Forecasting 25 GW Wind Power above North and Baltic Sea

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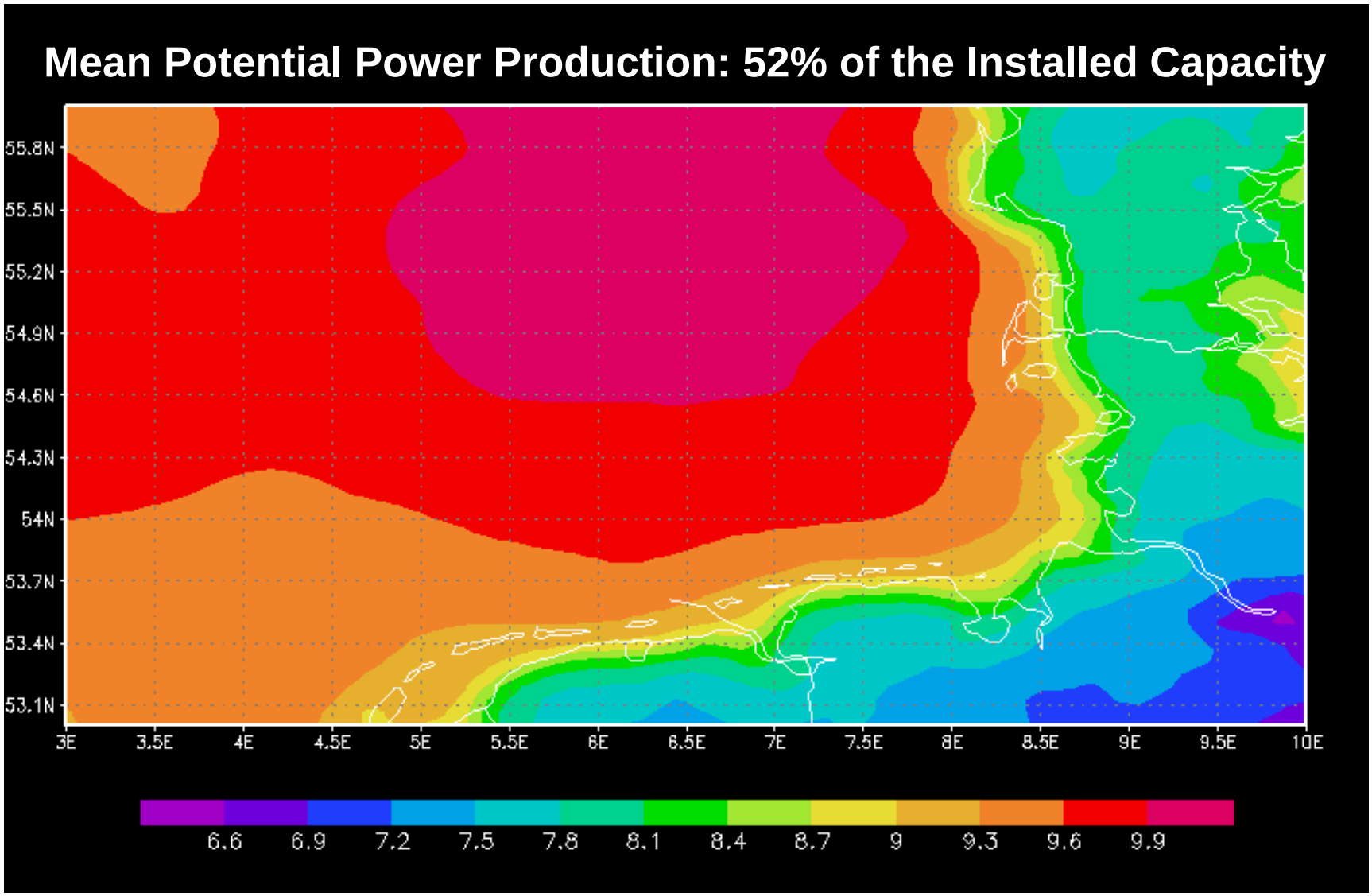
Copenhagen Offshore Wind, October 27th 2005, Copenhagen

