



How much model error in a 6h Ensemble forecast?

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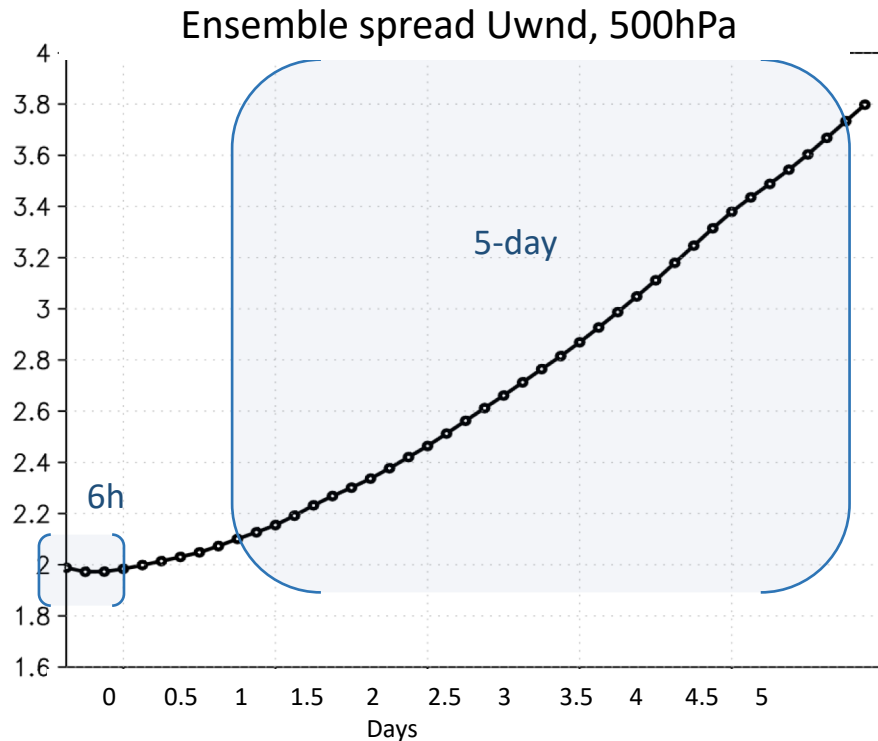
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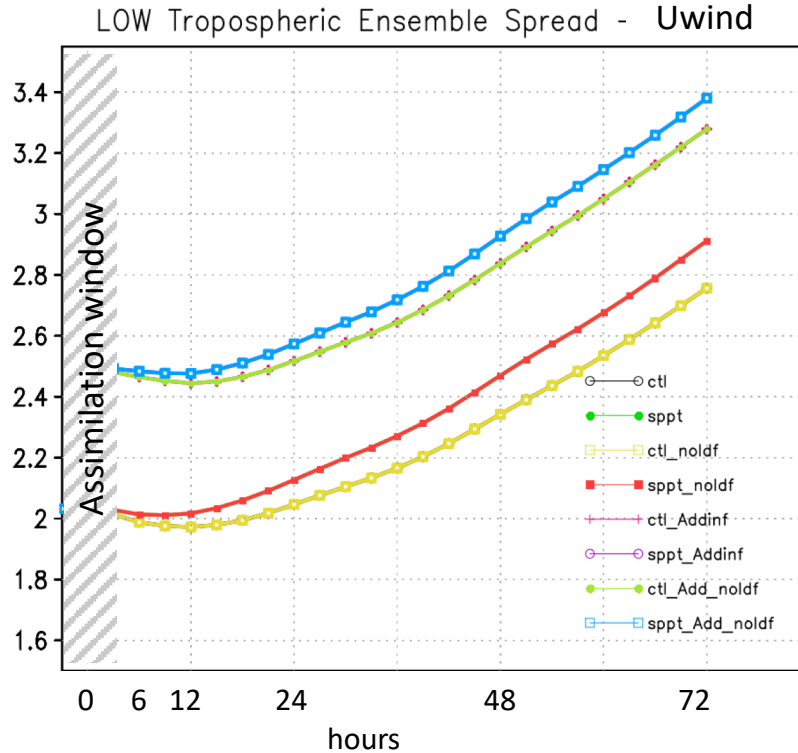


