Task 36 Forecasting for Wind Power

Gregor Giebel,
DTU Wind Energy

24 Jan 2017

AMS General Meeting,
Seattle, US

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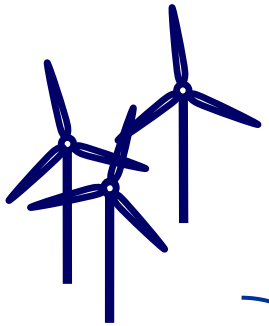
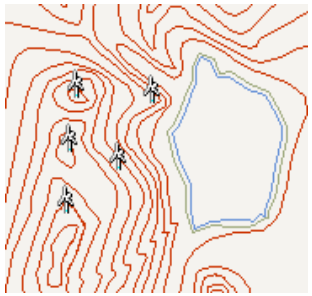
Short-Term Prediction Overview

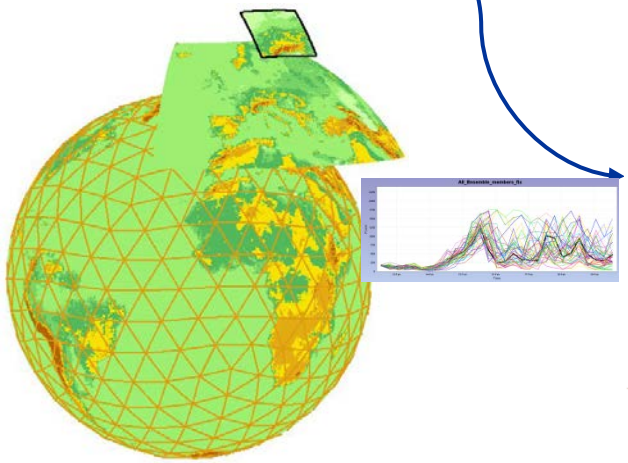


Online data

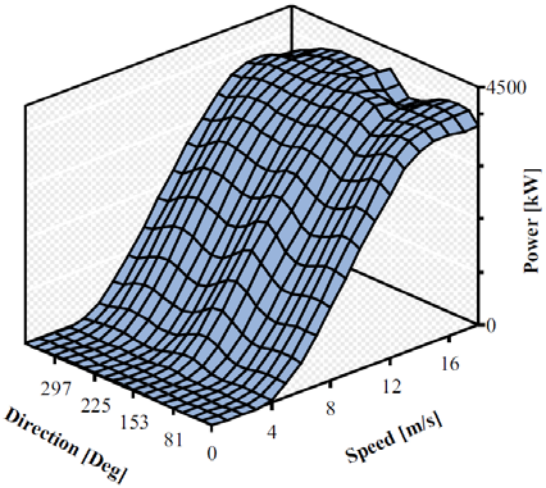


Orography
Roughness
Wind farm layout

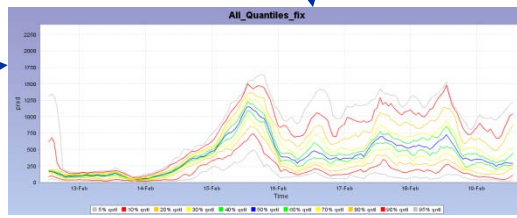
GRID



Numerical Weather Prediction



Prediction model



End user

TRADING

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

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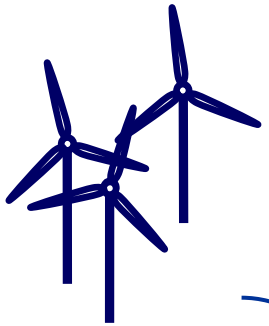

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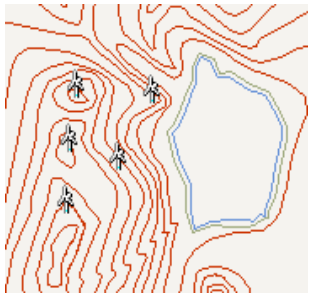

