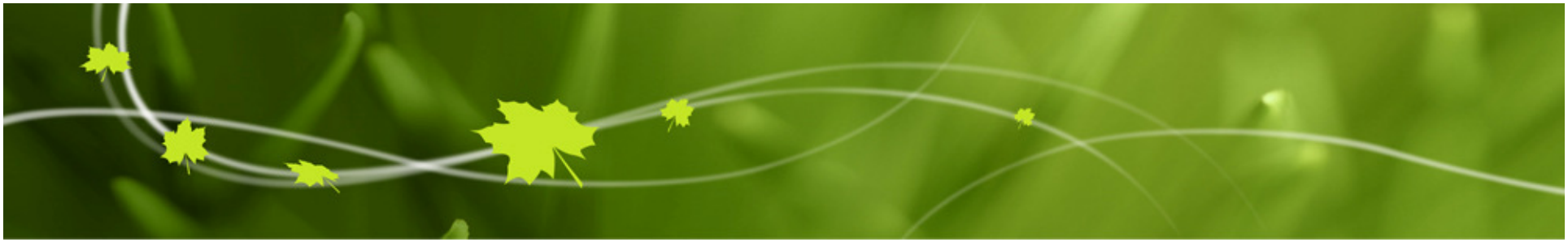
Environnement Canada Environment Canada

Canada



Addition of FNMOC ensemble in NAEFS: verification against radiosondes data in March 2010

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Outline

- New context
- Verification method
- New study: March 2010
- Comparison with last summer study
- Effect of bias correction
- Summary

New context

- The goal is to evaluate the impact of adding FNMOC members in the NAEFS ensemble.
- Since the verification done last summer covering August 2008 and January 2009, an upgrade was done to the FNMOC system (banded ET).
- In the current presentation we will show our evaluation of the performance of the new FNMOC system during March 2010.
- Evaluation against radiosondes data are done at CMC while NCEP is doing that against analyses (Bo Cui).

Verification method

- 5 fields: temperature, heights, zonal and meridional winds and dew-point depression
- 4 levels: 250, 500, 850 and 925 hPa
- Quality controlled radiosondes data from global network (636 stations)
- March 2010: 27 days at 00Z (missing March 3, 11, 23 and 27)
- Frequency : every 24 hour up to 10 days (24h, 48h, … 240h lead time)
- Raw forecasts (no bias correction)

Verification method

Scores:

- À la Candille et al.(2007) and Candille (2009)
- Reduced Centred Random Variable:
  - Bias= mean of RCRV
  - Dispersion = standard deviation of RCRV
- **Continuous Rank Probabilistic Score** and its decomposition:
  - CRPS = difference between forecast CDF and observation
  - reliability = capability of generating right average CDF
  - resolution = CRPS_pot, CRPS once forecast propabilities are calibrated ~ sharpness
- RMS of the ensemble mean and spread
- Confidence intervals by block bootstrapping (5-95%)

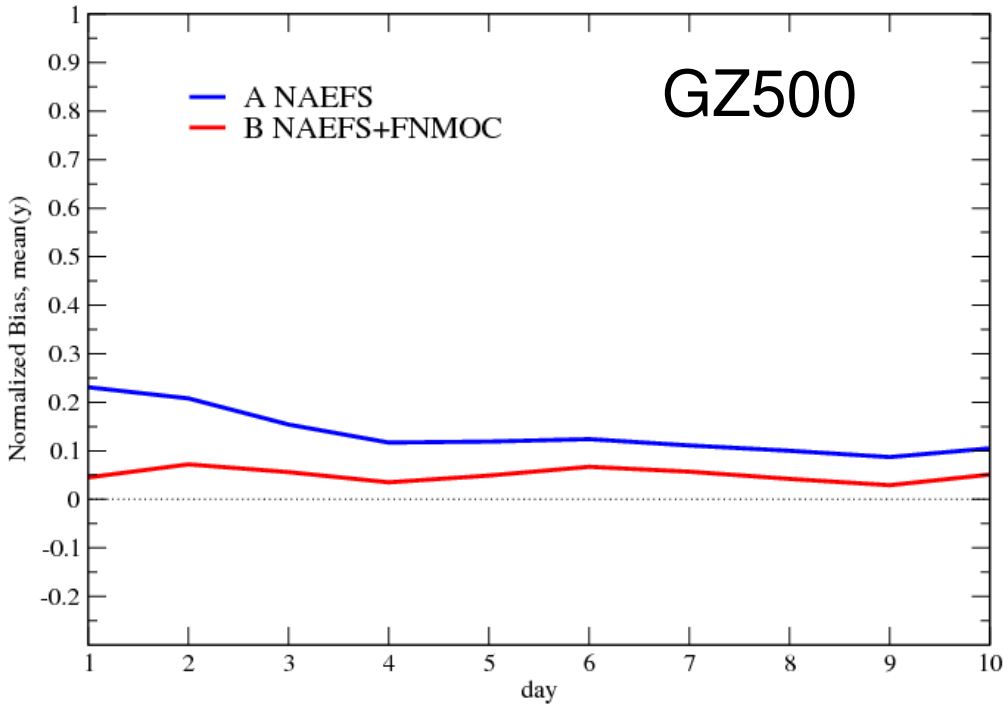
Verification method

- Caveats:
  - No verification of surface fields (temperature at 2m , surface winds, precipitation)
  - Short sample
  - Over land only (radiosondes network)
  - Limited verification of bias corrected fields (only FNMOC vs FNMOC debiased).

Bias

NAEFS in BLUE
NAEFS+FNMOC in RED

- Reduced for temperature at 925 hPa (CMC/FNMOC better than NCEP) and for heights at 500 and above (cancellation of bias: CMC/NCEP too low while FNMOC too high)
- Winds are neutral

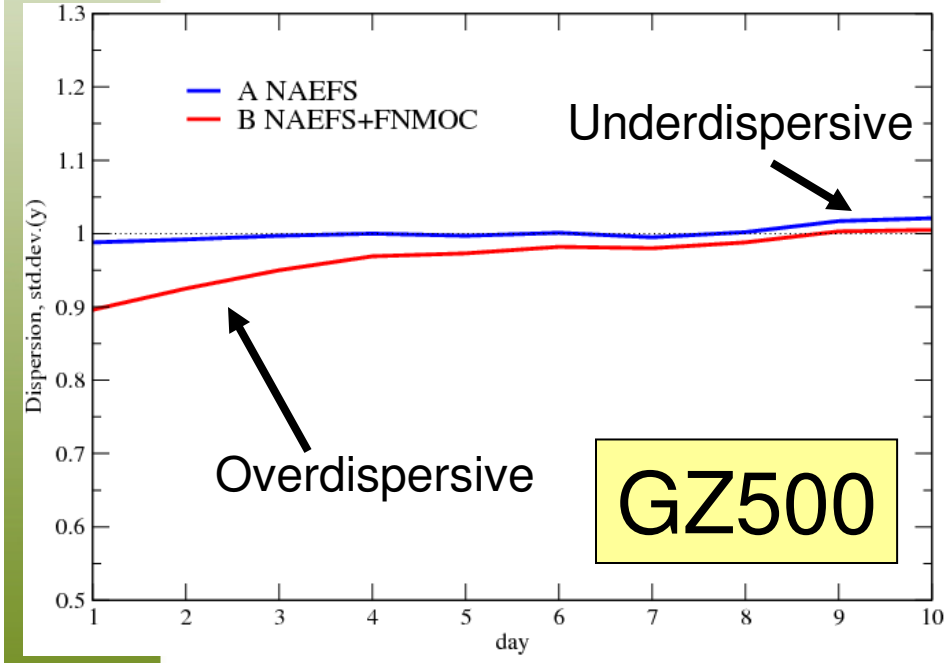


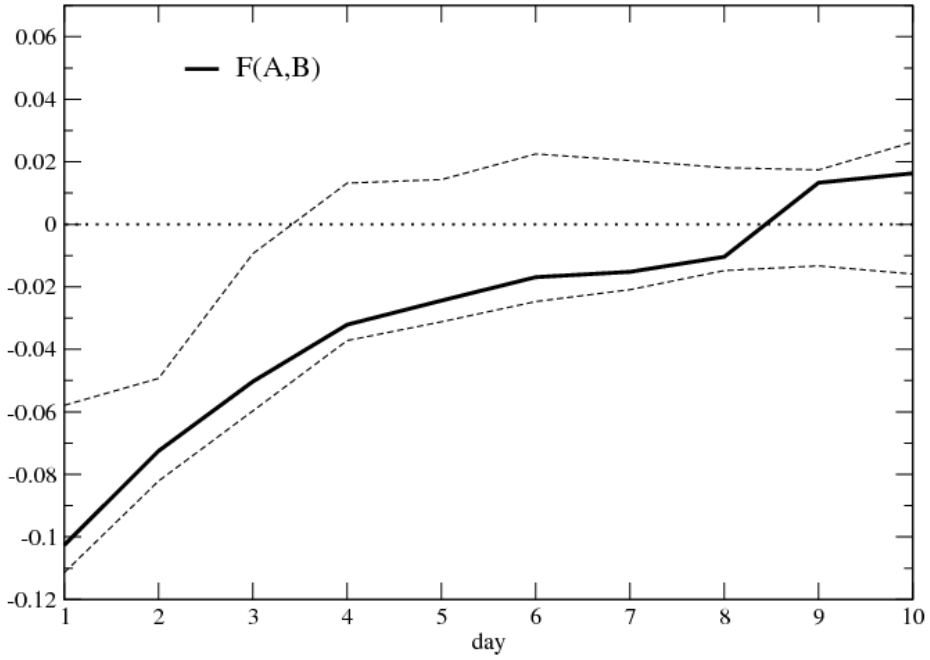
We want zero!

Dispersion(error/spread)

NAEFS in BLUE
NAEFS+FNMOC in RED

- Generally worst for heights and temperature (except at 925 hPa), winds neutral (850-925 hPa zonal worst days 1-4 while better for longitudinal ones).

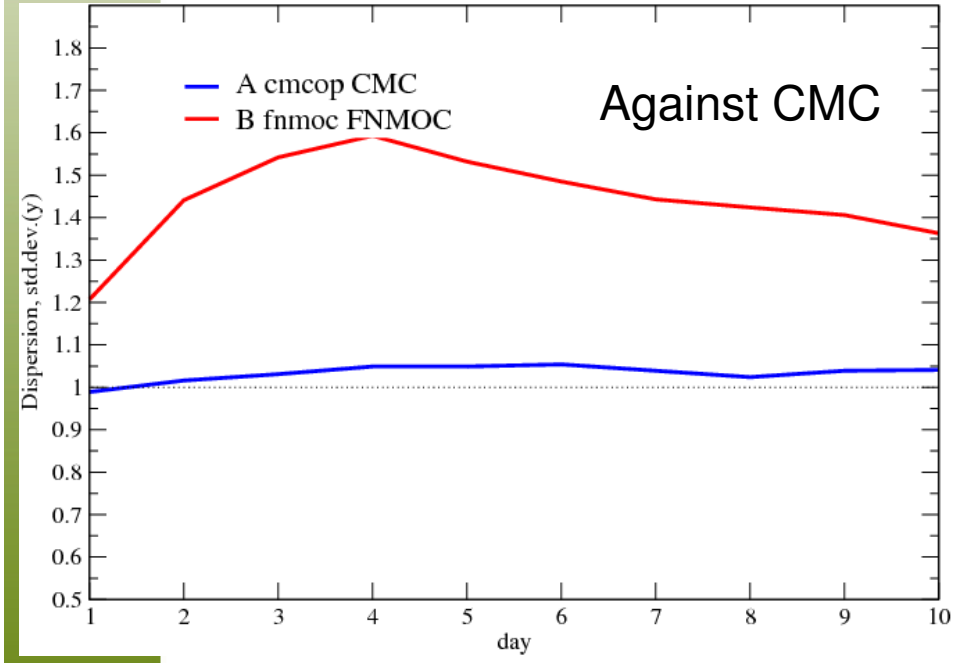


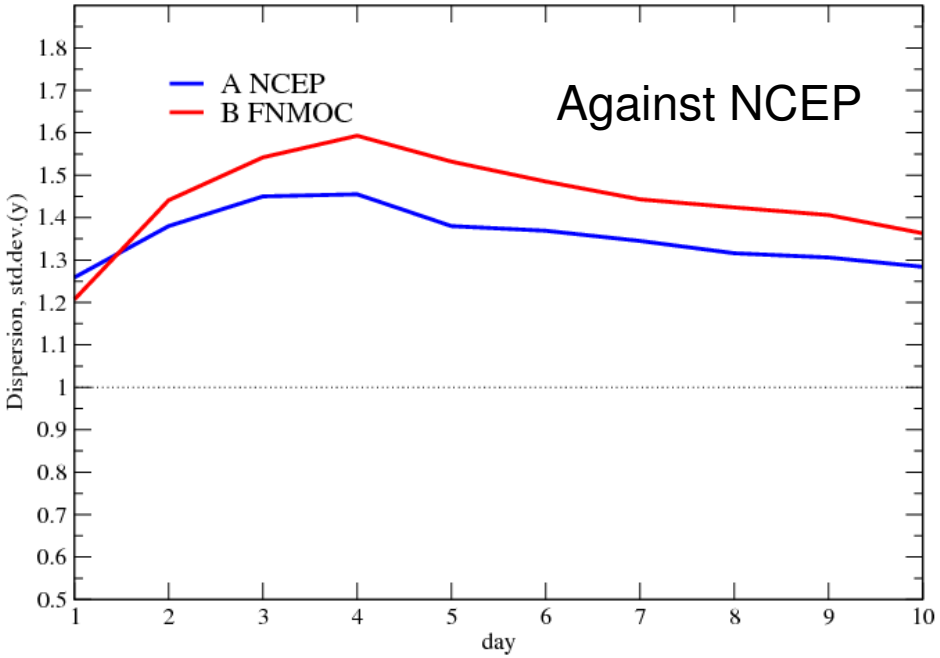


We want 1.0!

