Global Ensemble Data Assimilation for ICON

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DWD, Germany

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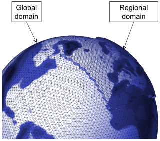
Outline

Motivation

ICON global model



- New global model ICON operational since last month (3D-VAR DA scheme)!
- Non-hydrostatic model developed jointly by MPI and DWD.
- Icosahedral grid, 13 km horizontal resolution.
- 90 z-coordinate levels up to 75 km (aprox. 0.026hPa).
- Two-way nesting, to eventually replace limited area models.
- Improved physics schemes.

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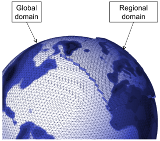

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See Roland Potthast's talk for more details!

Ensemble Data Assimilation and the LETKF

Implementation following Hunt et al. (2007).

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Current experimental status

Current settings: what is already in

One step at a time towards an operational global EDA system.

Deterministic DA

- 40km/80km 3D-VAR.
- SST, SMA and snow ana.
- Incremental analysis update.

Hybrid DA

- 40km/80km VarEnKF technical tests.

Ensemble DA

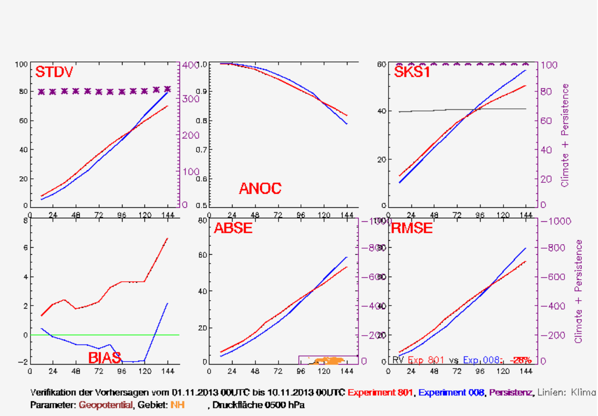
- 40 member 80km LETKF.
- Horizontal localization radius 300km.
- Relaxation to prior perturbations ($\alpha = 0.75$).
- Adaptive inflation ($0.9 \leq \alpha \leq 1.5$).
- SST perturbations.

Current settings: what is missing

- Incremental analysis update for the LETKF.
- SMA perturbations for ensemble members.
- Snow analysis for each ensemble member.
- ICON fine tunning for ensemble resolution.
- Fine tuning: relaxation to prior perturbations, adaptive inflation, perturbation (SST/SMA) lengthscales, localization. Resolution-ensemble size.
- VarEnKF experiments.
- ...

80km EPS vs 40km DET: verification against analysis

Geopotential 500hPa, northern hemisphere (10 forecasts Nov 2013)
EPS DET



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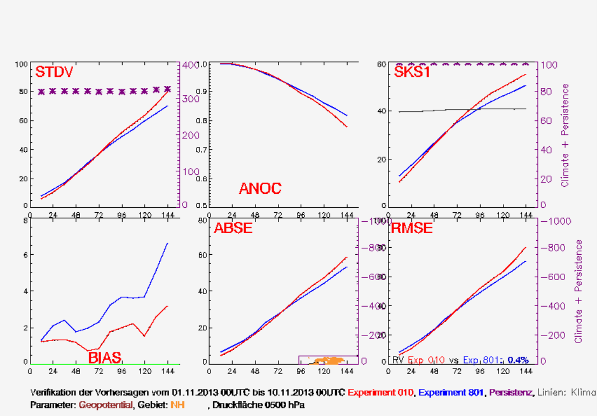
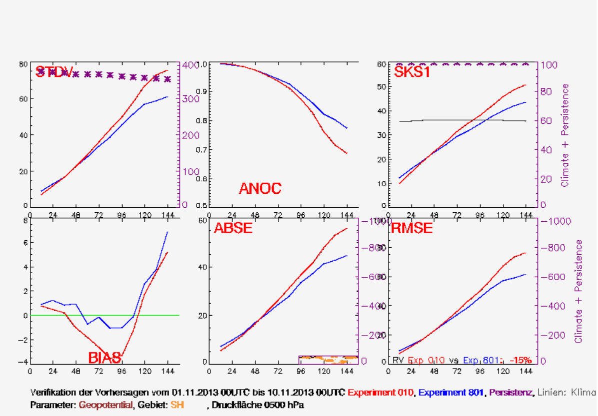


