IMPROVING THE USE OF QUALITY CONTROLLED AMVS IN THE NCEP GLOBAL FORECAST SYSTEM

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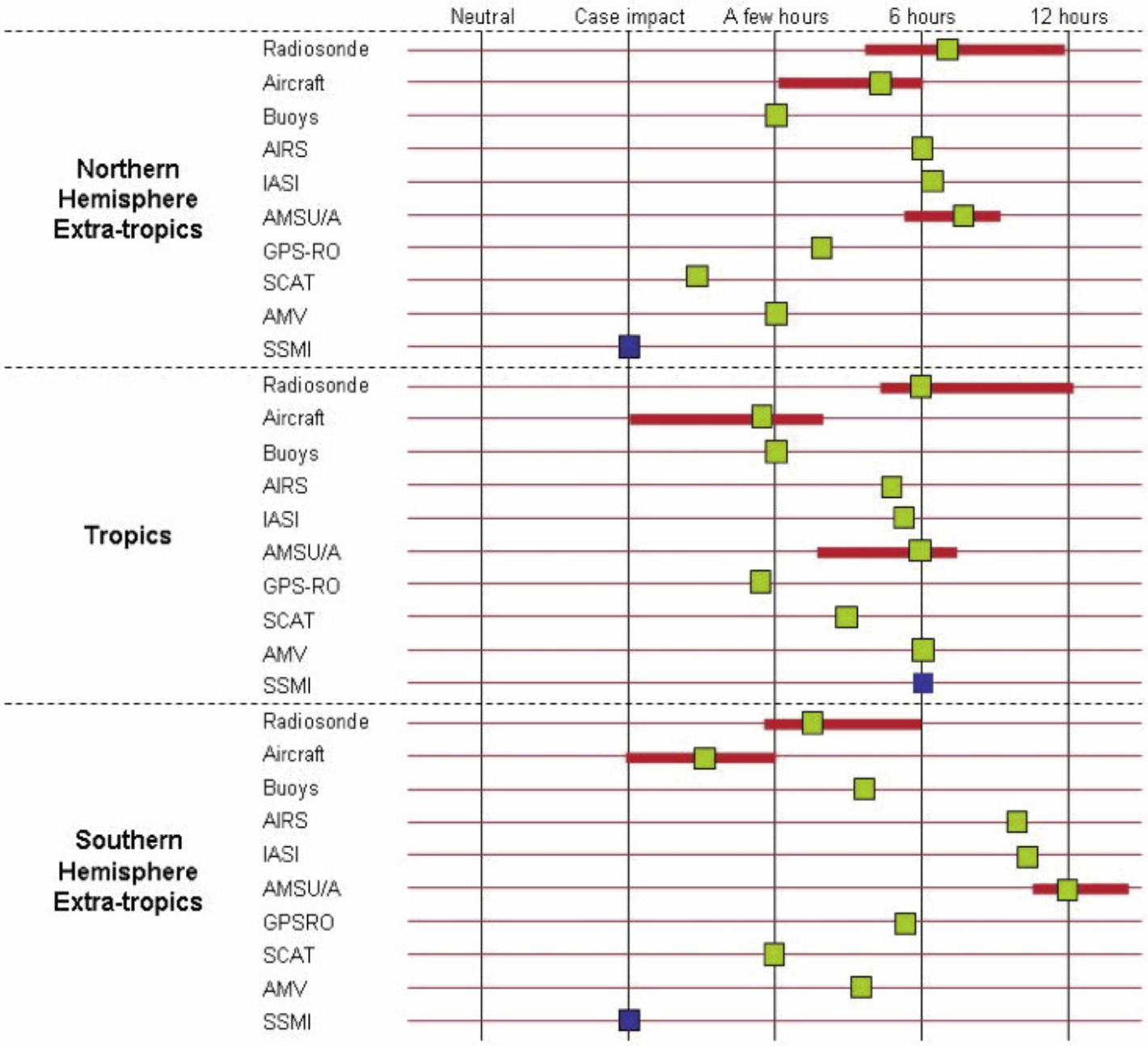
Outline

- Motivation
- "ECMWF screening" experiments
- Directional QC experiments (60 degrees)
- Preliminary results
- Summary and conclusions

