Hybrid DA experiments and towards a different/better ensemble

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Overview

- Effects of a *bigger* ensemble
  - Hybrid-4DVar and hybrid-4DEnVar experiments
    - 23 members v 176 members
    - Hybrid covariance weighting experiments
- Developing a *different (a better?)* ensemble
  - An ensemble of EnVars
  - Compare with ETKF

Control trial (KMA operational)

- Hybrid-4DVar
  - Analysis resolution = 432 x 325 x 70 (N216) ~53Km
  - Hybrid weighting: Bc/Be = 100/30
  - Localisation: 1200Km → 0.61, 2400Km → 0.14
- Forecast
  - 1024 x 769 x 70 resolution (N512) ~22Km
- Ensemble input = 23 member localised ETKF
  - 640 x 481 x 70 (N320) ~35Km
- Trials 8th -31st August 2012

- Met Office: 44 ensemble members at N400 resolution
- Met Office: hybrid-4DVAR at N320, UM Forecast at N768

How to close the gap?

- Andrew discussed
  - different initialisation techniques
- A different ensemble generation method

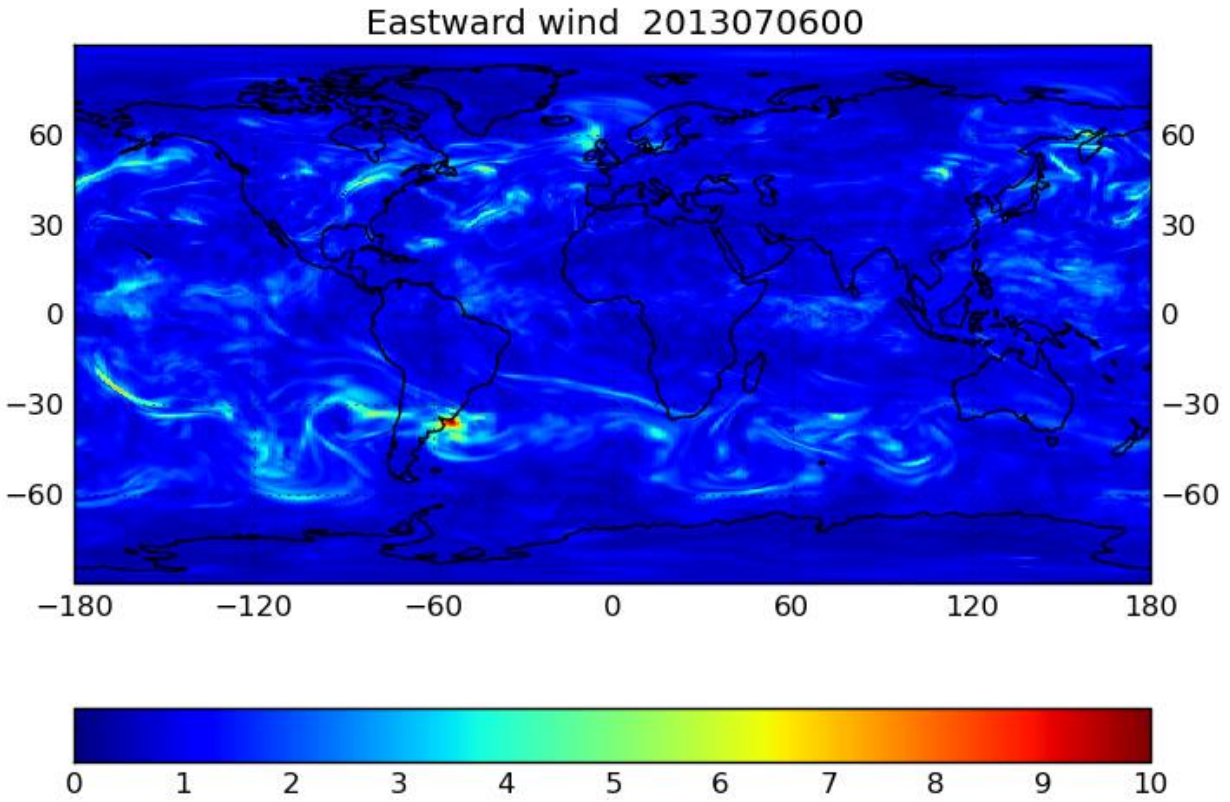
Cost of EDA

- Cheaper DA method now available (4DEnVar)
- EDA is affordable
  - Takes ~10mins to produce 22 ensemble members
  - 70 iterations for mean analysis
  - 30 iterations for ensemble perturbations
  - Use samples at T-3hr,T+0hr, T+3hr
  - Single hybrid-4DVar at same res takes ~10mins
- ETKF uses adaptive inflation scheme

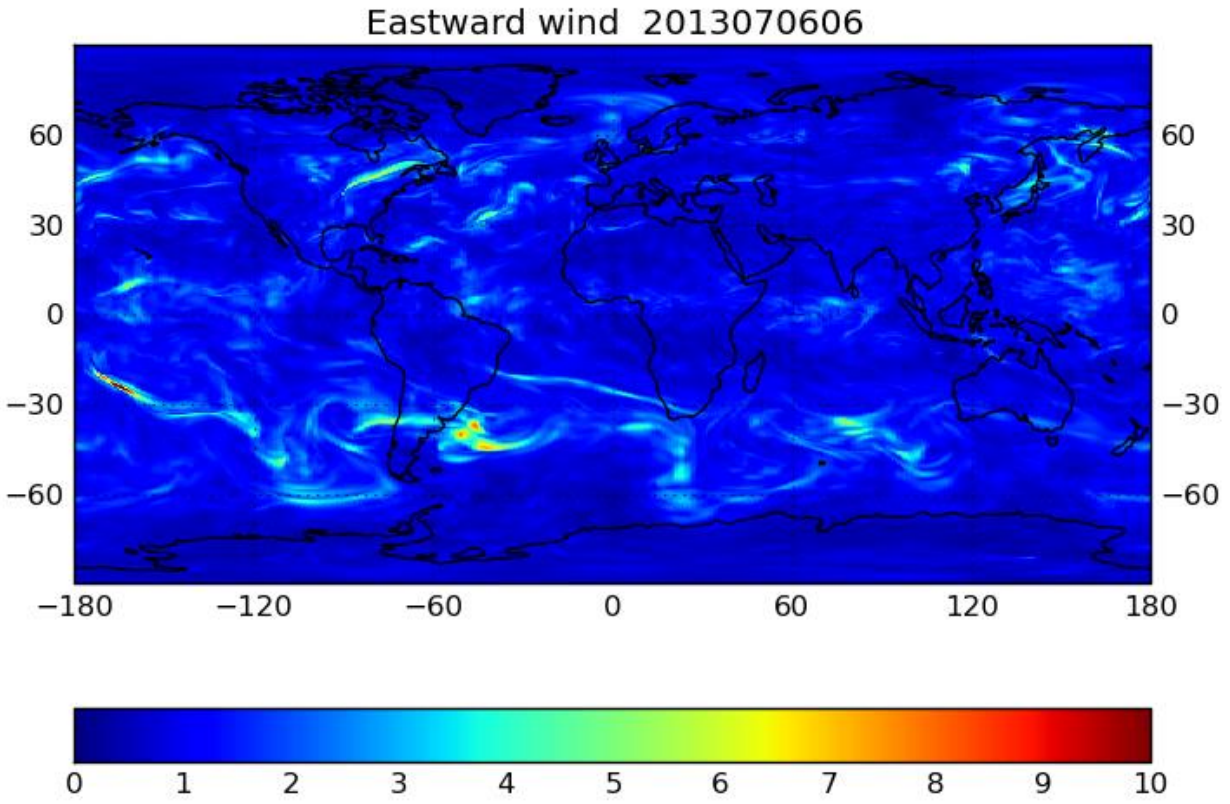
$$\mathrm{trace}((\mathbf{y}-\overline{\mathbf{Hx}})(\mathbf{y}-\overline{\mathbf{Hx}})^T) = \alpha\,\mathrm{trace}((\mathbf{HZ}_f)(\mathbf{HZ}_f)^T) + \mathrm{trace}(\mathbf{R})$$