Mean 100m Wind Speeds in the German Bight



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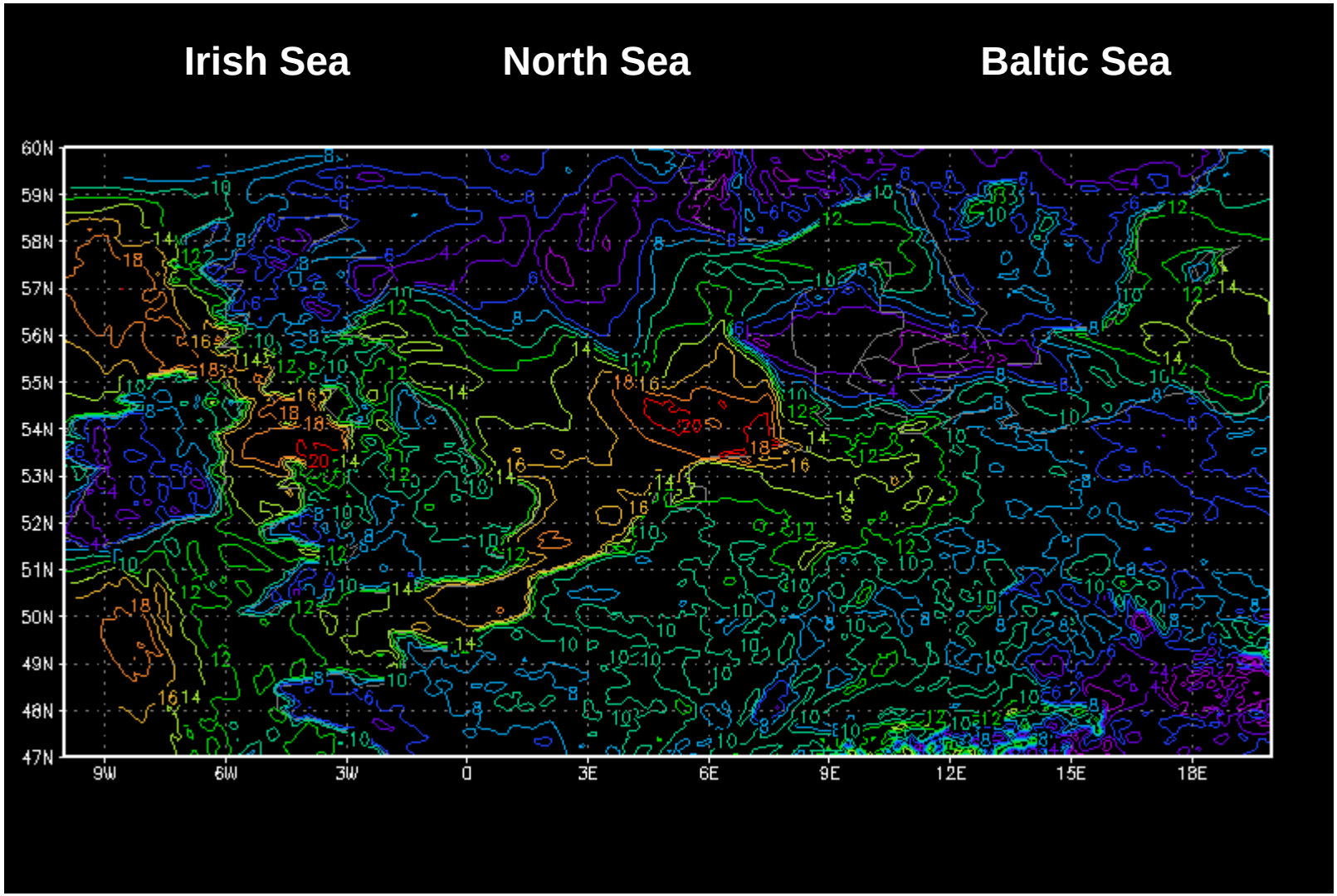
Wind Forecasts from Weather Services



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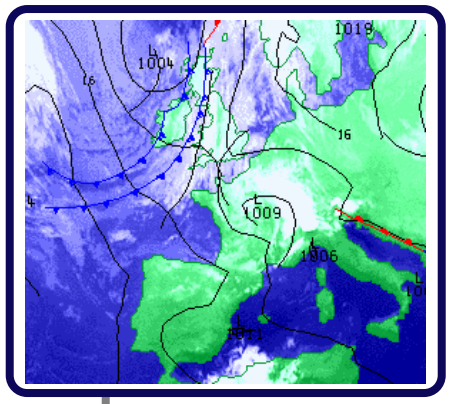
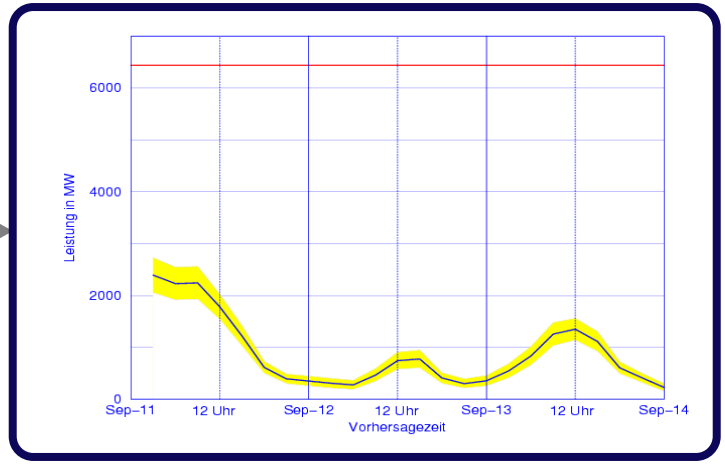
Physical System: *Previento*