Motivation



- Accepted idea: a good ensemble is able to represent the time evolution of the uncertainty, and that it implicitly accounts for both the initial condition and model errors in what it encompasses as forecast error.
- **Can a short 6h model integration capture/accurately represent the model error component of the forecast error?**

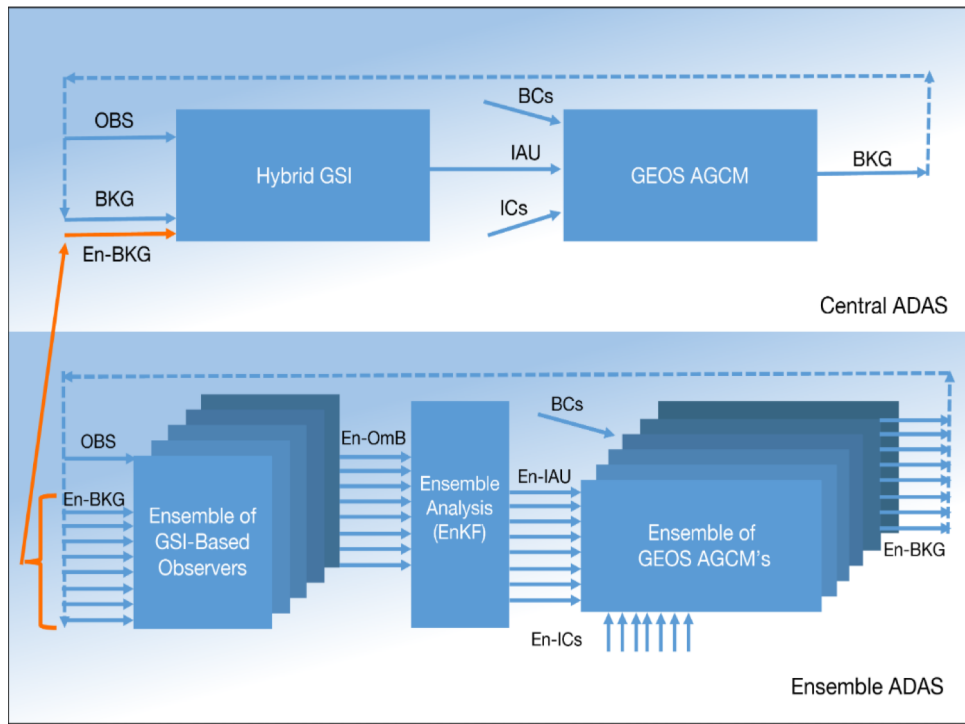
Motivation



Different perturbation / initialization scenarios! **Same growth shape.**



Ensemble-Variational Hybrid 4DEnVar



Modern

Sophisticated

Complex

Complicated

Unsustainable?