Orography
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Wind farm layout

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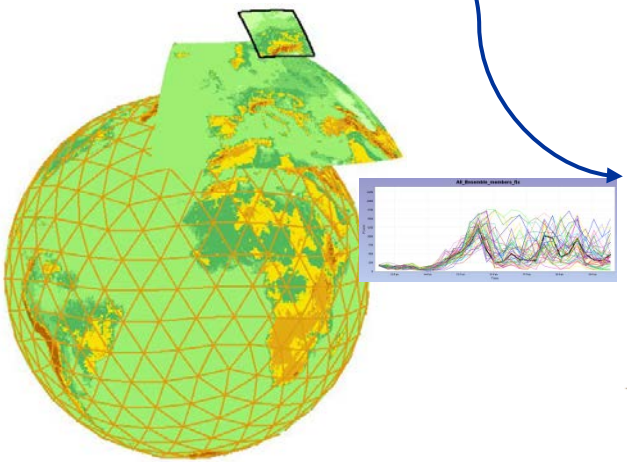

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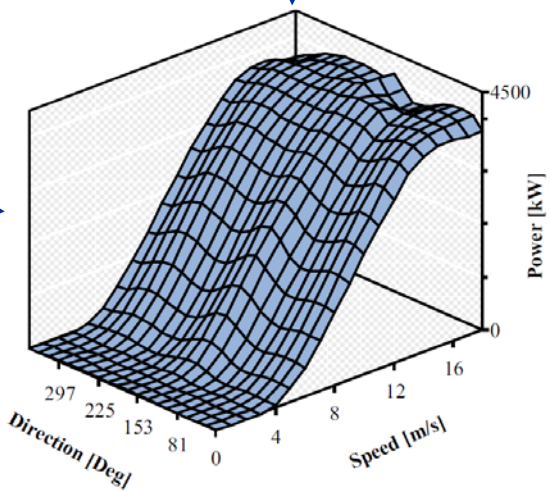

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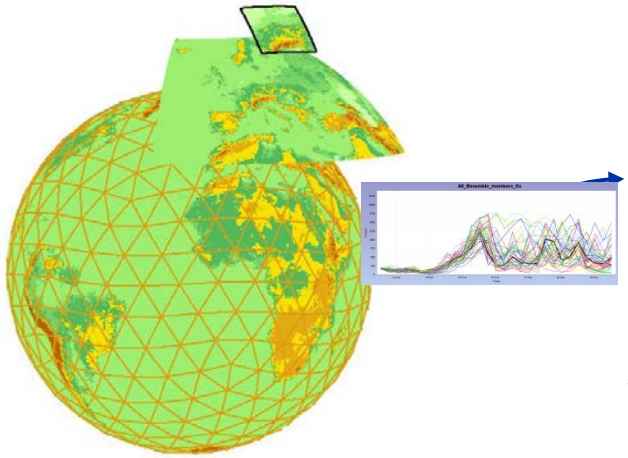

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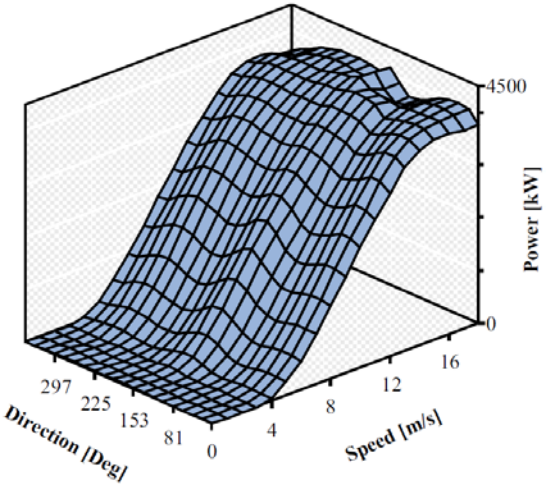