17 GW

Previento

- Spatial Refinement
- Thermal Stratification
- Farm Effects
- Regional Upscaling
- Forecast Uncertainty



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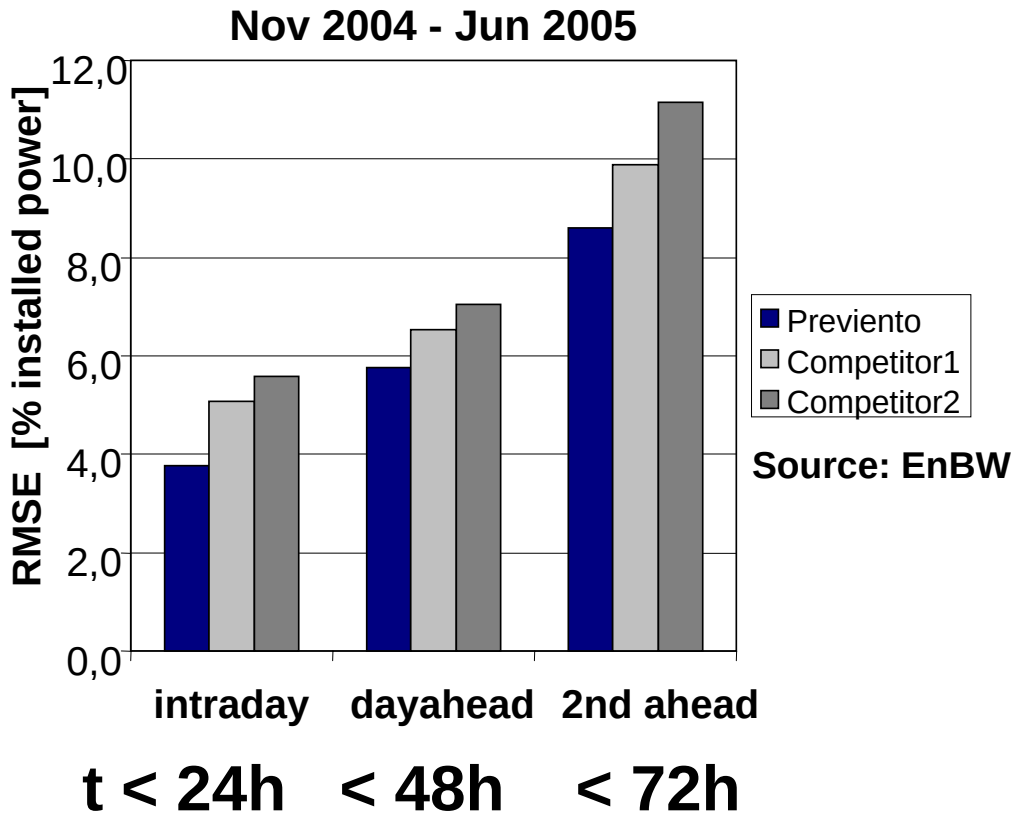
End-User Evaluation of 17 GW Onshore Forecasts

Root Mean Square Error
[% of installed Power]

RMSE
Advantages:

- amplifies extreme deviations
- reflects the cost function of regulative power



t < 24h < 48h < 72h

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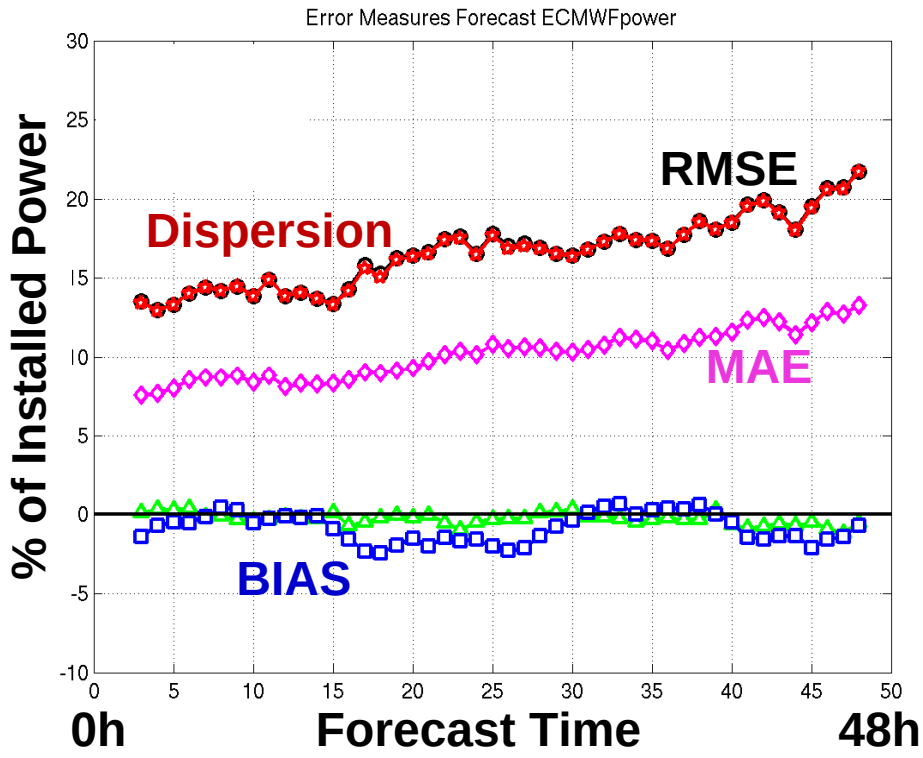
Observations in North and Baltic Sea

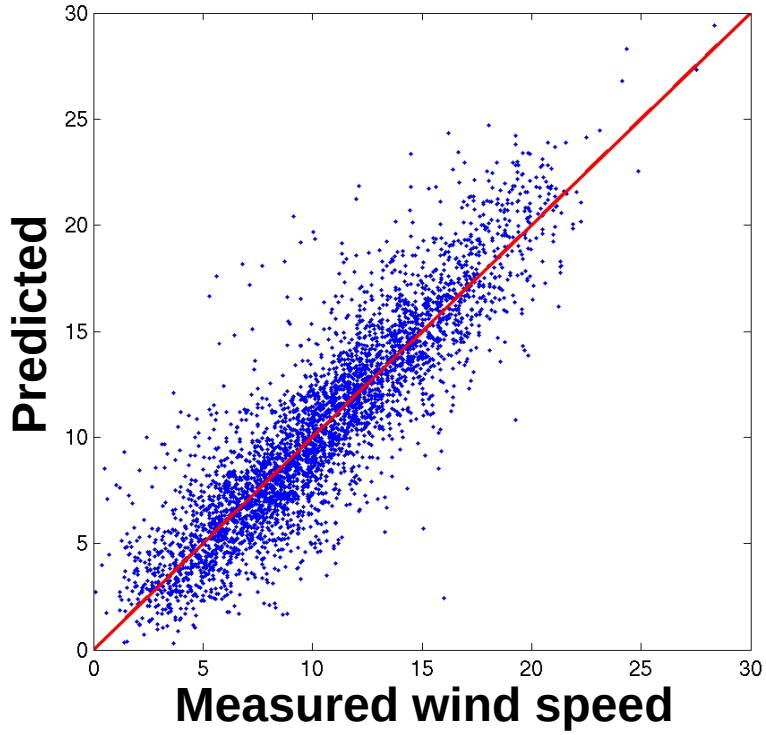
Wind Speed Measurements at FINO1

- **Location: German Bight / North Sea**
- **45km northerly of Island of Borkum**
- **Investigated Period: Jan-Dec 2004**
- **Heights: 30m to 100m**

Abb. 2: Das endgültige Erscheinungsbild der FINO1-Plattform mit abgeklappten Auslegern für die Windmess-Sensorik
Fig. 2: The finished set-up of the FINO1 platform with jibs for wind measurement sensors in folded-down position.

Accuracy of Power Forecasts at a single Offshore Site: FINO1, 100m Height, 12 months, 2004