- Uses sondes and ATOVS to estimate inflation

Spread in the EDA at ~500hPa



Spread in the EDA at ~500hPa



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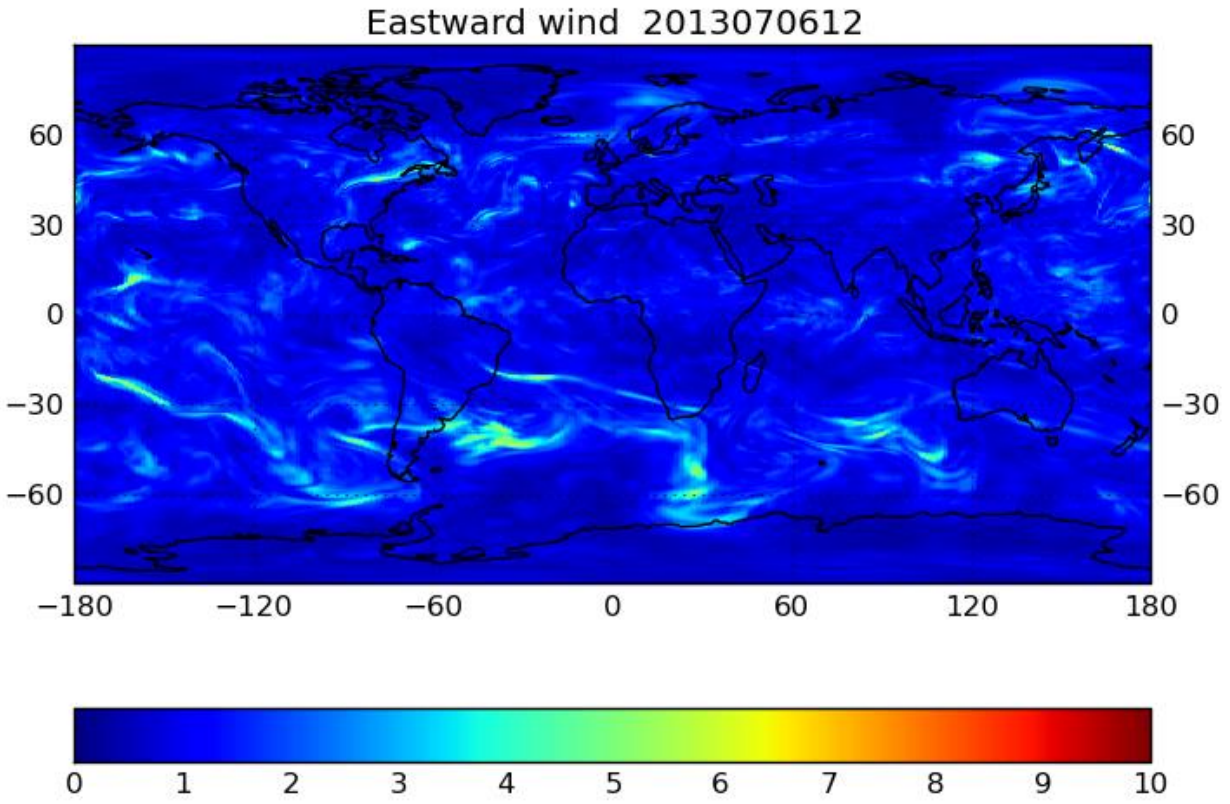
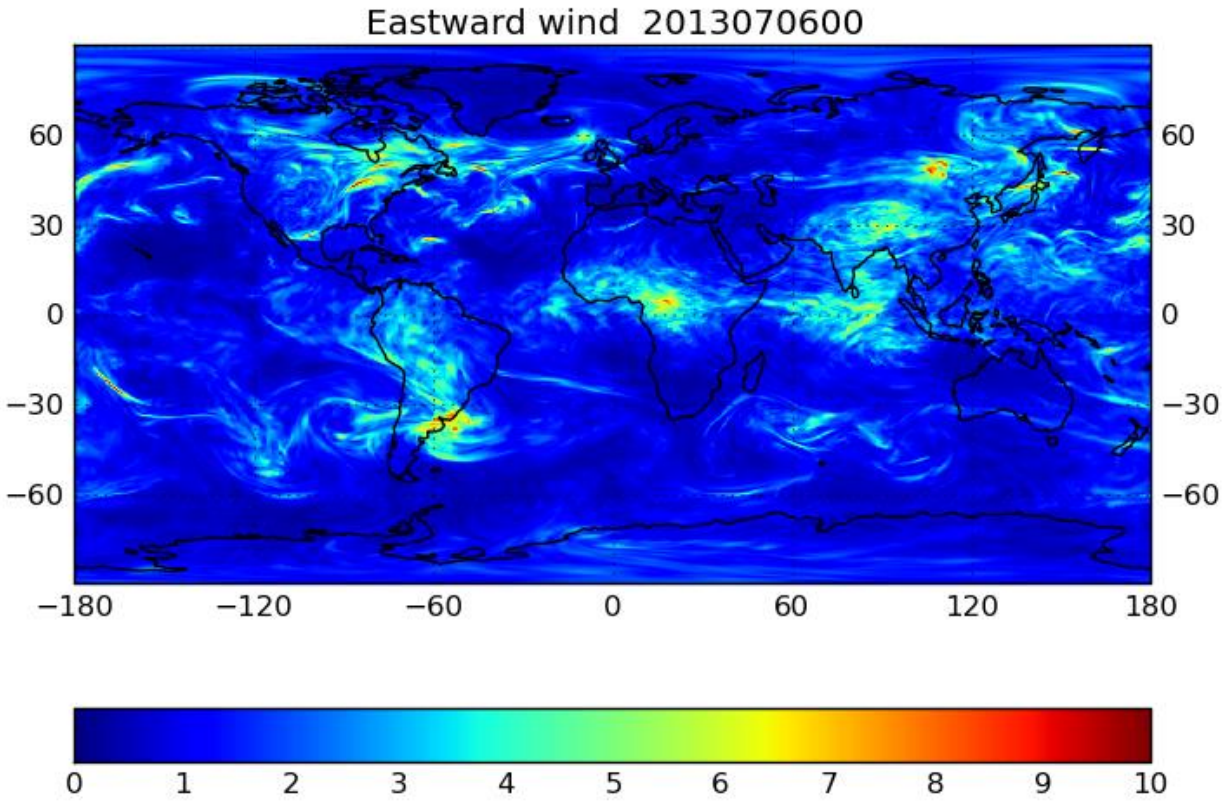
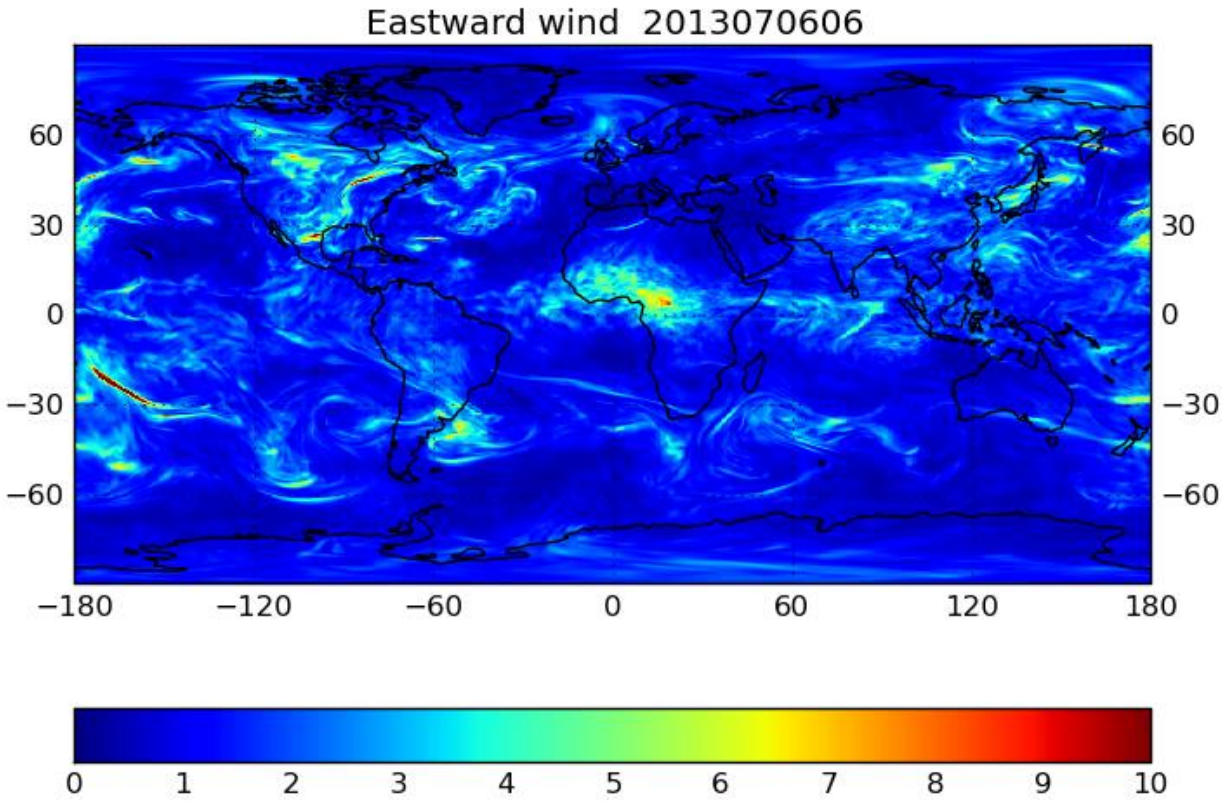