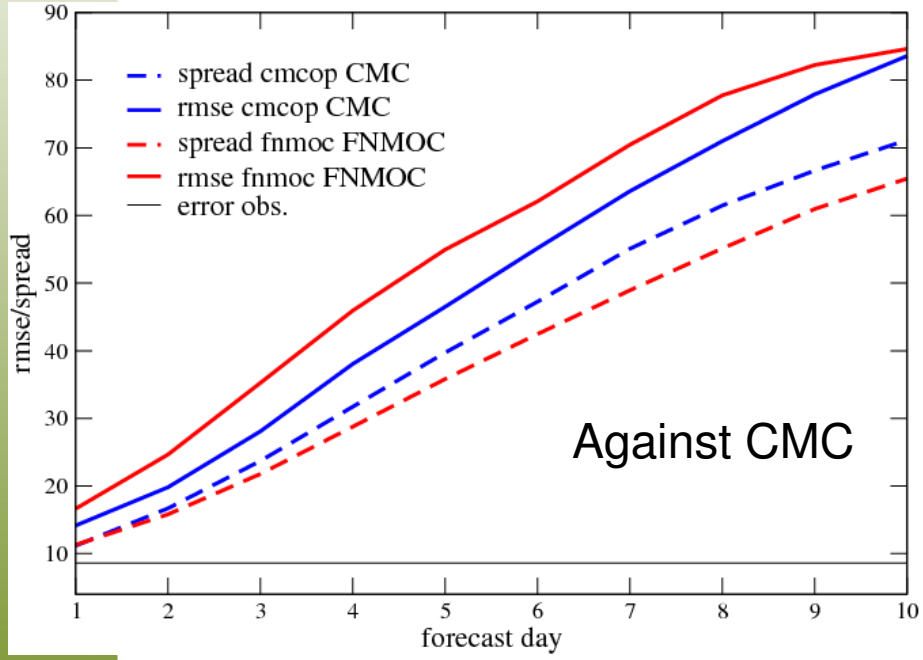
Dispersion GZ500

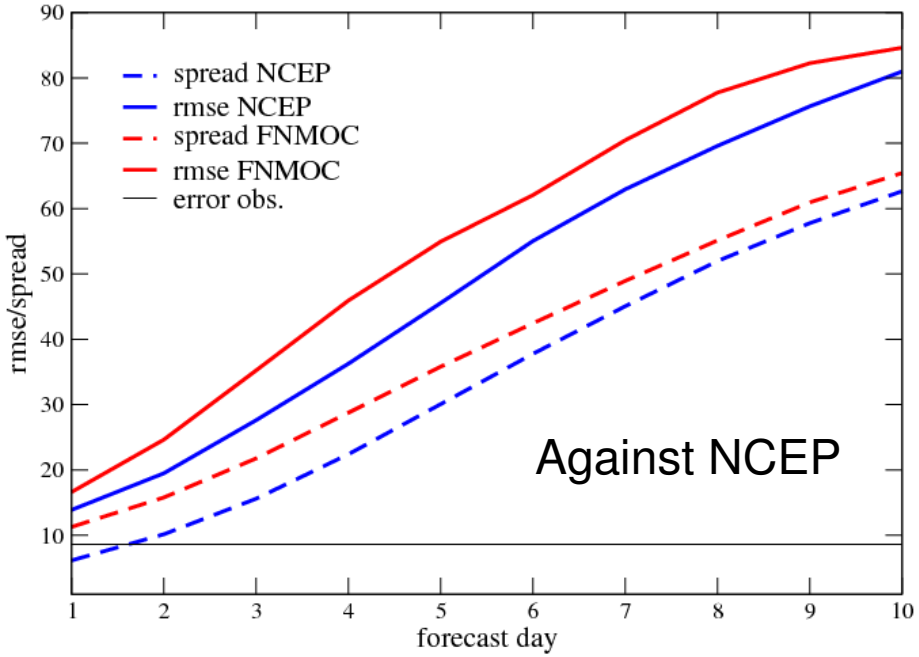
- FNMOC dispersion is inferior to CMC one for all forecast ranges and to NCEP one past day 1. NCEP and FNMOC are more similar (lack of spread).





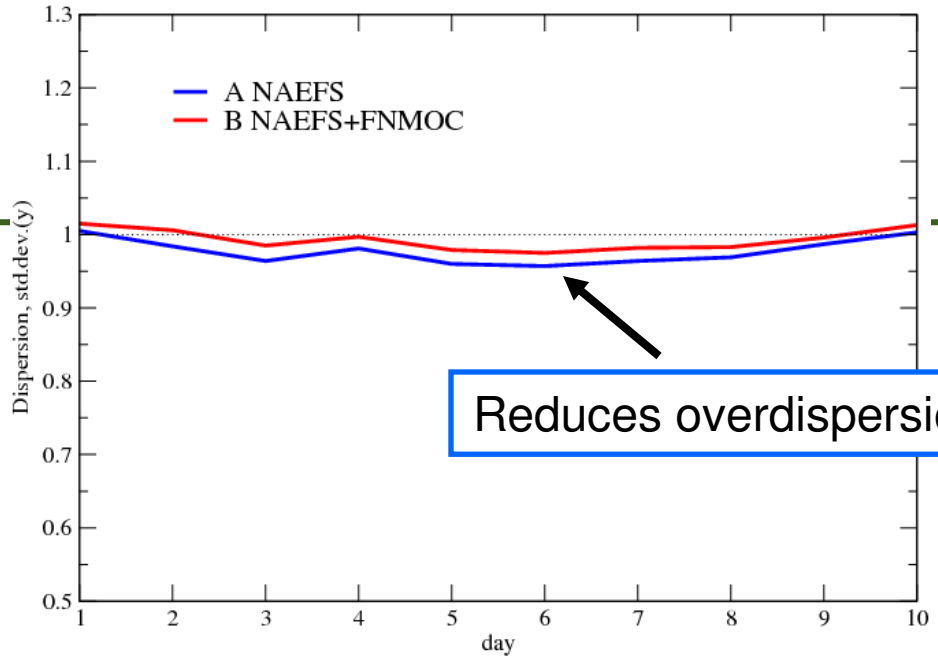
RMS/spread, GZ500



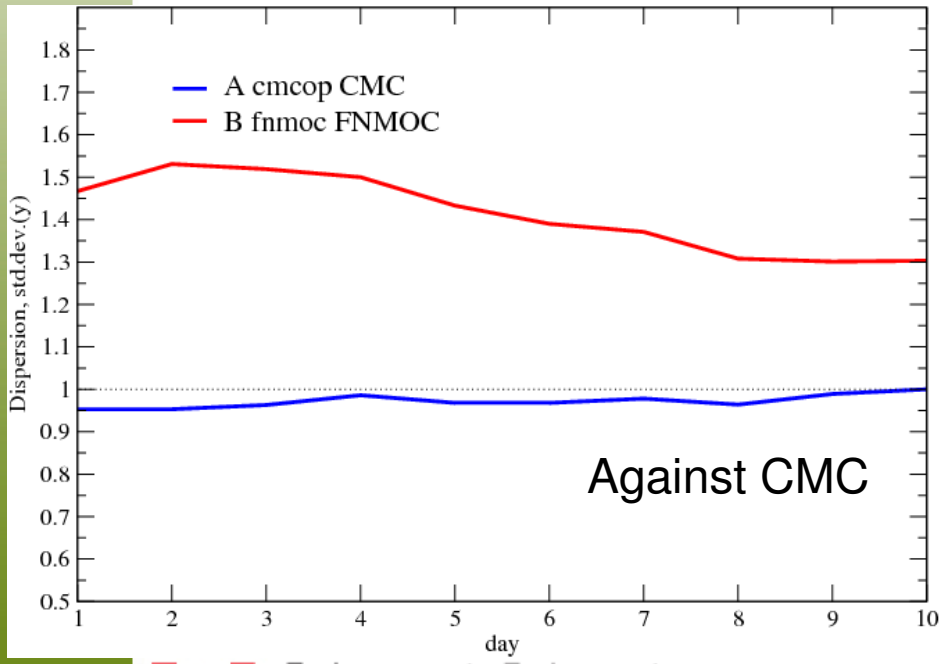


Dispersion: V wind 850 hPa

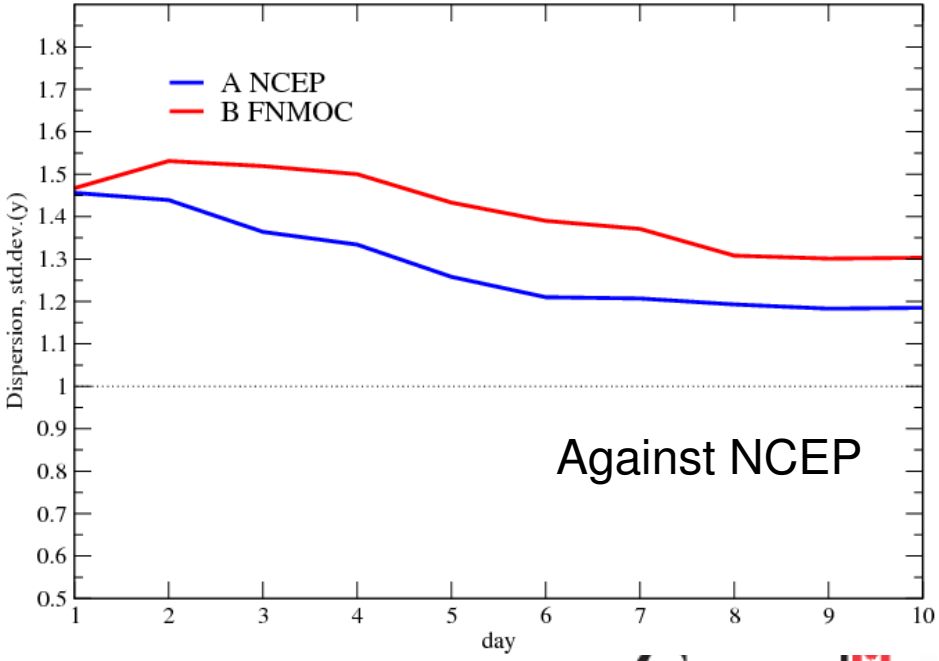
March 2010



Reduces overdispersion!



