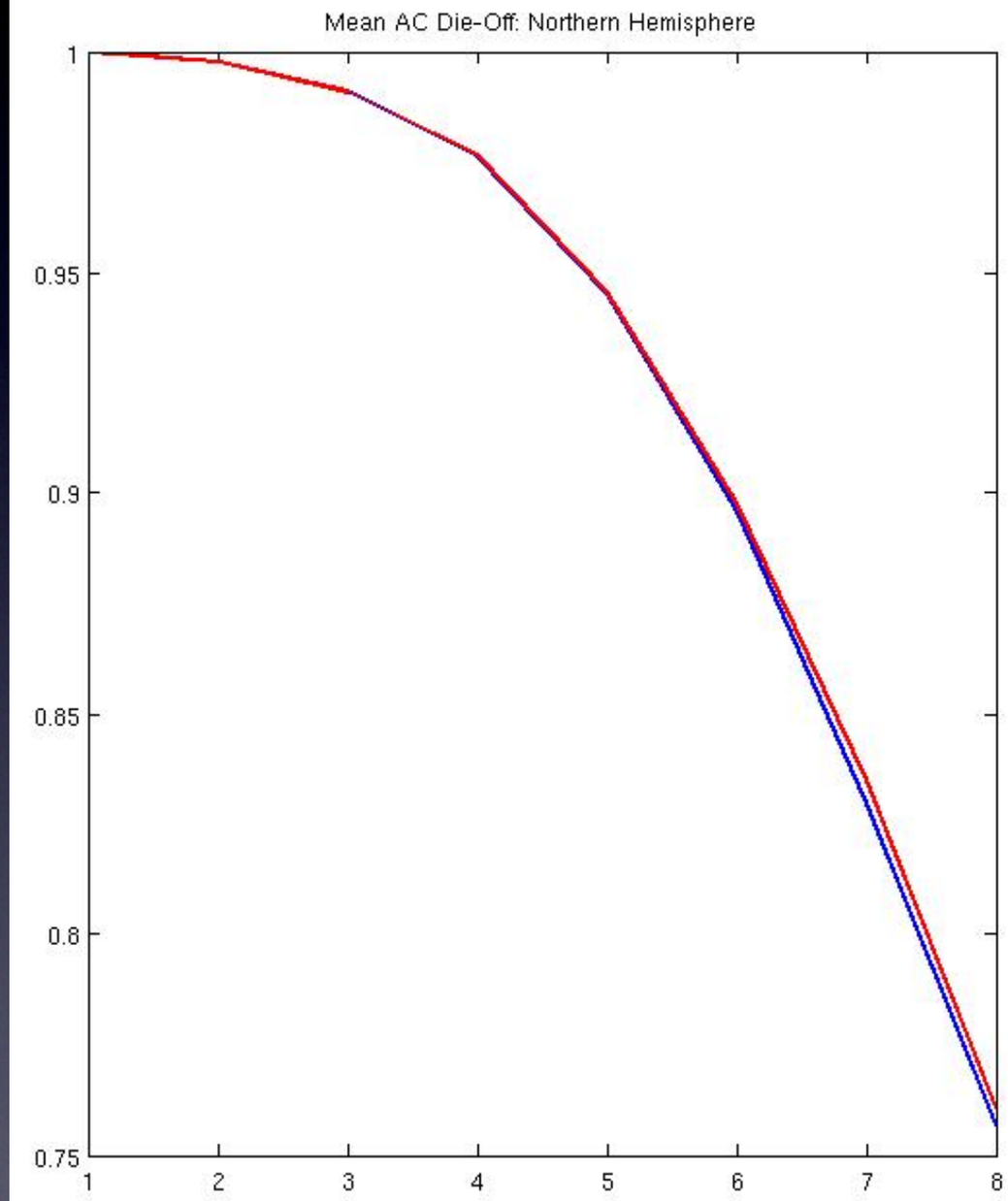


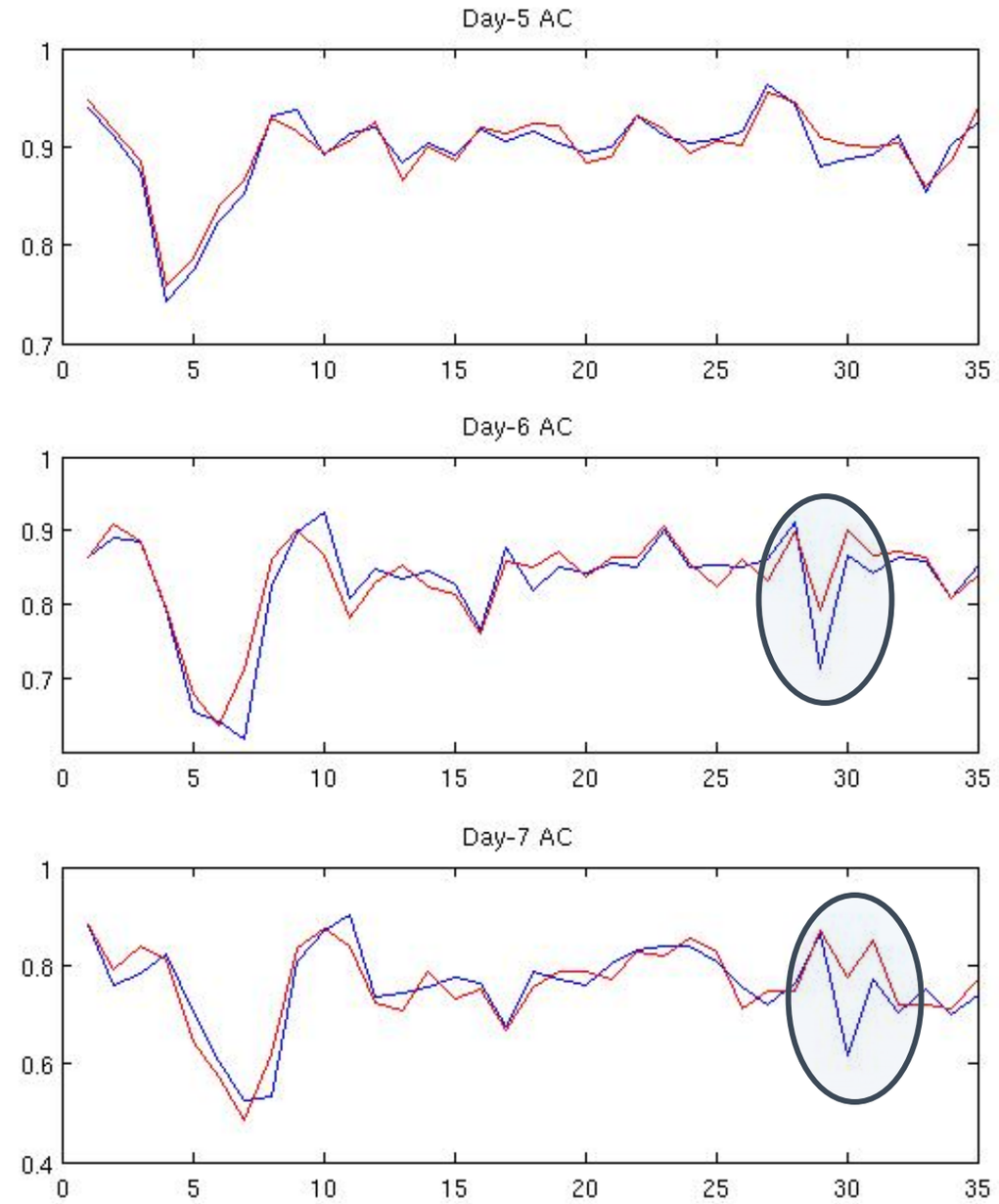


More slow winds (5 $ms^{-1)}$ are rejected; more mid-speed winds retained.

Few additional winds rejected that deviate < 7 ms^{-1} from background. More accepted when O-B > 7 ms^{-1}.

