



Task 36 Forecasting for Wind Power



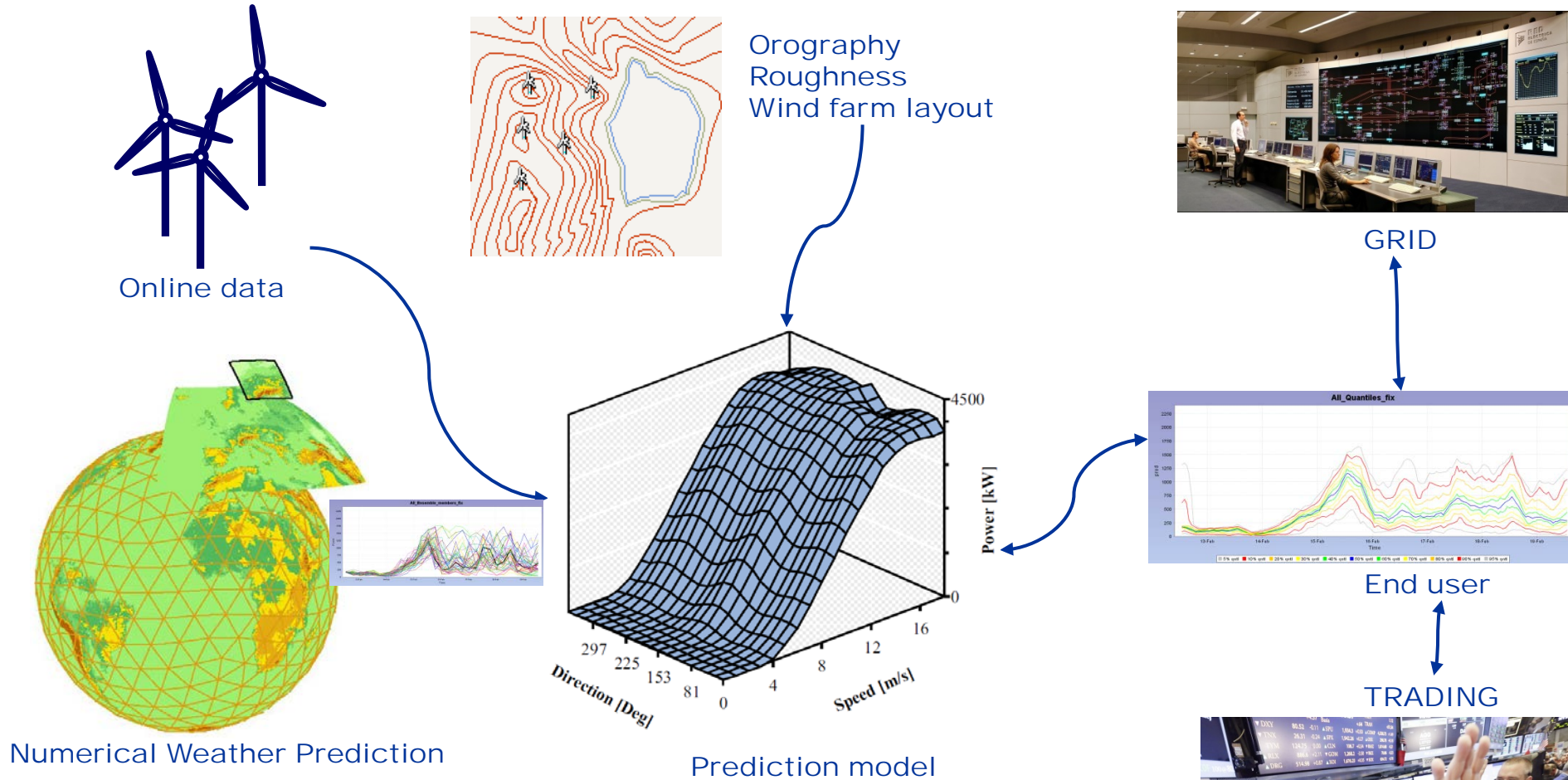
**Gregor Giebel,
DTU Wind Energy**

24 Jan 2017

**AMS General Meeting,
Seattle, US**



Short-Term Prediction Overview



Numerical Weather Prediction

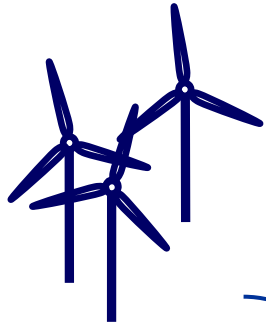
Prediction model



Image sources: DWD, WAsP, Joensen/Nielsen/Madsen EWEC'97, Pittsburgh Post-Gazette, Red Electrica de España.