Spread in the ETKF at ~500hPa



Spread in the ETKF at ~500hPa



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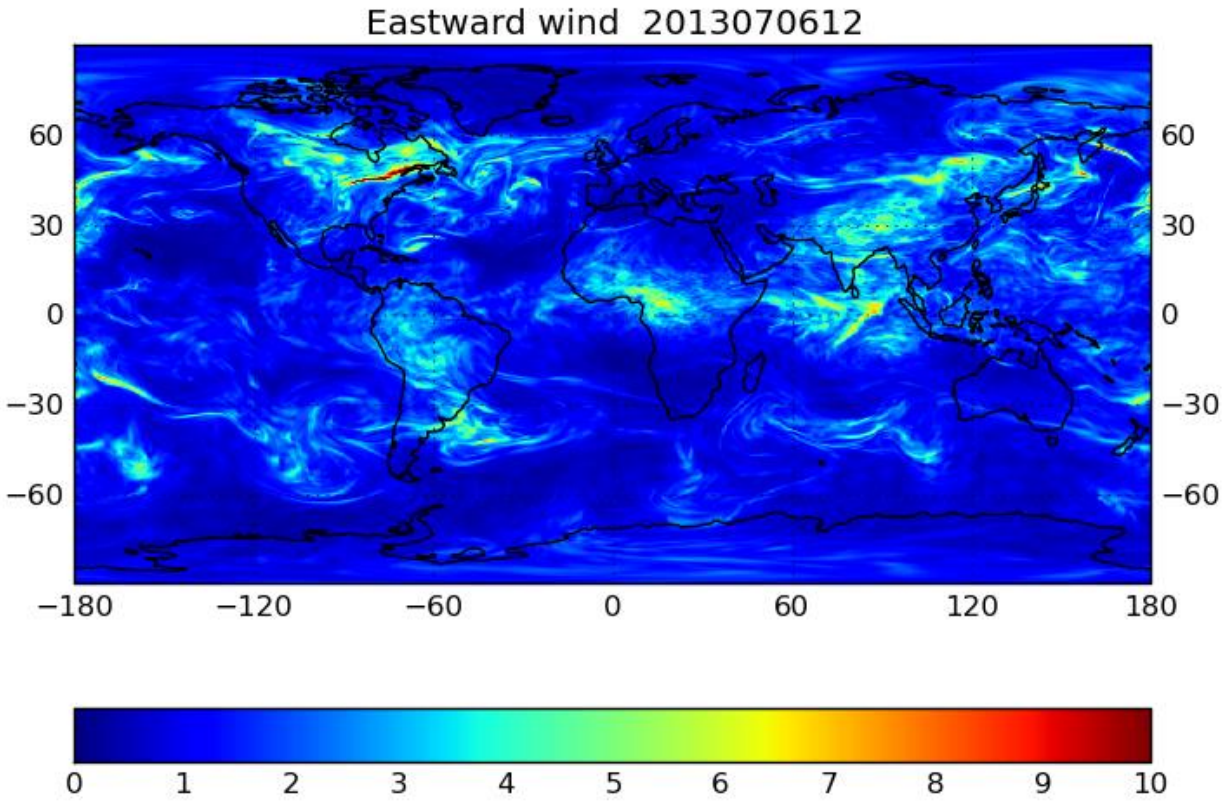
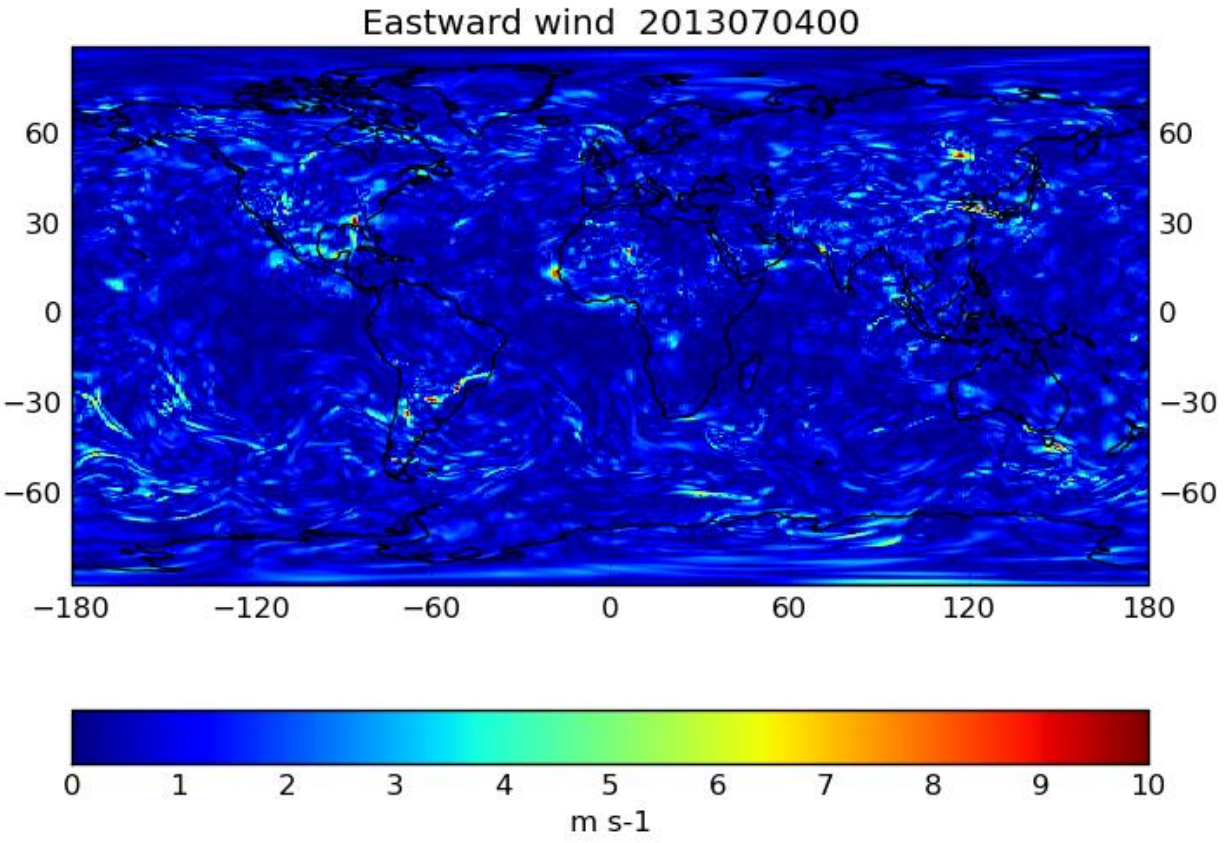
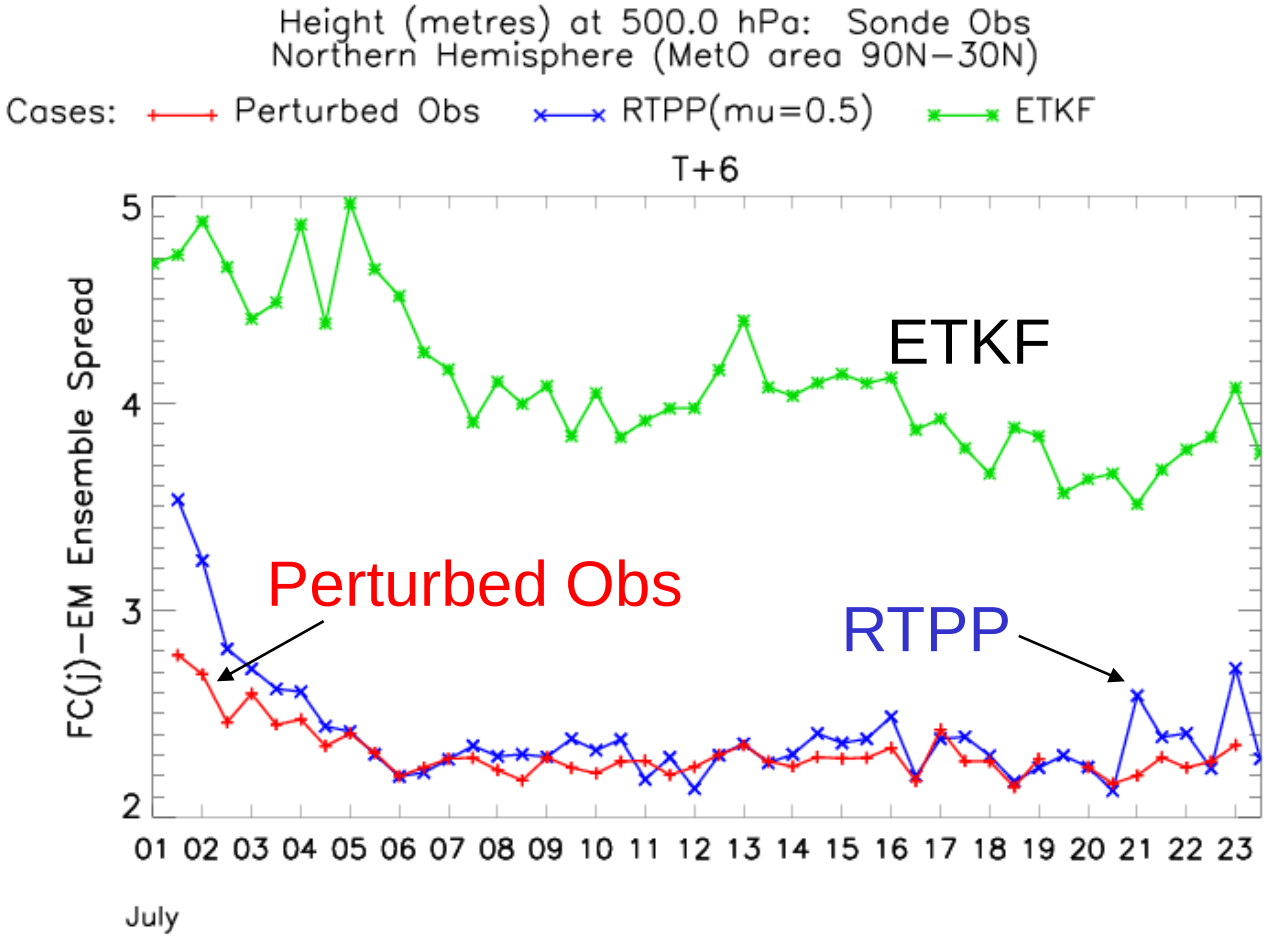