80km EPS vs 80km DET: verification against analysis

Geopotential 500hPa, southern hemisphere (10 forecasts Nov 2013)

DET EPS



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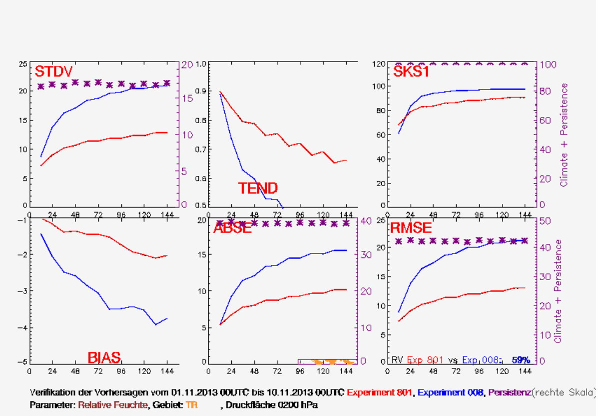
Relative humidity, tropics (10 forecasts Nov 2013)

EPS DET



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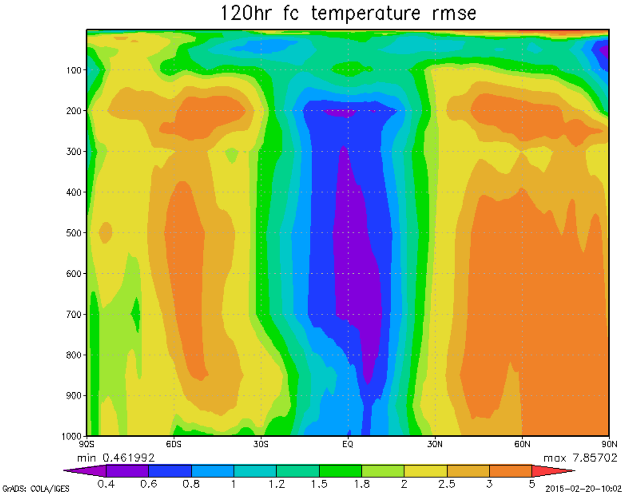

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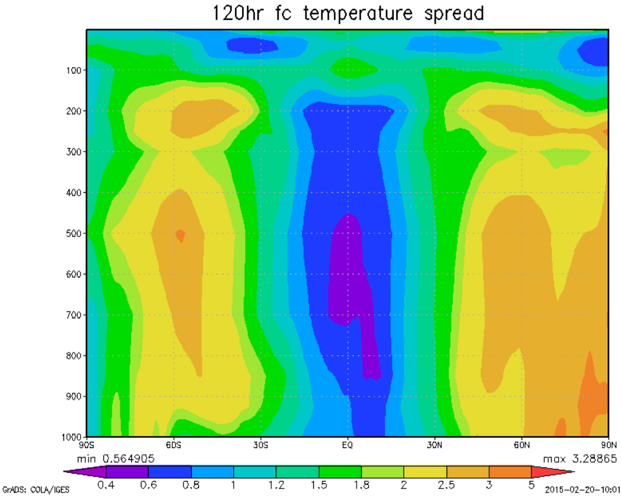