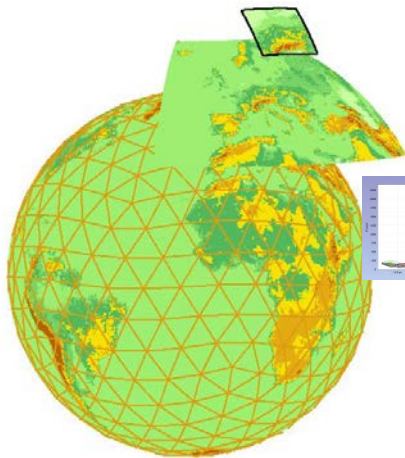
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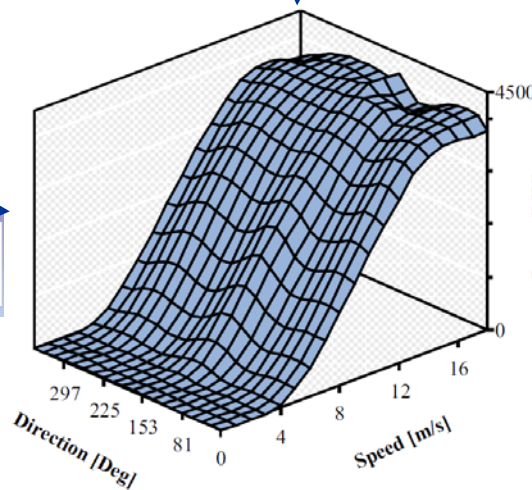
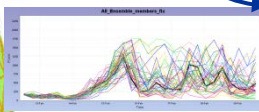
Online data



Orography
Roughness
Wind farm layout



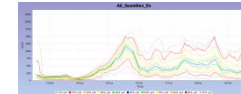
Numerical Weather Prediction



Prediction model



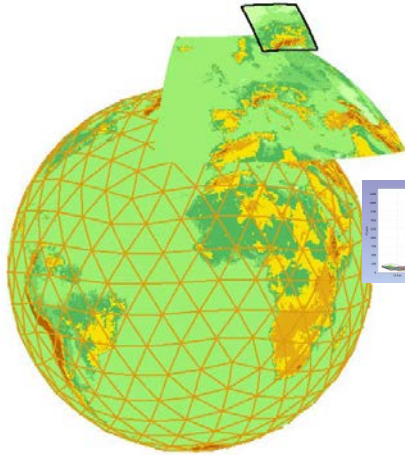
GRID



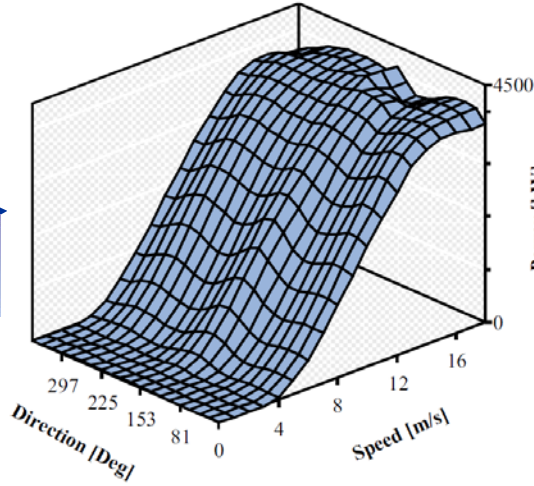
End user

TRADING

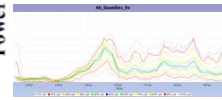




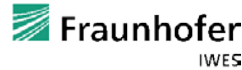
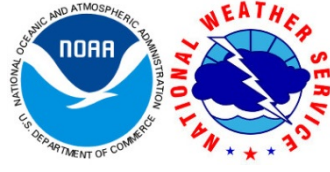
Numerical Weather Prediction

