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Wetter und Klima aus einer Hand

On the initial conditions of the ICON-D2-EPS ensemble: An analysis in terms of spread and skill

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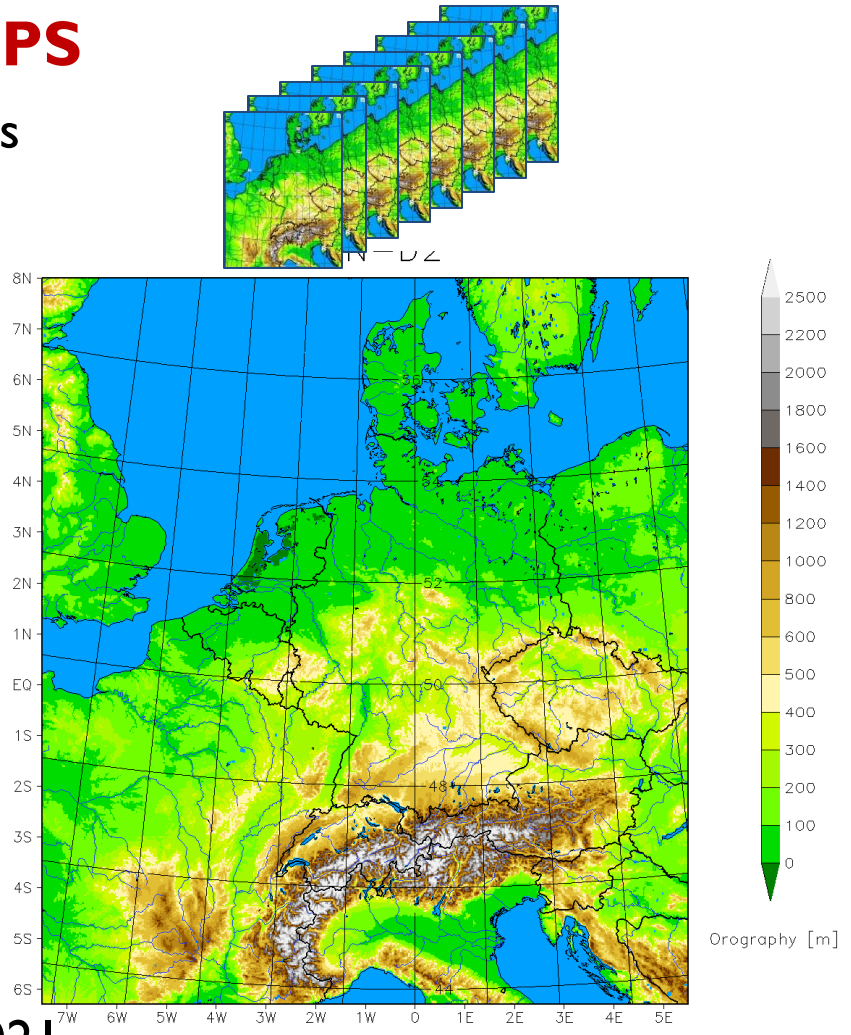
with the contribution of many DWD colleagues

Outline

- ICON-D2-EPS: ensemble set-up
- Aim of this work
- Evaluation of the ensemble perturbations
  - Spread and errors
  - Perturbation spectra
- Concluding remarks and future work

ICON-D2-EPS

- ~ 2.1 km icosahedral grid, 65 vertical levels
- 20 members
- 00, 03, 06, 09, 12, 15, 18, 21 UTC
- fc range: 27 hours (45 hours for 03 UTC)
- perturbation of
  - BC: from ICON-EU-EPS
  - Physics: randomized perturbations
  - **IC: 20 analyses from the LETKF data assimilation (KENDA)**
  - Soil moisture and soil temperature perturbation as part of KENDA
- pre-operational: 25 November 2019
- operational: end of 2020 – beginning of 2021



Aim of this work

- LETKF analyses (KENDA system) are used as Initial Conditions for the ensemble
- + : perturbed initial conditions, where the perturbations contain also the information on the convection-permitting scale uncertainties
- - : the analyses are "optimized" for the purpose of data assimilation.
- the ensemble of analyses which is the most suitable for initialising the next data assimilation cycle may not be the same which is the most suitable for initialising the weather forecast ensemble
- e.g. in terms of spread!
- In this work, the analyses generated by KENDA are evaluated from the point of view of ensemble forecasting initialisation.