Forecast - analysis

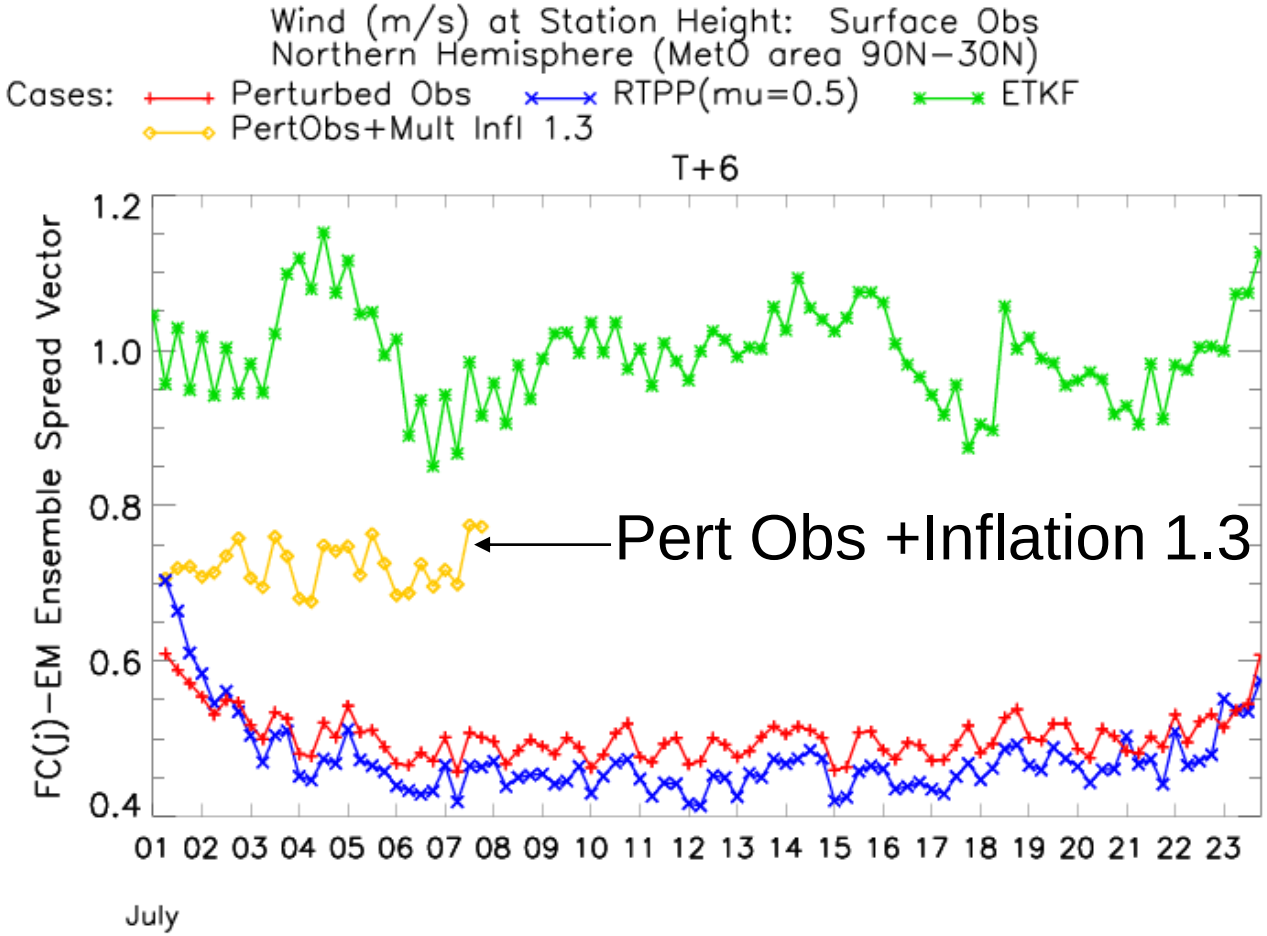


Pert obs v's relax to prior pert



RTPP: $\mu\left(x_f^i - \overline{x}_f\right) + (1-\mu)\left(x_a^i - \overline{x}_a\right) \mapsto x_a^i - \overline{x}_a$