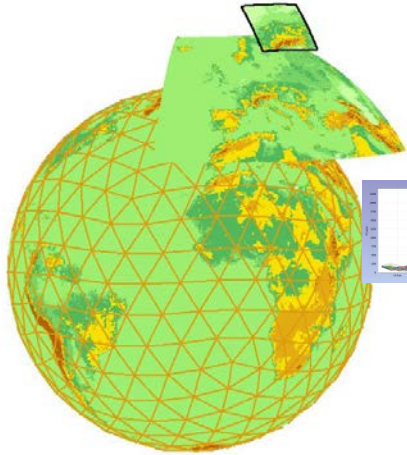


Prediction model

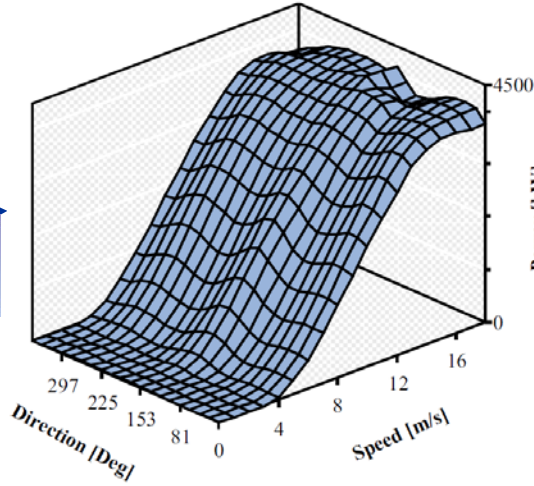
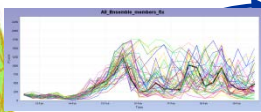


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Numerical Weather Prediction

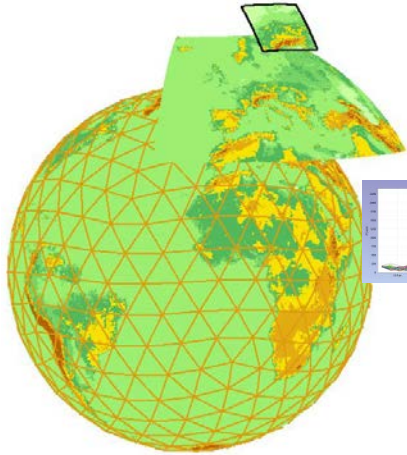


Prediction model

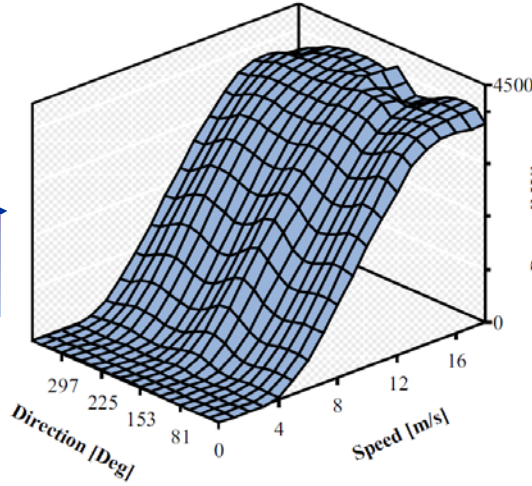
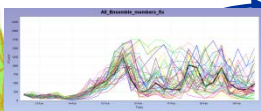


End user

WP1: Coordination Datasets Benchmarks



Numerical Weather Prediction



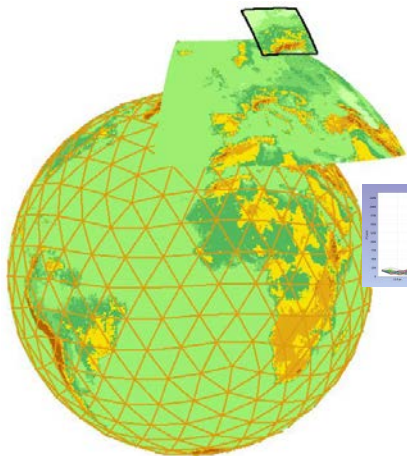
Prediction model



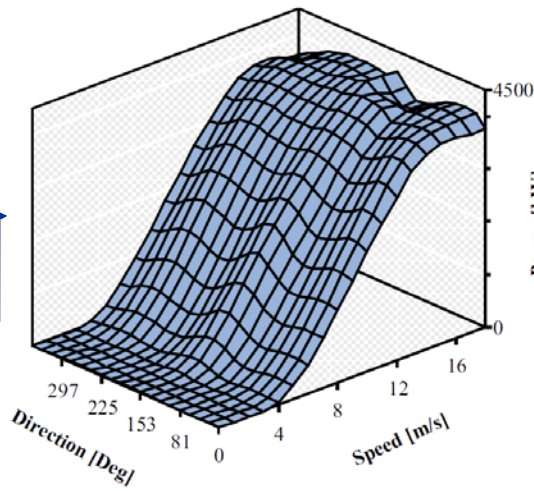
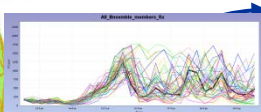
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WP2:

Benchmark Best
Practice
Standard evaluation
protocol
Benchmarks



Numerical Weather Prediction



Prediction model

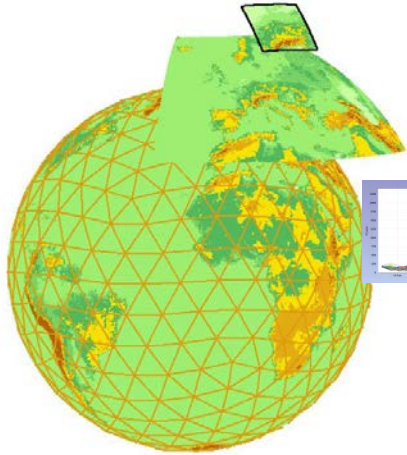


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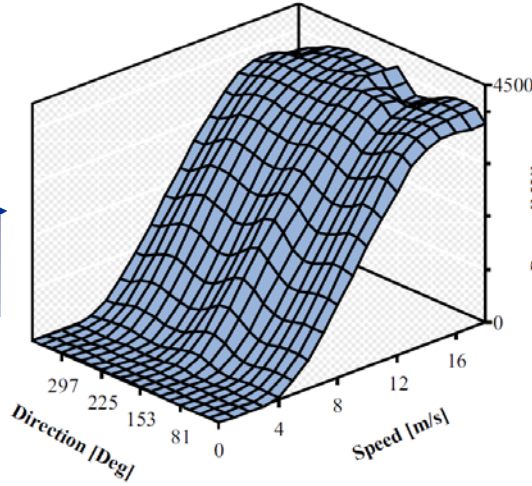
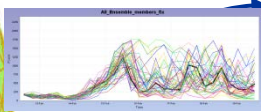
WP3:

Decision support

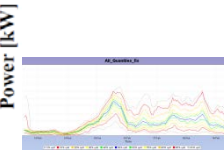
Scenarios
Best Practice in Use
Communication



Numerical Weather Prediction



Prediction model



End user

WP1: Coordination Datasets Benchmarks



WP1 Meteorology

Lead:

- Helmut Frank, DWD
- Joel Cline, DoE
- Will Shaw, PNNL





WP1 Meteorology

- Task 1.1: Compile list of **available data sets**, especially from tall towers.
- Task 1.2: Creation of annual reports documenting and announcing **field measurement programs** and availability of data.
- Task 1.3: Verify and Validate the improvements through a **common data set** to test model results upon and discuss at IEA Task meetings



Task 1.1

Compile list of available data sets, especially from tall towers.

Lead: DWD

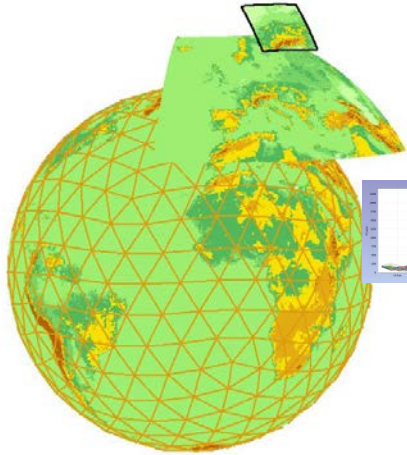
- Tall means $> 100\text{m}$ (offshore maybe a little less)
- List currently contains **12 masts**, more are welcome!
- Long-term, operational lidar/sodar measurements would be fine too.

For this conference “Observations Lead The Way”: this is the most important observation we need!

