Bundesministerium für Verkehr und digitale Infrastruktur

Fraunhofer IWES · 50hertz · TenneT Taking power further · amprion

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

# *Generation of probabilistic weather forecasts for renewable energy applications using KENDA*

EWeLiNE

## Overview

In the research project EWeLiNE, DWD and the Fraunhofer Institute IWES are working together with three German TSOs (transmission system operators) to improve weather and power forecasts for renewable energy applications. One aspect of this project is the optimisation of the ensemble forecasting system towards providing inputs to probabilistic power forecasts.

This poster outlines work to asses the impact of using KENDA to provide an ensemble of initial conditions for COSMO-DE-EPS, which is the high-resolution ensemble NWP system used at DWD. Because the KENDA ensemble members come directly from the COSMO model, no vertical filtering of the perturbations is required. This means that it should be possible to account for more uncertainty without making the model unstable.

Forecasts were produced using COSMO-DE-EPS, with initial conditions provided by the operationally-used BCEPS in the Control setup, and by KENDA in the Experimental setup. The two setups were otherwise identical.

The time period investigated was 18-28 May 2014, and one forecast was initialised per day at 00 UTC. The performances (**comparison of ensemble spread and RMSE of ensemble mean**) of the two systems were compared for three standard surface variables (precipitation, 2m temperature and 10m wind gust) and two variables of particular relevance to renewable energy (100m wind speed and surface shortwave radiation). **A second experiment looked at the effect of combining the two setups**.

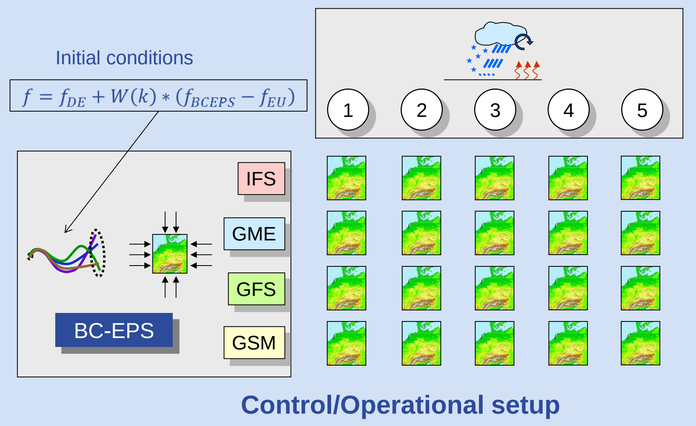
*NB: for wind speed only three observation locations were available, although the conclusions for wind speed were similar to those for wind gusts.*

## COSMO-DE-EPS

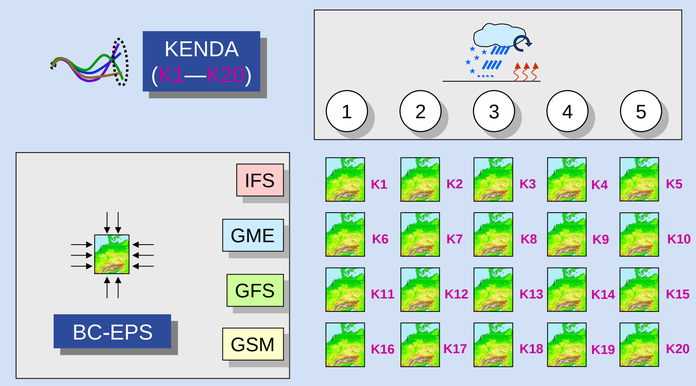
- **Horizontal resolution 2.8 km**
- **Operational** since May 2012
- **8 starts** per day **(from 00, 03,..,18, 21 UTC)**
- **Lead time** up to 27 h, with **45 h** for the **3 UTC** run
- **Nudging** is used to provide the initial deterministic analysis.
- **20 members:** variations in lateral boundaries and initial conditions based on 4 global models, and 5 physics setups

## KENDA

- **Kilometre-scale** version of **LETKF**, developed as a **COSMO Priority Project**
- **40-member** ensemble, of which the **first 20** are taken here
- **Conventional observations** assimilated
- **Latent heat nudging** of radar precipitation is incorporated.