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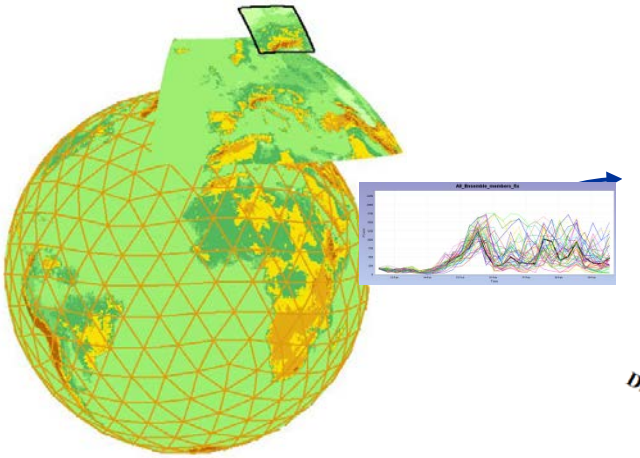

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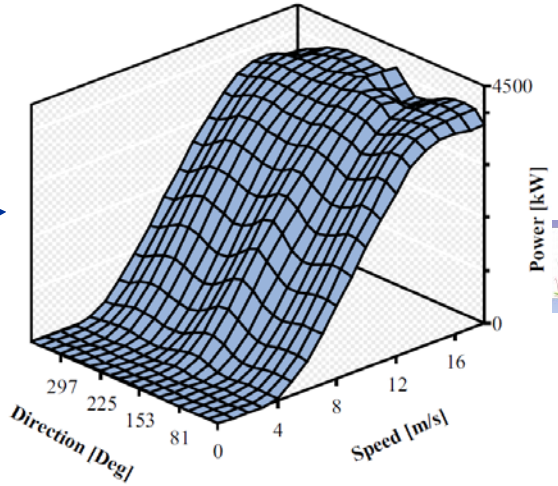
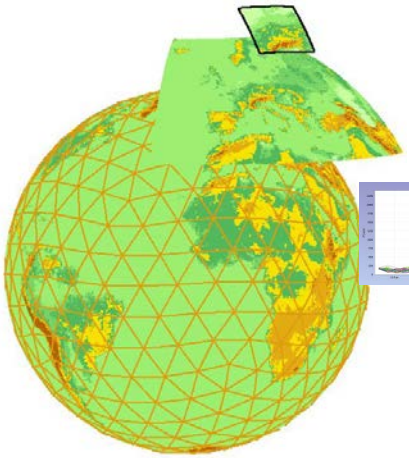


Prediction model

End user

WP1: Coordination Datasets Benchmarks

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



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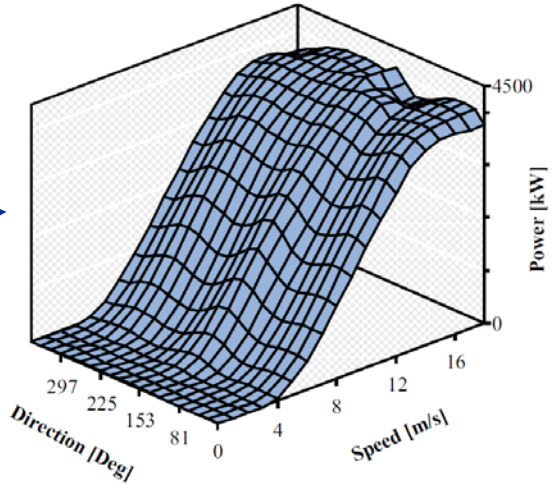

Prediction model

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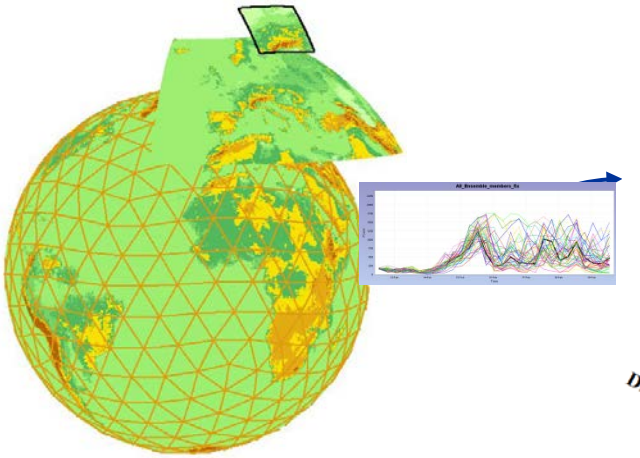
WP2:

Benchmark Best Practice
Standard evaluation protocol
Benchmarks

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



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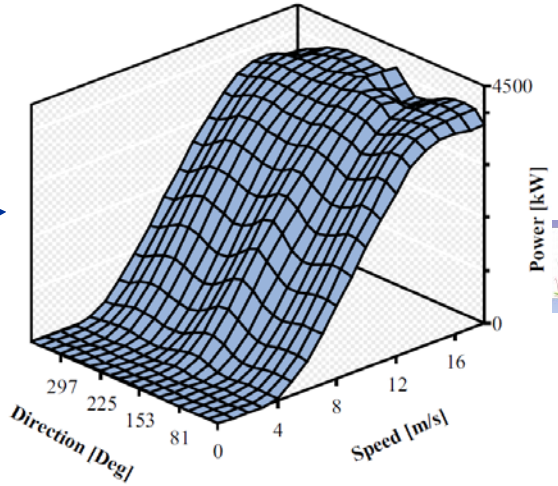

Prediction model

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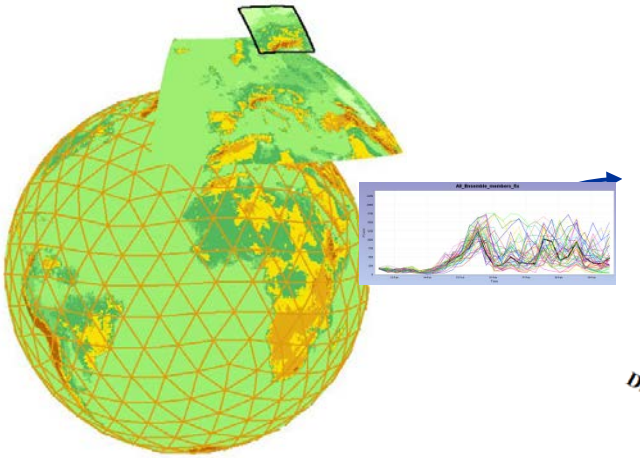
WP3:

Scenarios
Best Practice in Use
Communication

Decision support

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



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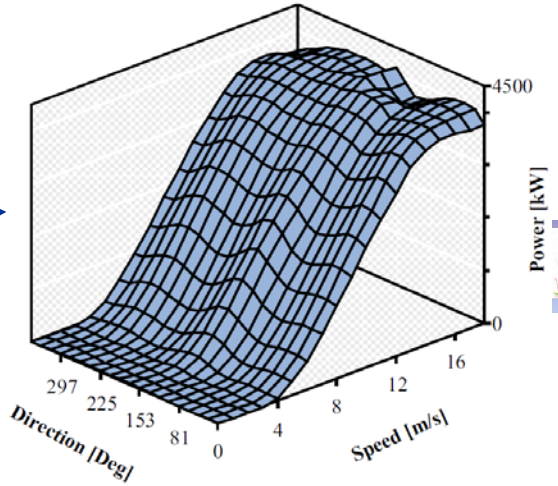

Prediction model

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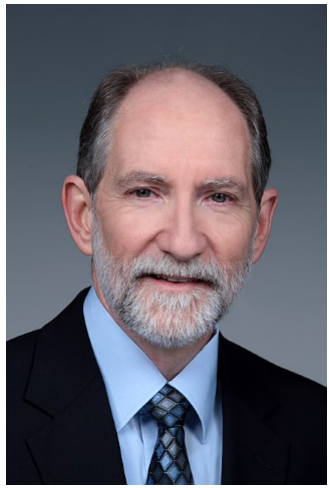
WP1: Coordination Datasets Benchmarks

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

WP1 Meteorology

Lead:

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



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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

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Task 1.1

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

- **Tall means > 100m** (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!