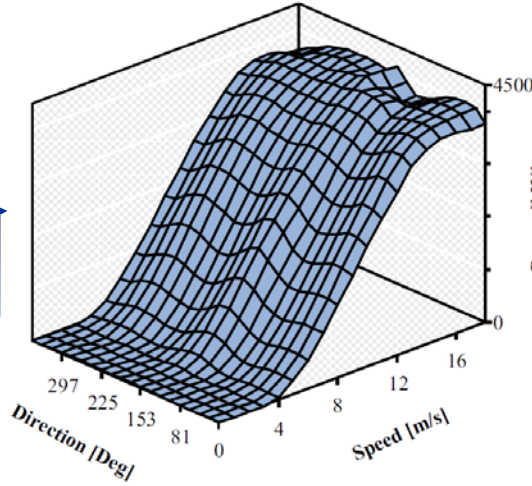
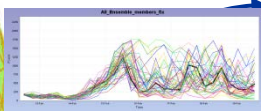


Wind observation need beyond 100m





Numerical Weather Prediction



Prediction model



End user

WP2:

Benchmark Best
Practice
Standard evaluation
protocol
Benchmarks





WP2 Benchmarks

Lead:

Pierre Pinson, DTU Elektro

Jakob Messner, DTU Elektro

Bri-Mathias Hodge, NREL

Caroline Draxl, NREL



iea wind



Task 2.1 – Lead DTU Elektro

Design of benchmark exercises: best practice

D2.1: IEA Recommended Practice on Wind Power Forecast Evaluation, for both deterministic and probabilistic forecasts



Task 2.2 – Lead DTU Compute / Elektro

Standard evaluation protocol for both deterministic and probabilistic forecasts: review of existing, best practice, and critical assessment of new proposals



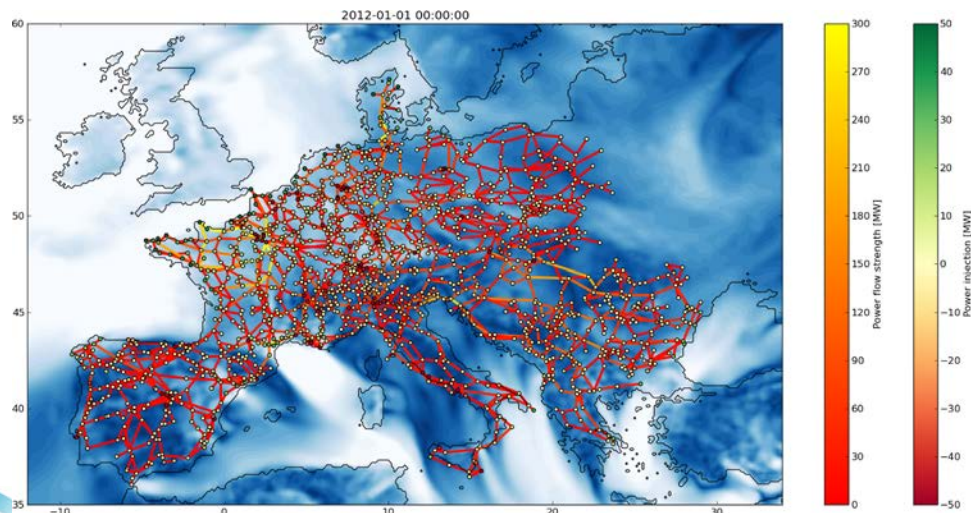
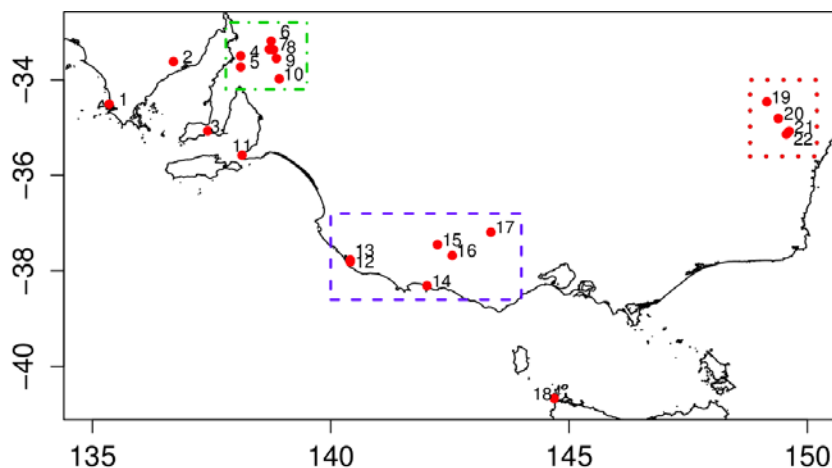
Task 2.4 – Lead DTU Elektro