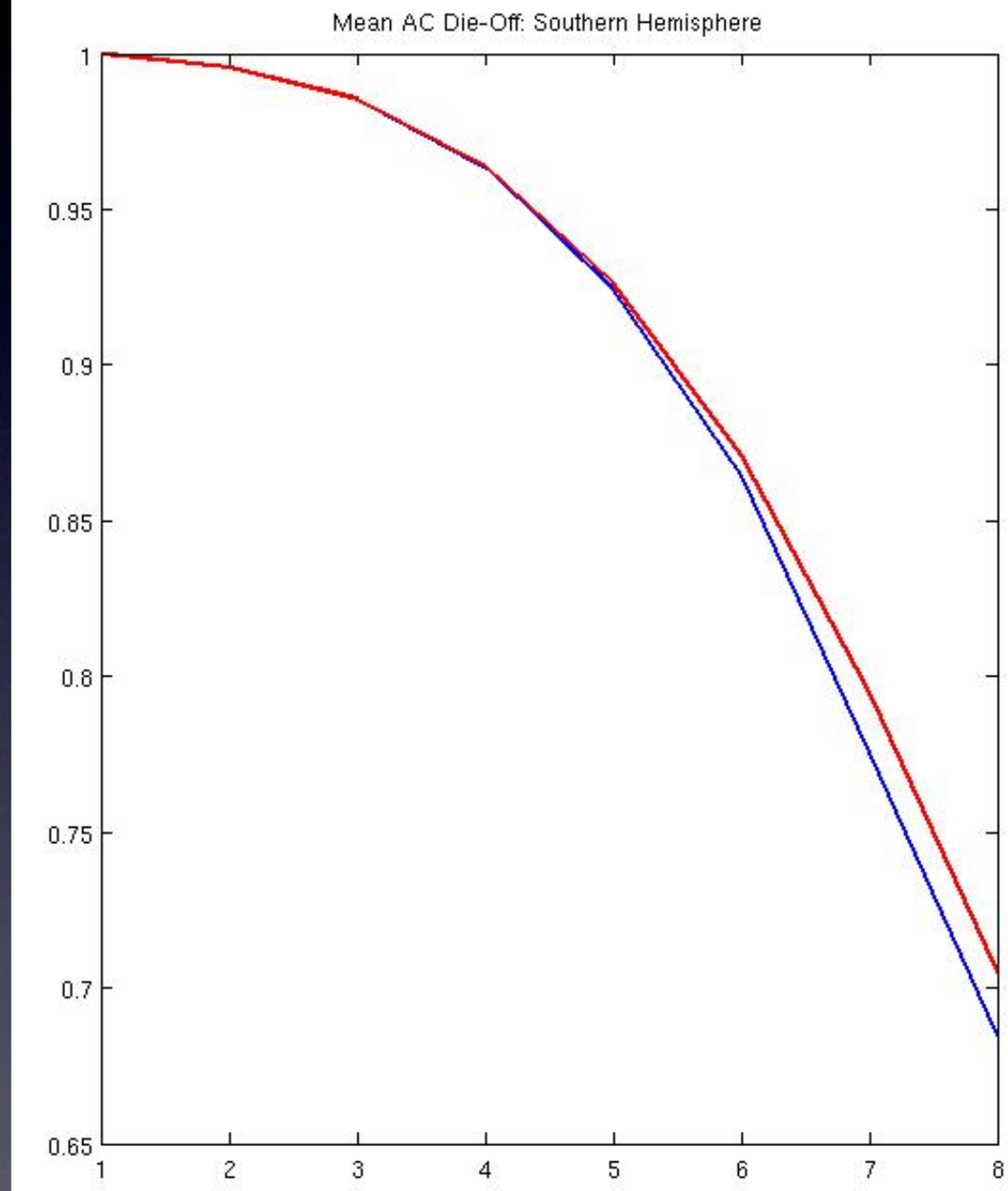
Northern Hemisphere