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Wind observation need beyond 100m

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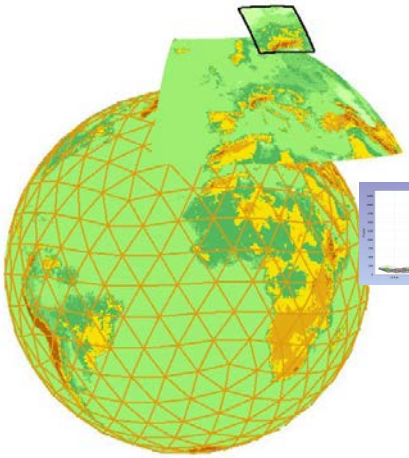

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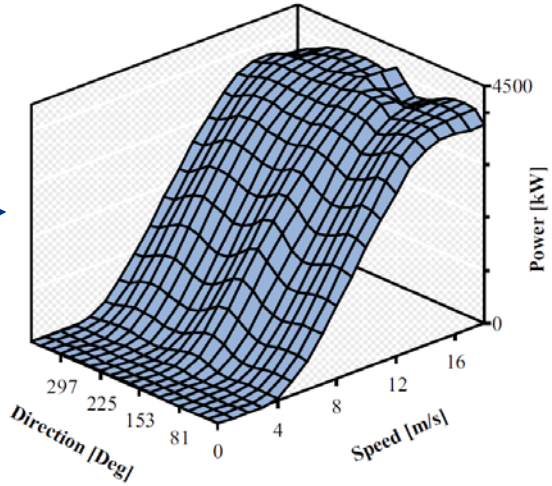

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WP2:

Benchmark Best Practice
Standard evaluation protocol
Benchmarks

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

WP2 Benchmarks

Lead:

Pierre Pinson, DTU Elektro

Jakob Messner, DTU Elektro

Bri-Mathias Hodge, NREL

Caroline Draxl, NREL

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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

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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

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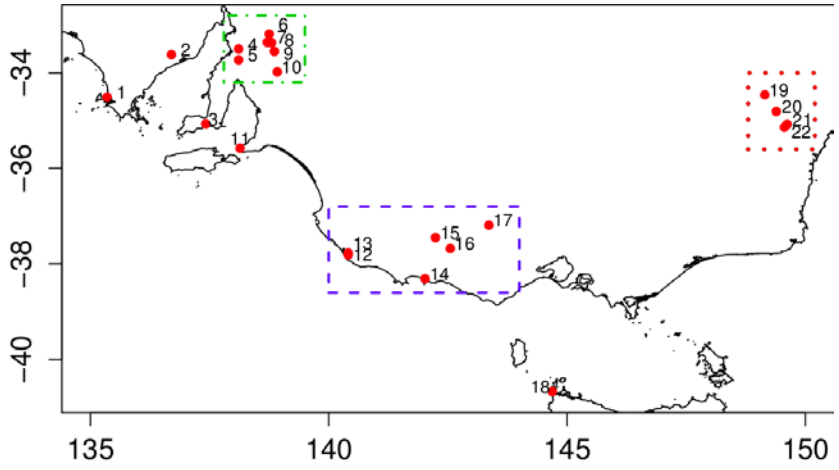
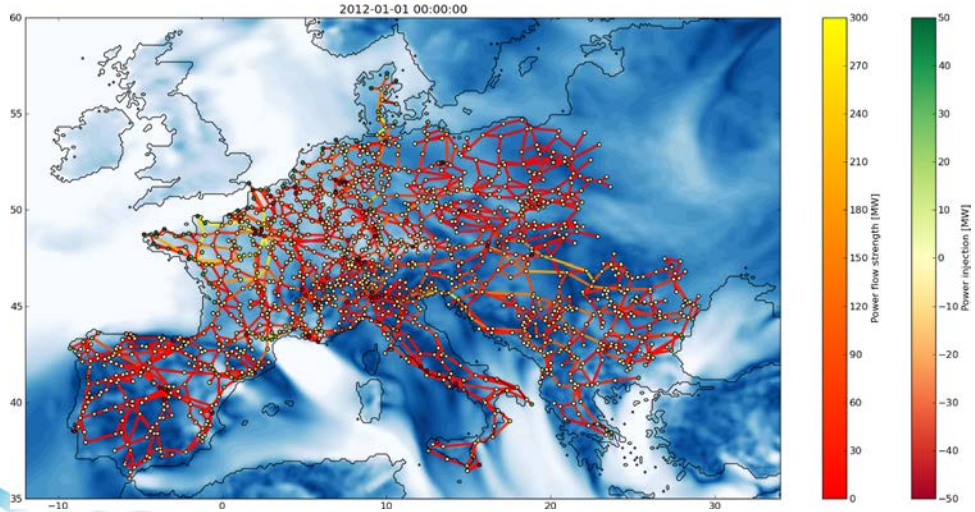
Task 2.4 – Example datasets