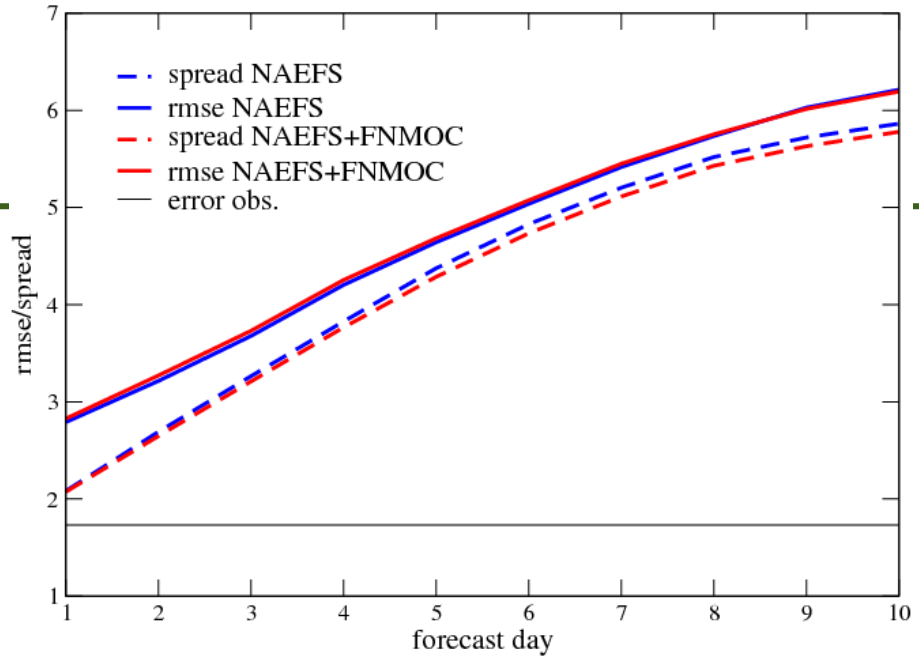
Against CMC

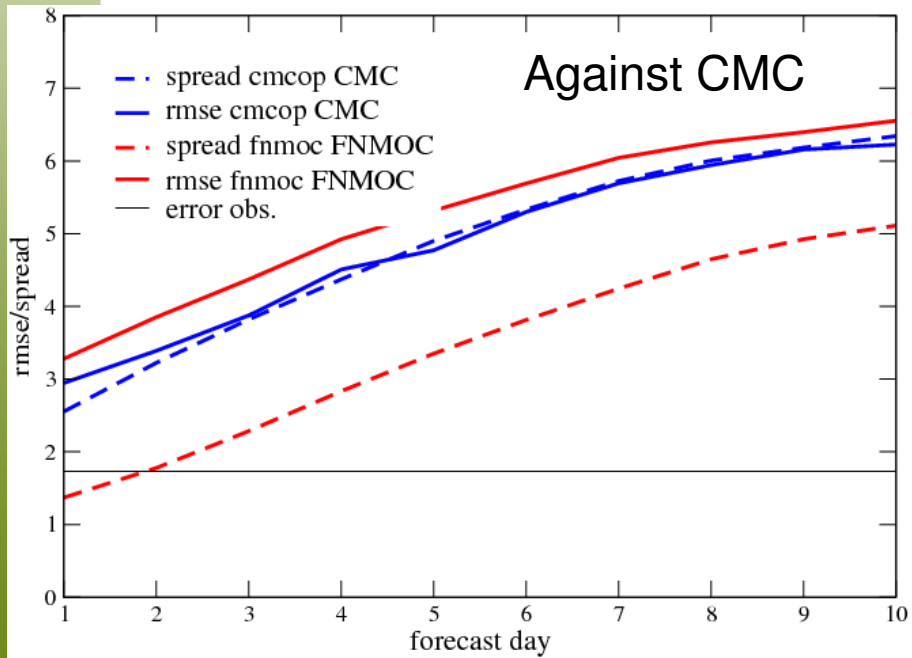


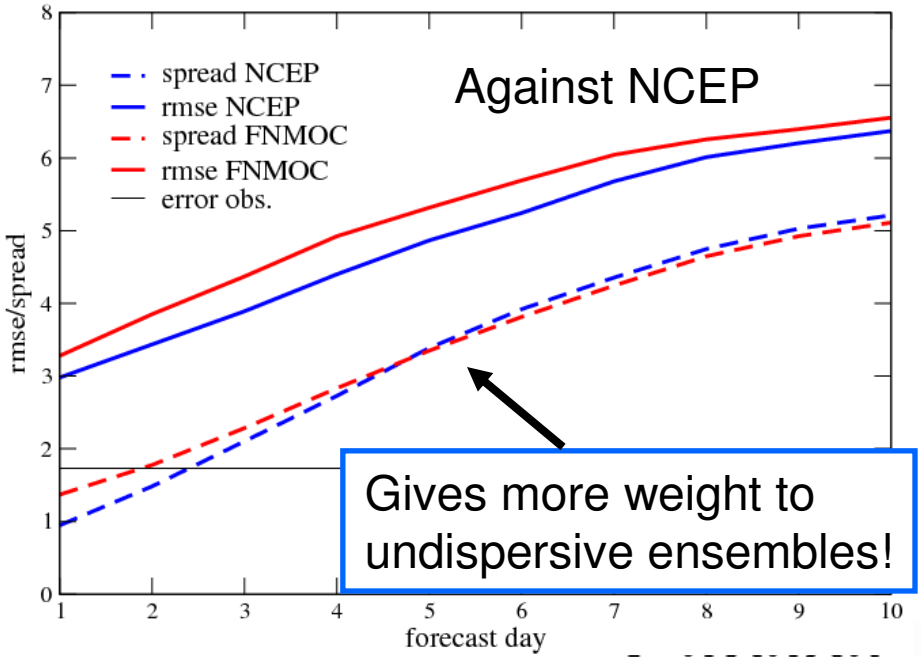
Against NCEP

RMS and spread: V wind 850 hPa

March 2010



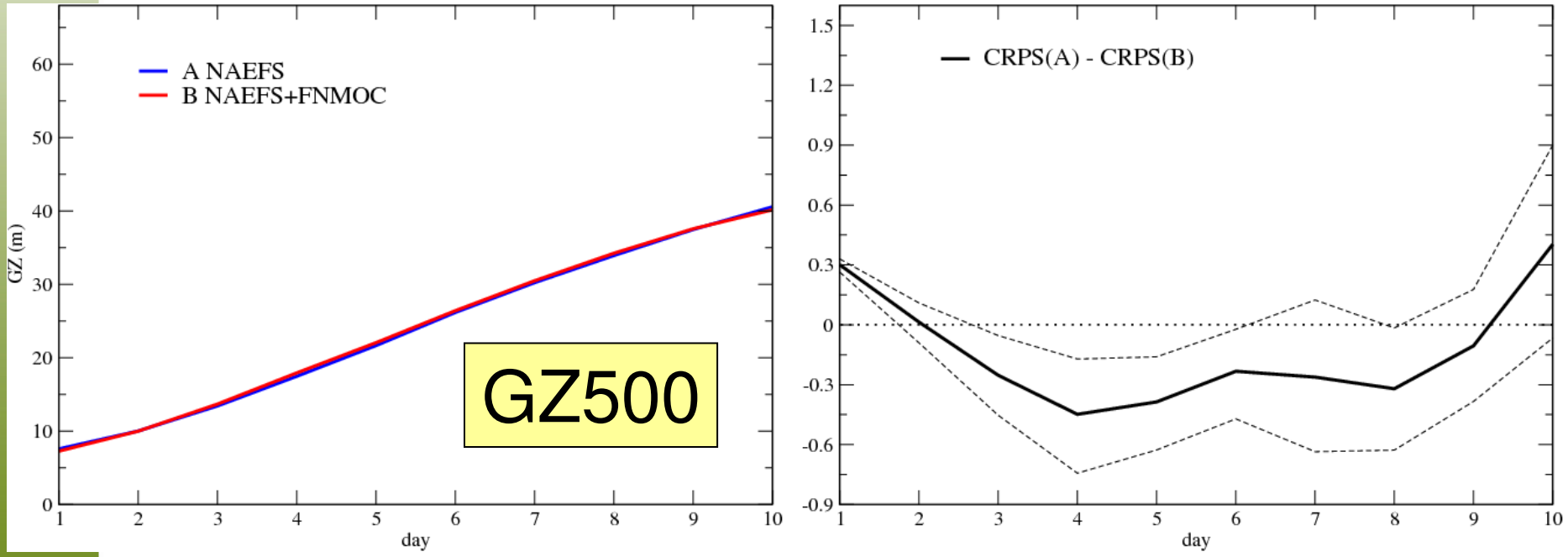




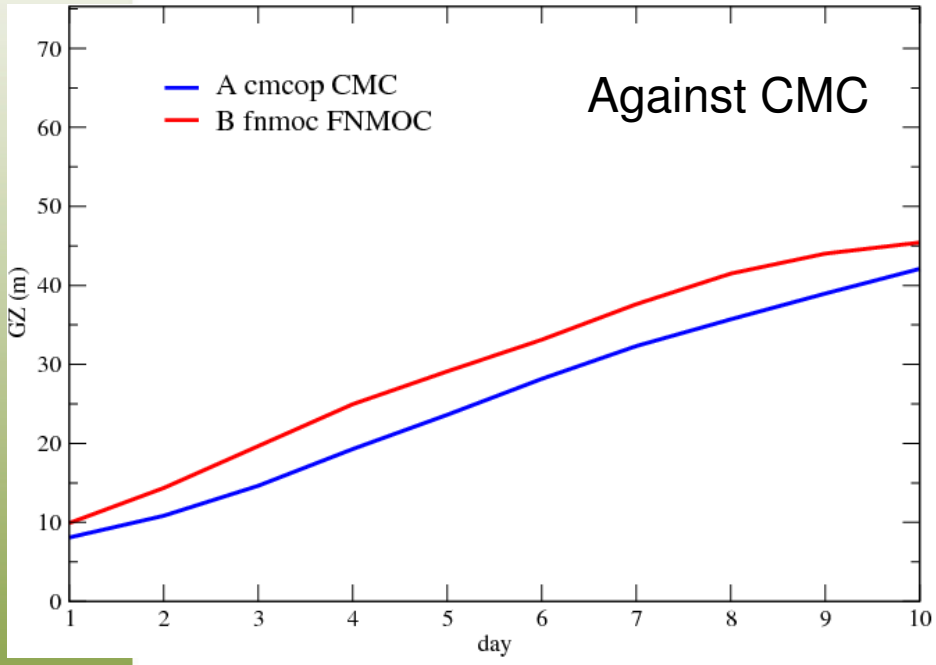
Main score: CRPS

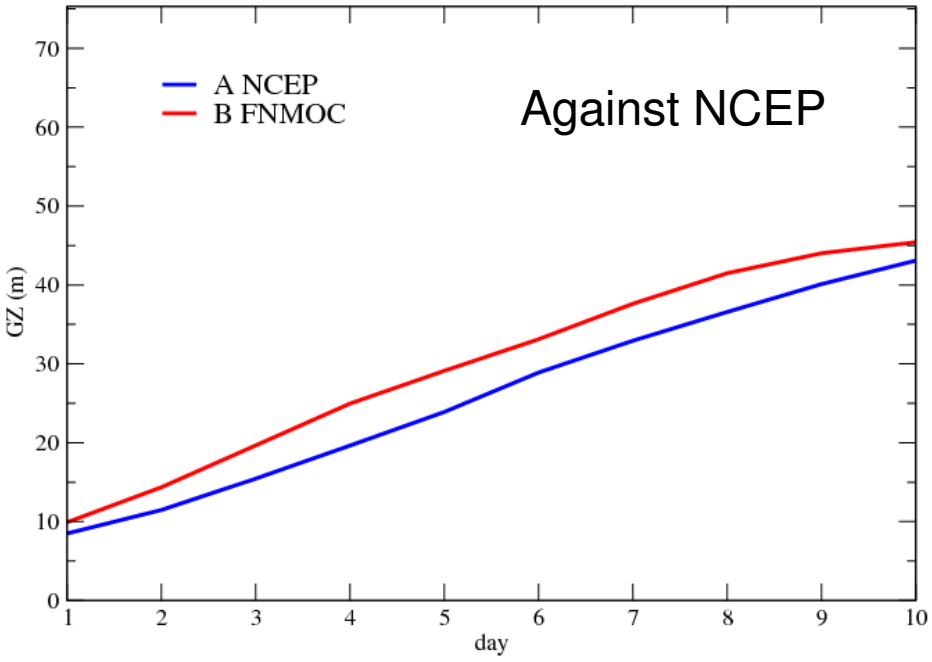
NAEFS in BLUE
NAEFS+FNMOC in RED

- CRPS slightly worst for temperature, heights (days 2 to 5) for all levels except temperature at 925 hPa (improvement at all lead times). Winds are more degraded (days 2 to 7). Otherwise it is neutral.