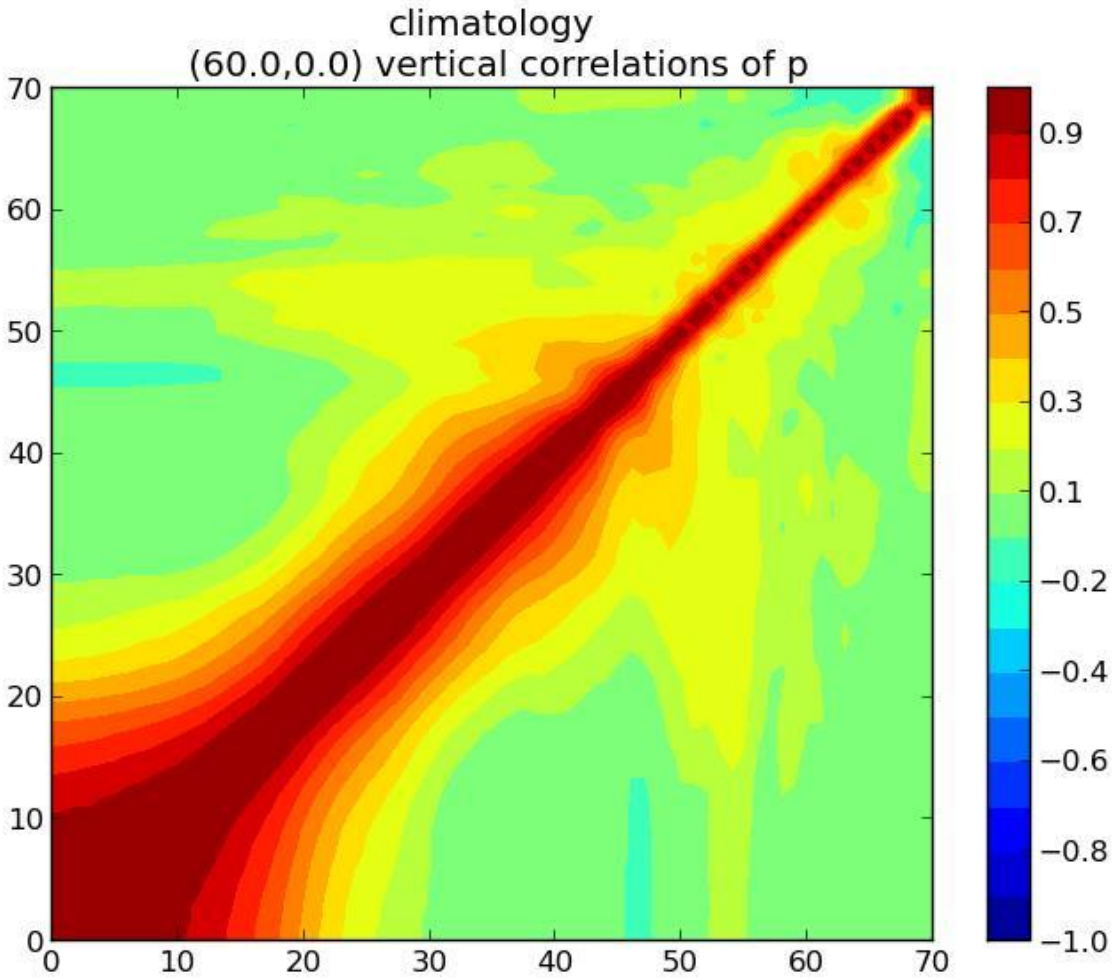
Multiplicative Inflation



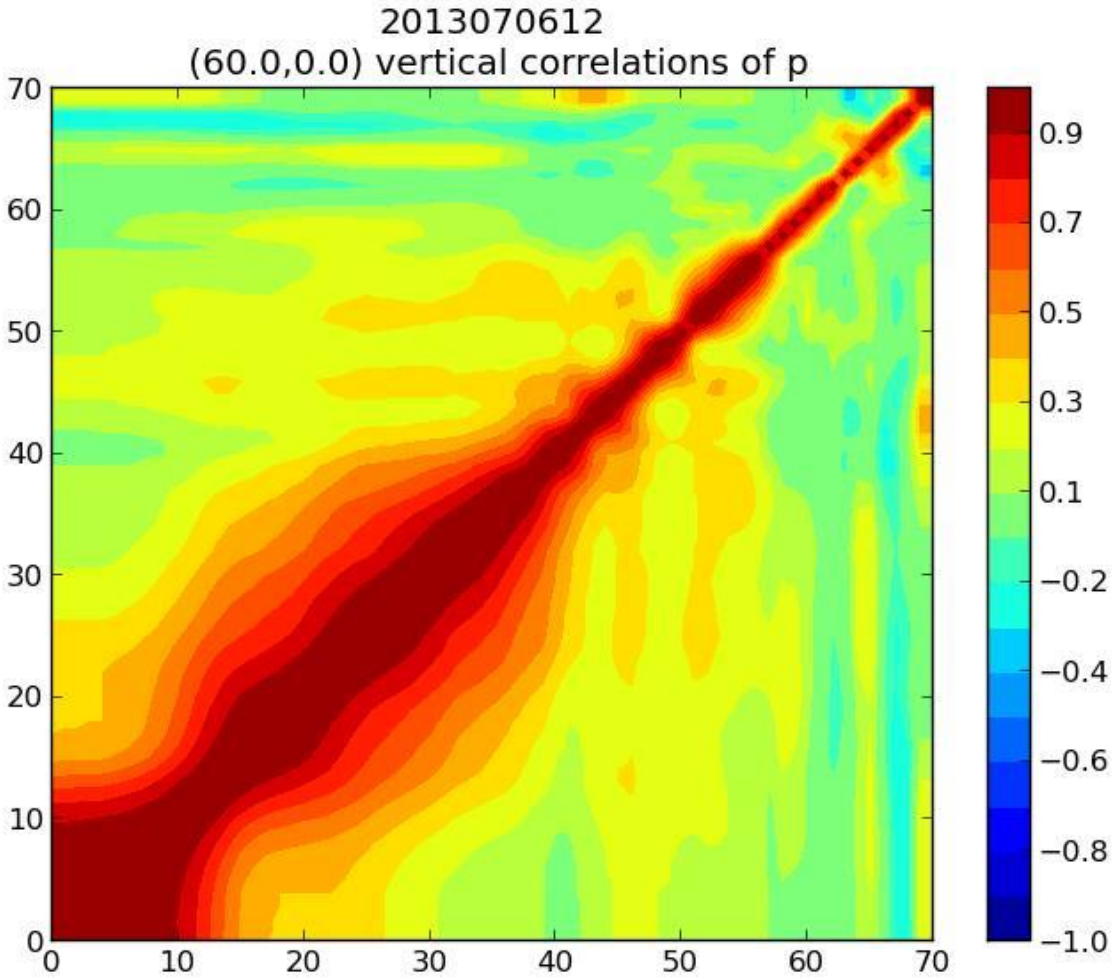
Further work

- Recentre around high-res deterministic?
- Additive inflation?
- Multiplicative inflation - adaptive, fixed, relax-to-prior-spread?
- Demonstrate better 'flow' from ensemble
  - Repeat single-obs tests (in Andrew's talk)
- Demonstrate better correlations + length scales