Comparison between ICON-D2-EPS and COSMO-D2-EPS

Scores computed against observations

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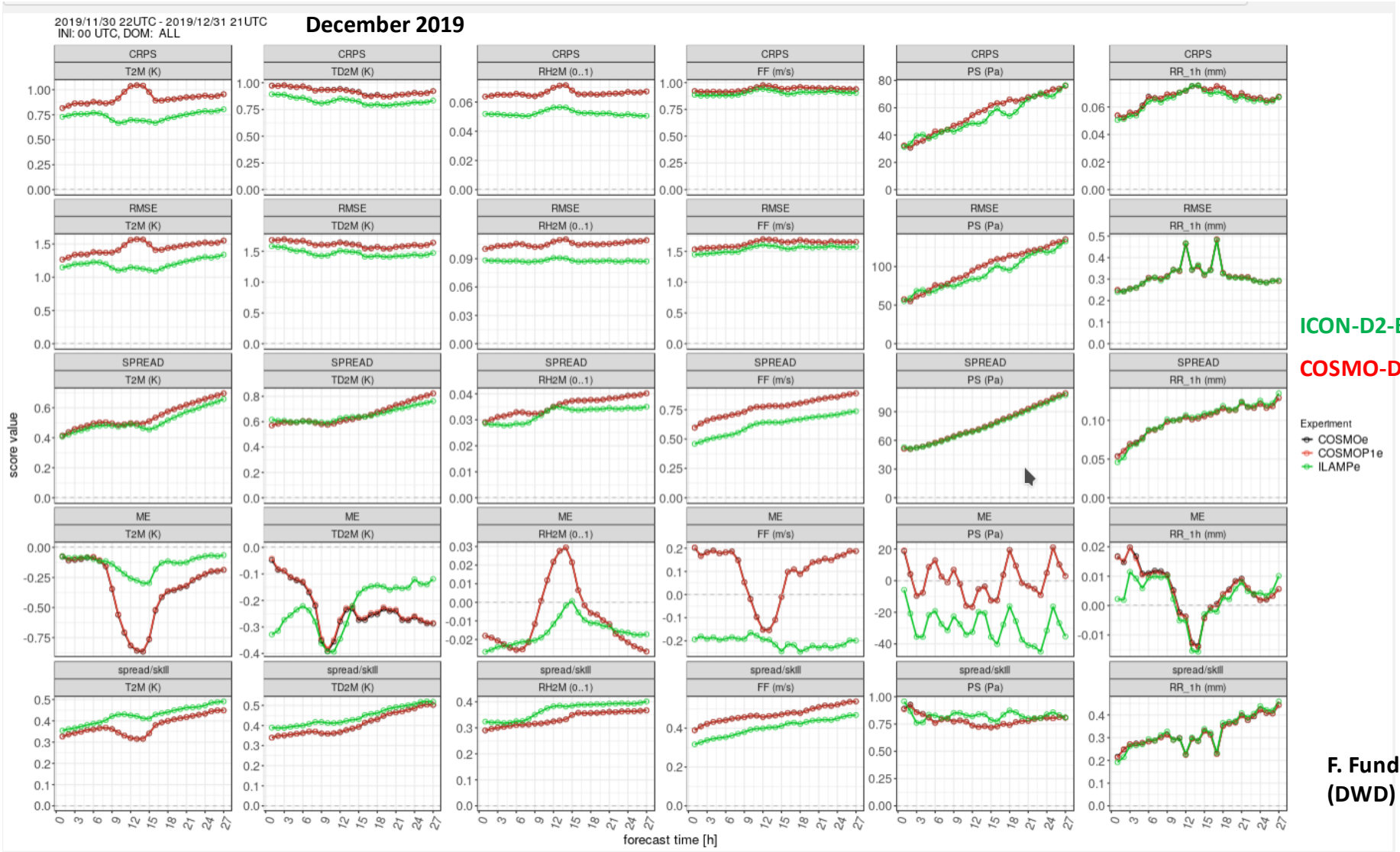