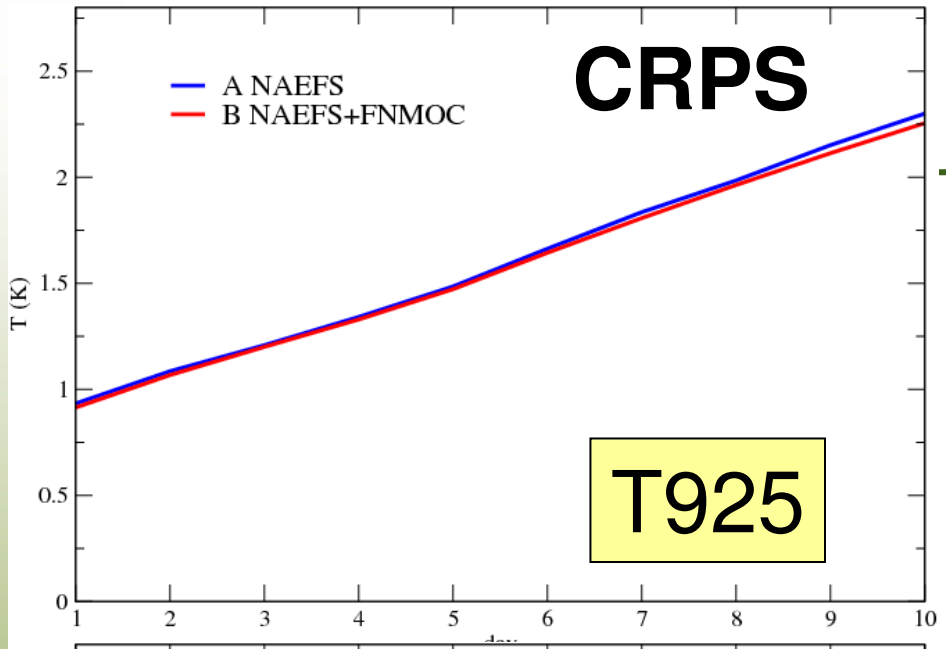


CRPS heights at 500 hPa (GZ500)