RMSE ~ Dispersion:
14% to 22%

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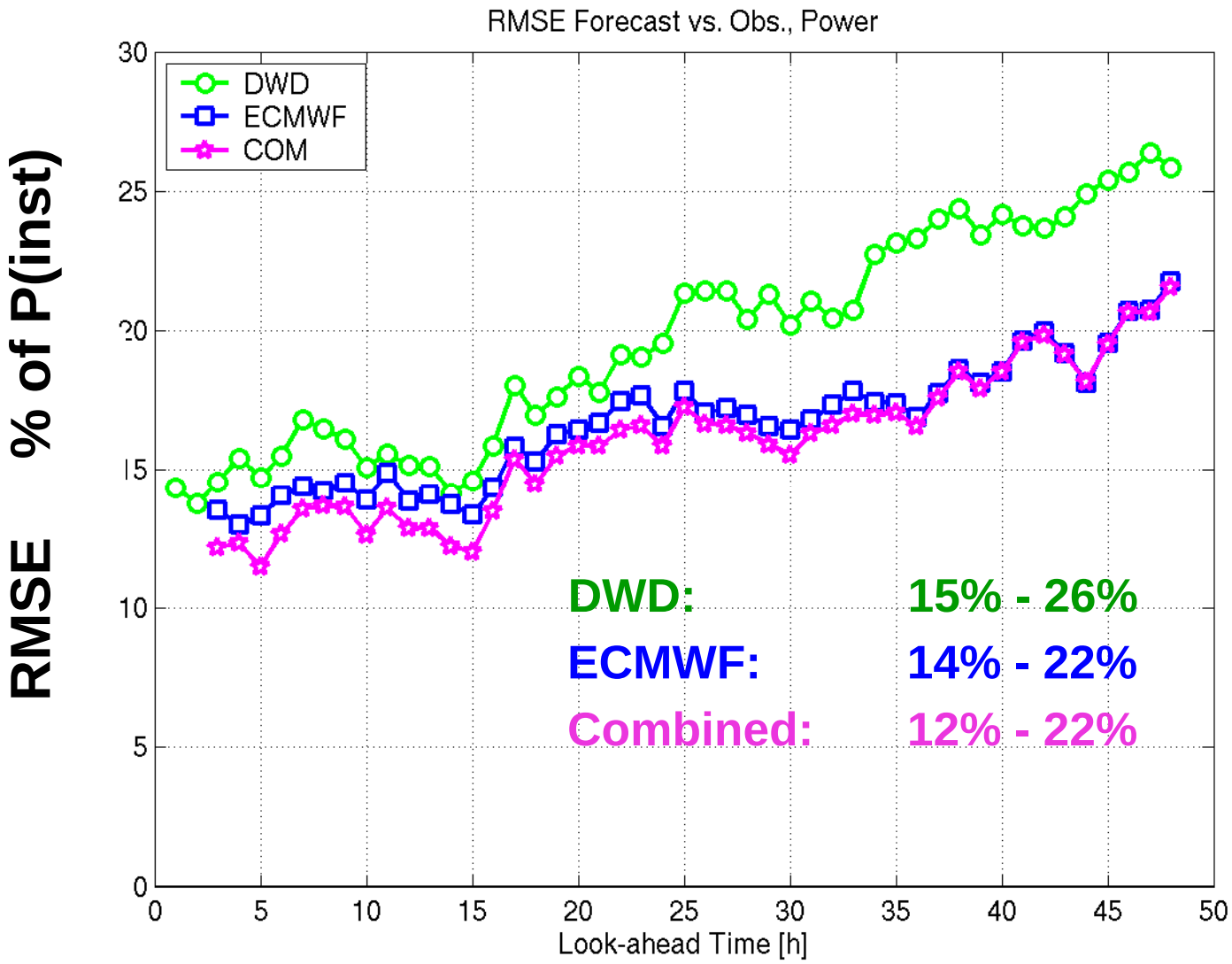
Combined Power Forecasts at FINO1, 100m Height, 12 months, 2004