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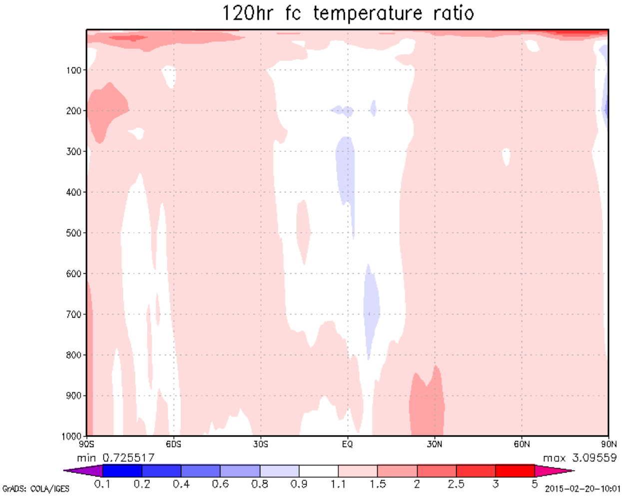

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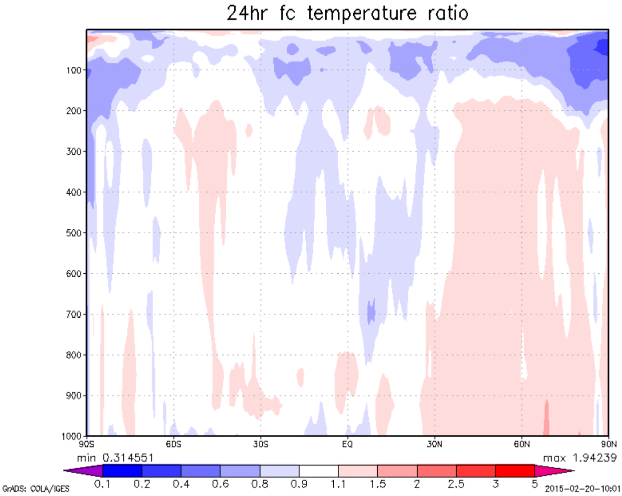

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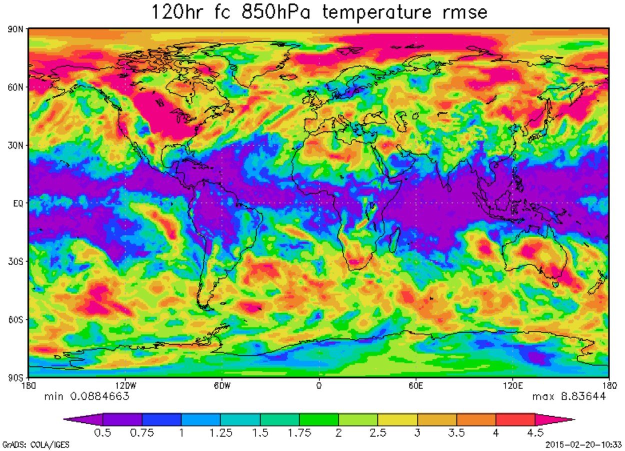

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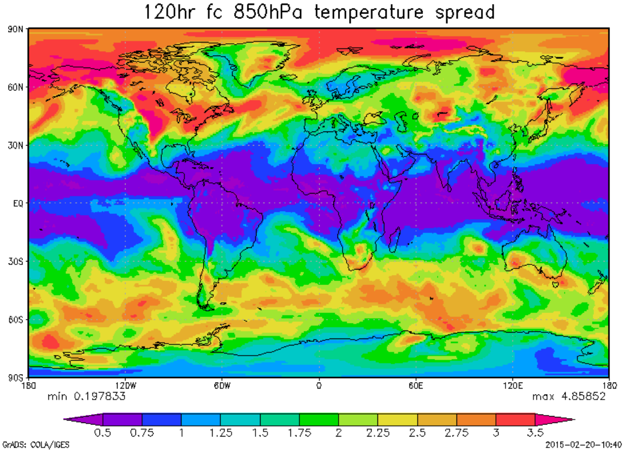