ICON-D2-EPS

COSMO-D2-EPS

F. Fundel (DWD)

Spectra of the perturbations, for each member

10m wind – 26/11/2019

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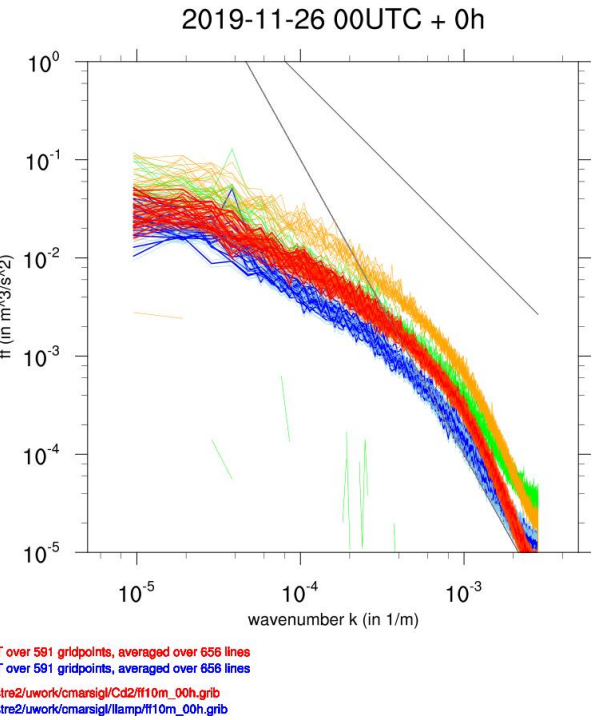

