





NAEFS Verification against observations: inclusion of FNMOC

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Outline

- New context
- Verification method
- Problems along the road...
 - Surface encoding from September 2011 to February 2012
 - Compression problem in February to April 2012
- Results for October 2011 to January 2012
 - Upper Air:
 - FNMOC EPS alone vs NCEP and CMC EPS alone
 - NAEFS vs NAEFS+FNMOC
 - comparison with last study
- Summary





New context

- The goal is to evaluate the impact of adding FNMOC members in the NAEFS ensemble.
- Since the verification done in 2010 some upgrades were done to the FNMOC system.
- In the current presentation, we will show our evaluation of the performance of the new FNMOC system during October 2011 to April 2012.
- This is the longest evaluation period (previously only one month of data was analysed, twice).
- Evaluation against observed data





Verification method (upper air)

- 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 (570-580 stations)
- Frequency: forecast issued every 12 hour (00Z and 12Z)
- Lead time : every 24 hours up to 15 days (24h, 48h, ... 360h)
- Raw forecasts (no bias correction)





Verification method

 À la Candille et al.(2007), Candille (2009) and Candille et al. (2010)

Reduced Centred random variable:

- Dispersion = standard deviation of RCRV (we want 1.0)
- Ratio of Error of the ensemble mean over spread (plus observational error)

Continuous Rank Probabilistic Score:

- CRPS = difference between forecast CDF and observation
- Confidence interval by block bootstrapping (5-95%), number of forecast per block = 3 (36 hours)





Verification method

Caveats:

- Over land only (radiosondes and surface stations network)
- No verification of precipitation
- No verification of bias corrected fields

And then some problems...

So, no surface verification





Problems along the road

1. Surface:

- In September 2011, a change in the encoding of surface fields has created problems with our GRIB decoding of FNMOC data.
- This was solved in February 2012 only.
- This has prevented us from doing surface evaluation from September 2011 to the end of February 2012.
- 2. JPEG compression
 - Starting early February (on the 3rd) some fields (T925, T850, UV 10 m, ES 2m ?etc.) from GRIB files were quite strange.
 - This was fixed by turning off the JPEG compression (April 11th 2012). Therefore files are now fine but bigger.
 - This is putting a lot of doubts on many fields over the period February to April 2012. So, I will not discuss the verification during this period.





CMC vs FNMOC in March 2012



CMC vs FNMOC in March 2012



Problem in GRIB files from FNMOC

Observations and FNMOC EPS 24hr forecasts of T 925 at station 70308 in Alaska in February 2012





Environment Environnement Canada Canada

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Problem in GRIB files from FNMOC



Problem is resolved since April 11 by turning off GRIB compression but files are now bigger



So going back before the problem: <u>CMC/NCEP vs FNMOC in January 2012</u>



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CMC/NCEP vs FNMOC in January 2012



CMC/NCEP vs FNMOC in January 2012



Summary of individual EPS comparison

- FNMOC EPS is usually inferior to the NCEP and CMC ones during week 1 (6 to 24 hours of predictability)
- Usually in week 2 the FNMOC skill is closer to the other 2 centers.
- Anyhow, does the addition of FNMOC in NAEFS can lead to improvement ?
 - Let's see NAEFS (40 members) vs NAEFS+FNMOC (60 members)
 - Comparison with previous study





Dispersion of NAEFS vs NAEFS+FNMOC

NAEFS in **BLUE** NAEFS+FNMOC in **RED**

gz at 500 mb level (disp)





Summarizing analysis

- Statistically significant if confidence intervals do not cross the zero line.
- Green = FNMOC addition leads to significant improvement
- Red = FNMOC addition leads to significant degradation
- White = no statistically significant difference





| | Dispersion on global scale, significantly positive = green, negative = red | | | | | | | | | | | | | | | red | | | | |
|-----------------|---|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|
| V A r | T 2 5 0 | T 5 0 0 | T 8 5 0 | T 9 2 5 | Z 2 5 0 | Z 5 0 0 | Z 8 5 0 | Z 9 2 5 | U 2 5 0 | U 5 0 0 | U 8 5 0 | U 9 2 5 | V 2 5 0 | V 5 0 0 | V 8 5 0 | V 9 2 5 | ES 2 5 0 | ES 5 0 0 | ES 8 5 0 | ES 9 2 5 |
| Oct1 1 W1 | | | | | | | | | | | | | | | | | | | | |
| Nov | | | | | | | | | | | | | | | | | | | | |
| 11 W1 | | | | | | | | | | | | | | | | | | | | |
| W2 Dec | | | | | | | | | | | | | | D | | | | | | |
| 11 W1 | | | | | | | | | | | | | | 2- | | | | | | |
| W2 Jan | | | | | | | | | | | | | | | | | | | | |
| 12 W1 | | | | | | | | | | | | | | | | | | | | |
| W2 | | | | | | | | | | | | | | | | | | | | |