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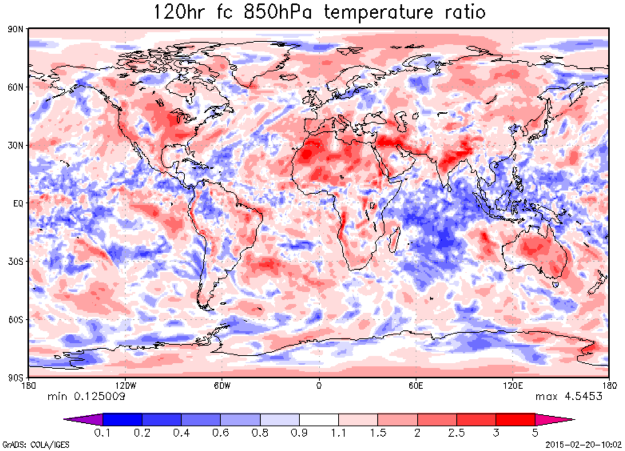

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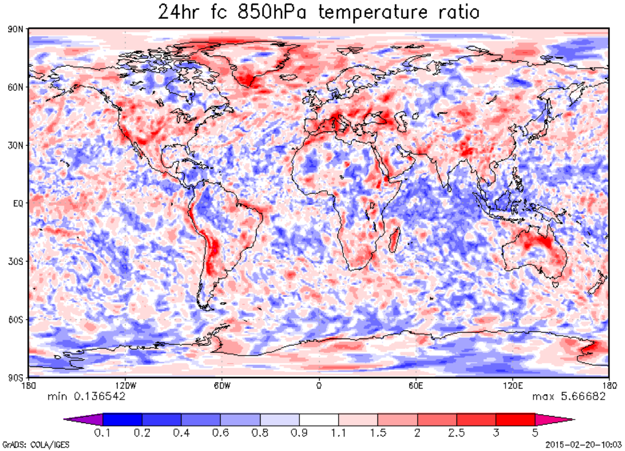

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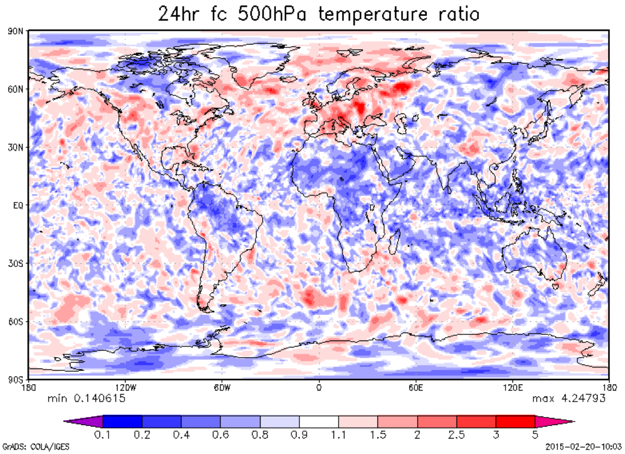

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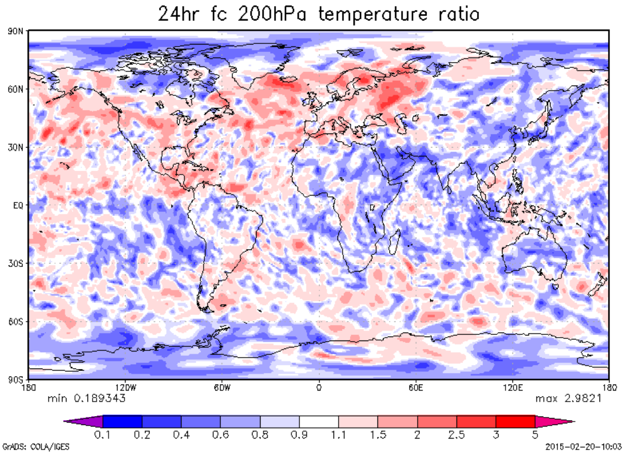