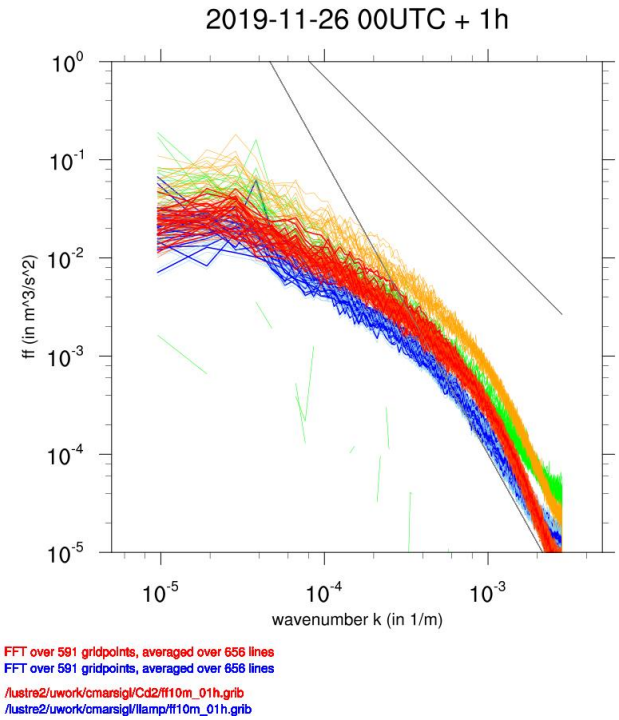

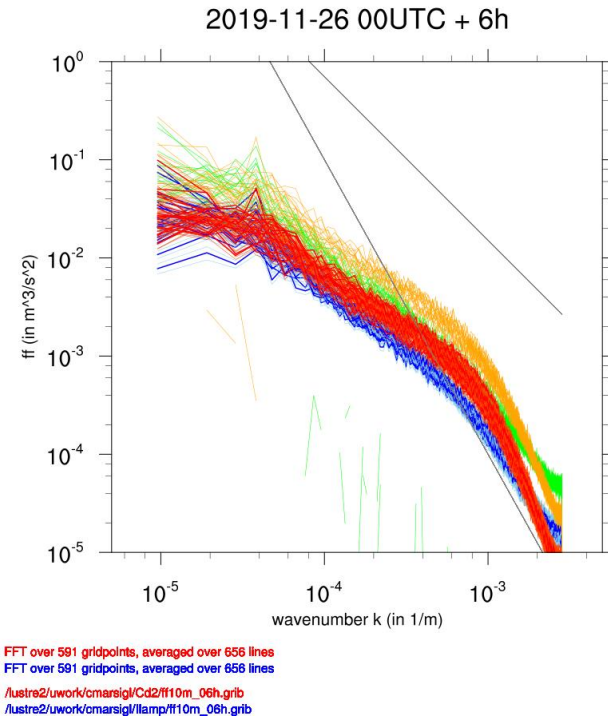

ICON-D2-EPS

COSMO-D2-EPS

Spectra of the perturbations, for each member

10m wind – 30/11/2019

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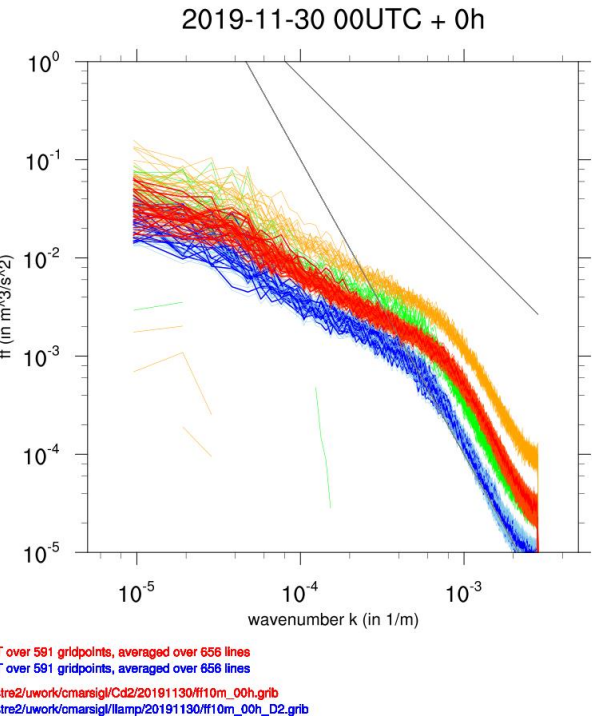