CRPS of NAEFS vs NAEFS+FNMOC



CRPS of NAEFS vs NAEFS+FNMOC

CRPS NAEFS vs NAEFS+FNMOC

CRPS on global scale, significantly positive = green, negative = red

| V A r | T 2 5 0 | T 5 0 0 | T 8 5 0 | T 9 2 5 | Z 2 5 0 | Z 5 0 0 | Z 8 5 0 | Z 9 2 5 | U 2 5 0 | U 5 0 0 | U 8 5 0 | U 9 2 5 | V 2 5 0 | V 5 0 0 | V 8 5 0 | V 9 2 5 | ES 2 5 0 | ES 5 0 0 | ES 8 5 0 | ES 9 2 5 |
|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|
| Oct11 W1 | | | | | | | | | | | | | | | | | | | | |
| W2 | | | | | | | | | | | | | | | | | | | | |
| Nov 11 W1 | | | | | | | | | D4 - | | | | |
| W2 | | | | | | | | | | | | | | | | | | | | |
| Dec 11 W1 | | | | | | | | | | | | | | | | | | | | |
| W2 | | | | | | | | | | | | | | | | | | | | |
| Jan 12 W1 | | | | | | | | | D4 - | D4 - | D4 - | D4 - | | | | | | | | |
| W2 | | | | | | | | | | | | | | | | | | | | |

Summary

- Problems related to GRIB files have cost 2.5 months of evaluation for upper air fields and 5 months for the surface fields.
- No reliable surface verification yet
- Upper air improvements since the 2010 evaluation period
- Still more CONS than PROS on global scale
- Might be different at for some specific locations.

Bonus

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CMC vs FNMOC in March 2012

CMC vs FNMOC in March 2012

Too tough to be the 3rd buddy?

 The analysis was done in taking NCEP and CMC as third ingredient of the mix instead of one of the first twos.

Dispersion on global scale, significantly positive = green, negative = red CMC as the 3rd model

| V A r | T 2 5 0 | T 5 0 0 | T 8 5 0 | T 9 2 5 | Z 2 5 0 | Z 5 0 0 | Z 8 5 0 | Z 9 2 5 | U 2 5 0 | U 5 0 0 | U 8 5 0 | U 9 2 5 | V 2 5 0 | V 5 0 0 | V 8 5 0 | V 9 2 5 | ES 2 5 0 | ES 5 0 0 | ES 8 5 0 | ES 9 2 5 |
|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|
| Jan1 2 W1 | | | | | | | | | | | | | | | | | | | | |
| W2 | | | | | | | | | | | | | | | | | | | | |
| Feb 12 W1 | | | | | D 3- | | | | | | | | | | | | | | | |
| W2 | | | | | | | | | | | | | | | | | | | | |
| Mar 12 W1 | | D 3- | | | D 3- | | | | | | | | | | | | | | | |
| W2 | | | | | | | | | | | | | | | | | | | | |

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CRPS on global scale, significantly positive = green, negative = red **CMC as the 3rd model**

| V | Т | Т | Т | Т | Ζ | Z | Z | Ζ | U | U | U | U | V | V | V | V | ES | ES | ES | ES |
|-----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|----|----|----|
| А | 2 | 5 | 8 | 9 | 2 | 5 | 8 | 9 | 2 | 5 | 8 | 9 | 2 | 5 | 8 | 9 | 2 | 5 | 8 | 9 |
| r | 5 | 0 | 5 | 2 | 5 | 0 | 5 | 2 | 5 | 0 | 5 | 2 | 5 | 0 | 5 | 2 | 5 | 0 | 5 | 2 |
| | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 |
| Jan1 2 | | | | | | | | | | | | | | | | | | | | |
| W1 | | | | | | | | | | | | | | | | | | | | |
| W2 | | | | | | | | | | | | | | | | | | | | |
| Feb | | | | | | | | | | | | | | | | | | | | |
| 12 W/1 | | | | | | | | | | | | | | | | | | | | |
| VVI | | | | | | | | | | | | | | | | | | | | |
| W2 | | | | | | | | | | | | | | | | | | | | |
| Mar | | | | | | | | | | | | | | | | | | | | |
| 12 W1 | | | | | | | | | | | | | | | | | | | | |
| W2 | | | | | | | | | | | | | | | | | | | | |

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