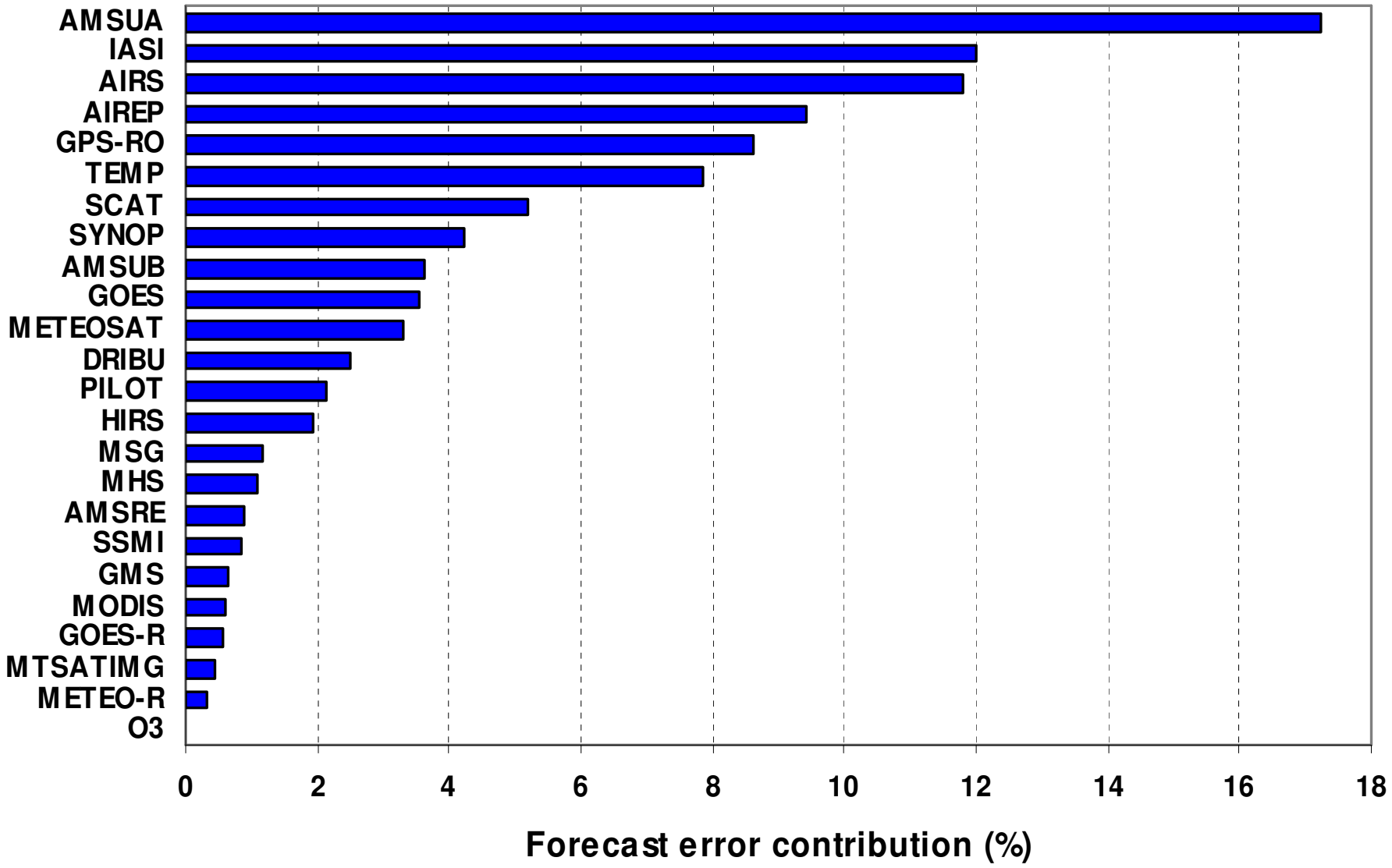
Motivation

- Diminished relative impact of AMVs in some other global NWP systems as recorded in the last WMO-sponsored impact workshop (Geneva, May 2008)
- However, some adjoint sensitivity studies show very significant impacts, especially on a per observation basis
- Inconsistencies among assessments of AMV impact
  - Minimal impact in NCEP GFS
  - Targeted in certain NCEP dropout cases
  - What can be done in short order to at least partly address this?
  - See also following presentations by Jung, Su

From the Summary of WMO Impact Workshop, Geneva, May 2008:



from Cardinali et al., slide courtesy of E. Andersson

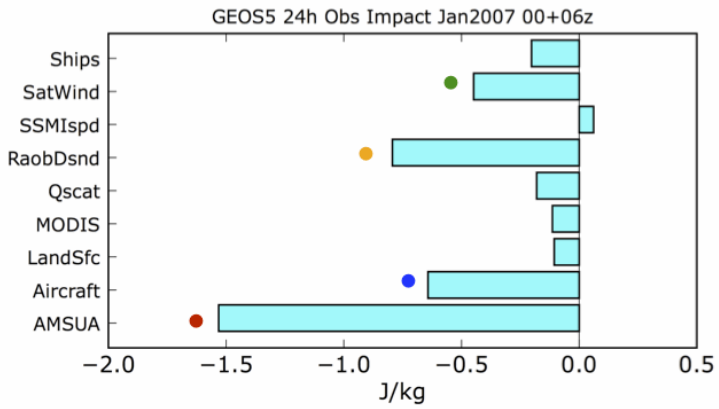


Slide by Gelaro, WMODA5

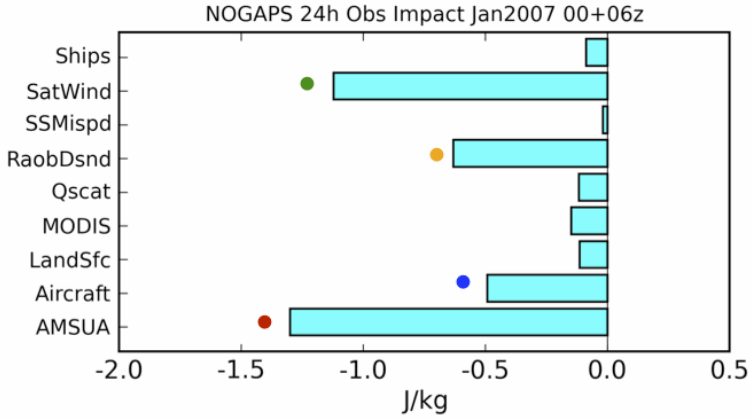
Daily average observation impacts

Global domain: 00+06 UTC assimilations Jan 2007

GEOS-5

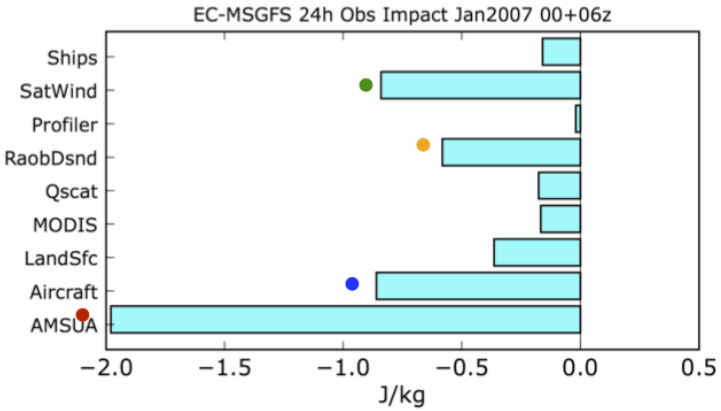


NOGAPS



FCST ERROR REDUCTION

EC-MSGFS



FCST ERROR REDUCTION

All obs types, except SSMI speeds in GEOS-5, are beneficial

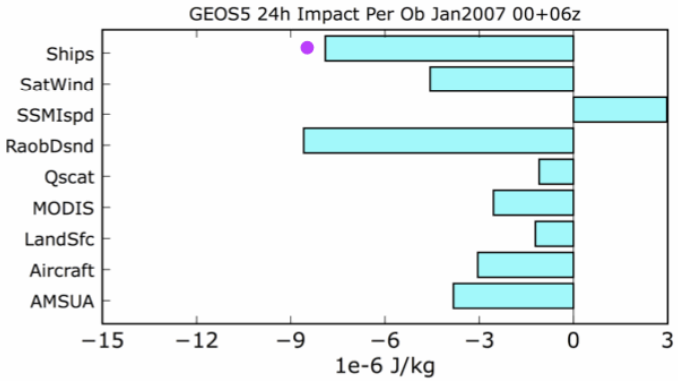
- AMSU-A, Raob, Satwind and Aircraft have largest impact in all systems

Slide by Gelaro, WMODA5

Impacts per-observation

Global domain: 00+06 UTC assimilations Jan 2007

GEOS-5



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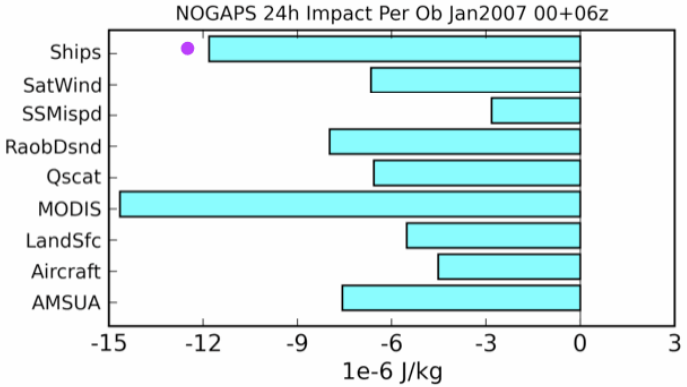

FCST ERROR REDUCTION

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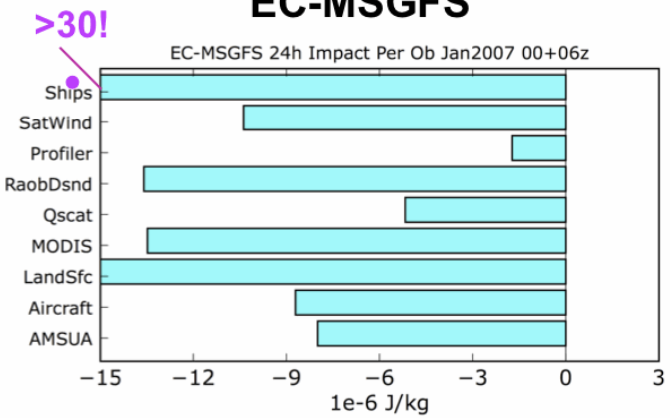