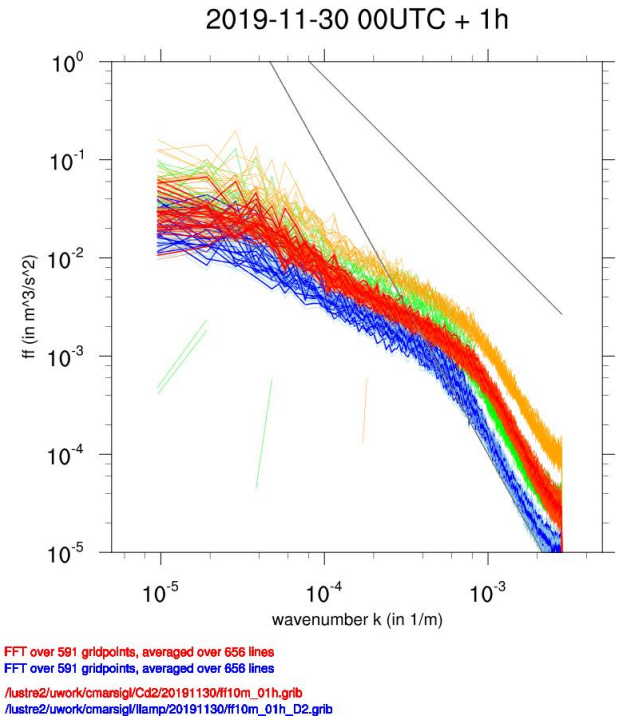

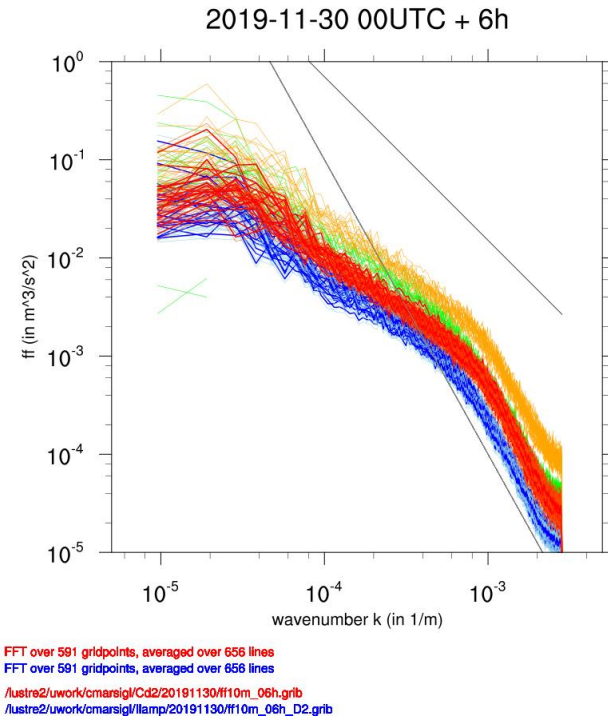

ICON-D2-EPS

COSMO-D2-EPS

ICON-D2-EPS: scores against model deterministic analysis (in fact, +1h forecast, first guess of the KENDA cycle)

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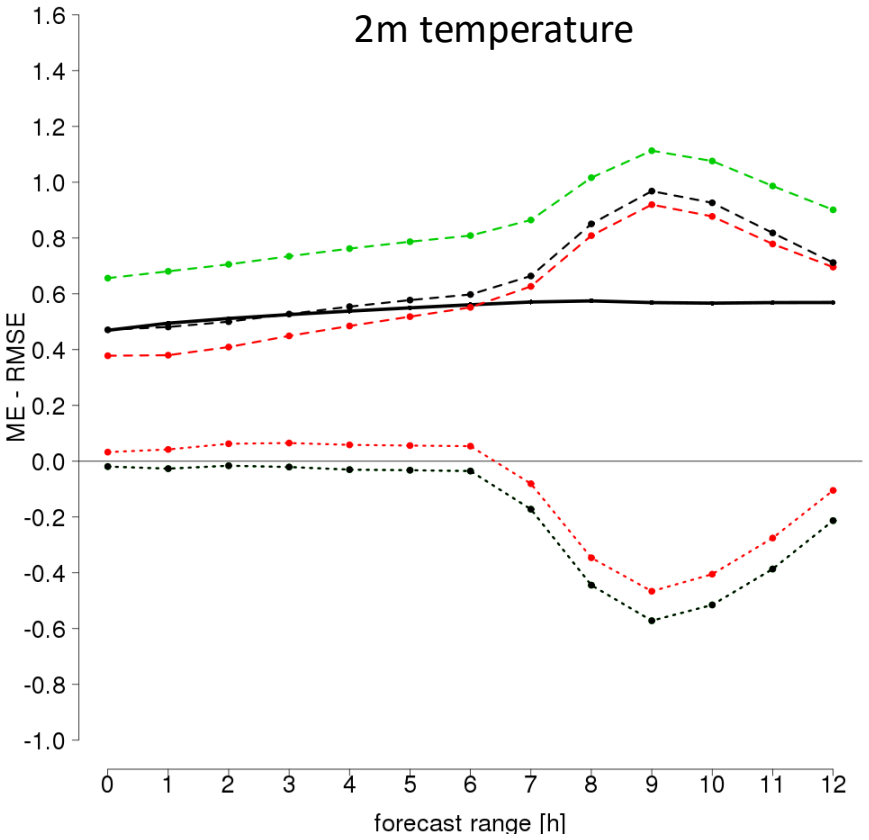
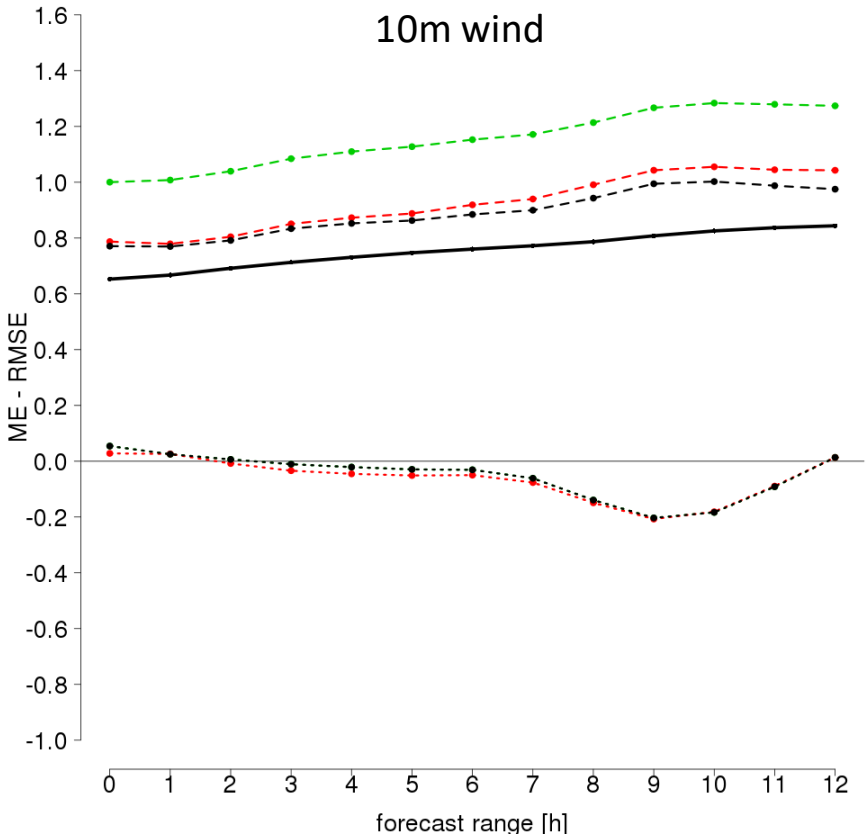
December 2019





