Application and verification of ECMWF products 2015

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1. Summary of major highlights

For more than ten years the DWD uses IFS/ECMWF in operational post-processed forecasts. There are several forecasting systems at DWD based on Model Output Statistics (MOS), which process IFS/ECMWF and ICON/DWD individually as well as a combination of both.

In the MOSMIX system the use of ECMWF-MOS has been intensified recently with extended forecast time up to 243h and advanced production time three hours earlier. Combined with ICON-MOS it provides the backbone of operational short and medium range forecasts.

WarnMOS also uses IFS/ECMWF and ICON and gives an automatic weather warning guidance on the short-term scale (up to 3 days).

An Ensemble-MOS system has been set up for COSMO-DE-EPS and ECMWF-EPS recently and is currently being included in the ModelMIX system that enhances the operational WarnMOS by the ensemble models. A trial study of ECMWF-EPS for TIGGE-data has been carried out, a short verification is provided in Sec. 3.1.2 .

2. Use and application of products

2.1 Post-processing of ECMWF model output

2.1.1 Statistical adaptation

MOSMIX

MOSMIX is the operational MOS system that provides the backbone of short and medium range forecasts of DWD. It consists of the individual post processing systems ICON-MOS and ECMWF-MOS and their statistically optimal combination and provides almost all relevant meteorological parameters as observed at synop stations. Forecast times up to 243 hours are computed in 3 hourly intervals, work is in progress to increase time resolution to 1 hour. The forecasts comprise about 4000 stations worldwide, which are updated four times every day.

AutoTAF

The DWD operates an automated MOS system with coupled TAF generation based on ECMWF HRES since 2013. Before the driving model has been the GME (DWD). A statistical interpretation is calculated using a large number of direct model output predictors from HRES, of prior observations and derived predictors. It is optimized at the geographic locations of German and international airports and for aviation-relevant meteorological parameters, e.g. visibility and ceiling. 12h, 24h, and 30h TAF's are generated (encoded) from the hourly MOS predictions (TAF guidance) under the condition to obtain a preferably short TAF with minimal loss of information. AutoTAF runs every hour with current SYNOP, METAR and remote sensing observations (radar, lightning) and every 12 hours with the new model run. MOS forecasts are calculated up to 41 hours.

WarnMOS

The MOS system WarnMOS gives an automatic weather warning guidance on the short-term scale (up to 3 days). Probability forecasts are calculated on a 1km-grid over Germany based on mixed model forecasts (ICON and IFS HRES), SYNOP reports, and high frequent observations of precipitation radar and lightning strikes. The linear regression equations are derived for synop stations which are clustered for regions with similar climatic characteristics resulting in multi-station equations. WarnMOS runs every hour with current remote sensing data and synop observations and approx. every 6 hours with respective new model forecasts. A large number of single predictands (more than 170) is calculated due to the many different reference periods which range from 1 hour to 48 hours. A system of rules condenses these forecasts to obtain the set of warning elements specified for operational use at the DWD.

ModelMIX

ModelMIX will enhance WarnMOS with the ensemble forecasts of COSMO-DE-EPS and ECMWF-EPS. Individual ensemble MOS systems have been set up for both ensembles that will be combined with WarnMOS in order to provide an optimal and consistent basis for the generation of automatic weather warning guidances. The ensemble MOS system uses statistical products of the ensemble models like ensemble mean and standard derivation and is tailored for probabilistic forecasting including the use of logistic regression, a focus on calibration and sharpness for threshold probabilities and the estimation of forecast uncertainty.

2.1.2 Physical adaptation

Include limited-area models, hydrological models, dispersion models etc. that use ECMWF model data (HRES and/or ENS) as input (eg for initial conditions / boundary conditions / ..)

2.1.3 Derived fields

Include post-processing of ENS output e.g. clustering, probabilities

2.2 Use of ECMWF products

Describe how ECMWF products are used in operational duties, in particular for severe weather situations

3. Verification of products

Include medium-range HRES and ENS, monthly, seasonal forecasts. ECMWF does extensive verification of its products in the free atmosphere. However, verification of surface parameters is in general limited to using synoptic observations. More detailed verification of weather parameters by national Services is particularly valuable.

3.1 Objective verification

Describe verification activities and show related scores.

3.1.1 Direct ECMWF model output (both HRES and ENS)

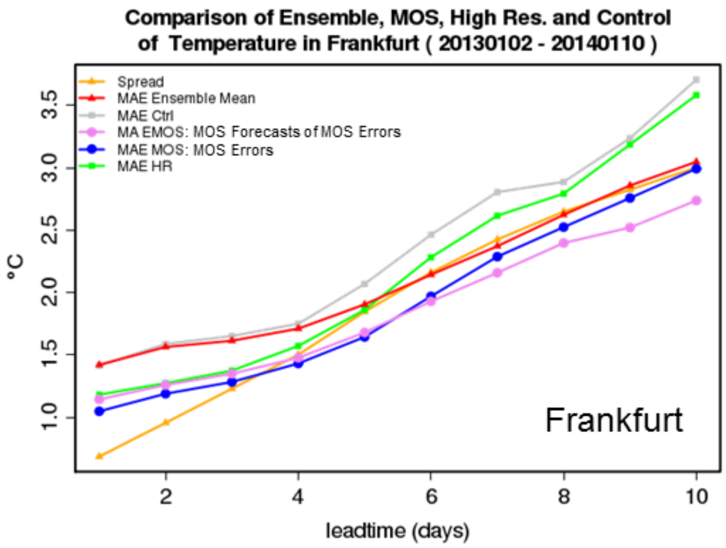
Focus on local weather parameters verified for locations which are of interest to your service