Set-up and dissemination of benchmark test cases and data sets

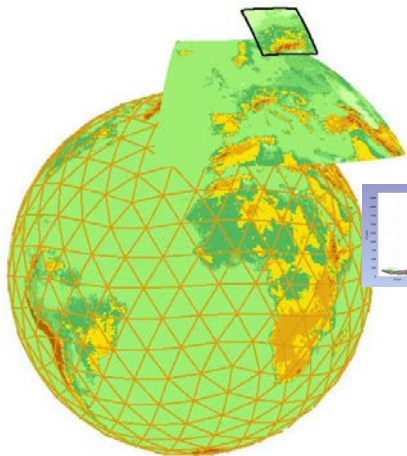
E.g. Global Forecast Competition on Kaggle,
ANEMOS comparison



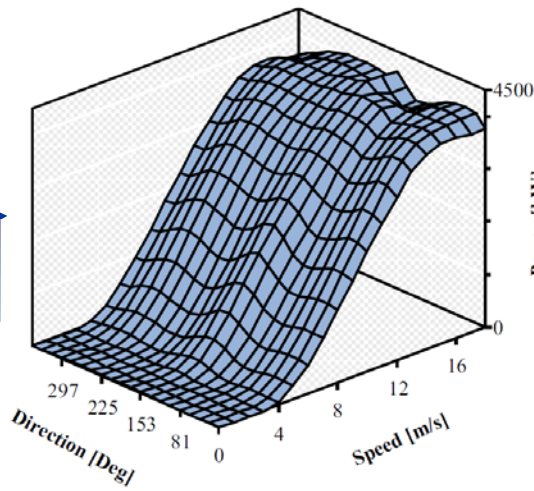
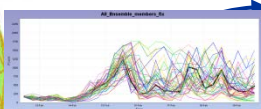
Task 2.4 – Example datasets



- AEMO dataset
(Australia, 20 wind farms,
5min res. over several years)
-
-
-
- RE-Europe (Europe,
1500 nodes with wind and
solar power, hourly res. over
3 years – to be extended)



Numerical Weather Prediction



Prediction model



End user

WP3:

Decision support

Scenarios
Best Practice in Use
Communication



WP3 Advanced Usage

Lead:

George Kariniotakis, Mines ParisTech

Industry co-lead





Task 3.1 – Lead: WEPROG

State of the art of use of forecasts uncertainties in the business practices (operation/management, planning of power systems, markets operation/participation) of actors in the power systems sector (TSOs, DSOs, ESCOs, traders etc).

Please fill in the questionnaire at

<http://www.ieawindforecasting.dk/topics/workpackage-3/task-3-1>

(also linked from main page of the task)



Task 3.1: Use of Forecast Uncertainties in the Power Sector: State-of-the Art of Business Practice

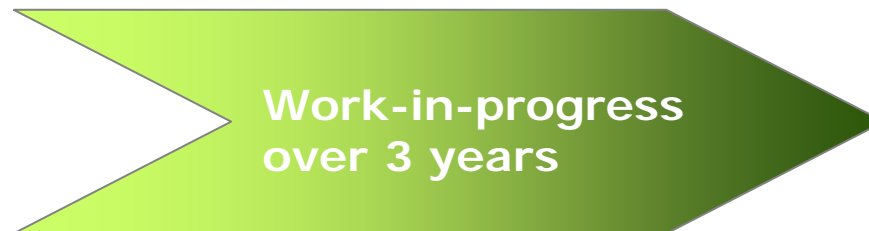
Purpose:

- Get an overview of the current use and application of probabilistic forecasts in the power industry sector;
- Investigate how participants estimate and deal with uncertainties.