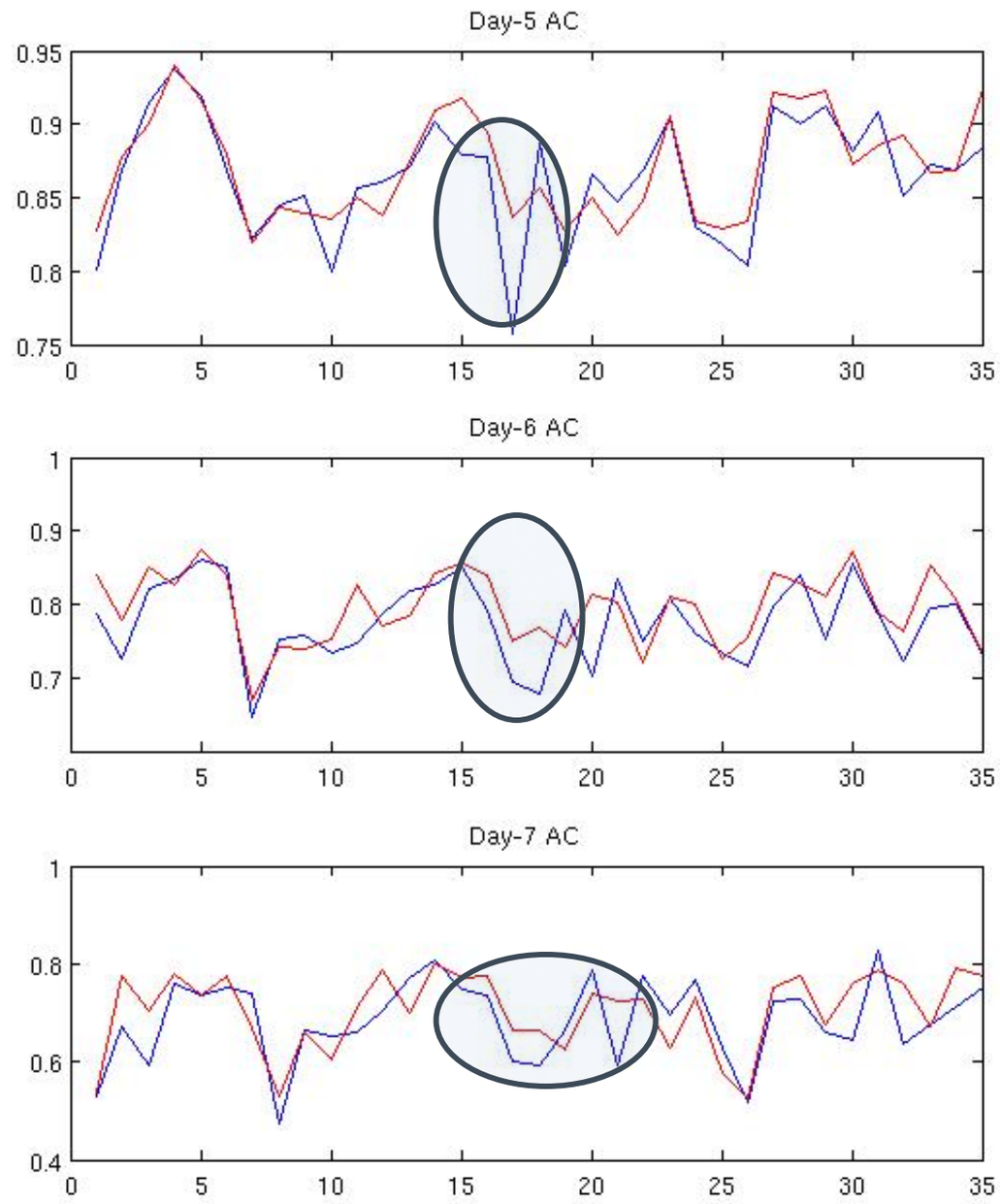




500 hPa ACC: EERAT (red) Control (blue)