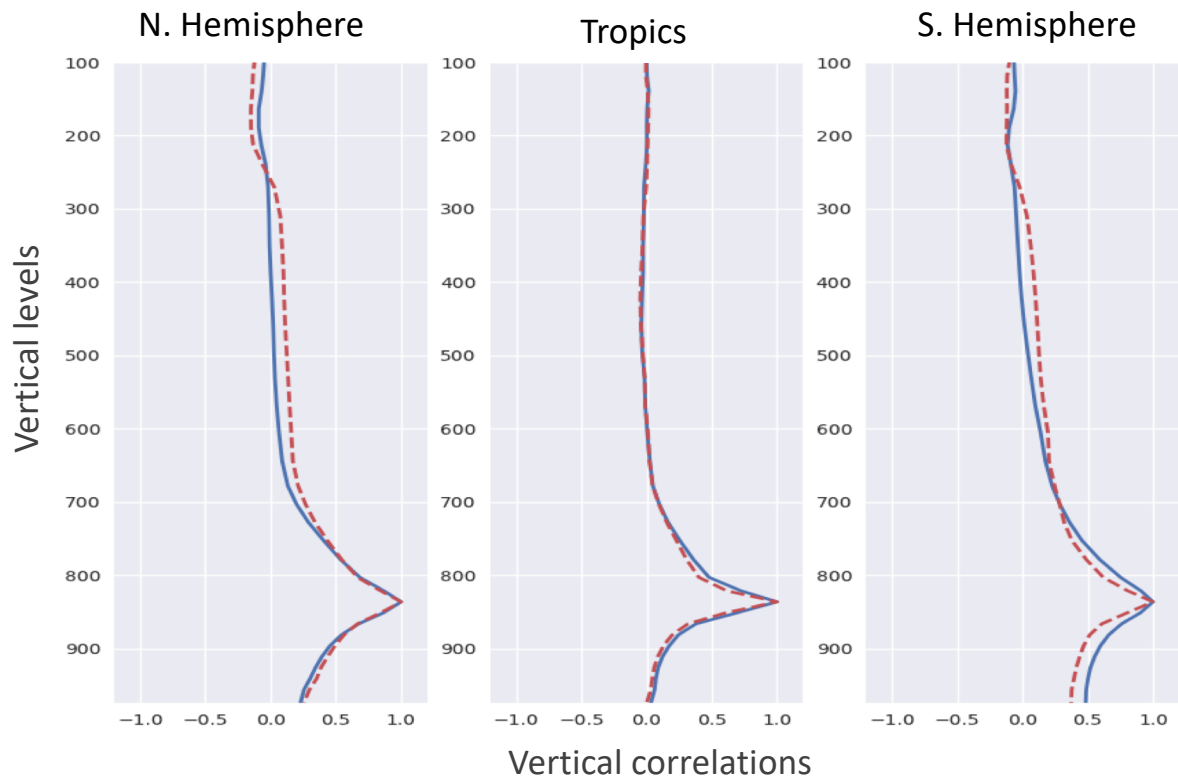


Filter-Free hybrid scheme

Vertical correlations

Temperature
~830mb

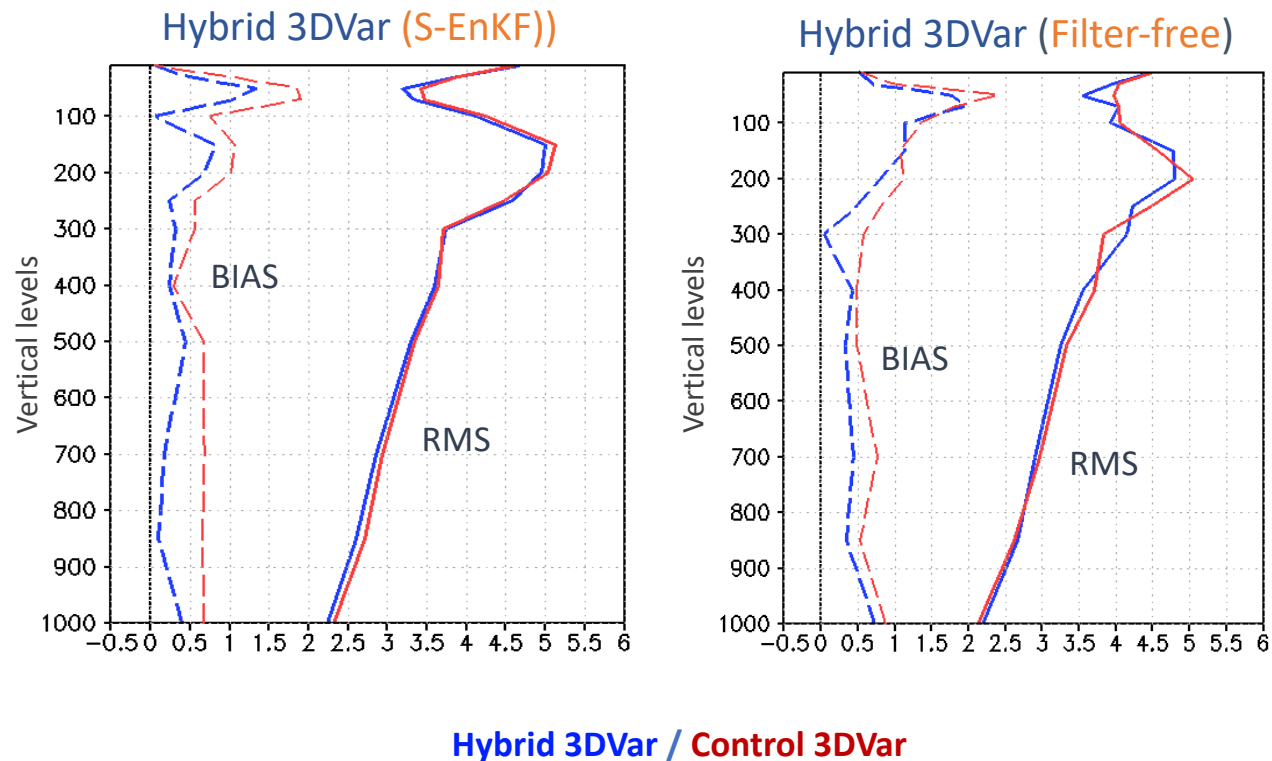
----- EnKF-based ensemble
_____ Filter-Free ensemble