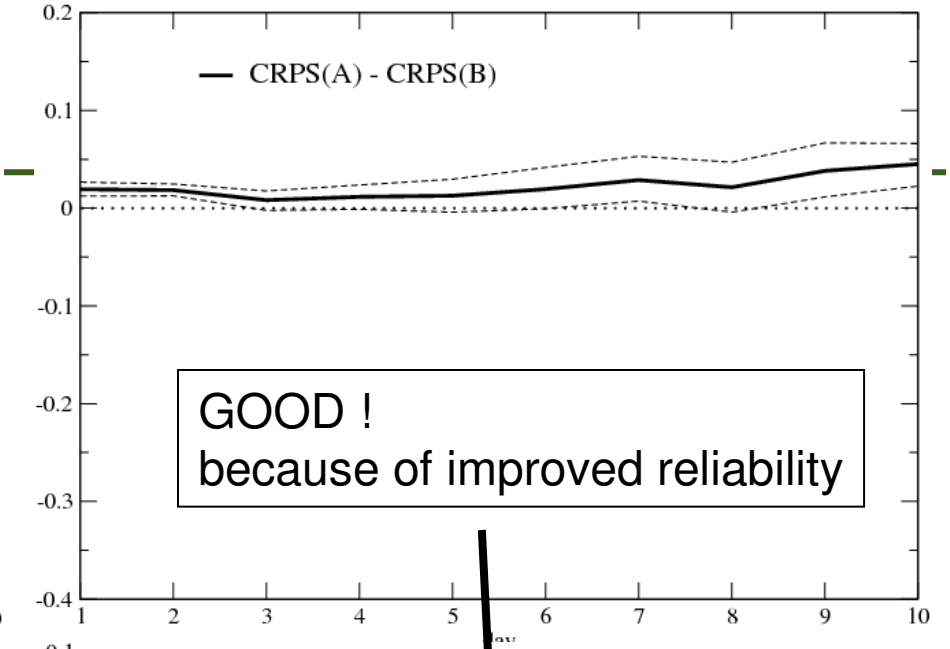




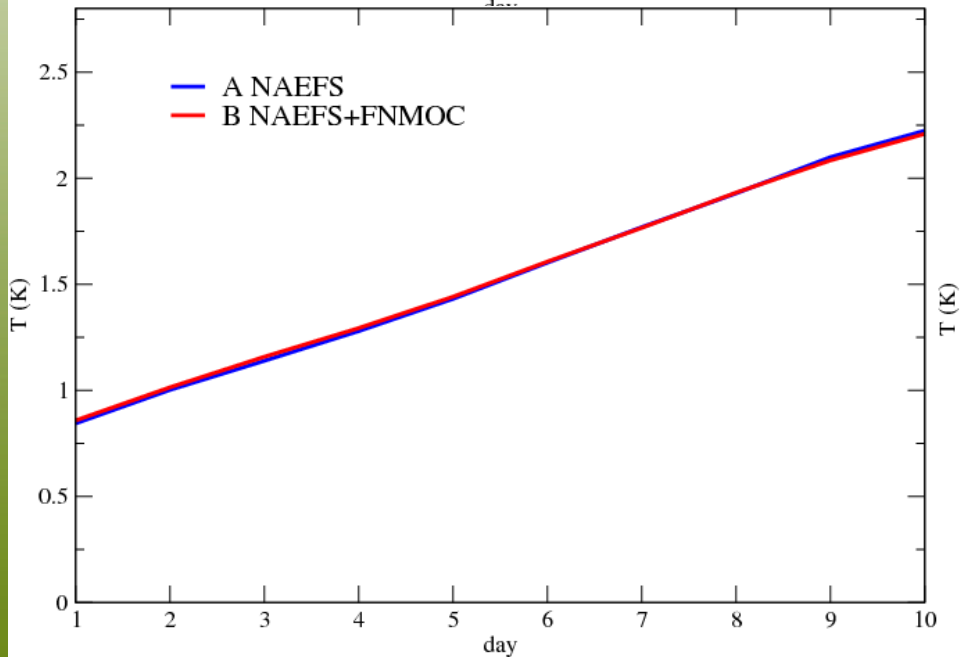
CRPS

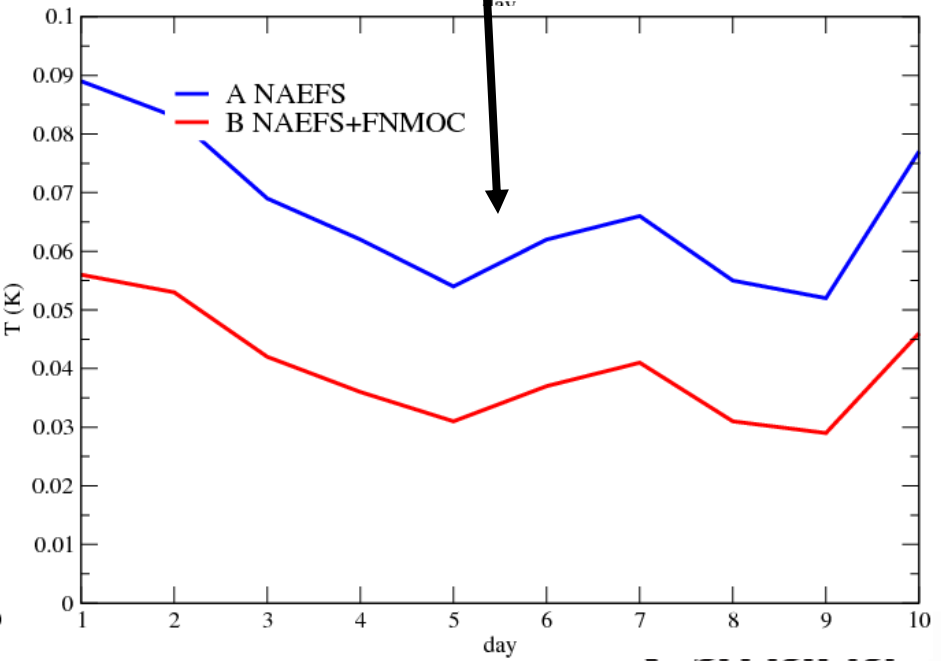


T925

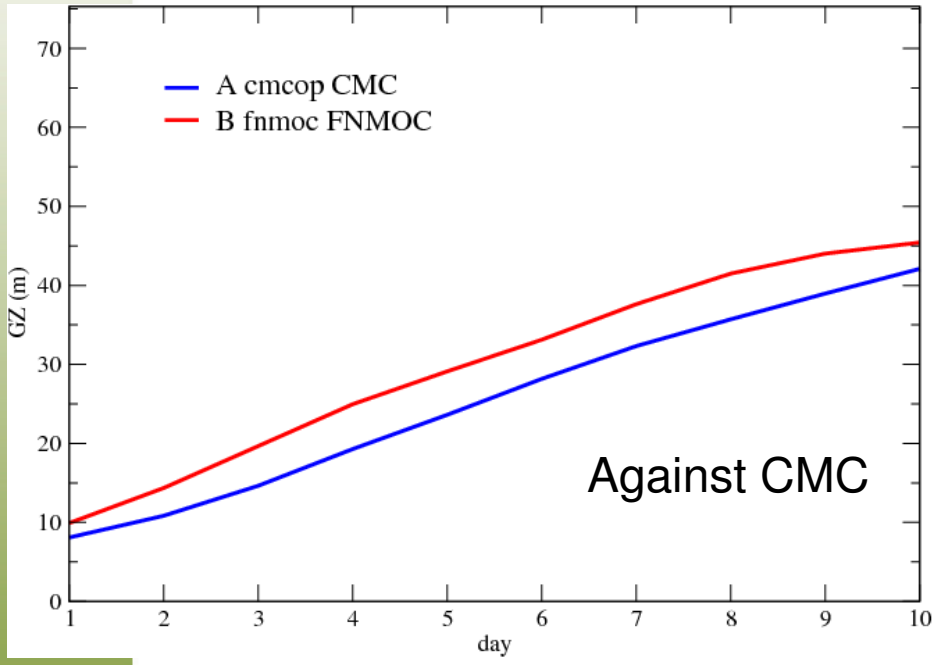


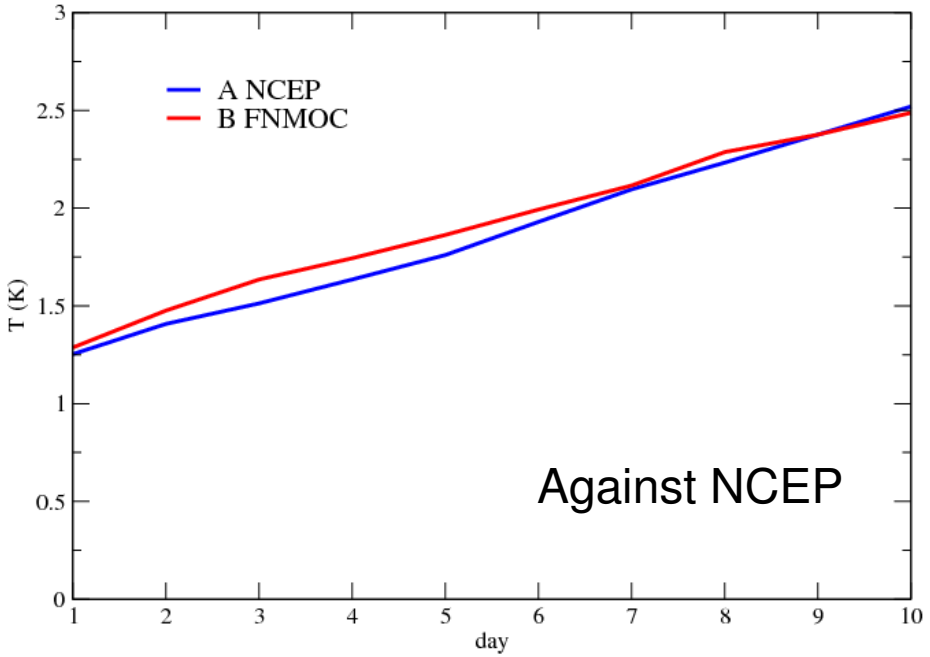
GOOD !
because of improved reliability

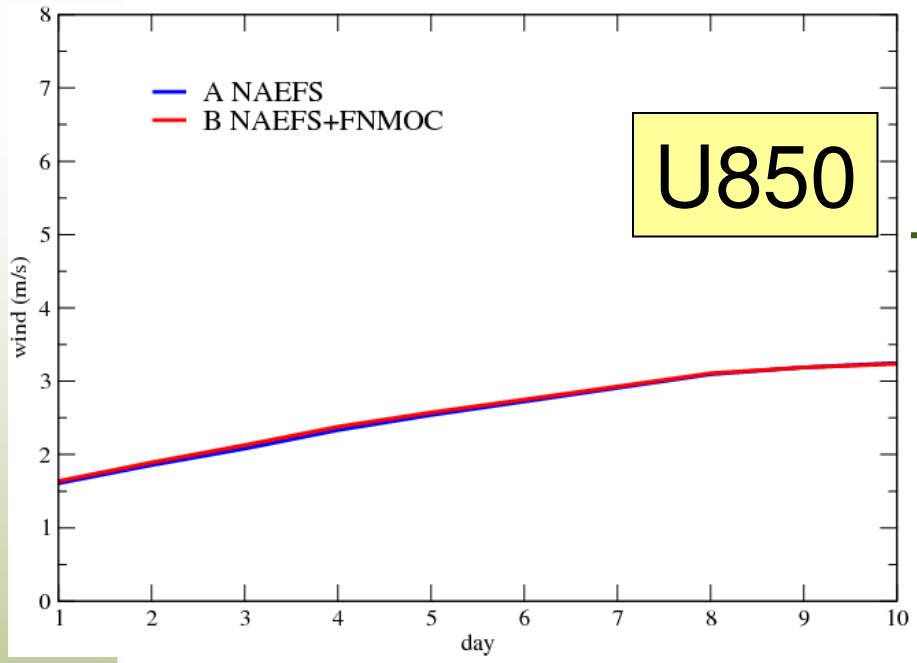




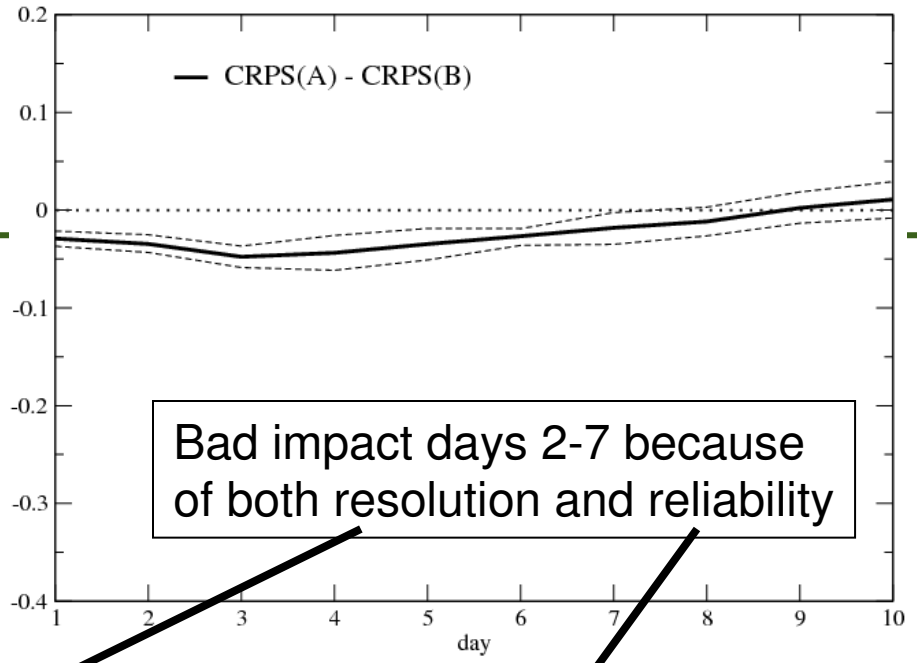
CRPS T at 925 hPa



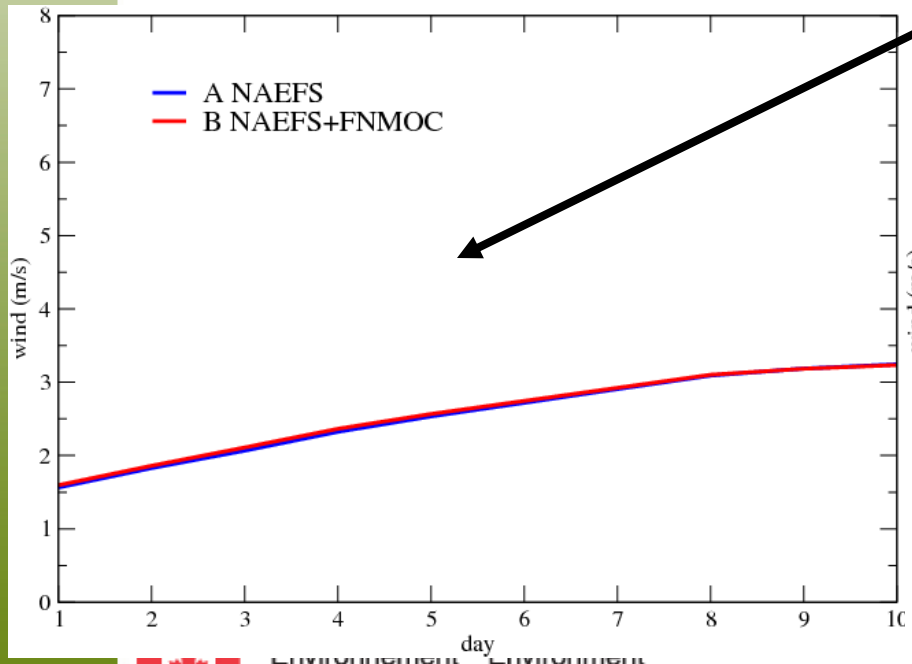


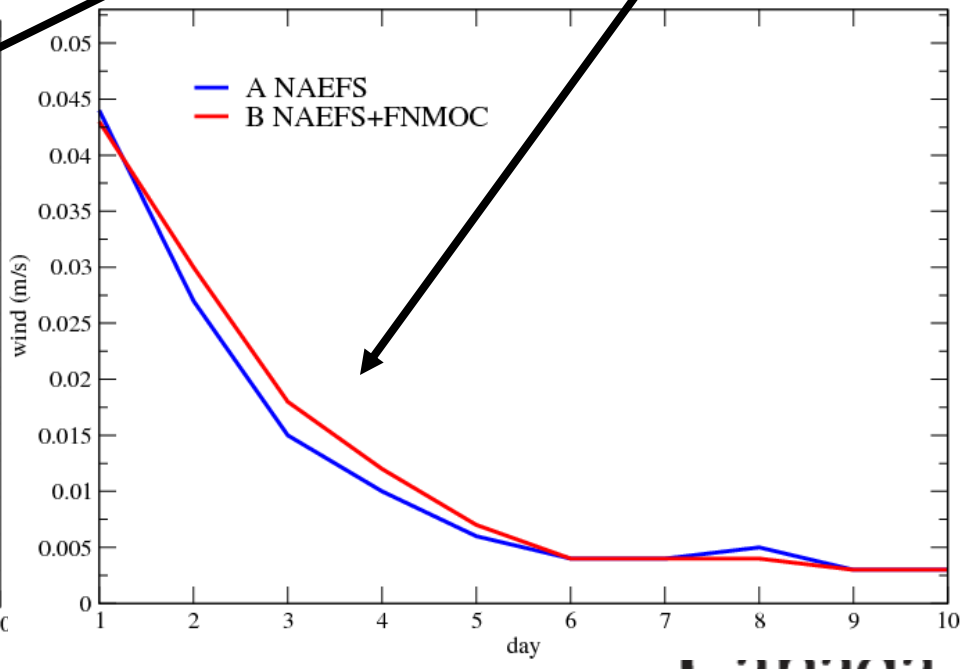


U850

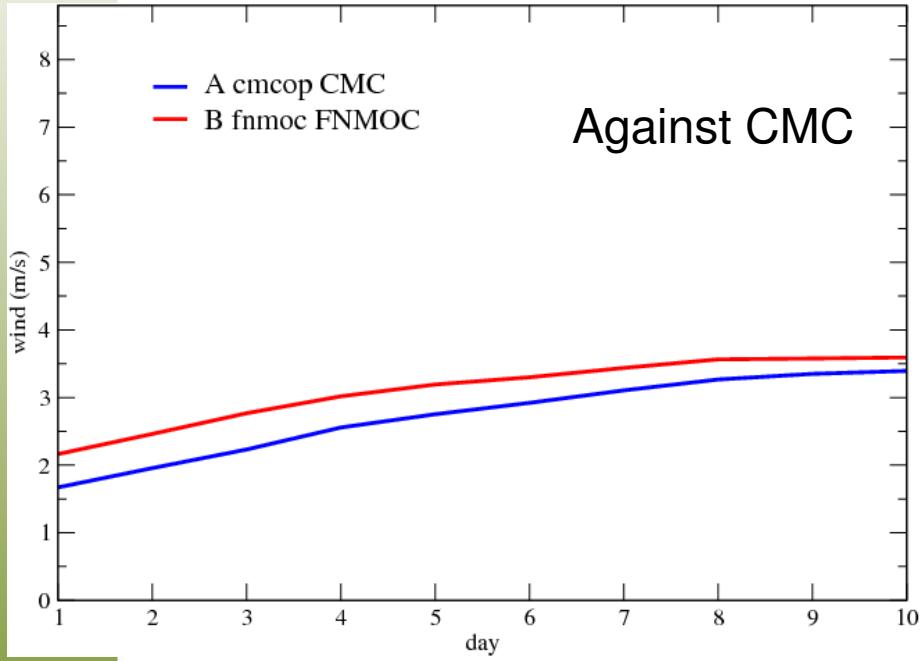


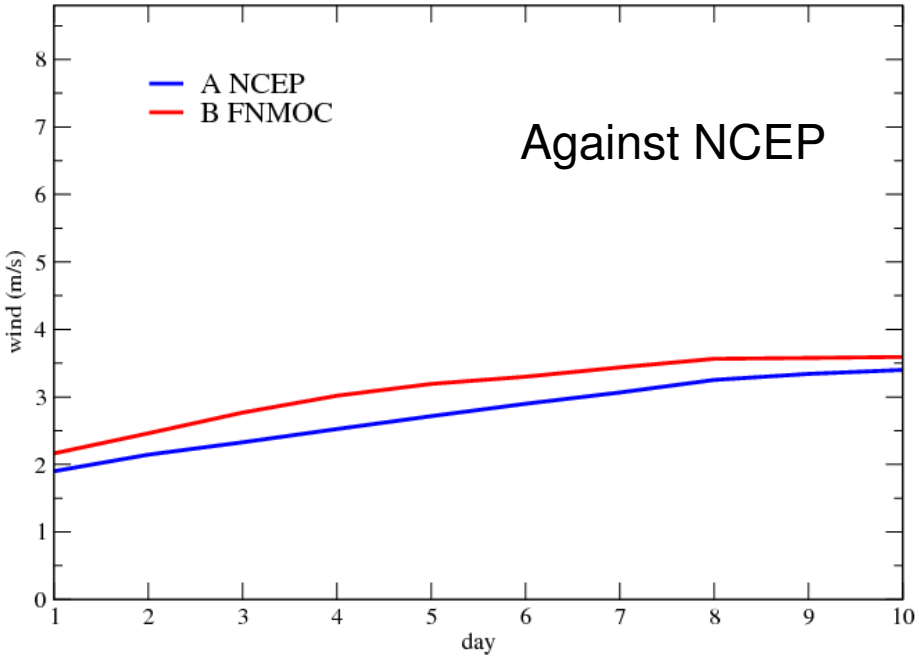
Bad impact days 2-7 because of both resolution and reliability