FCST ERROR REDUCTION

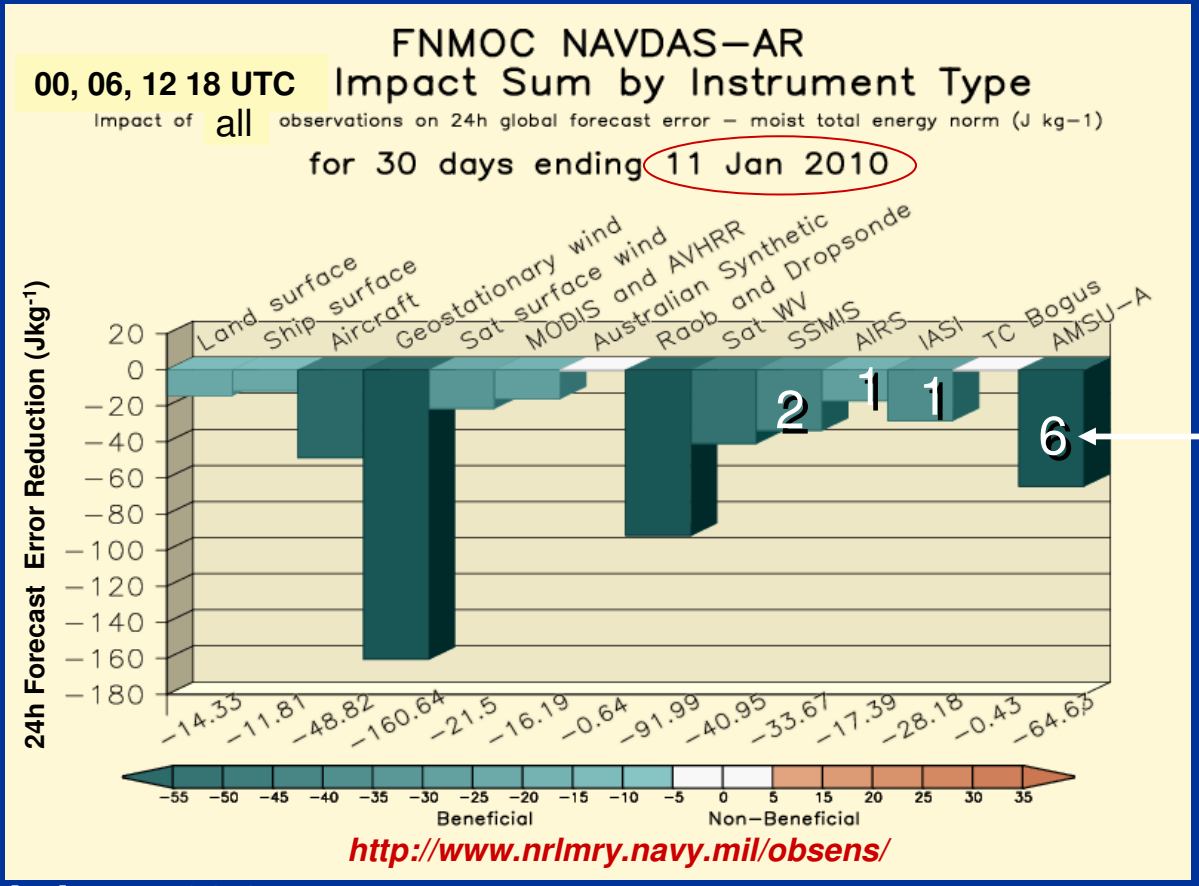
GEOS-5 has smallest impact per-ob …more obs are assim-ilated (next slide)

Very large impact per-ob for
- Ships in EC-MSGFS is an outlier

Update on Navy Satellite Data Assimilation

Accomplishments and Contributions Relevant to JCSDA Goals

Satellite Data has become the single most important component of the global observing network for NWP

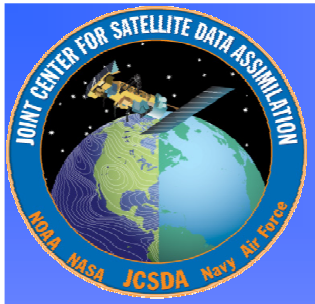


Σ Sat Winds = -198.3 **Σ Conv = -168.0** **Σ Sat Radiances = -143.9**

Slide provided courtesy of R. Langland, N. Baker

Experimental setup

- Three experiments
  - Control; full complement of observations used in operations at the experiment times
  - ECMWF Screening
    - Screening of winds implemented as described on NWP SAF page
  - Directional QC (+EC Screening)
    - Winds with direction deviating by more than 60 deg from background eliminated
- NCEP Global Forecast System (close to operational version) at T-382
- Two experimental periods
  - Jul 1-Aug 31, 2009
  - Dec 1 2009 – Jan 31 2010



The EUMETSAT Network of Satellite Application Facilities

NWP SAF
Numerical Weather Prediction

Met Office ECMWF KNMI METEO FRANCE

AMV usage in the ECMWF NWP model

Last updated August 2008

Back to use in NWP table

Physical characteristics

- Spectral model
- Horizontal resolution: TL799 (~25 km Gaussian grid), analysis: TL255 (~78 km Gaussian grid)
- Vertical resolution: 91 vertical levels
- Analysis times: 00,12 Z

Data assimilation method

- Since 29th June 2004, ECMWF have been running an early delivery stream (DA) and a delayed cut-off stream (DCDA). The DCDA is the equivelent of the Met Office update run and is used to generate the background for the next cycle. The early delivery stream is the equivelent of the Met Office main forecast run and is used to generate the operational forecasts.
  - DA: 4-D VAR, 6-h time window.
  - DCDA: 4-D VAR, 12-h time window.
- Time window:
  - DA: T ± 3 hr
  - DCDA: T-3 hr - T+9 hr
- Time constraints (model runtime):
  - DA: 1 hr after time window ends
  - DCDA: 5 hr after time window ends

AMV types assimilated

- Meteosat-9 BUFR IR, VIS0.8, cloudy WV6.2 and cloudy WV7.3
- Meteosat-7 BUFR IR, VIS, cloudy WV
- GOES-11 BUFR IR, VIS, cloudy WV
- GOES-12 BUFR IR, VIS, cloudy WV
- MTSAT-1R BUFR IR, VIS, cloudy WV
- NESDIS MODIS Terra IR, cloudy WV, clear sky WV
- NESDIS MODIS Aqua IR, cloudy WV, clear sky WV