Filter-Free hybrid scheme

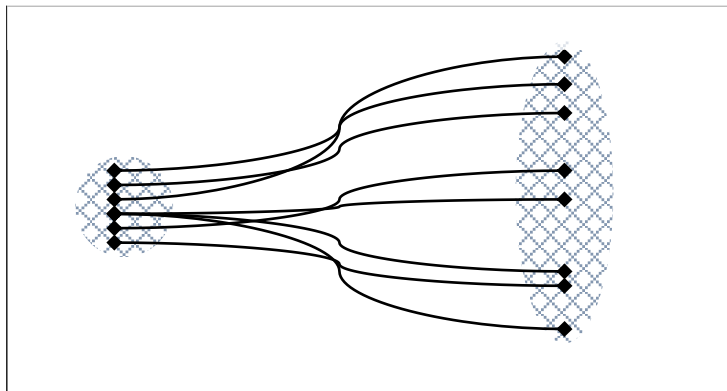
Innovation statistics

(Uwind tropics)

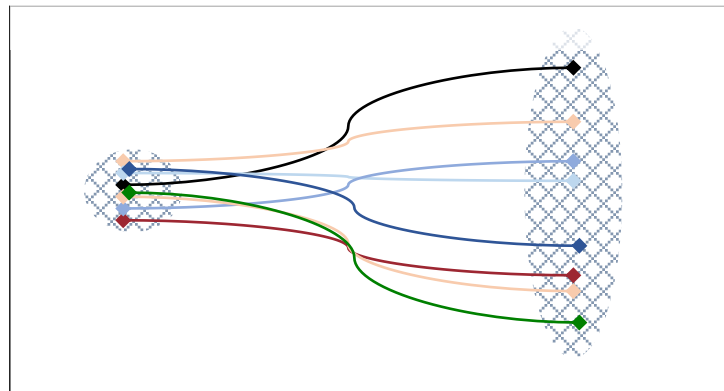


It's all about representing uncertainties within the assimilation window

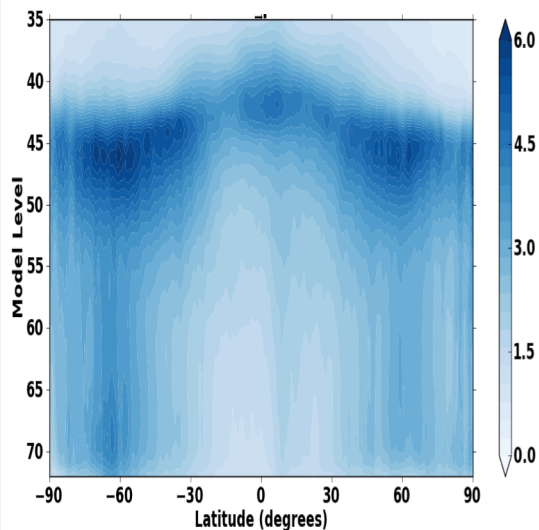
Uncertainties in initial conditions
(Additive inflation)



Uncertainties in model representation of
certain processes (SPPT, SKEB)