Southern Hemisphere

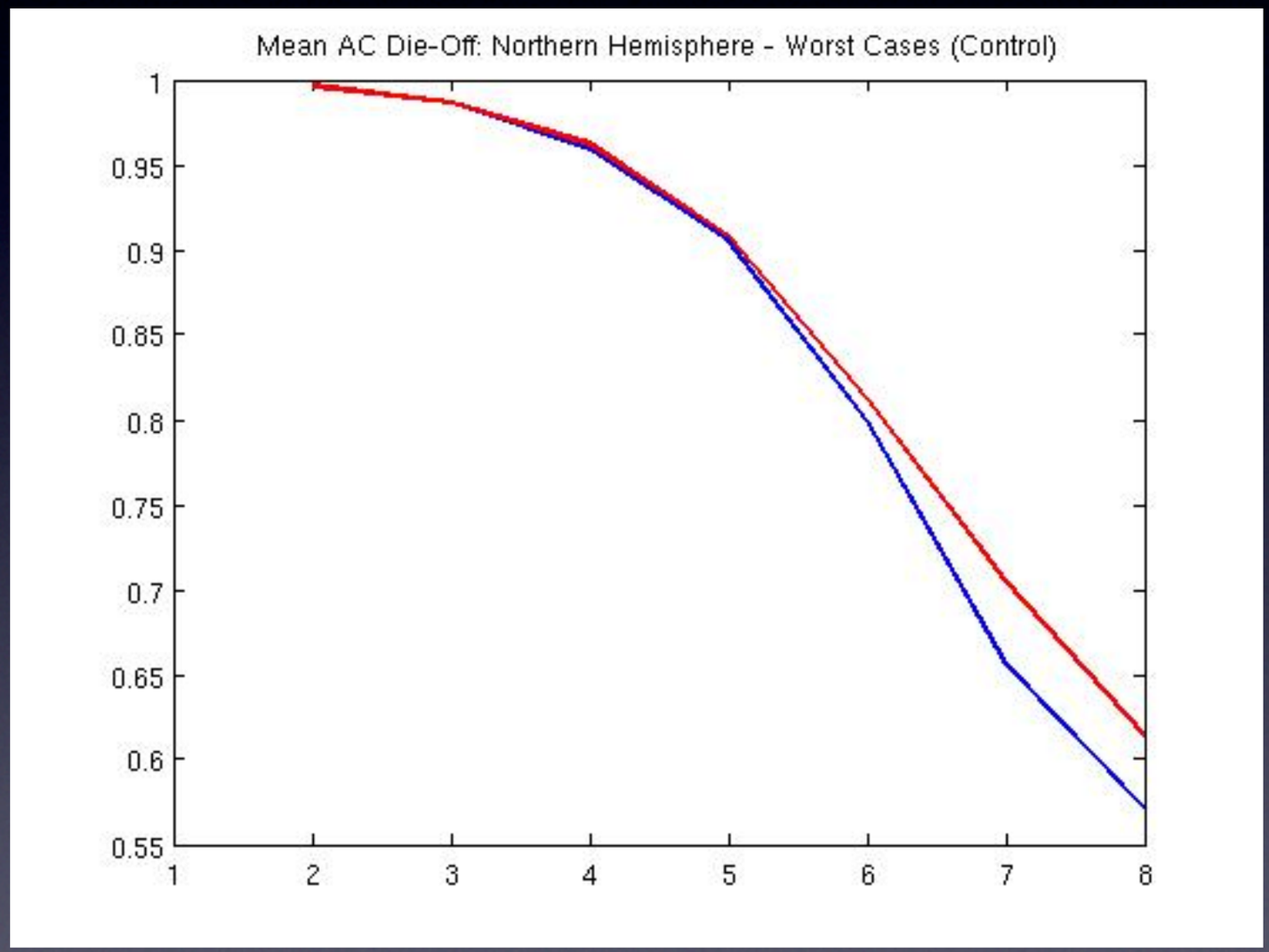




500 hPa ACC: EERAT (red) Control (blue)

Northern Hemisphere

Worst cases (4-6)