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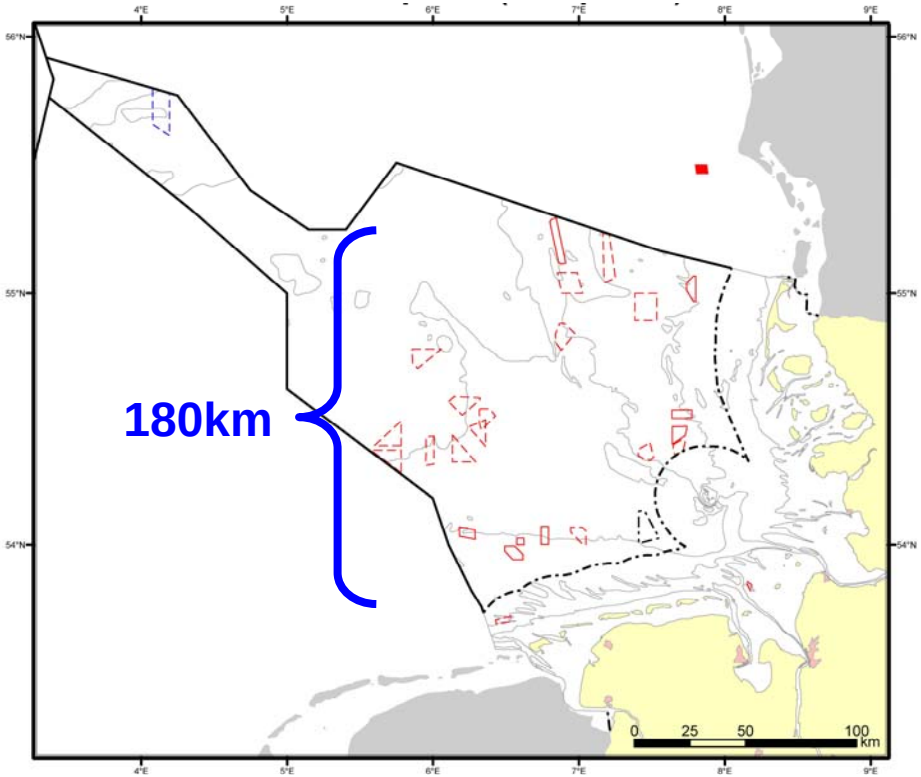
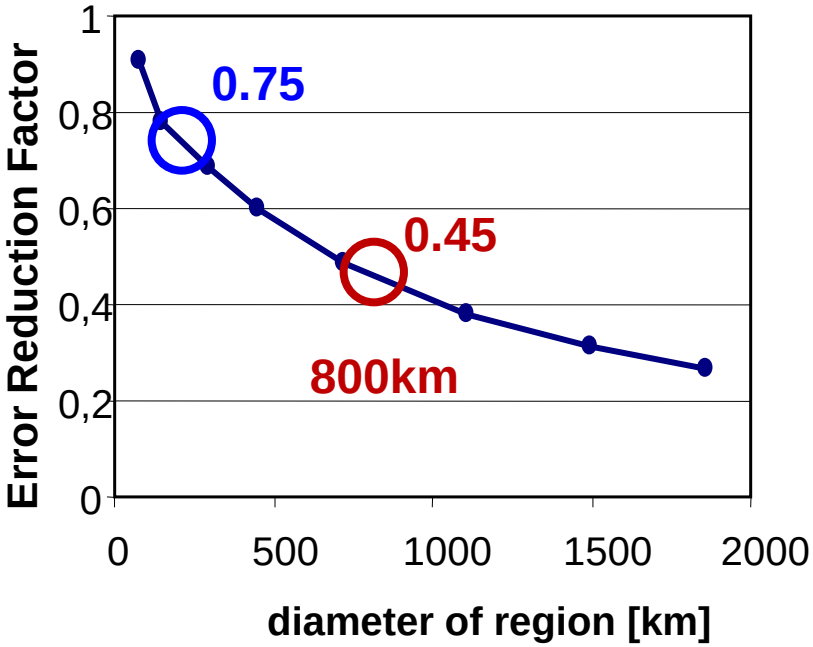
Power Forecasts for 25 GW Offshore Wind Farms, 12 months, 2004



Planned Wind Farms in the German Bight
Source: www.bsh.de

Smoothing of errors same size as onshore?



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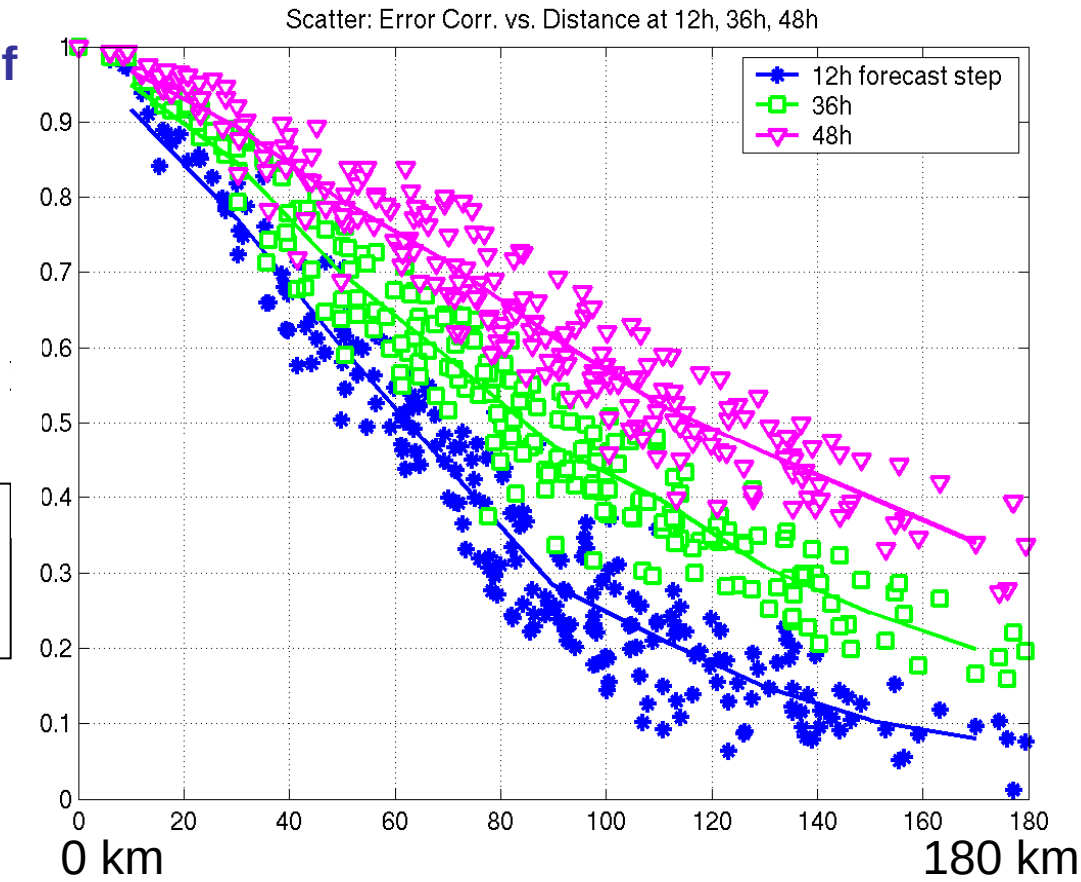
Power Forecasts for 25 single Offshore Wind Farm Sites, 12 months, 2004