Phase 1: Collection of Information

Phase 2: Analysis of Results

Phase 3: Communication and Dissemination





How we setup the interviews

Questions were separated into 2 categories:

General character to identify:

- the type of business
- the size of the organisation
- the span of the business processes
- the possible existing barriers

Forecasting & uncertainty to identify:

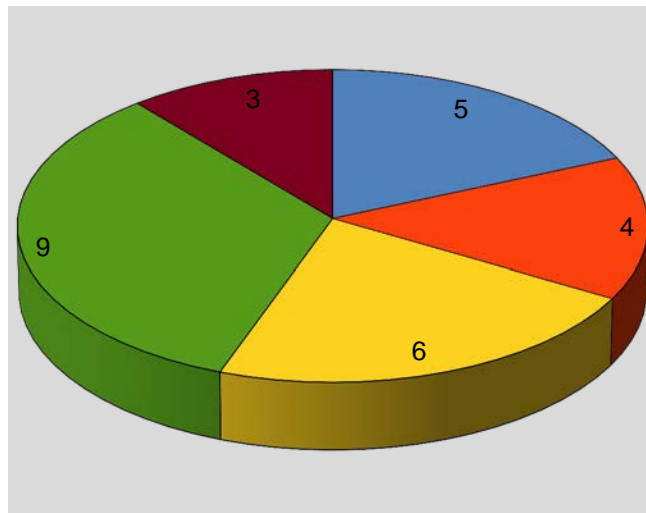
- the forecasting products used today
- the knowledge & awareness of probabilistic products
- the challenges that hinder the implementation of new products

Get a broad overview of state-of-the-art use of forecasting and uncertainty in the power market



First Results: 24 (27) participants

Questionnaires: Participation by Role



- R&D : Research & Development
- PP_PMC : Power Producer/Power Management Company
- ESO : Energy Service Organisation/Utility
- SO : System Operator
- ETC : Energy Trading Company

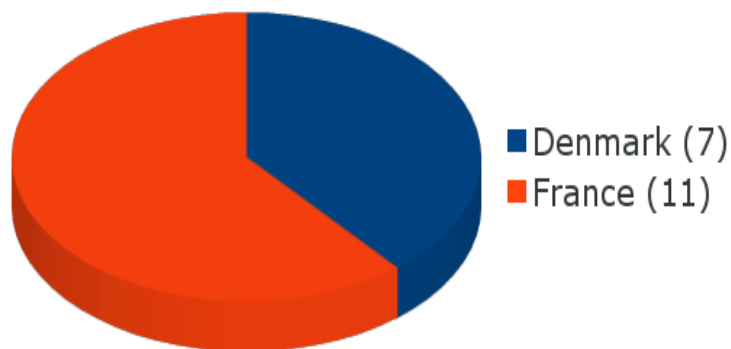
Under-representation of Traders



First Results: 24 (27*) participants

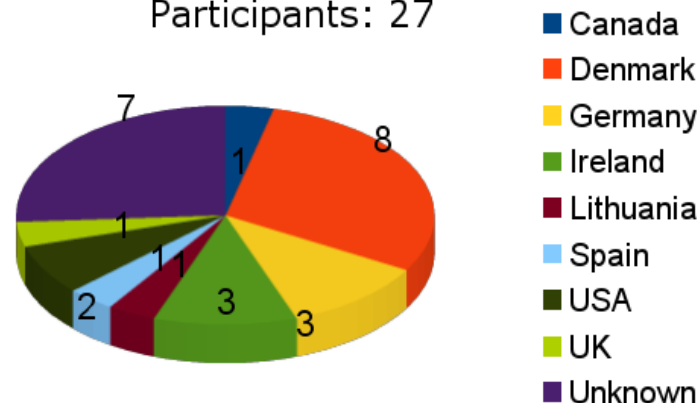
Interviews Task 3.1

Participants: 18



Answers distribution over countries

Participants: 27



Note: "Unknown" means the interviews have been submitted anonymously

Under-representation of Asia/Africa/SouthAmerica

* 3 participant's questionnaires arrived after the paper submission deadline



Task 3.4 – Lead: NREL

Review of existing/proposal of best practices on how to measure/quantify the value from the use of probabilistic forecasts

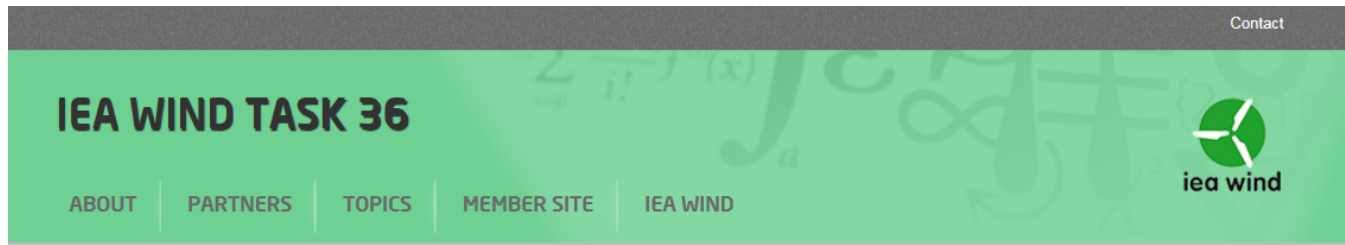


Task 3.5 – Lead: INESC TEC

Communication of wind and wind power forecasts to end-users. Review, recommendations/best practice. Is it necessary to standardise wind power forecasting products?