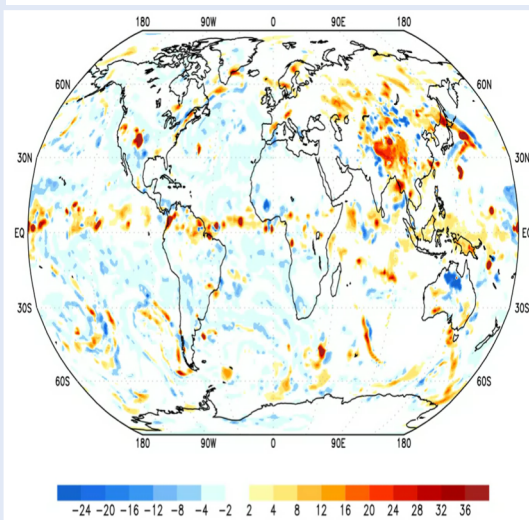


Zonal mean NMC-pert RMS – Uwnd



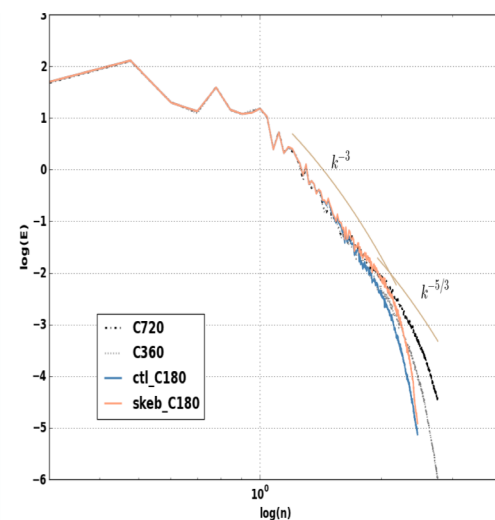
Forecast differences
{f48-f24}

Tendency DTD Physics, 700 mb (K/day)



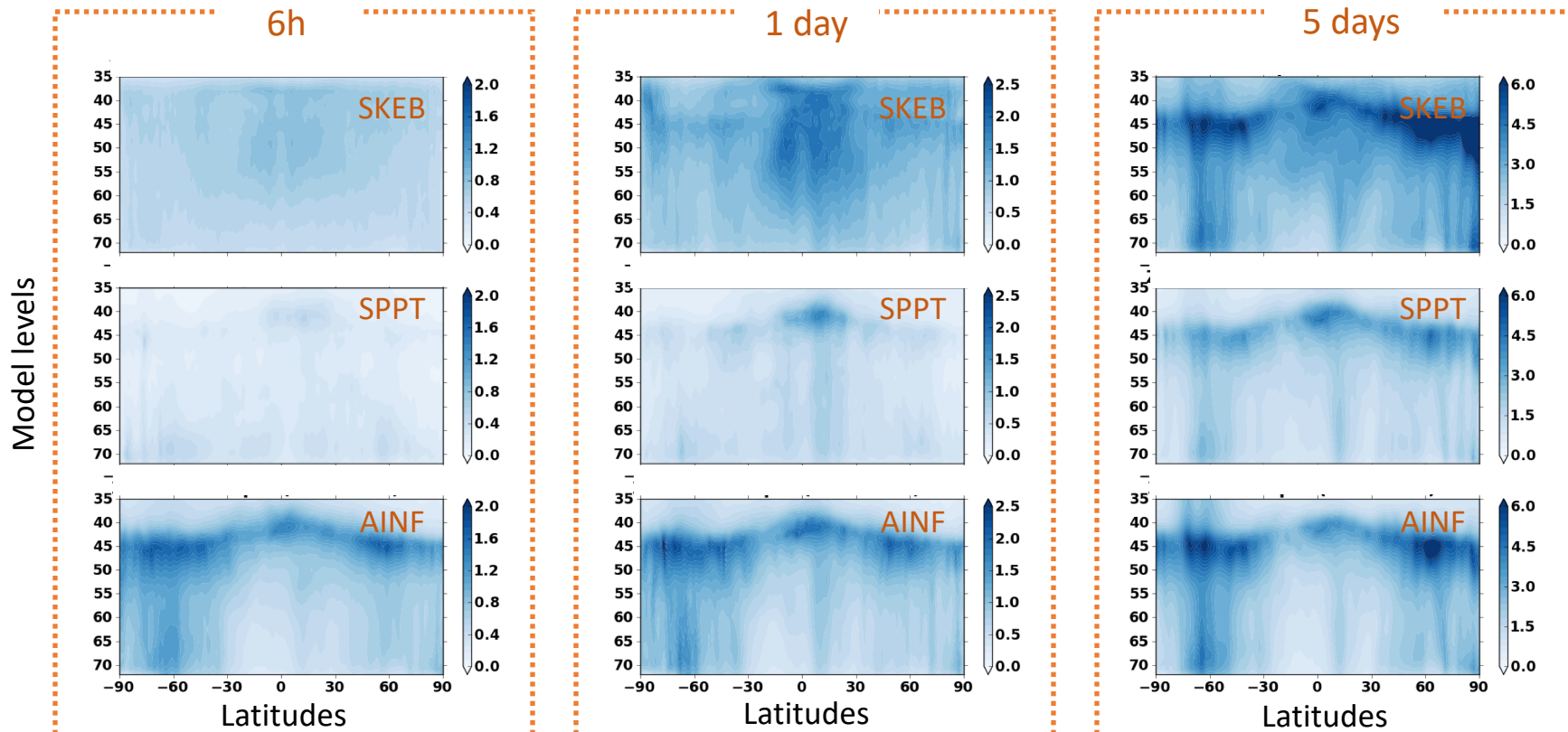
Stochastically perturbed Physics
Tendencies