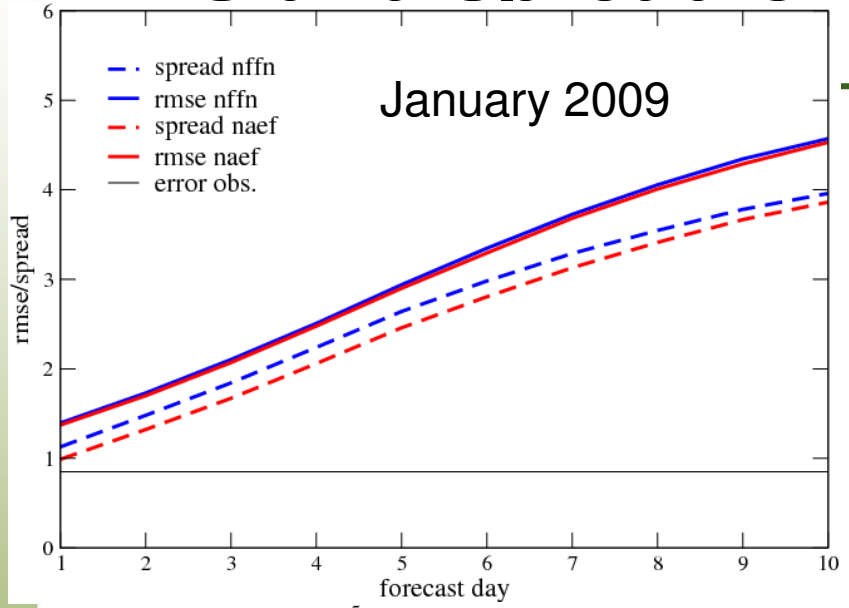


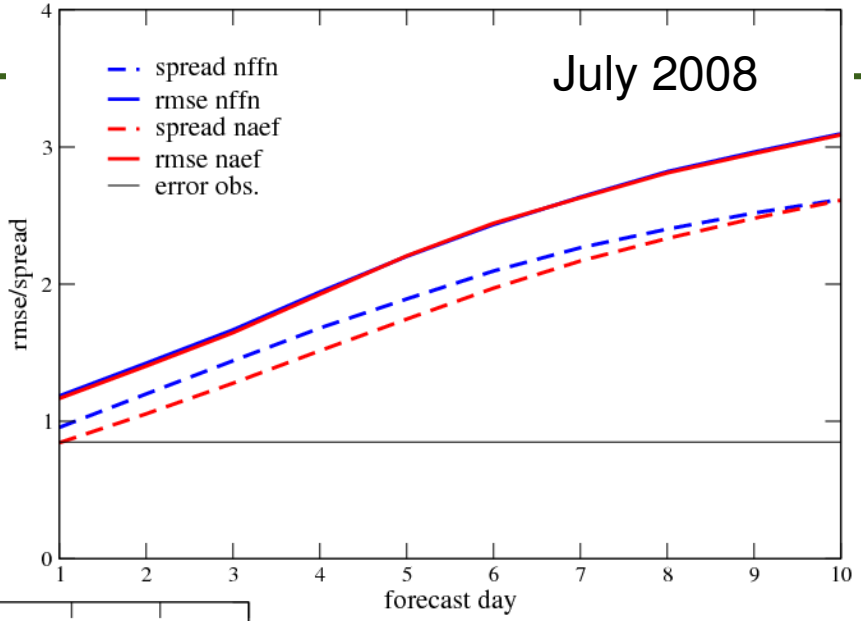
CRPS U at 850 hPa

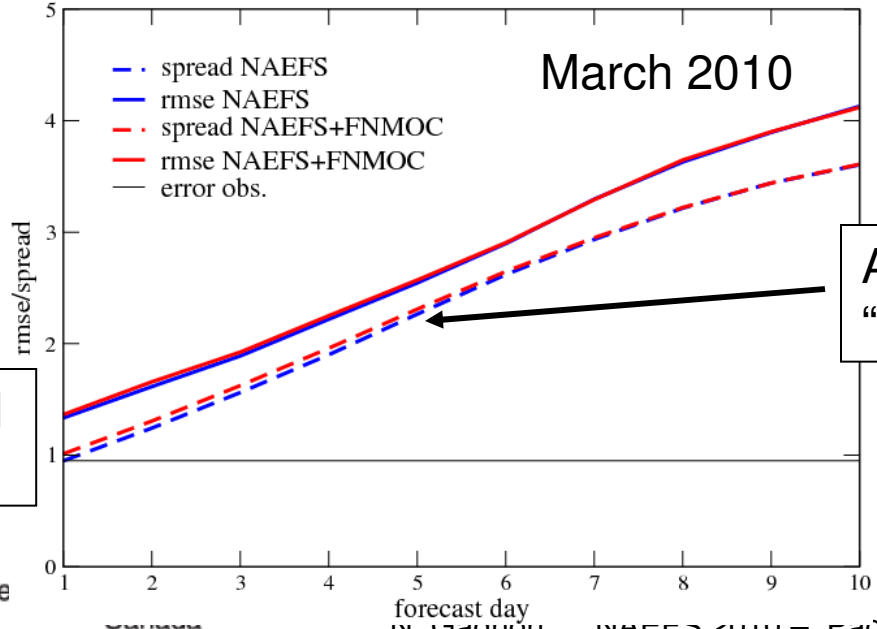




Comparison with previous verification: RMS and spread of TT850



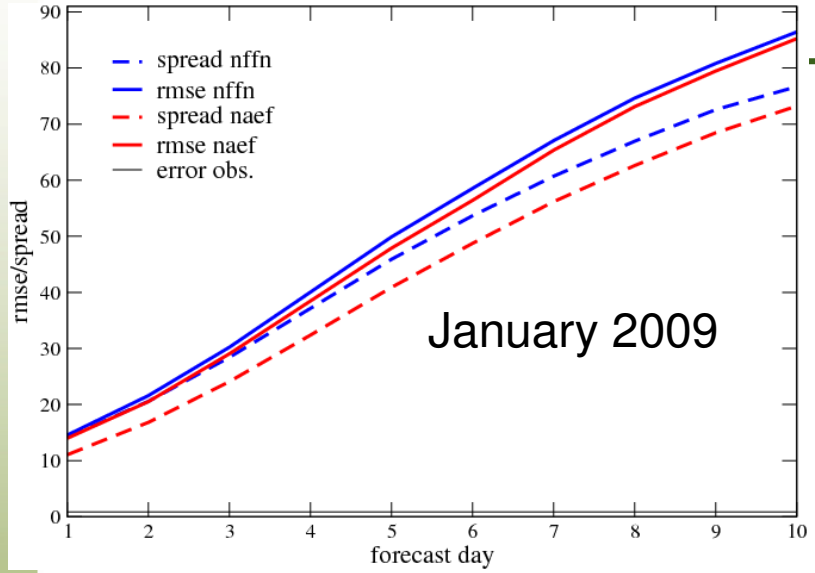


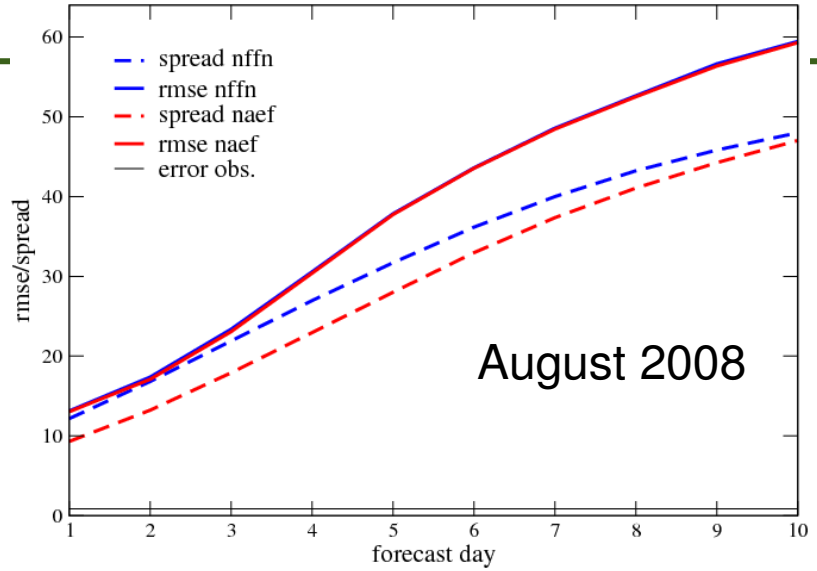


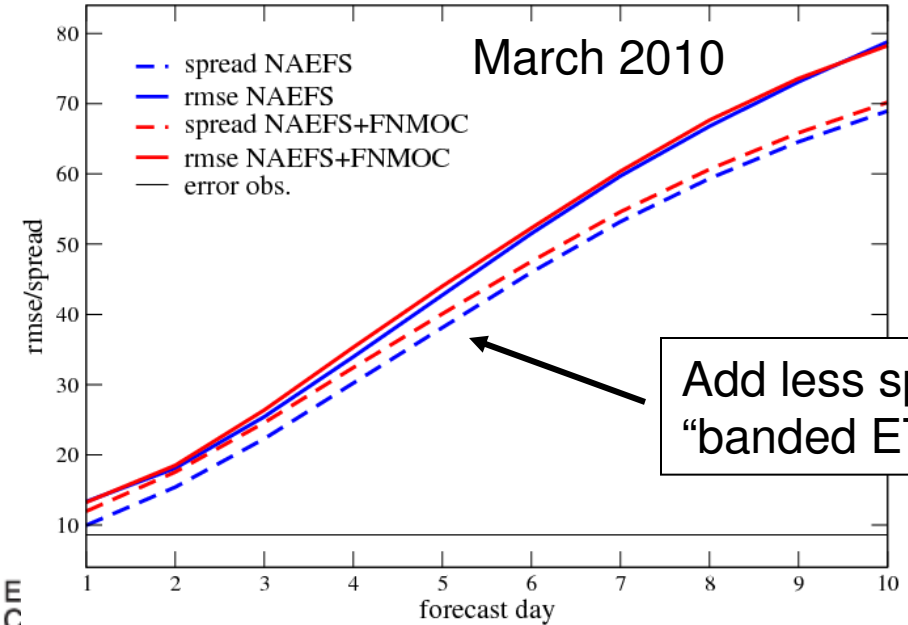
Add less spread, impact of the "banded ET upgrade"?

Warning inversed colors!!!

Comparison with previous verification RMS and spread: GZ500



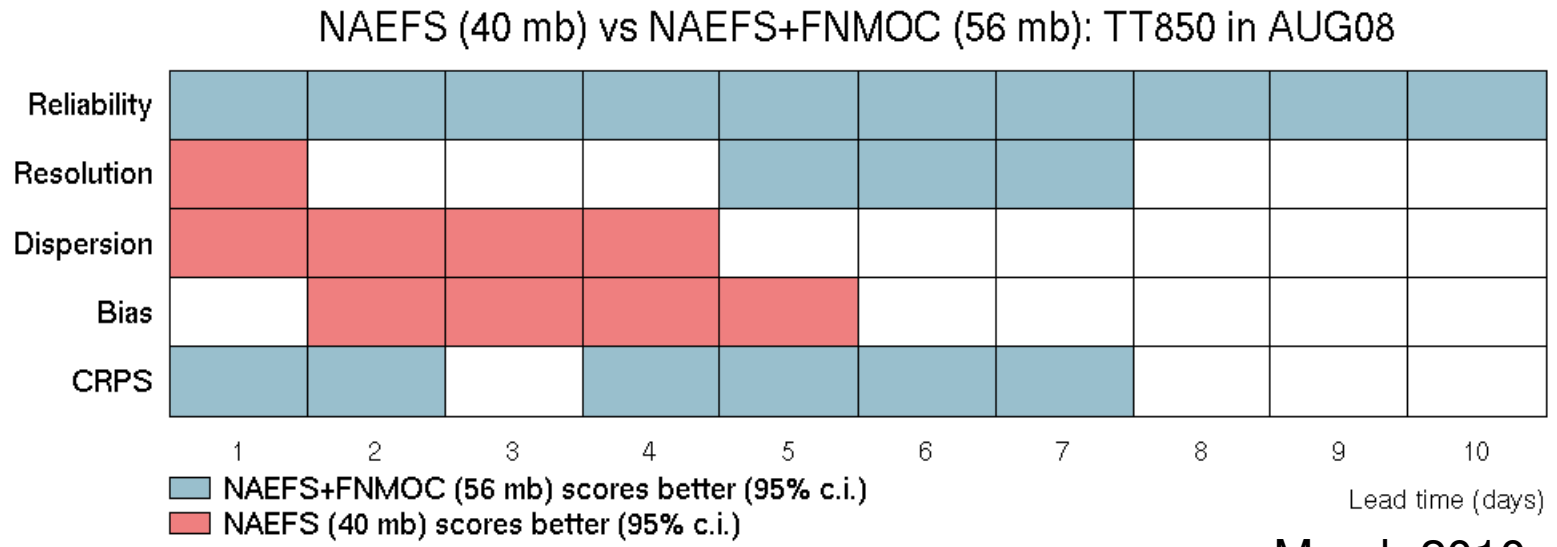




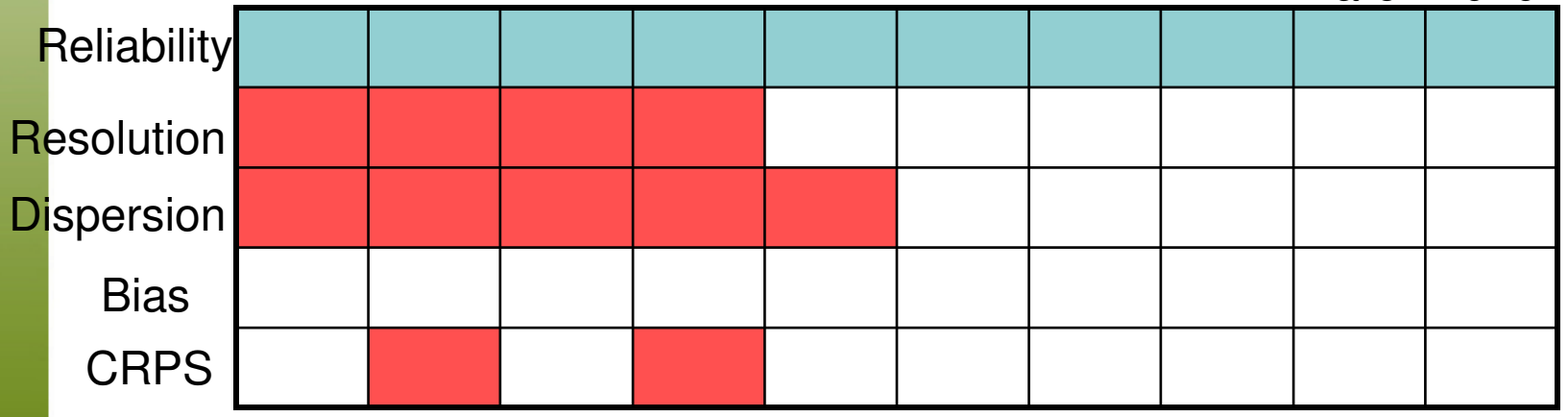
Warning: inversed colors!!!

Add less spread, impact of the "banded ET upgrade"?