ECMWF Forecasts evaluated against DWD Wind Speed Analysis

Cross correlation of forecast errors at single sites

Decay same as Onshore



0 km

180 km

Distance of single sites

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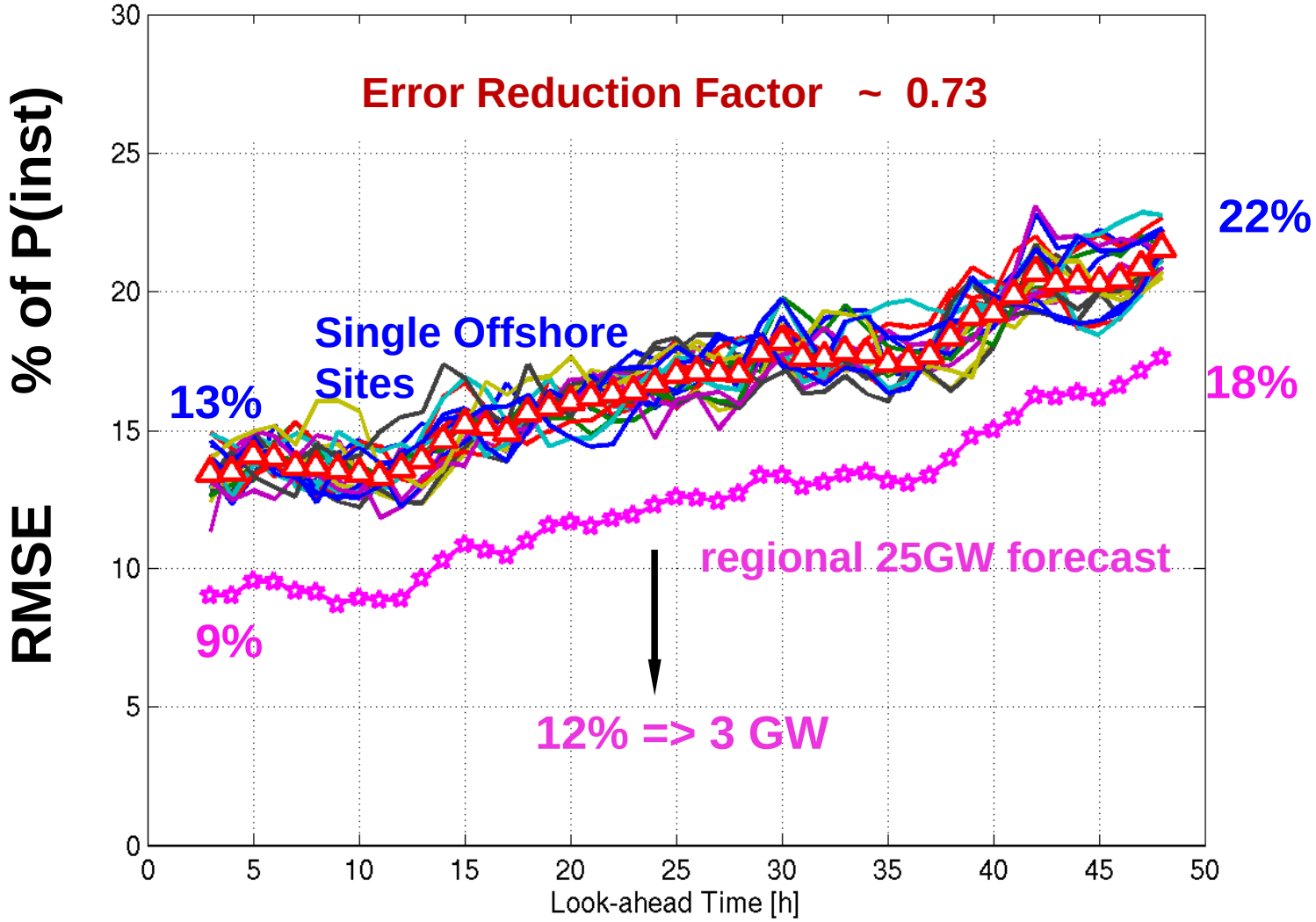
Power Forecasts for 25 GW Offshore Wind Farms, 12 months, 2004



