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Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Advancing Model Output Statistics (MOS) in the new German project EWeLiNE for enhanced temporal resolution and wind forecasting

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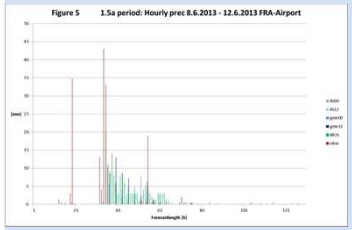
In the German project EWeLiNE (Simultaneous improvement of weather and power forecasts for the grid integration of renewable energies), which is fulfilled in collaboration of DWD (German Weather Service) and IWES (Institute on Wind and Energy Systems), one of the main goals is an adjustment of the DWD-system MOSMIX (combining the global models IFS and GME) to the demands of the transmission system operators (TSOs). These are e.g. an increase of the temporal resolution of the forecast steps (from 3h to 1h), or the expansion of the MOSMIX to particular fields of interest (e.g. windspeed in heights > 10m).

2 What about the length of the training period?

Generally the length of the training period enhances the robustness of the applied statistics and prohibits overfitting. Also, the RMSE decreases by a prolongation of the training period. The current MOSMIX at DWD is developed by training periods of more than 10years. As processing time should be saved and the availability of measurements for the wind measurements, all of the training periods within this study has been defined from about 1.5a (01-01-2012 until 2012-06-08) (e.g. figure 5). To show the impact of longer training periods for the hourly precipitation forecast has been comparatively computed from (2001-01-01 until 2012-06-08) (figure6). The RMSE becomes slightly worse (by 0.8mm) for the longer period, which can be explained by the more frequent precipitation forecasts. Still the first event is not represented by the forecast with the period of 1.5a and the second event is far better represented in figure6.



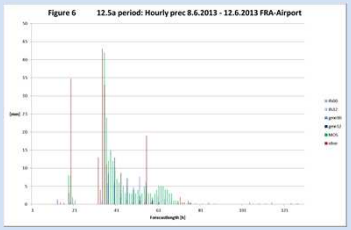


Figure 5 & 6: Forecasted hourly precipitation and observed hourly precipitation for the airport Frankfurt on 5 consecutive days. On figure 5 the training period is calculated from 1.5 years before the forecast, while in figure 6 the training period is started 12.5 years before. The reliability of the forecast is enhanced by the longer training period.

station	Lindenberg	Hamburg	Fuhlsbüttel	Frankfurt Airport
heights of windspeed	10m, 20m, 40m, 60m, 80m, 98m	10m, 50m, 110m, 175m, 250m	10m	10m
heigst of wind direction	10m, 20m, 40m, 60m, 80m, 98m	10m, 50m, 110m, 175m, 250m	10m	10m
lat	52.17°	53.52°	53.38°	50.03°
lon	14.12°	10.1°	9.59°	8.36°
height above ground	73m	0,3m	11m	112m

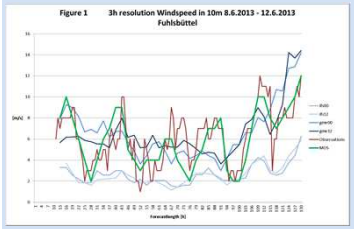
General MOS advantages:

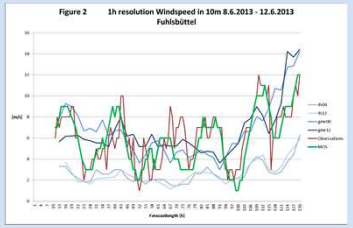
- Accounts for specific local characteristics
- Downscaling to point forecasts
- Correction of biases and systematic errors by the numerical models
- Derivation of further predictands of interest is possible
- Includes persistency (own forecast is used as predictor , when progressing in the forecast horizon)
- Easy (everywhere applicable by simple statistics = multiple linear regression)