- 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)

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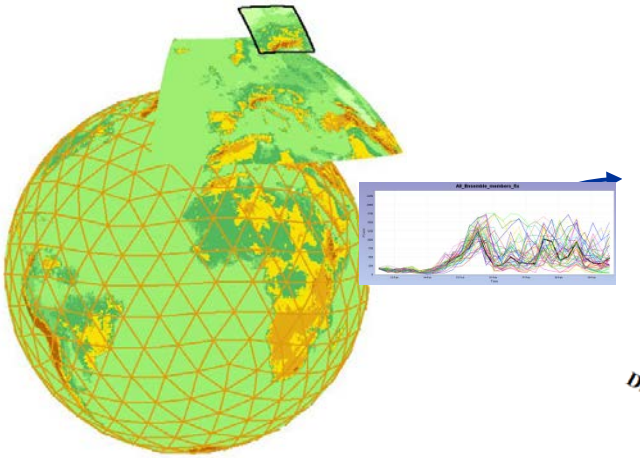

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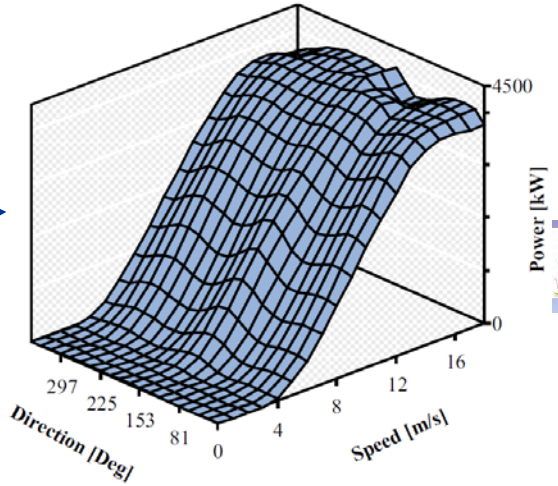

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WP3:

Scenarios
Best Practice in Use
Communication

Decision support

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

WP3 Advanced Usage

Lead:

George Kariniotakis, Mines ParisTech

Industry co-lead

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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)

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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

Work-in-progress over 3 years

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

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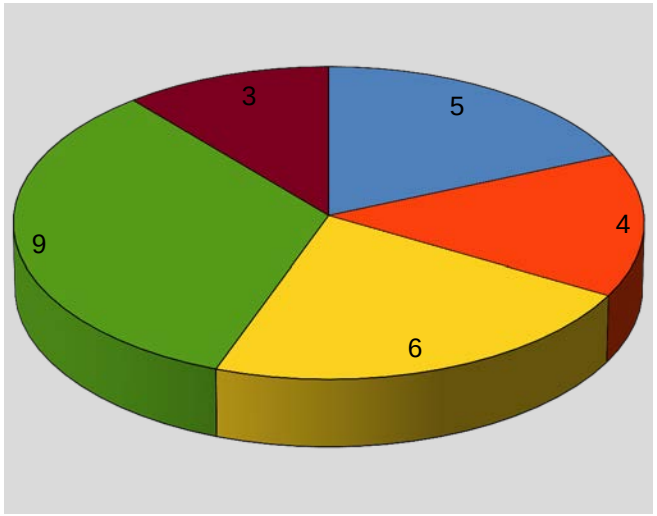
First Results: 24 (27) participants