ME of the ensemble mean
RMSE of the ensemble mean
ensemble spread
average RMSE of the members
ME of the deterministic
RMSE of the deterministic

ICON-D2-EPS: scores against model deterministic analysis (in fact, +1h forecast, first guess of the KENDA cycle)

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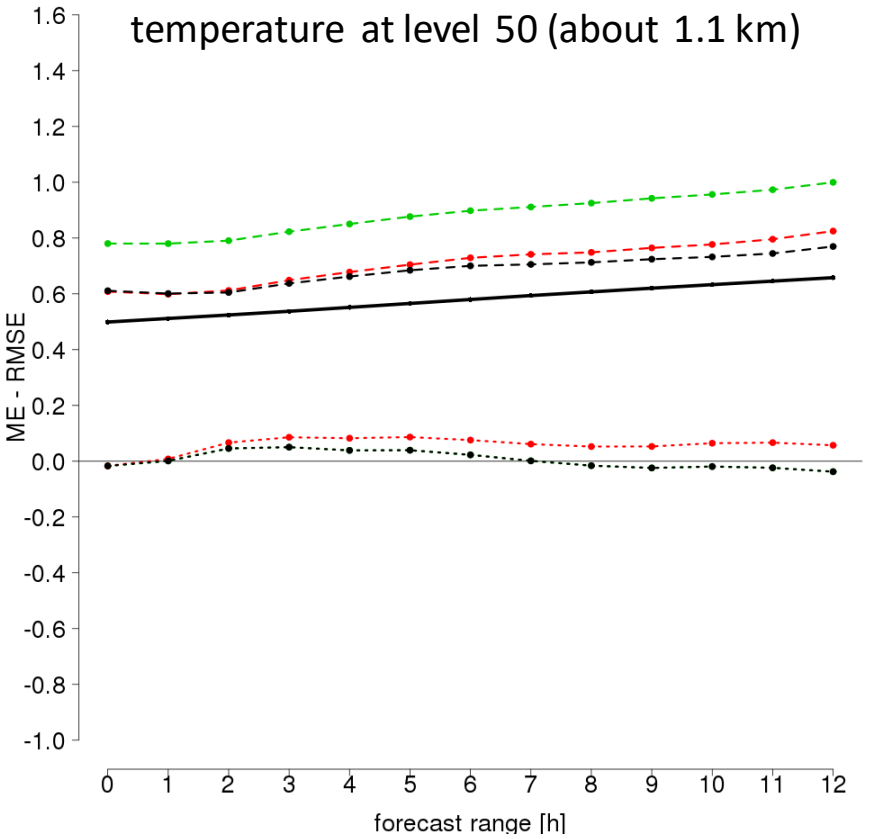