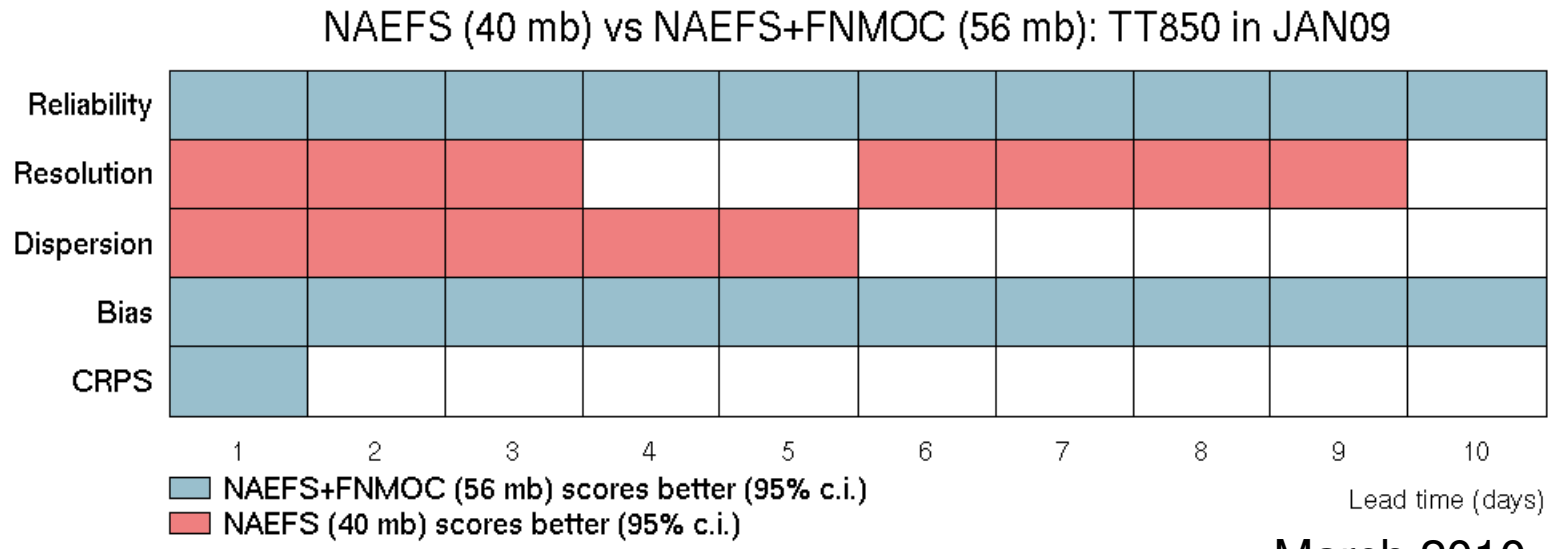
Comparison previous verification: temperature at 850 hPa



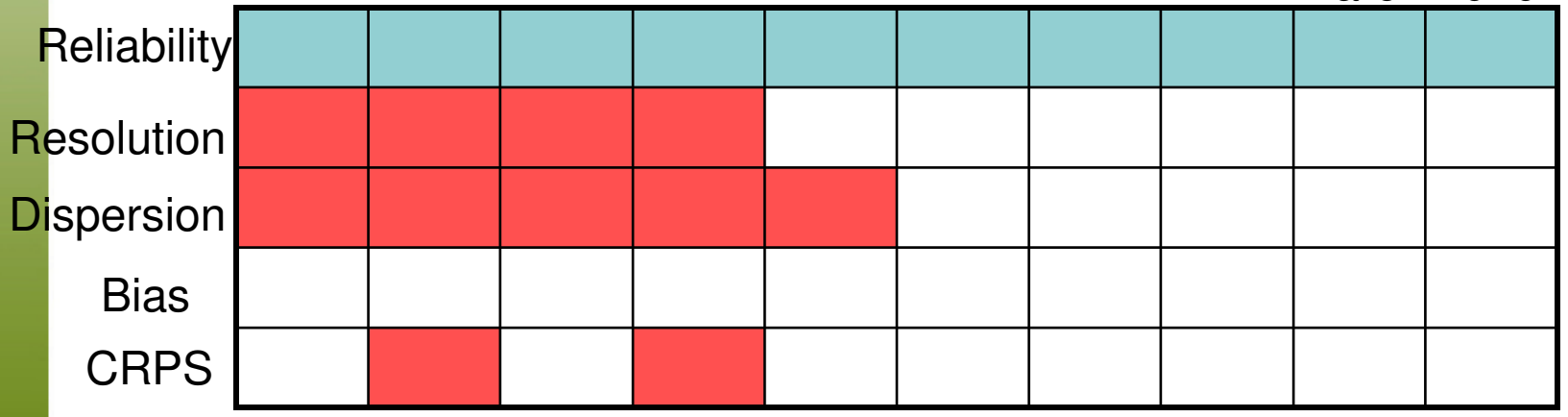
March 2010



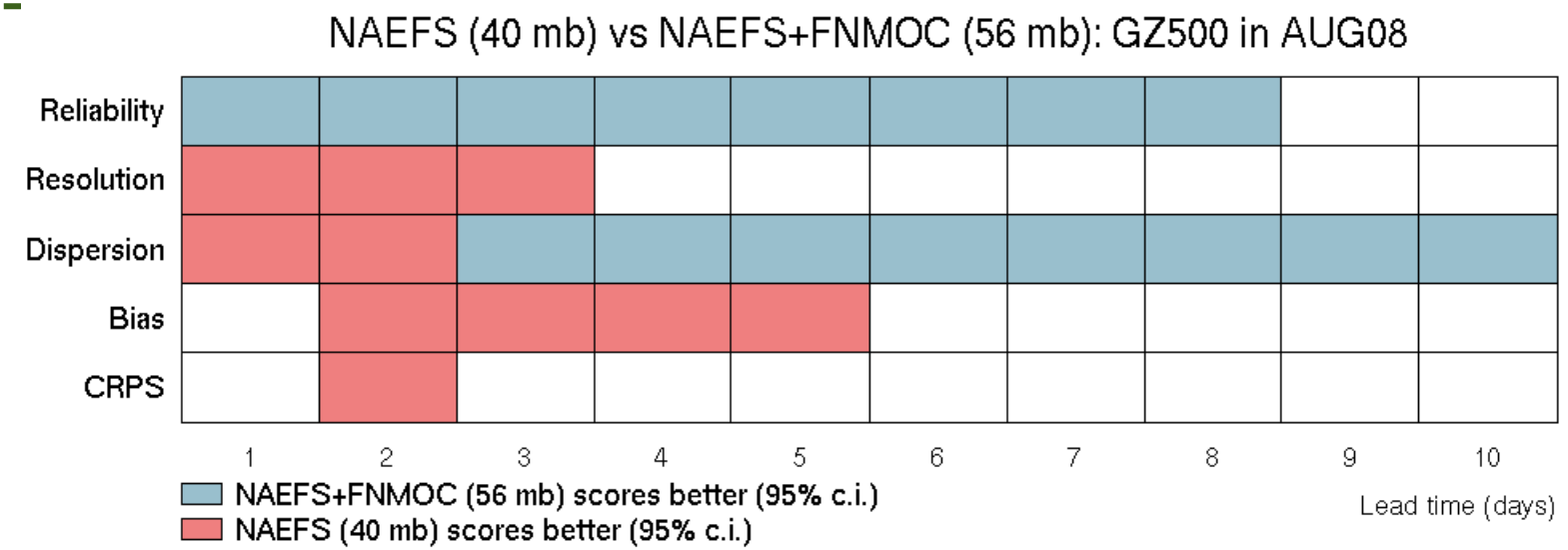
Comparison previous verification: temperature at 850 hPa