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Conclusions

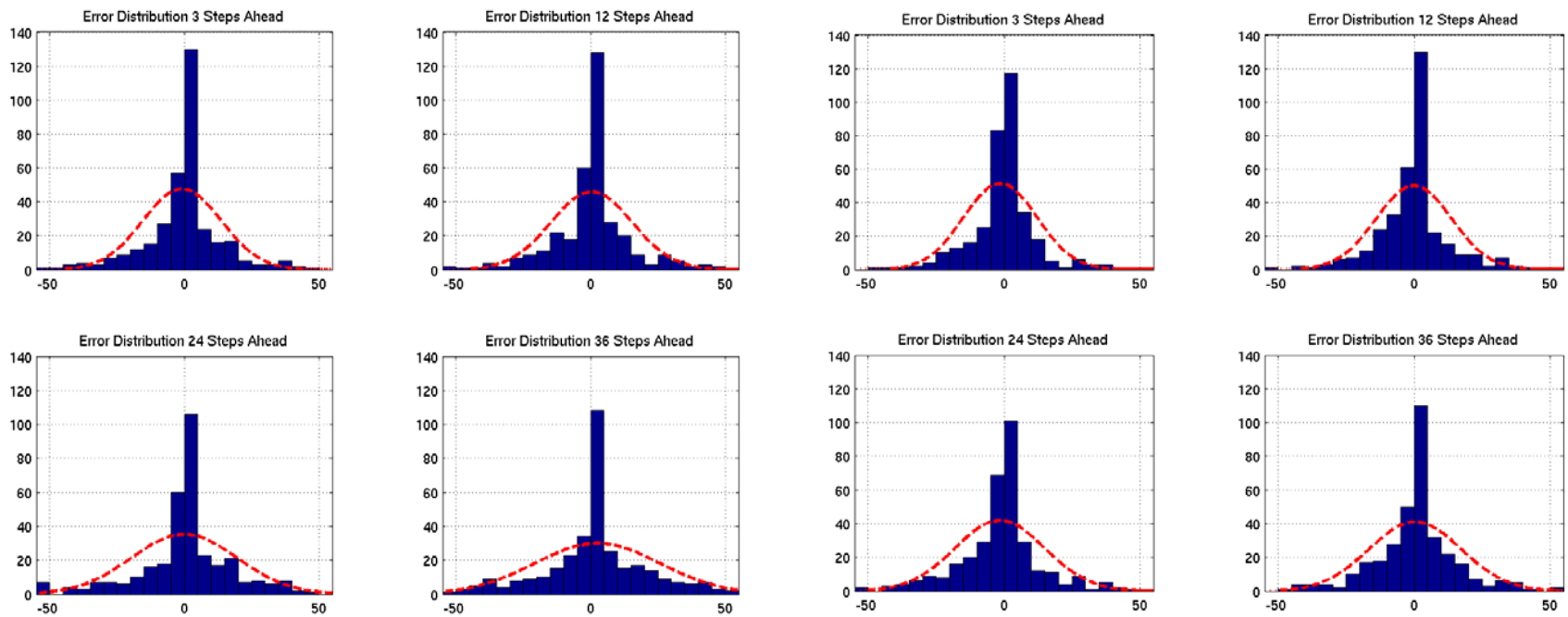
- **Combinations of forecasts from DWD and ECMWF increase the accuracy**
- **Regional smoothing of errors: same as onshore**
- **25 GW Offshore Forecasts: RMSE of 12% (3 GW)**
- **50 GW in an 800km region (On&Offshore): RMSE of 7% (3.5 GW)**

Thanks to the EC for funding the ANEMOS Project

Thank you for your Attention!

Accuracy of POWER forecasts at FiNO1, 100m height, 12 months, 2004

Error Frequency



DWD
Abs(Error) < 15% at 36hours:
230 of 350 forecast runs

ECMWF
Abs(Error) < 15% at 36hours:
262 of 350 forecast runs

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