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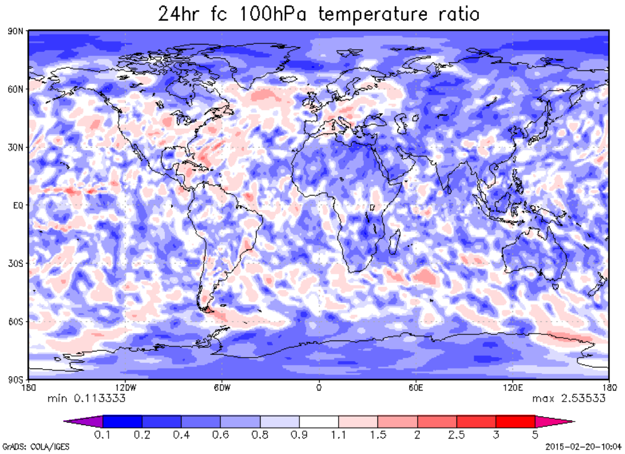

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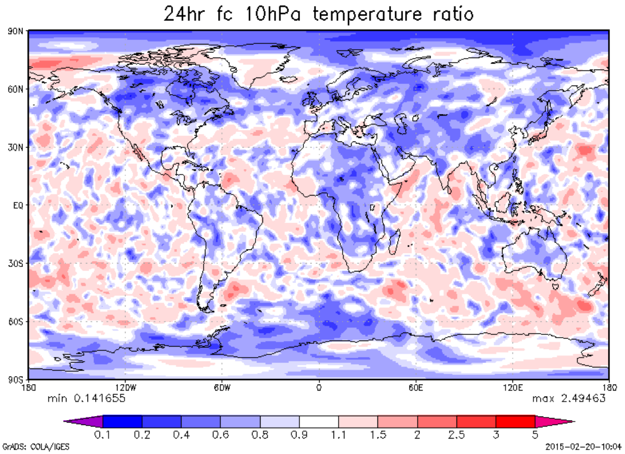

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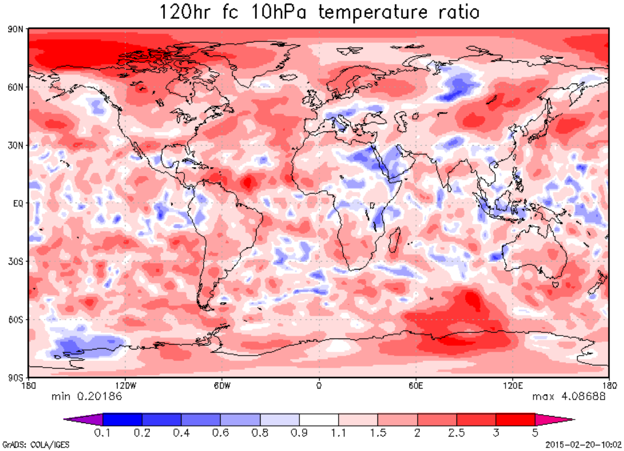

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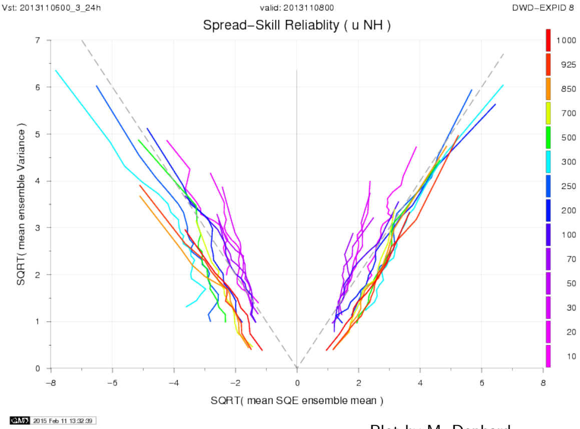
Wind u component, northern hemisphere, 24 hour forecasts.