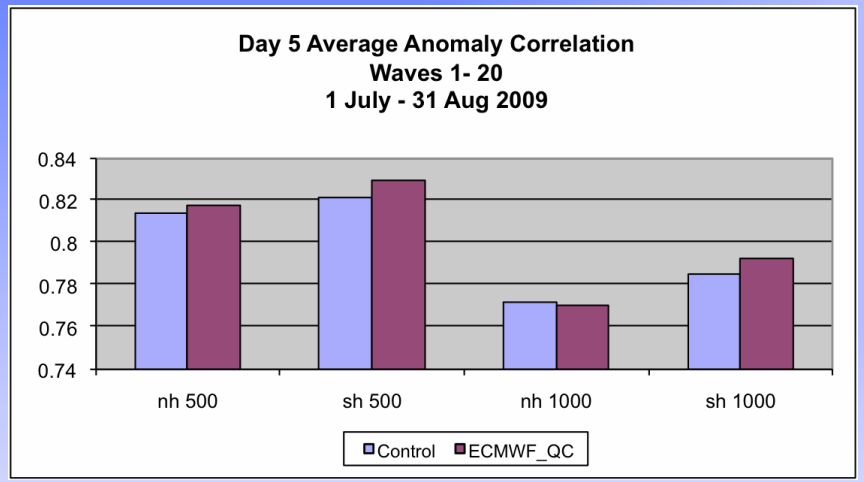
Quality control

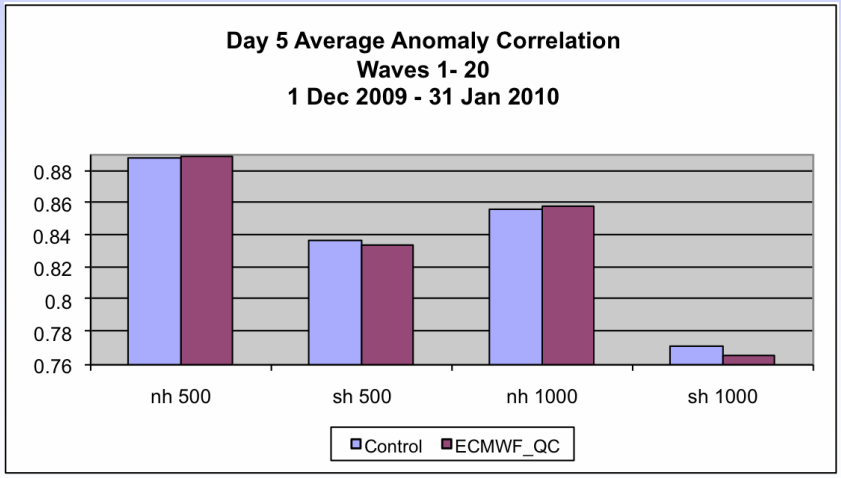
Blacklisting in space

- All VIS winds at 700 hPa and above
- All geostationary WV winds below 400 hPa except for Meteosat-9 WV7.3 where all below 600 hPa.
- All goestationary winds over land below 500 hPa and additionally the following areas:
  - All Met-7 winds over land west of 30E and north of 35N
  - All non-Met-7 geostationary winds over land east of 20W and north of 20N
  - All geostationary winds over land west of 20W and north of 35N
- All Met-7 winds between 25N and 40N and 70E and 105E.
- All MODIS winds equatorwards of ± 60° latitude
- All MODIS winds over land below 400 hPa.
- All MODIS IR winds over sea below 700 hPa.
- All MODIS cloudy and clear sky WV winds over sea below 550 hPa.