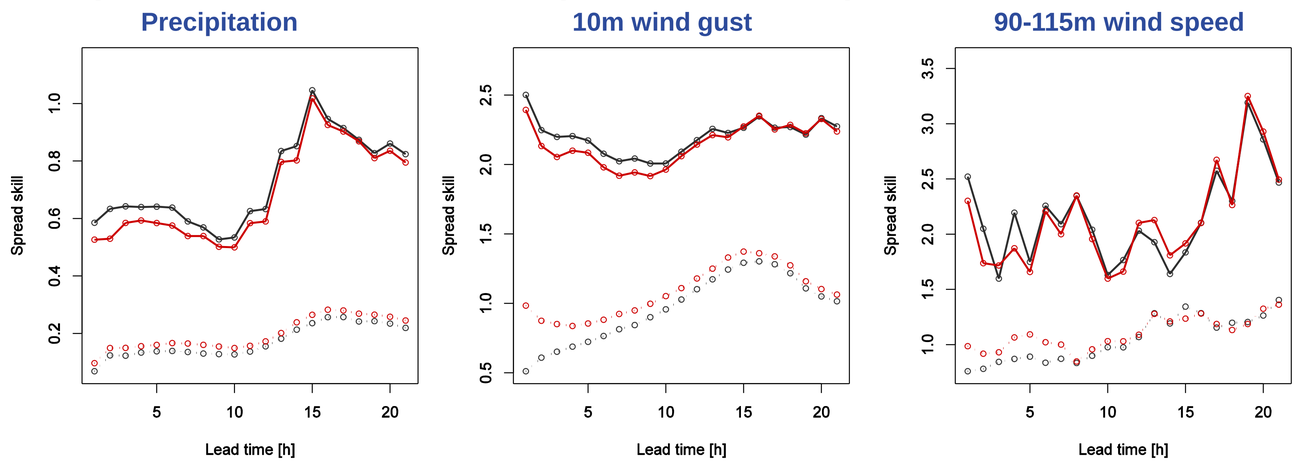

**Control/Operational setup**




**Experimental setup**

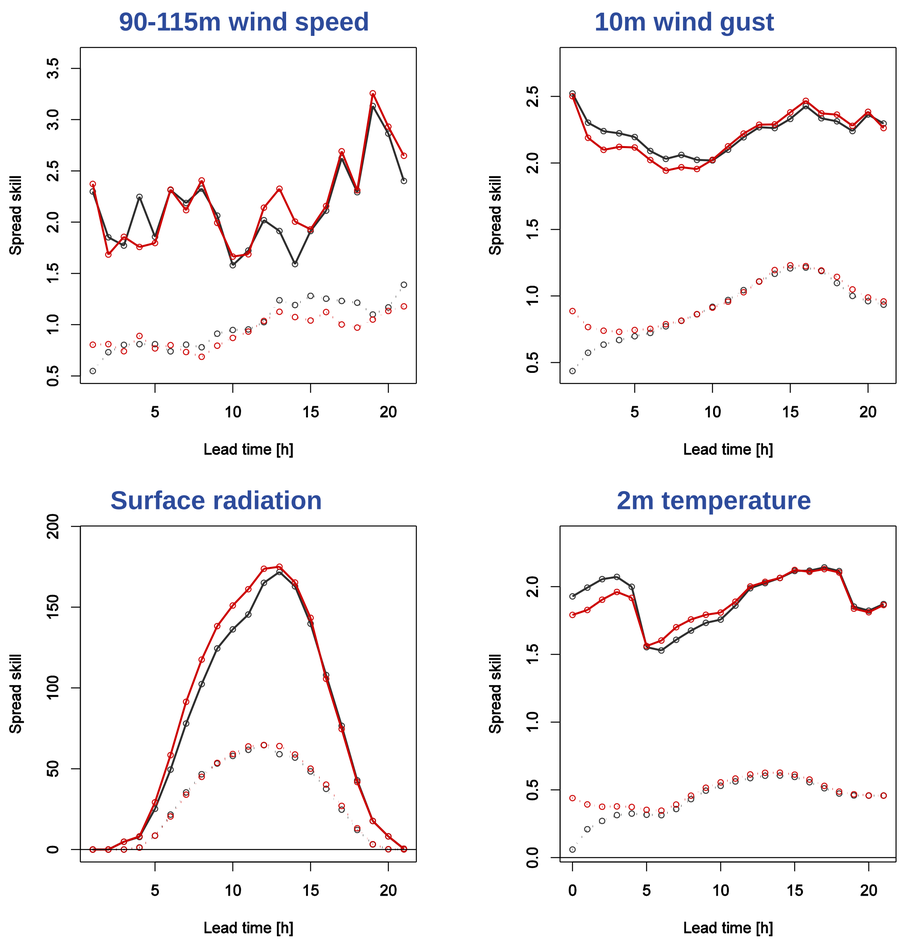
## First results from combining the two setups: a 20 member ensemble with members 1, 4, 7, 10, 13, 16, 19 from the Control setup and the rest from the Experimental setup