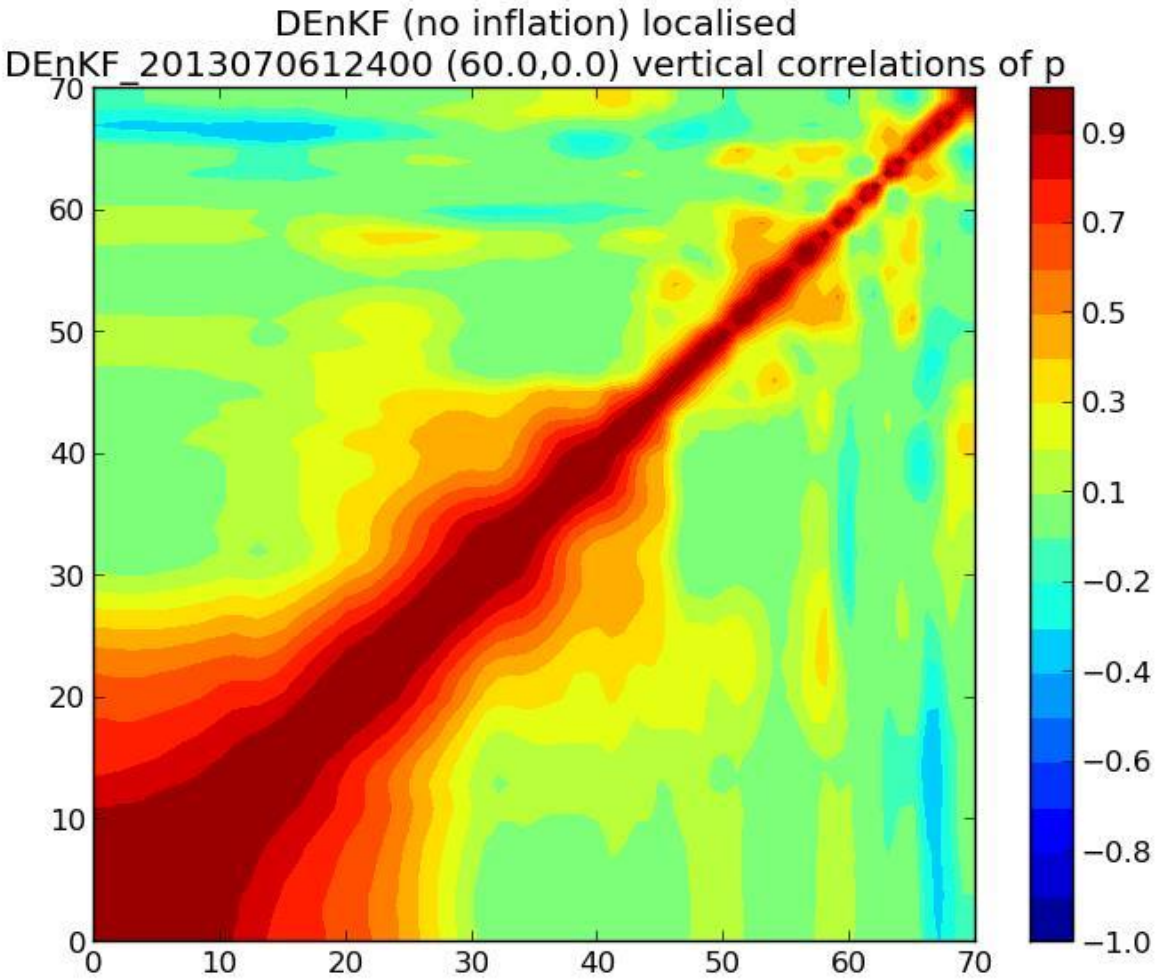
Climatology correlation in p



ETKF correlation in p



EDA correlation in p

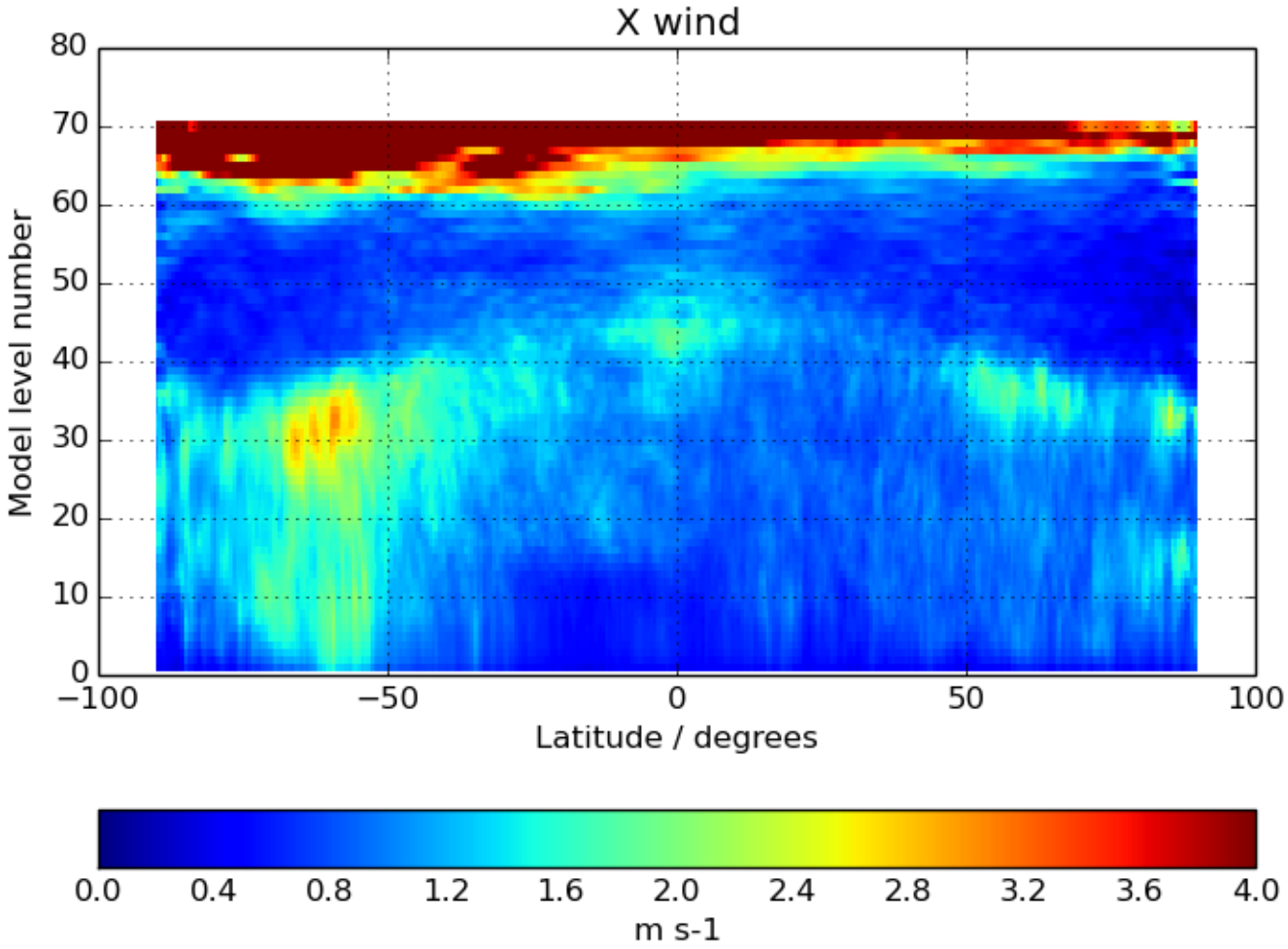


Trial verification

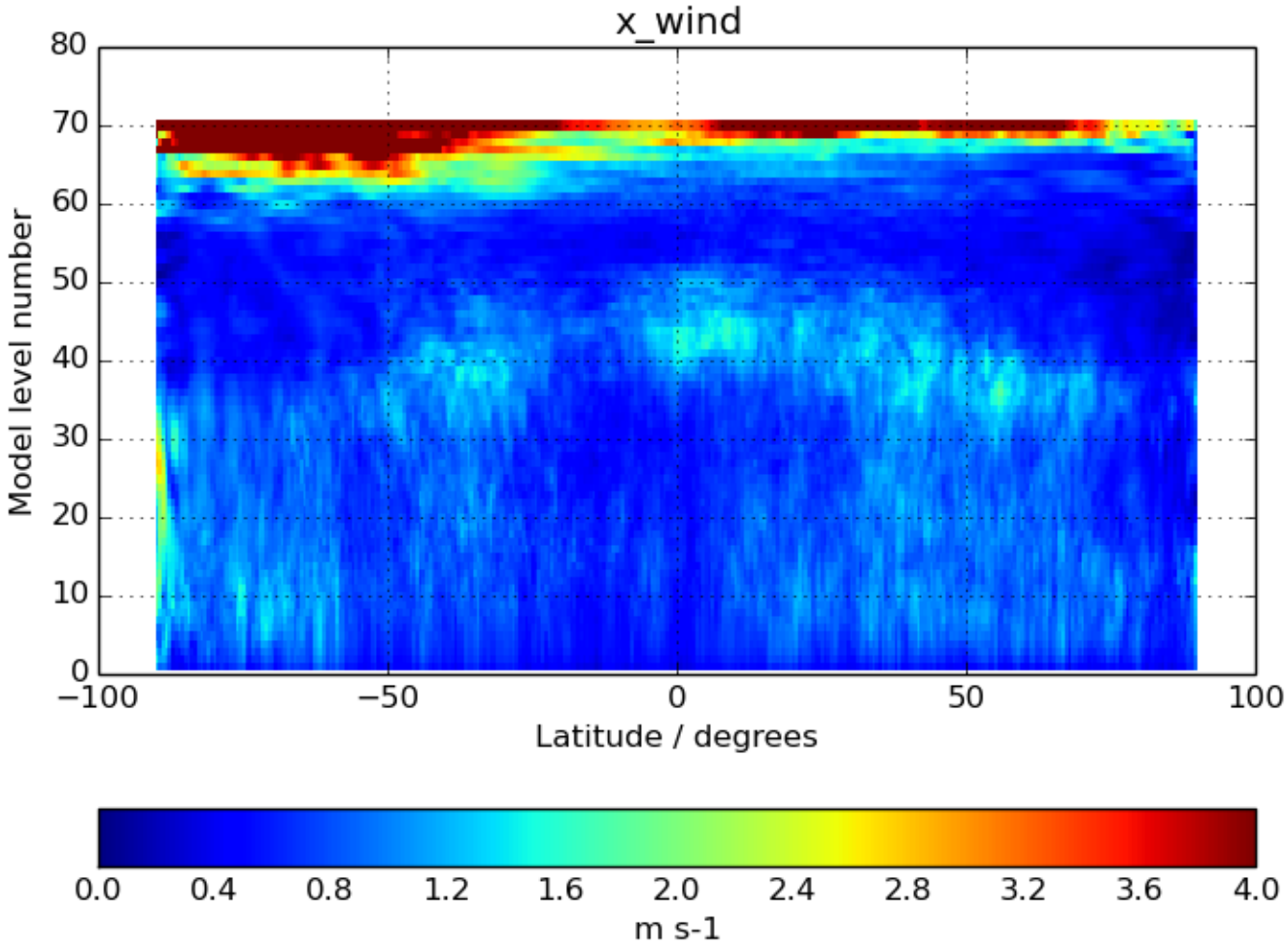
- Verification against **observations** only over the following 123 variables:

Field	Levels (hPa)	Forecast ranges (hrs)
PMSL	-	T+24, T+48, T+72, T+96, T+120, T+144
Height	850, 700, 500, 250, 100, 50	T+24, T+48, T+72, T+96, T+120, T+144
Wind	850, 700, 500, 250, 100, 50	T+24, T+48, T+72, T+96, T+120, T+144
Temperature	850, 700, 500, 250, 100, 50	T+24, T+48, T+72, T+96, T+120, T+144
RH	850, 700, 500	T+24, T+48, T+72

Zonal wind spread in EDA



Forecast – analysis



Zonal wind spread in ETKF