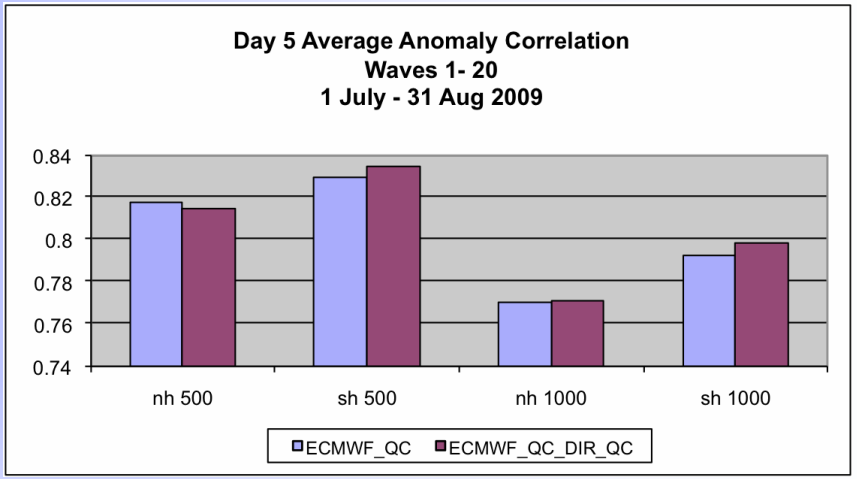
ACC scores, Day 5

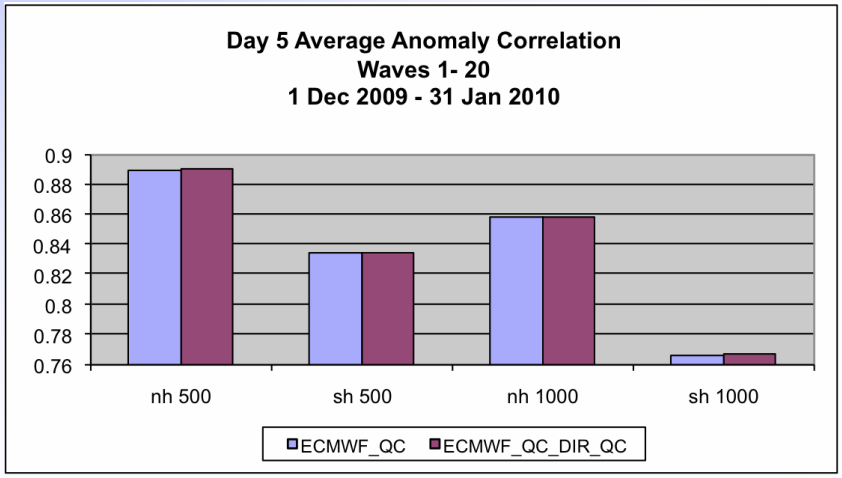
EC experiment vs. Control





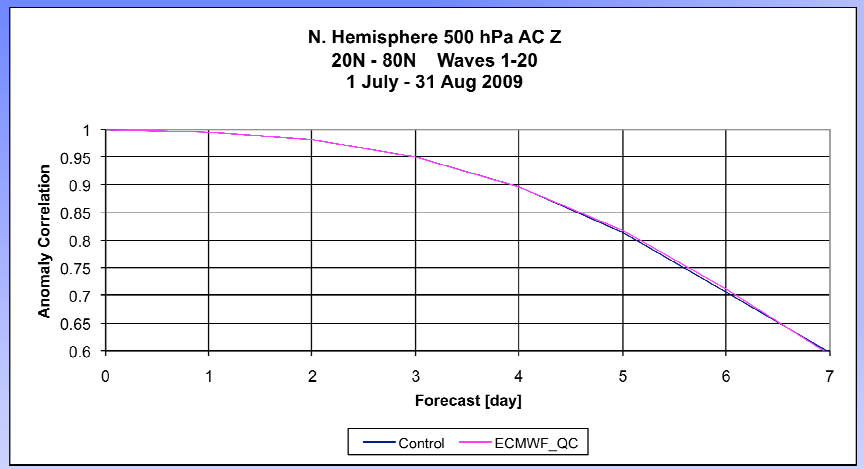
Dir. QC vs. EC

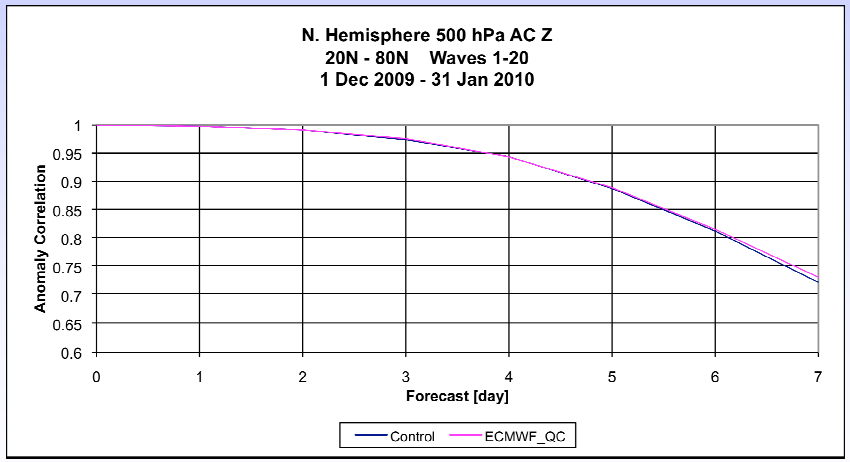




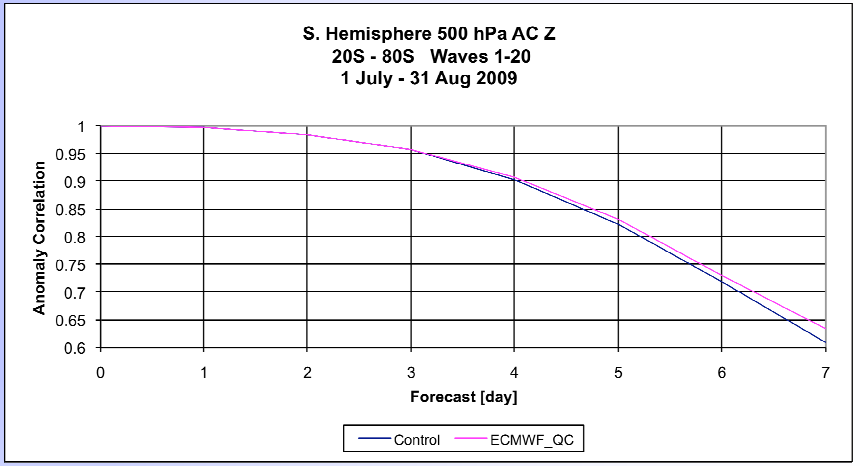
EC Exp. vs. Control; 500 hPa ACC

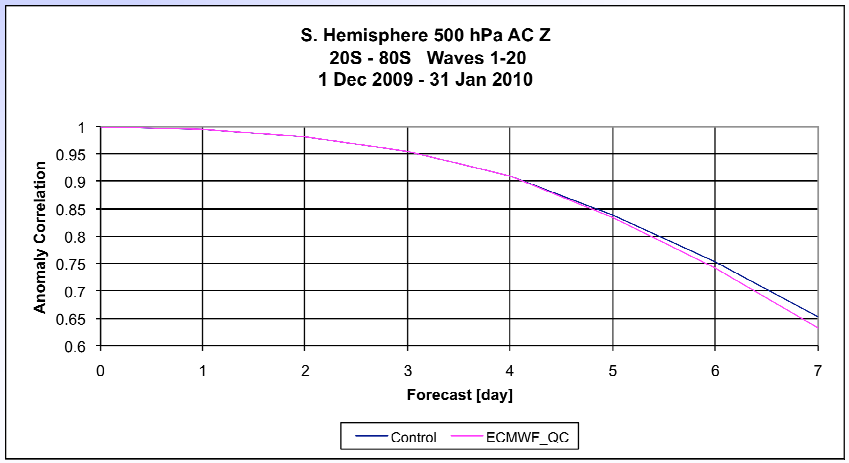
NH





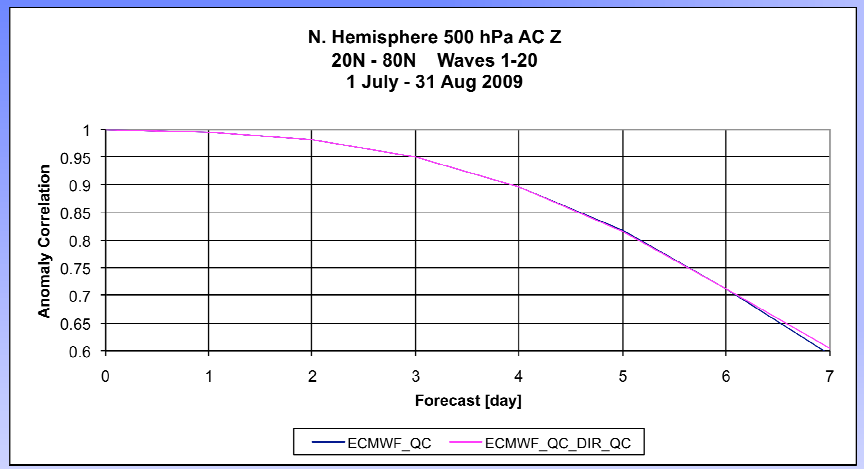
SH