Plot by M. Denhard.

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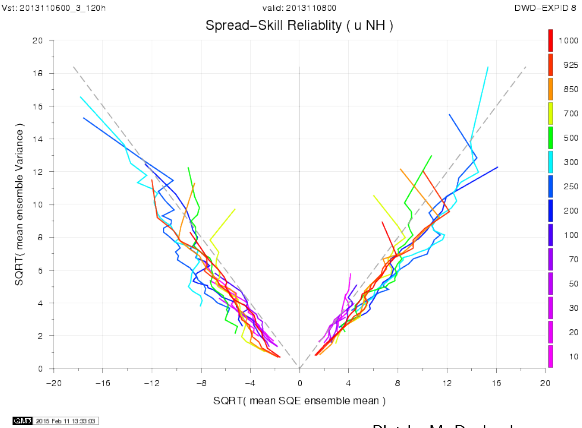

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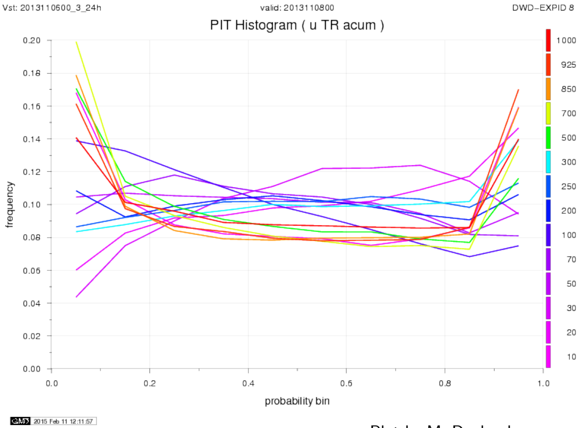

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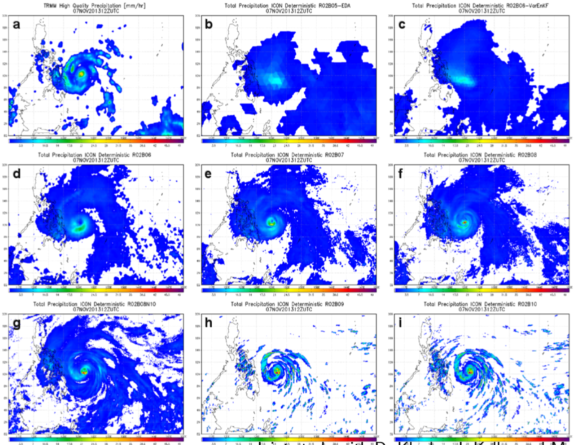
Case study: Haiyan typhoon

Total precipitation (mm/hr) at 12UTC 07/11/2013



Joint study with D. Klocke, J. Keller and M. Koehler.

Summary and next steps

To sum up...

EPS performance regarding:

- **Fields:** Very good for relative humidity, good for winds and temperature, not so good for geopotential and surface pressure.
- **Regions:** Very good in the tropics, good in the southern hemisphere, not so good in the northern hemisphere.
- **Levels:** Problems near the surface and for very high levels (overdispersiveness/underdispersiveness).
- **Leadtime:** Tendency to underdispersiveness as forecast lead time becomes larger.

Next steps

LETKF:

- Include all missing bits and pieces: IAU, SMA perturbations, snow analysis.
- Move to a higher resolution for the ensemble.
- Tune the system: relaxation to prior perturbations, adaptive inflation, surface analysis perturbations.
- Test different ensemble sizes-resolutions.
- Run longer periods.

VarEnKF:

- Tune weights.
- Understand similarities/differences between the 3D-VAR and LETKF covariance matrix structure.
  See Dora Fohring's poster!
- Retune observation errors?

Thanks for your attention!

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