Questionnaires: Participation by Role



Under-representation of Traders

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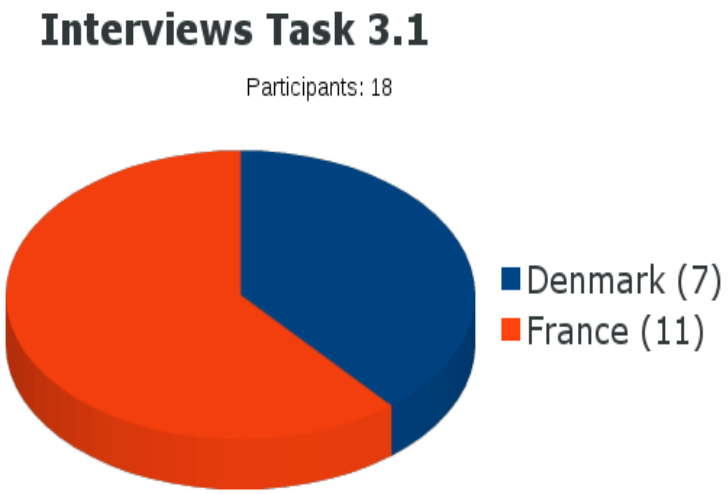
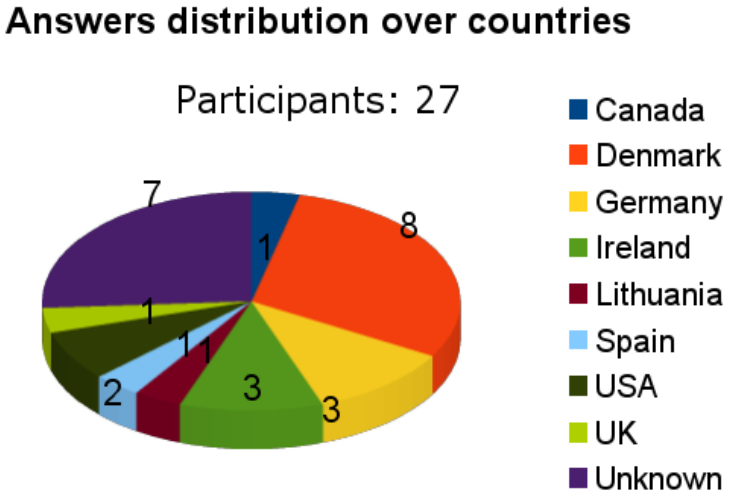
First Results: 24 (27*) participants





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

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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