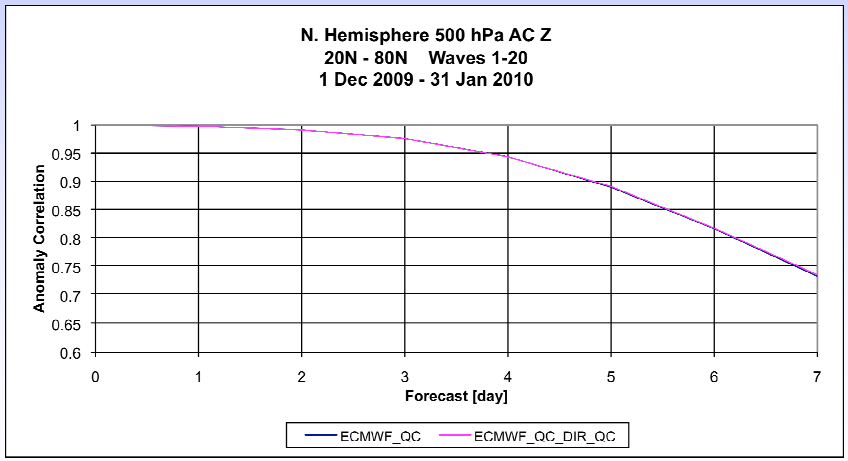




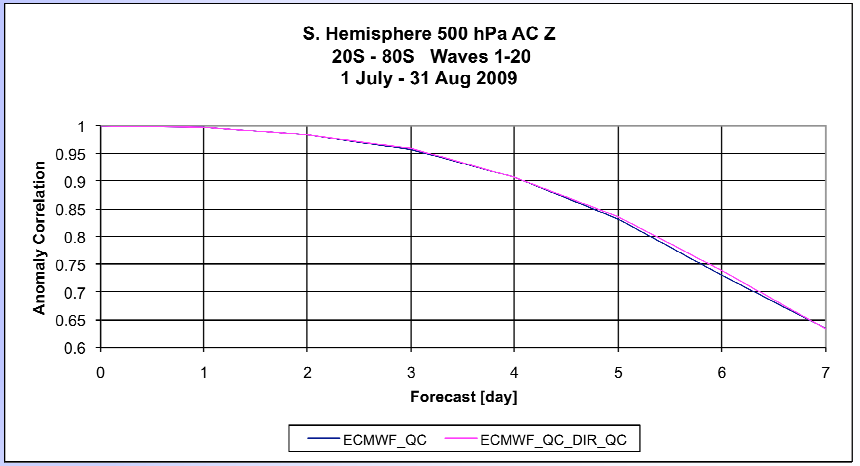
Directional QC vs. EC; 500 hPa ACC

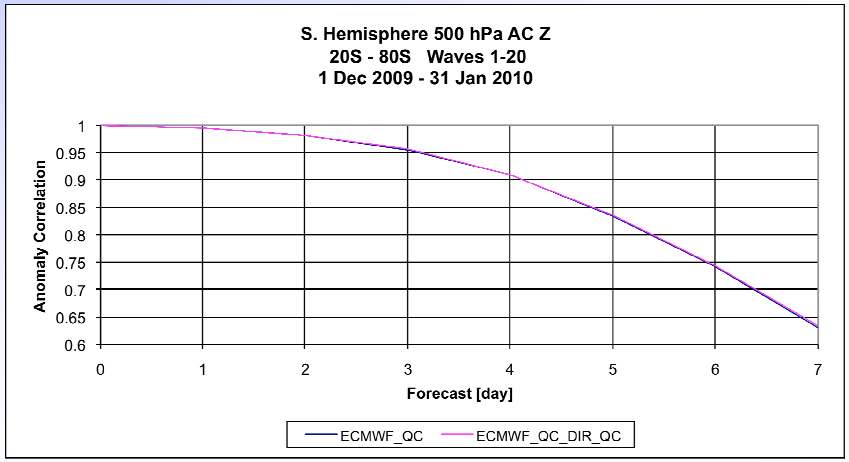
NH





SH

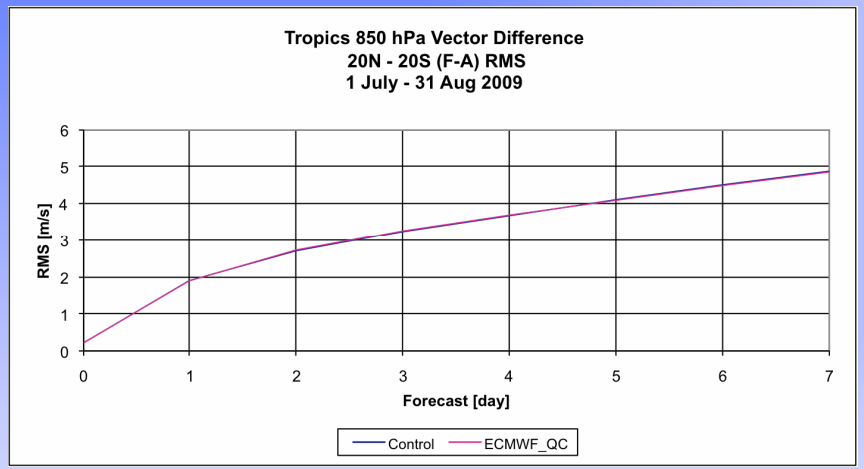


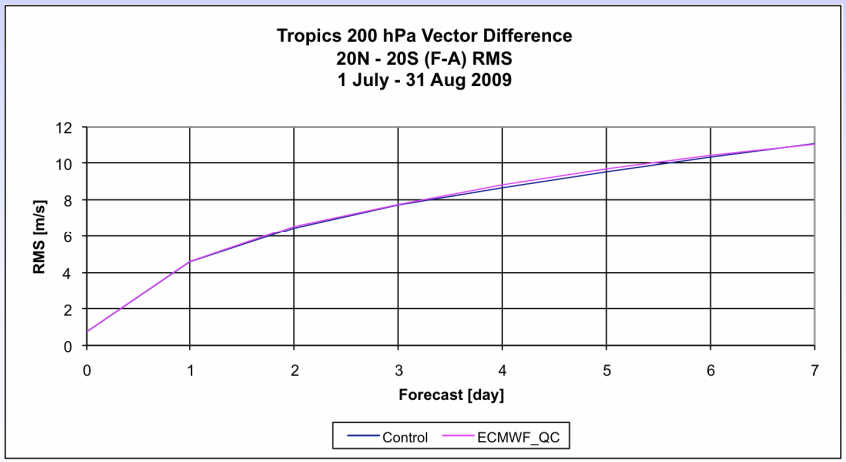


Tropics

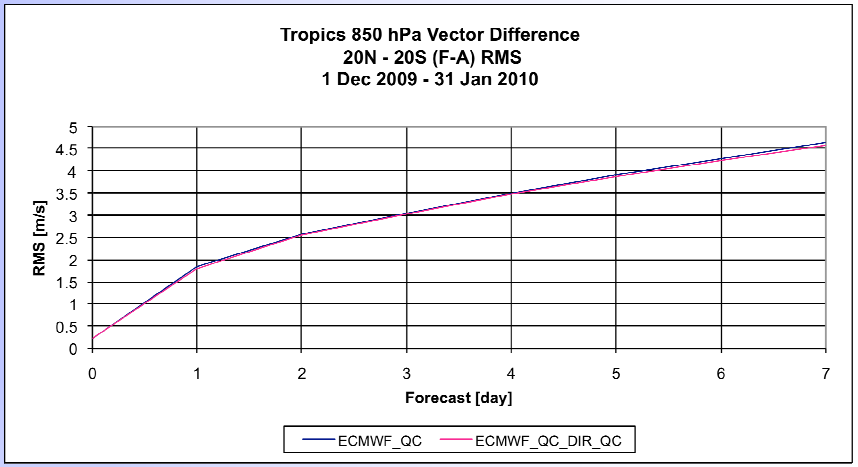
(nothing to see here, move along …)

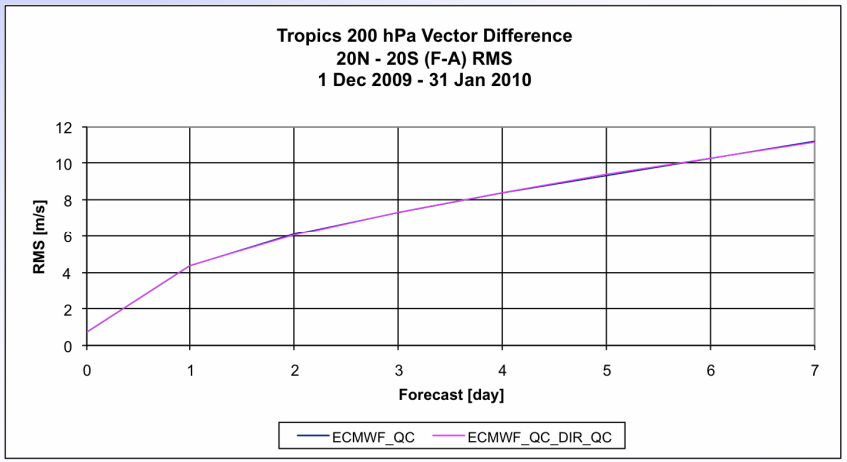
EC vs. Control, RMSVD





Dir. QC vs. EC, RMSVD





Summary and conclusions

- Despite inconsistencies, diagnostics leave little doubt about information content in AMVs
- Thinning may not be a winning strategy
  - Satellite soundings already outnumber AMVs by a significant margin
- "ECMWF screening" leads to immediate, significant (but not dramatic) improvement in NCEP GFS
- Directional QC adds little above and beyond this
  - Wrong idea?
  - Wrong implementation?