Website: www.ieawindforecasting.dk



- RELATED PROJECTS**
- > IEA Wind
 - > IEA Wind Task 25 - Large-sc...
 - > IEA Wind Task 31 Wakebench
 - > EWeLiNE
 - > WFIP2
 - > New European Wind Atlas



Source: Red Eléctrica de España

- NEWS** All
- 03 June 2016
Questionnaire on State of the art...
 - 18 May 2016
10 June 2016: IEA Wind Task 36...
 - 18 May 2016
9 June 2016 Workshop in Barcelona
 - 18 May 2016
8 June 2016 Potentially sub-task...

Wind power forecasts have been used operatively for over 20 years. Despite this fact, there are still several possibilities to improve the forecasts, both from the weather prediction side and from the usage of the forecasts. The new International Energy Agency (IEA) Task on Forecasting for Wind Energy tries to organise international collaboration, among national weather centres with an interest and/or large projects on wind forecast improvements (NOAA, DWD, ...), operational forecaster and forecast users.

The Task is divided in three work packages: Firstly, a collaboration on the improvement of the scientific basis for the wind predictions themselves. This includes numerical weather prediction model physics, but also widely distributed information on accessible datasets. Secondly, we will be aiming at an international pre-standard (an IEA Recommended Practice) on benchmarking and operational wind power forecasts, including probabilistic forecasts. This will

[g/task_25.html](#)





Collected Issues

Nowcast (especially for difficult situations, thunderstorms, small lows, ...)

Sub 1 hour temporal resolution

Meteorology below 1km spatial resolution

Stability issues, especially with daily pattern / (Nightly) Low level jets

Icing

Farm-Farm interaction / quality of direction forecast

Short-term ensembles

Ramps and other extremes

Spatio-temporal forecasting

Rapid Update Models (hourly, with hourly data assimilation)

Use of probabilistic forecasts and quality of the extreme quantiles

Do DSOs need different forecasts than TSOs?

Penalties for bad performance? Incentives for improved perf.?

Seasonal forecasting? What's the business case?

Data assimilation (with non-linear Kalman filters, 4D Var, ...)

Red: Important research, but (to be) done elsewhere
Green: We work on at least some aspects



iea wind



TORQUE 2016

Munich, Germany, 5-7 October

Paper on future research issues:

<http://iopscience.iop.org/article/10.1088/1742-6596/753/3/032042>

Wind power forecasting: IEA Wind Task 36 & future research issues

G Giebel¹, J Cline², H Frank³, W Shaw⁴, P Pinson⁵, B-M Hodge⁶, G Kariniotakis⁷, J Madsen⁸ and C Möhrlen⁹

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[Journal of Physics: Conference Series](#), [Volume 753](#), [B. Wind, wakes, turbulence and wind farms](#)

The Science of Making Torque from Wind (TORQUE 2016)

Journal of Physics: Conference Series 753 (2016) 032042

IOP Publishing

doi:10.1088/1742-6596/753/3/032042

Wind power forecasting: IEA Wind Task 36 & future research issues

G Giebel¹, J Cline², H Frank³, W Shaw⁴, P Pinson⁵, B-M Hodge⁶, G Kariniotakis⁷, J Madsen⁸ and C Möhrlen⁹

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Abstract. This paper presents the new International Energy Agency Wind Task 36 on Forecasting, and invites to collaborate within the group. Wind power forecasts have been used operatively for over 20 years. Despite this fact, there are still several possibilities to improve the forecasts, both from the weather prediction side and from the usage of the forecasts. The new International Energy Agency (IEA) Task on Forecasting for Wind Energy tries to organise international collaboration, among national meteorological centres with an interest and/or large projects on wind forecast improvements (NOAA, DWD, MetOffice, met.no, DMI, ...), operational forecaster and forecast users.



Thank You!!

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www.ieawindforecasting.dk

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