Kinetic Energy rotational wind

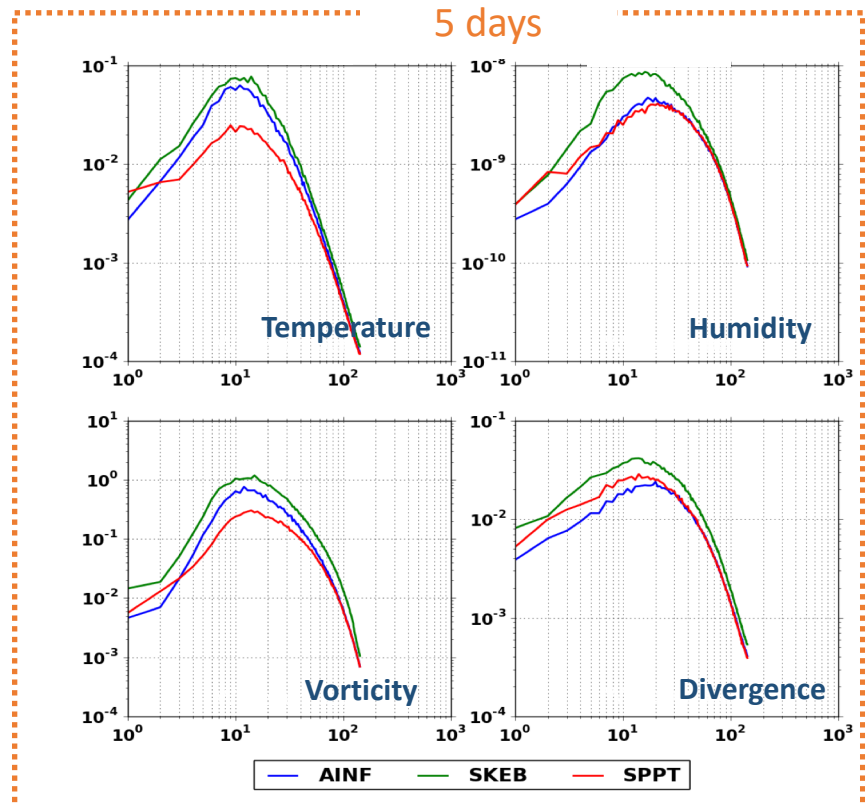
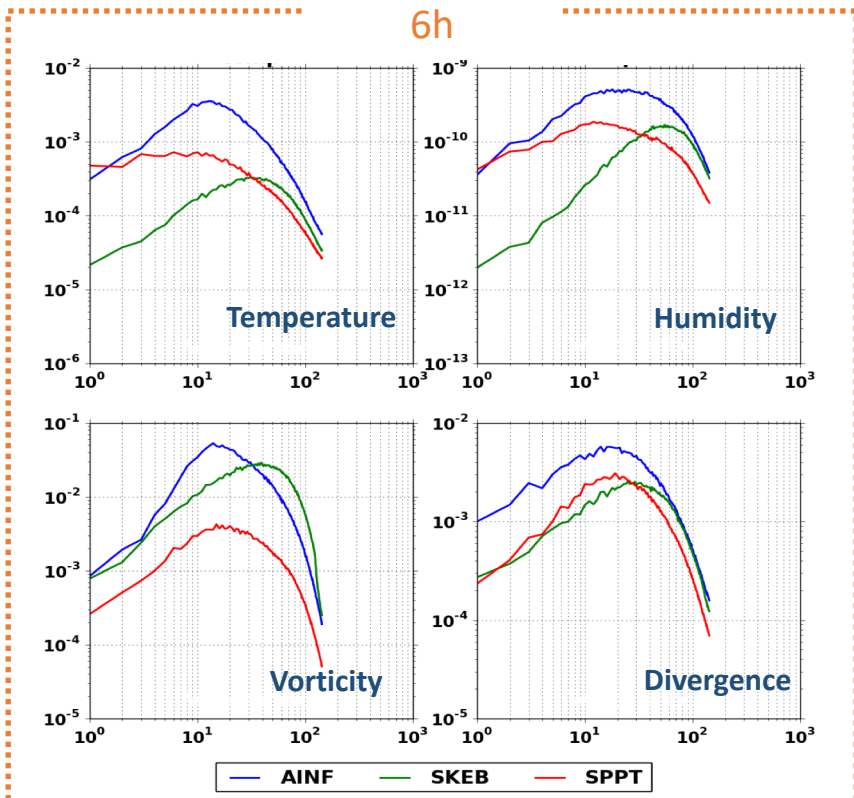