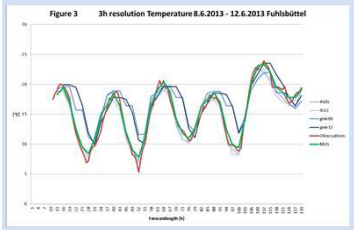
Further steps

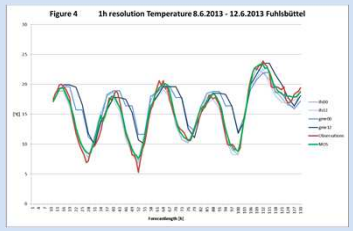
- Building longer time series to provide meaningful statistics for evaluation in a parallel routine (e.g. RMSE, MAE, etc.).
- Implement further variables of interest: i.e. windspeeds and directions from other heights.
- Implement complementary fields of solar variables (e.g. diffuse and direct radiation)
- Implement GFS into MOSMIX as a third global model to compensate for the change of GME to ICON.

1 Enhancing the forecast resolution from 3h to 1h time steps







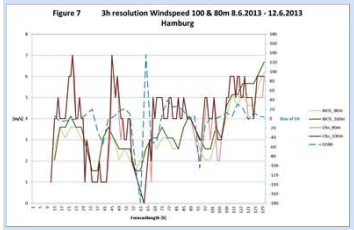


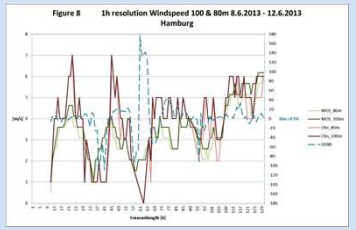
The resolution of the forecast is enhanced from 3hour steps to steps of 1hour. Thus, the multiple linear regression is calculated hourly. Though, the models only provide their input on 3hour steps, the obeservations are available on hourly resolution. That is why the models can be used as predictor only for every third hour, while the observations are regularly used for each temporal step of the prediction. For this development time dependant variables have to be computed in a new way (e.g. precipitation). The RMSEs roughly stay the same.

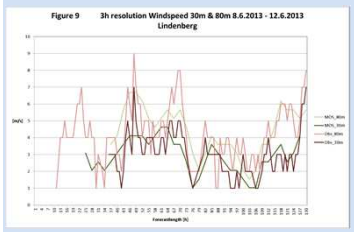
Fuhlsbuettel RMSEs	3h	1h
Temperature	0.90°C	0.82°C
10m Windspeed	1.72m/s	1.73m/s

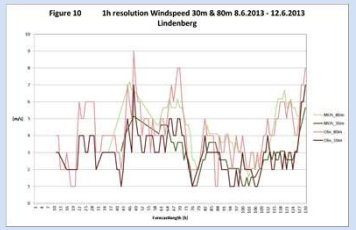
Figure 1: 3hour forecast steps of windspeed in 10m height with observations and models for Fuhlsbüttel.
Figure 2: 1hour forecast steps of windspeed in 10m height with observations and models for Fuhlsbüttel.
Figure 3: as figure 1but for temperature in 2m height
Figure 4: as figure 2 but for temperature in 2m height

3 Implementation of windmeasurements and prediction of wind parameters with the new resolution









As a next step, further variables have been implemented as predictands. These variables are not included by models, thus the specific variable can only used as predictor by the observations. The stations have been acquired within the EWeLine project, whereat there is still lack of a sufficient number of observation stations. Finally absent heights of windspeed , which have not been accounted for by measurements, are derived by an adequate 2nd order polynome. Extrapolation is prohibited. Direction is linearly interpolated by directions in adjacent heights.

Hamburg RMSEs	3h	1h
80m Windspeed	1.39m/s	1.31m/s
100m Windspeed	1.39m/s	1.22m/s

Lindenberg RMSEs	3h	1h
30m Windspeed	0.95m/s	0.91m/s
80m Windspeed	1.22m/s	1.10/s

Figure 7: 3hour forecast steps of windspeed in 80m and 100m and the interpolated observations. With the bias of the forecasted direction in 80m to the interpolated observation.
Figure 8: As figure 7 but for 1hour forecast steps
Figure 9: as figure 7 but for 30m and 80m windspeed, whereat only 30m windspeed is interpolated
Figure 10: as figure 8 but for 30m and 80m windspeed, whereat only 30m windspeed is interpolated

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