3.1.2 ECMWF model output compared to other NWP models

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

EnsembleMOS for ECMWF-EPS

- Verification of 2013 – 2m temperature errors



- TIGGE/THORPEX data
  - 50 ensembles, 1 high resolution run
  - 2m temperature, mean wind, cloud coverage, 24h precipitation
  - observations as predictands
  - ensemble products, mean, stddev as predictors
  - training sample 2002-2012 (10 years)
  - free forecasts for 2013

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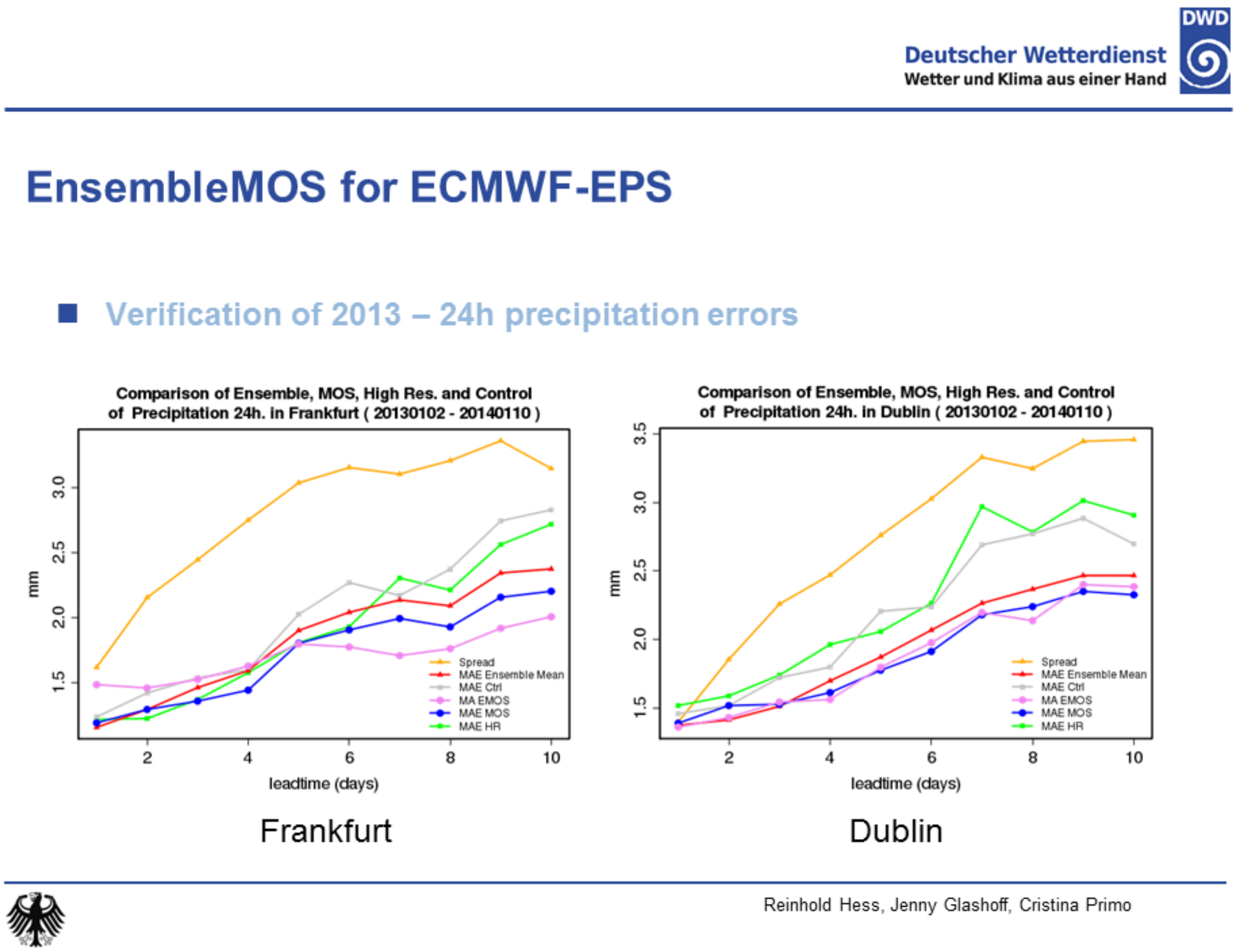

3.1.3 Post-processed products

e.g. Kalman filtered products, calibrated ENS probabilities, etc.

3.1.4 End products delivered to users

3.2 Subjective verification

3.2.1 Subjective scores (including evaluation of confidence indices when available)

3.2.2 Case studies

Severe weather events/non-events are of particular interest. Include an evaluation of the behaviour of the model(s).

4. References to relevant publications