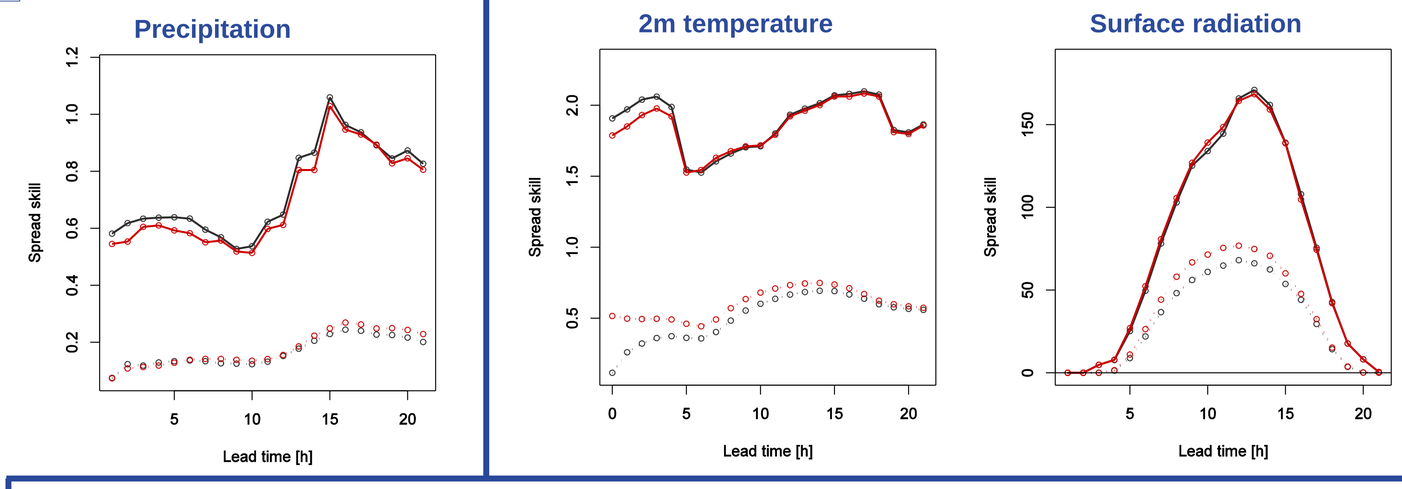
Nudging + BCEPS (Operational )
Combination




## Direct comparison between Control and Experimental setups

Nudging + BCEPS (Operational )
KENDA (Experimental)




## Summary

- Using initial conditions from **KENDA significantly improves** the ensemble for general **surface variables**, while **the impact on variables relevant to renewable energy** is **neutral**
- **Combining** the two setups **further improves** the ensemble for general **surface variables,** and also leads to an **improvement for renewable energy variables**
  - This improvement **persists for 10-15 hours**
  - The CRPS (not shown) shows a similar improvement, suggesting that the extra **spread is added where it is needed**
- **Future work** will involve investigating **further forecast periods** and **start times,** in order to assess the **significance** of the results (and to better assess the impact on renewable energy variables)**,** and **further combinations of KENDA and BCEPS**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