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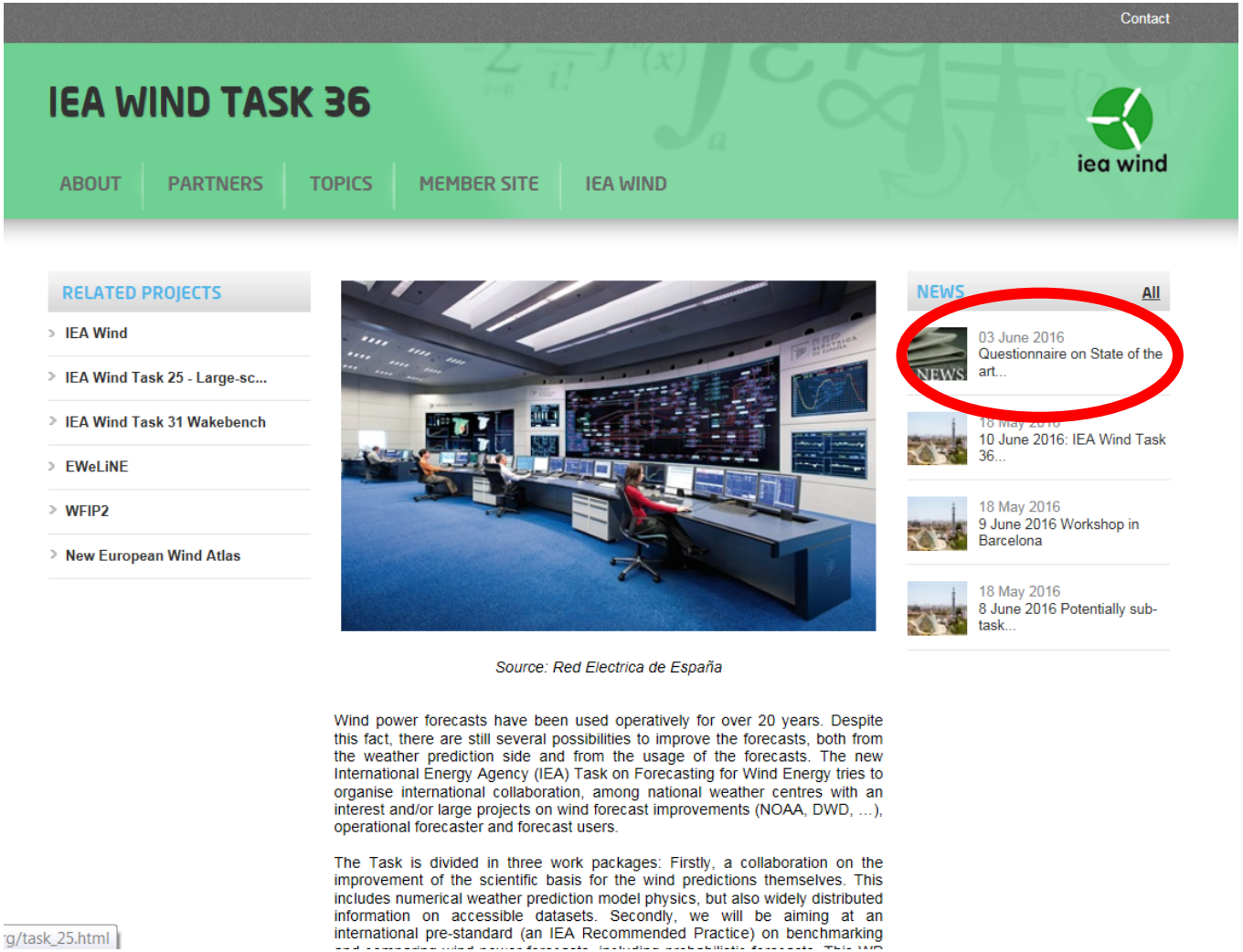
Task 3.5 – Lead: INESC TEC

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



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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

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Paper on future research issues:

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

The Science of Making Torque from Wind (TORQUE 2016) IOP Publishing
Journal of Physics: Conference Series **753** (2016) 032042 doi:10.1088/1742-6596/753/3/032042

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

G Giebel[1], J Cline[2], H Frank[3], W Shaw[4], P Pinson[5], B-M Hodge[6], G Kariniotakis[7], J Madsen[8] and C Möhrlen[9]

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Journal of Physics: Conference Series, Volume 753, B. Wind, wakes, turbulence and wind farms

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[4] Pacific Northwest National Laboratory, 902 Battelle Boulevard, P.O. Box 999, MSIN K9-30, Richland, WA 99352 USA
[5] DTU Elektro, Ørsteds Plads, 2800 Kgs. Lyngby, Denmark
[6] National Renewable Energy Laboratory, 15013 Denver West Parkway, MS ESIF200, Golden, CO 80401, USA
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[8] Vattenfall AB, Jupitervej 6, DK-6000 Kolding, Denmark
[9] WEPROG Aps, Willemoesgade 15B, 5610 Assens

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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.

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Thank You!!

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www.ieawindforecasting.dk

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