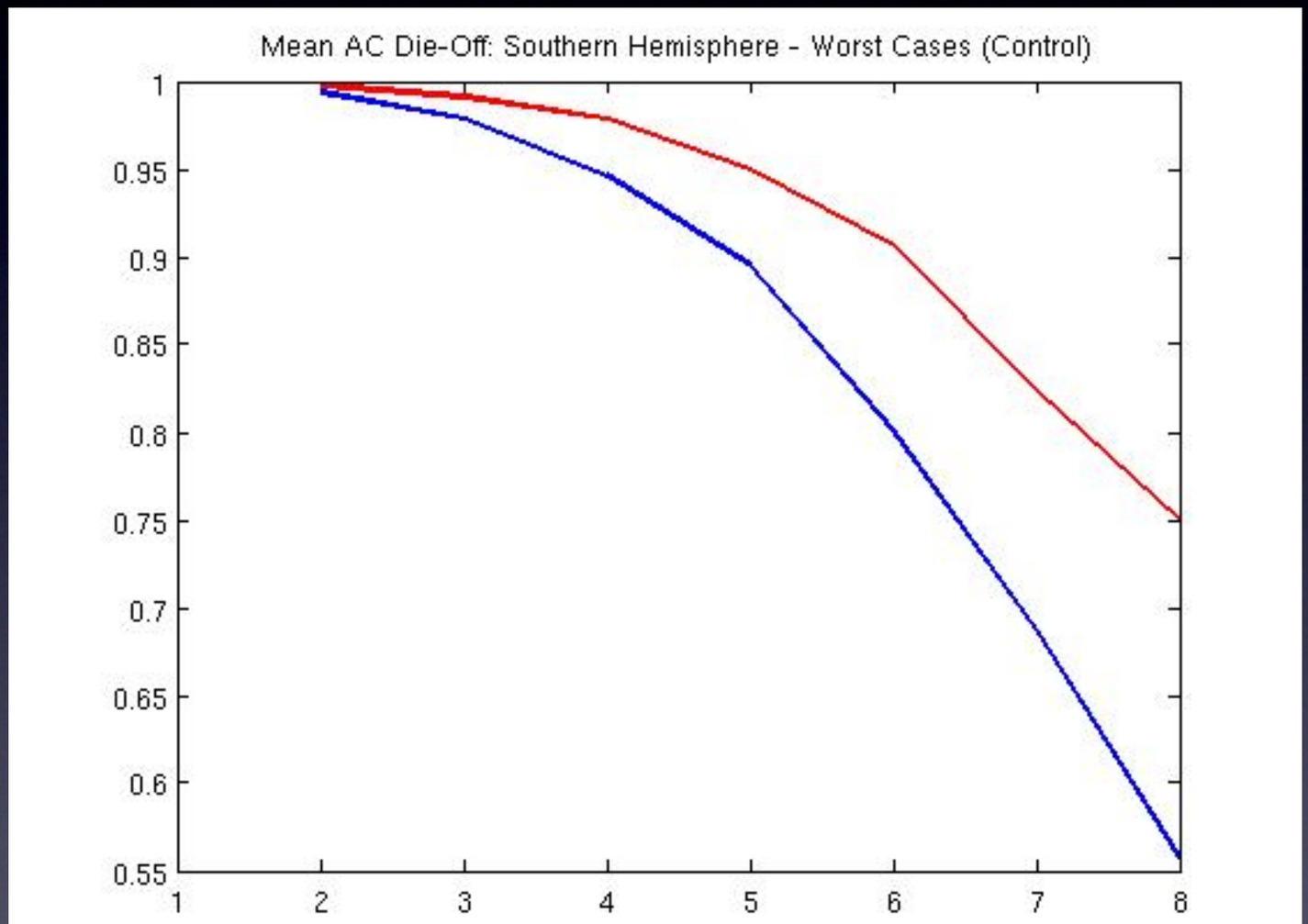


500 hPa ACC: EERAT (red) Control (blue)

Control cases below 1 std dev from mean

Southern Hemisphere

Worst Cases (5-8)



500 hPa ACC: EERAT (red) Control (blue)

Control cases below 1 std dev from mean

Status and Future Plans

- Creating a subversion code branch
- Configuring a summer season for MODIS winds using the EE Ratio
- Setting up experiments with AVHRR polar winds (NOAA, Metop), now that NESDIS is producing these operationally and with Expected Error
- Expecting satellite-derived winds from VIIRS (Suomi NPP) early 2013

NOAA: NA10NES4400011