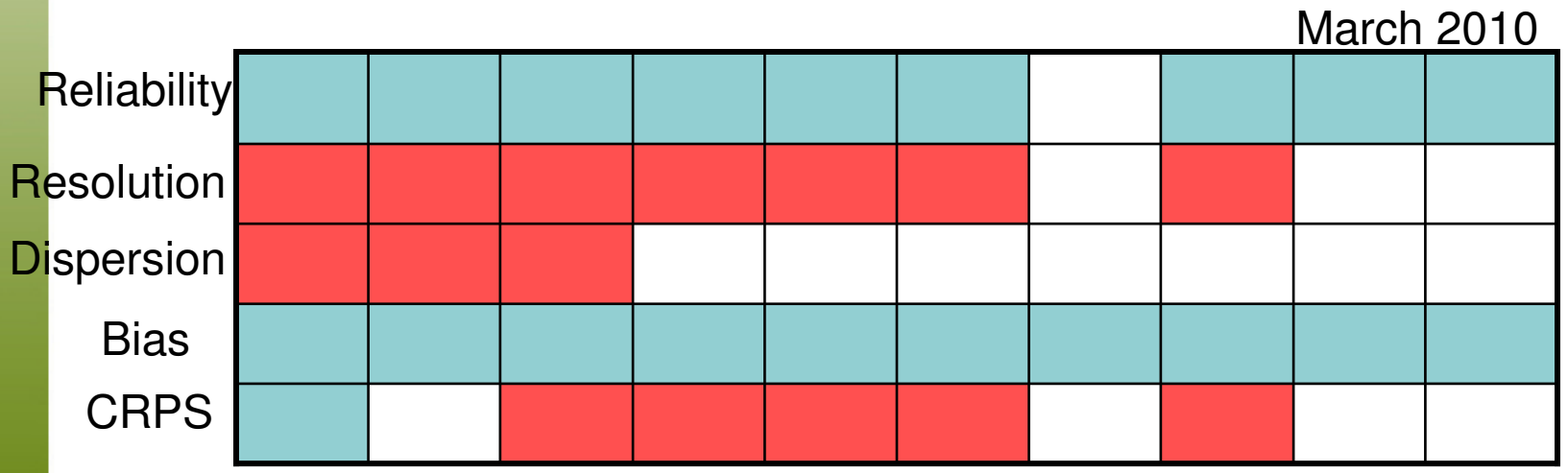


March 2010

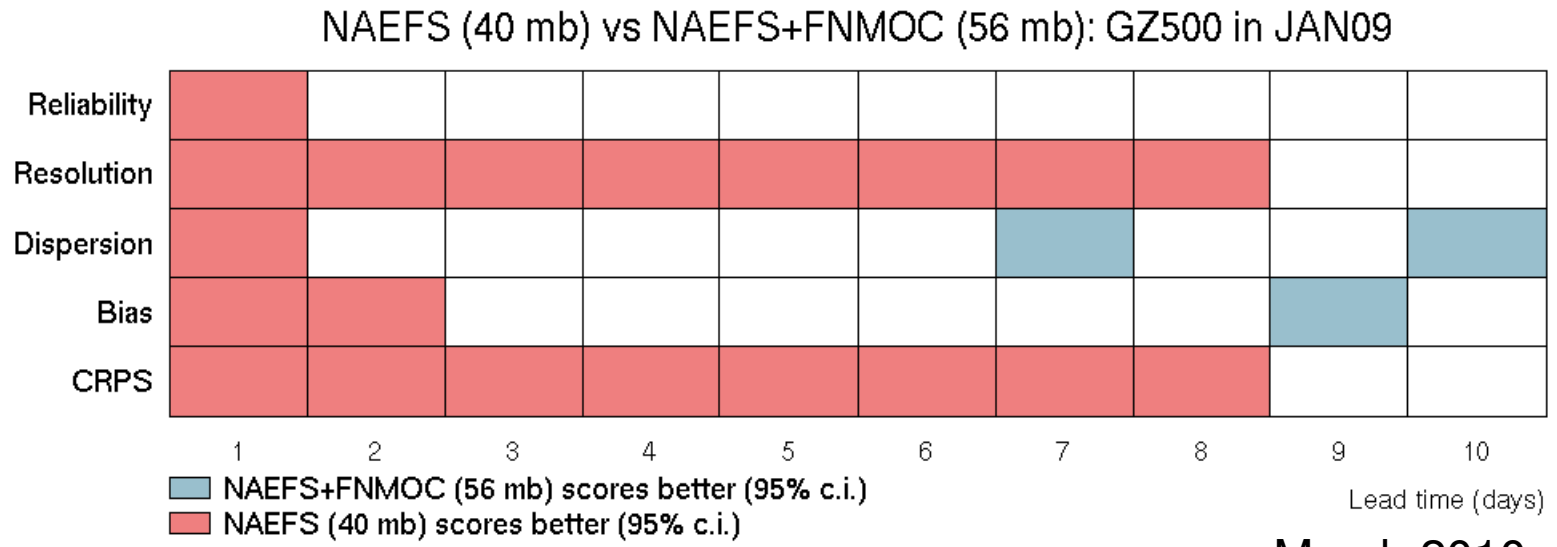


Comparison previous verification: heights at 500 hPa

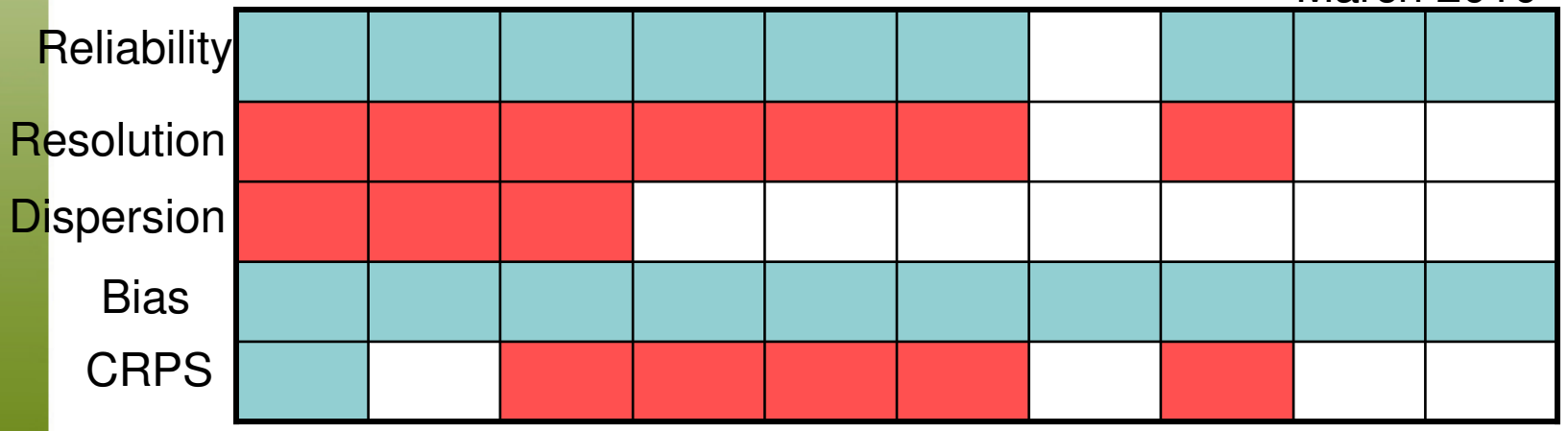




Comparison previous verification: heights at 500 hPa



March 2010

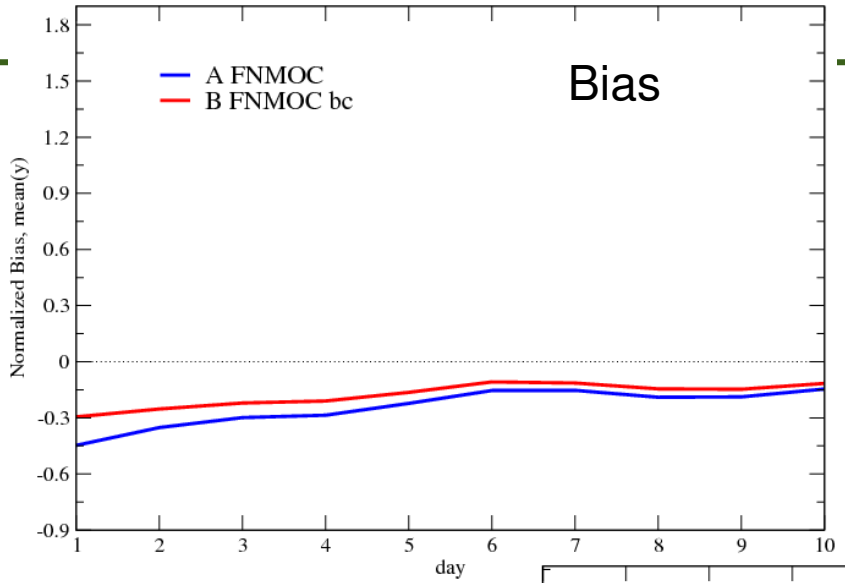


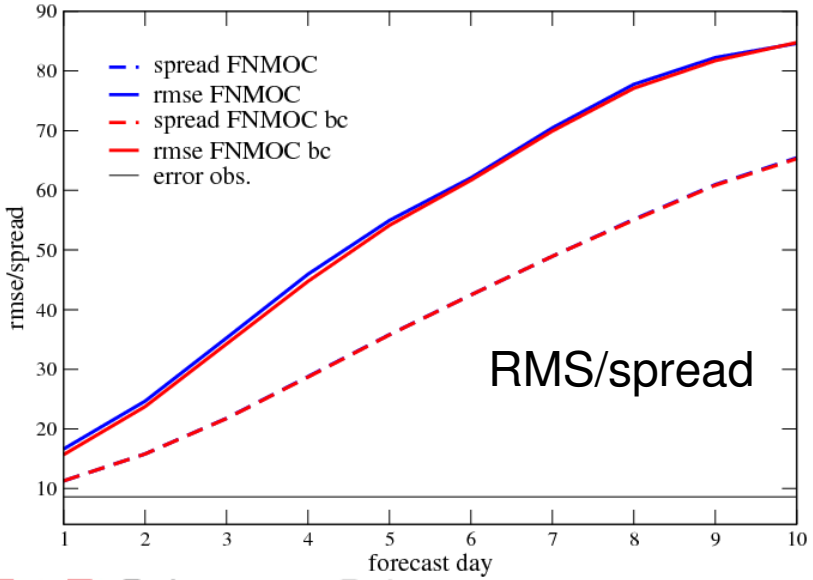
Impact of bias correction on FNMOC forecasts

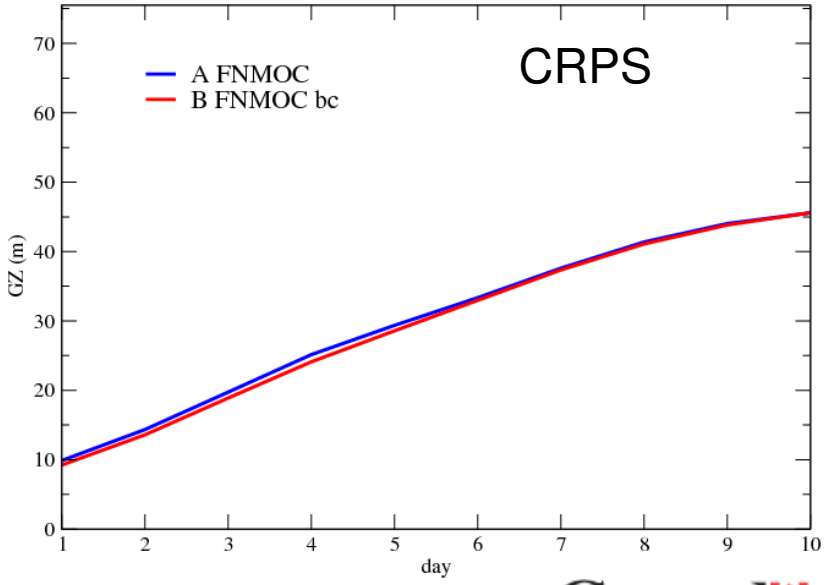
- Positive or neutral change for temperature and heights at all levels for bias(!), dispersion and CRPS
- Weak impact on winds
- As expected no change of the forecast spread (one model system)

Effect of bias correction on FNMOC forecasts

GZ500

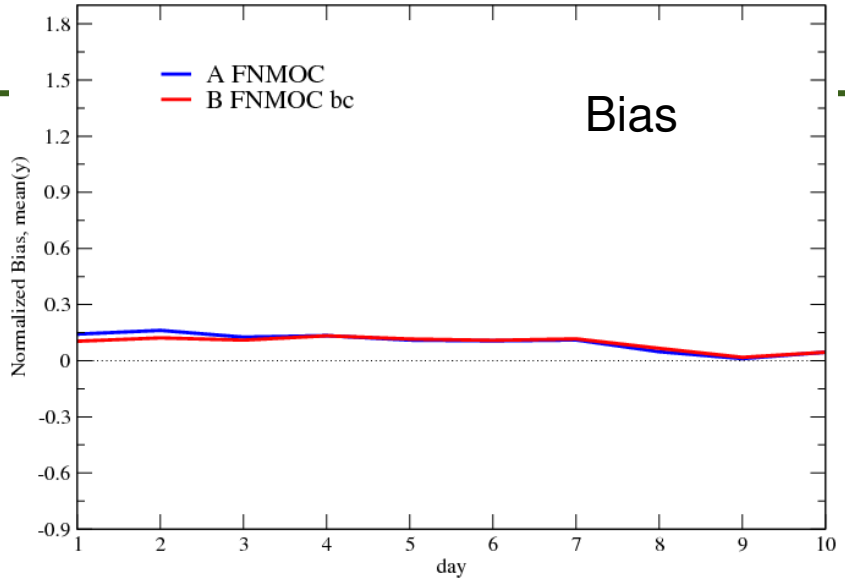


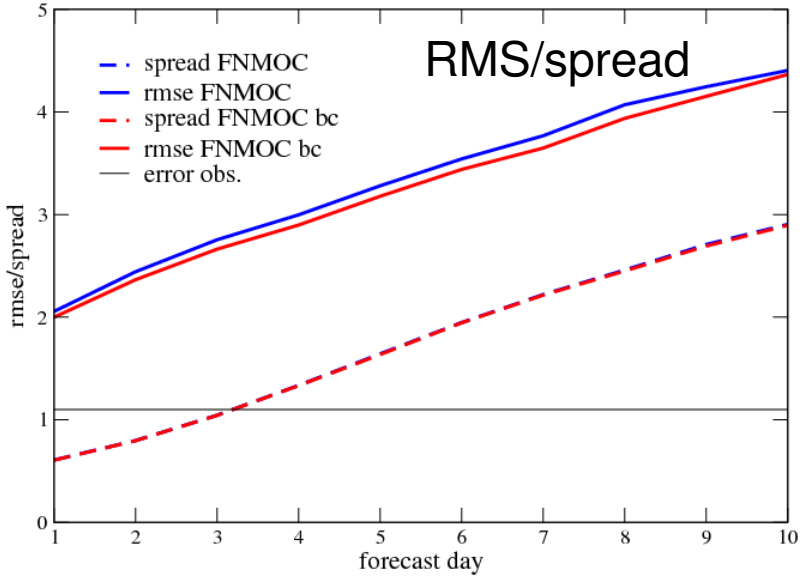


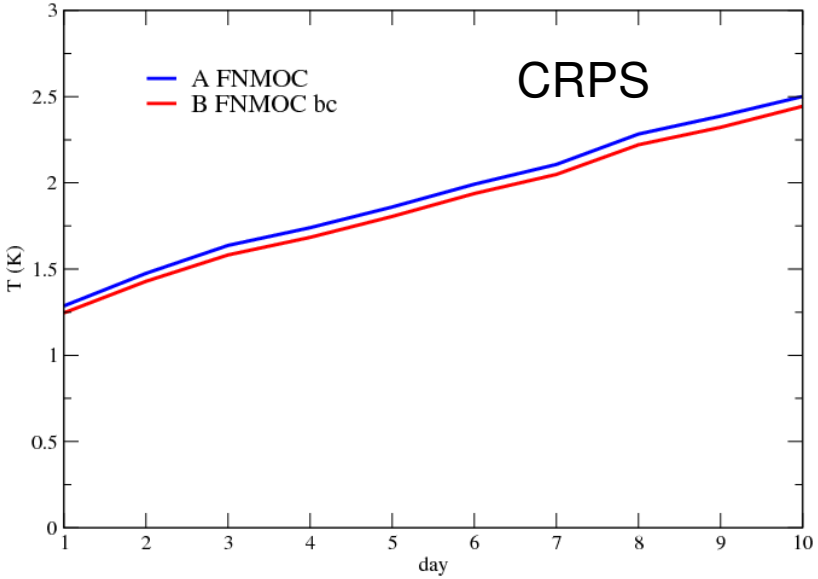


Effect of bias correction on FNMOC forecasts

TT925







Summary

- The addition of FNMOC would :
  - leads to improvement in reliability
  - slight reduced bias of temperature and heights in lower troposphere
  - general deterioration in dispersion, CRPS and resolution
- FNMOC system has a higher CRPS and worst dispersion than the other twos.
- RMS of the ensemble mean is inferior for all variables at all lead times to
  - CMC one except for heights at days 9-10
  - NCEP one except for temperature at 925 hpa at days 7-10 .
- Spread is
  - lower than CMC at all lead times for all fields
  - of the same order as NCEP for temperature at 850-925hPa and for winds at all levels.

Summary (2)

- The upgrade made to the FNMOC system has not solved all the problems as expected.
- Bias correction leads to improvement. This has to be evaluated in multi-centre ensemble.