Stochastic kinetic Energy
Backscatter

Ensemble spread (at 6h, 1d, 5d) : Zonal mean - U Wind



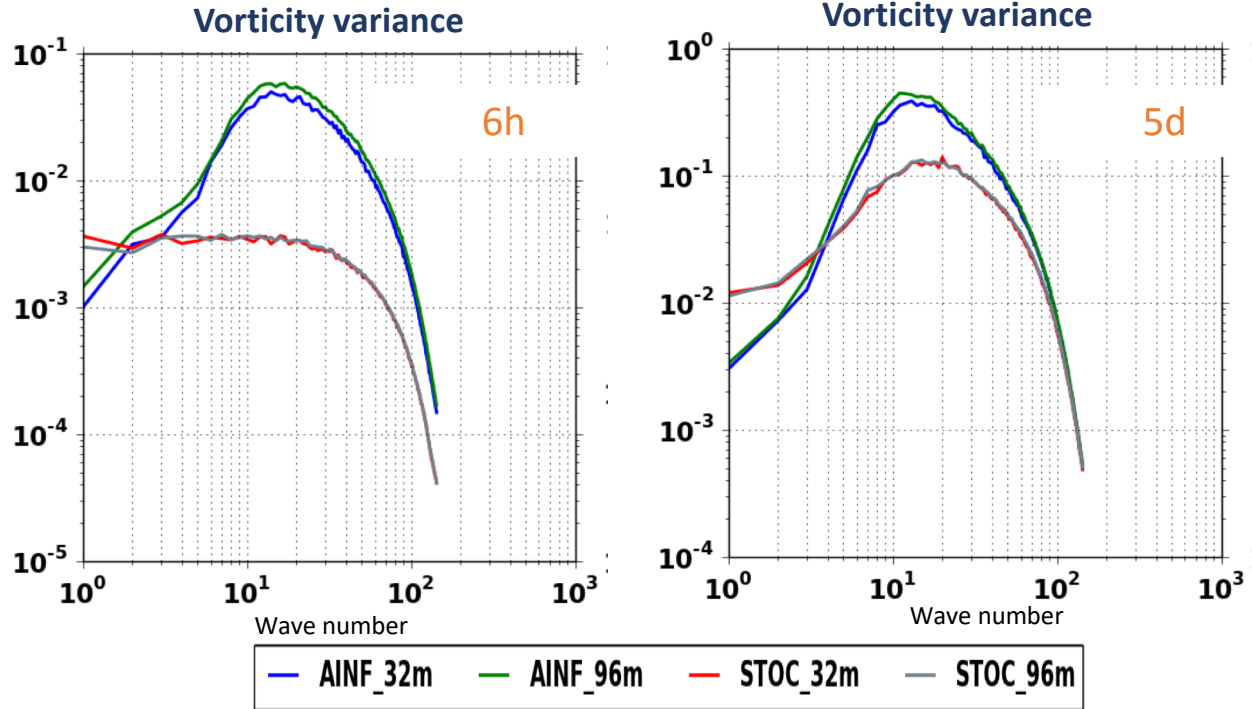
Spectral decomposition of ensemble variance (at 6h. and 5d)