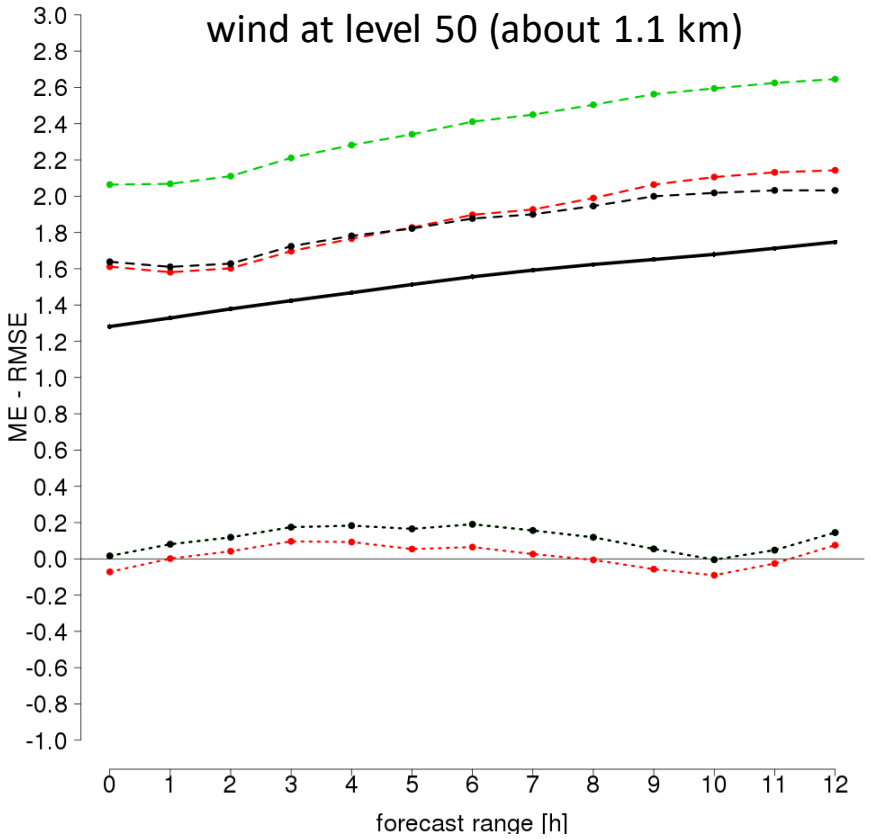

ME of the ensemble mean
RMSE of the ensemble mean
ensemble spread
average RMSE of the members
ME of the deterministic
RMSE of the deterministic

Comments and future plans

- The ensemble has too little spread, particularly for wind, when compared to the forecast error, computed against its own analysis.
- Initial Conditions seem to have too little spread, both for near-surface and upper-air.
- Also in comparison with COSMO-D2-EPS (spectra).
- For 2m temperature, the spread at the beginning of the forecast is better matched by the error.
- Next step: test the impact of generating a different set of KENDA analyses, by performing an extra LETKF step where the inflation is increased. (These analysis will not be used in the successive KENDA cycle, only for ensemble initialisation).
- The idea is to generate analyses better suitable for ensemble initialisation, without influencing the data assimilation. This can be extended to other aspects than the inflation.

Thank you for your attention!

Method

- Slide 5: Verification of ICON-D2-EPS and COSMO-D2-EPS against observations
- Slides 6-7: The spectra of the model perturbations are computed, for each member (member – ensemble mean), both for ICON-D2-EPS and COSMO-D2-EPS. Two different days are shown. (Please watch only the red and the blue lines).
- Slides 8-9: The spread of the ensemble is computed and compared with the ensemble forecast error, for ICON-D2-EPS. Here, the RMSE is computed against the model deterministic analysis, in order to evaluate the spread/skill relation independently from the model systematic error (at least at time 0).