Spectral decomposition of ensemble variance (at 6h, and 5d)

Ensemble size

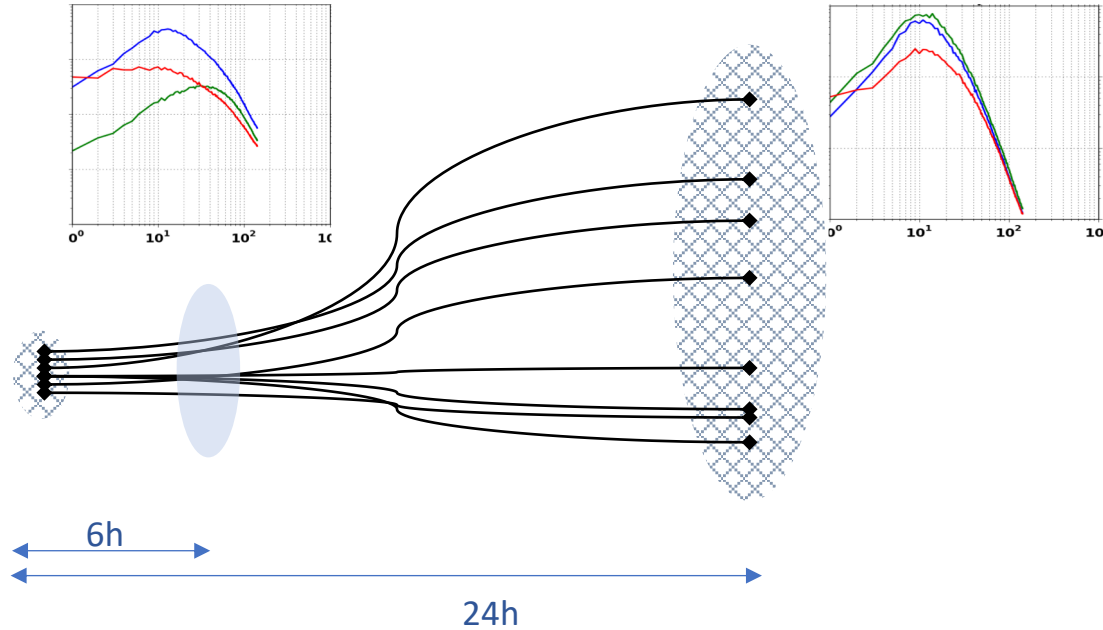
96 vs 32



What about a long-window Hybrid 4D-EnVar?

Are we any closer to representing model error?

Observations at the end of the window are weighed against a “converged climatology” of the error statistics.





Discussion points

- The simplified scheme (filter-free) may help mitigate the need to maintain two full-scale DA systems. We will be exploring more ways to create and propagate the initial perturbations.
- Regardless of the type of perturbations (additive inflation, stochastic physics), the ensemble spread tends quickly toward a converged climatology of the forecast error; the same used to create the climatological NMC-based background error statistics.
 - Perturbations affect the spread at different scales within the first hours of the forecast.
 - From day-1 onwards, all cases saturate to the same structure as the NMC-perturbations.
- **Similar to the need to question the validity of the tangent linear approximation and the strong constraint in a long window assimilation, we also need to be mindful of the interpretations we attribute to ensembles and their properties.**