IEA Wind Task 36 Forecasting

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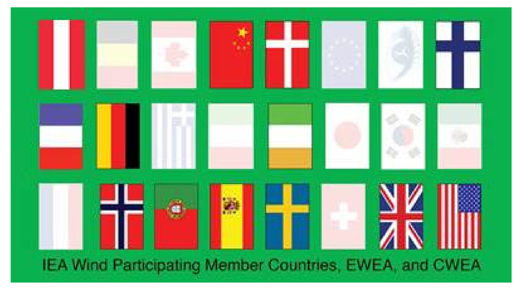
EGU2018

DTU Wind Energy
Department of Wind Energy



IEA Wind Participating Member Countries, EWEA, and CWEA

Summary

This poster provides an overview of the IEA Wind Task for Wind Power Forecasting. The Operating Agent is Gregor Giebel of DTU, Co-Operating Agent is Will Shaw from Pacific Northwest National Laboratory. Collaboration in the Task is solicited from everyone interested in the forecasting business. The task runs for three years, 2016-2018.

Main deliverables are an up-to-date list of current projects and main project results, including data sets, which can be used by researchers around the world for analysis and model improvements, an IEA Recommended Practice on performance evaluation of wind power forecasts, a position paper regarding the use of probabilistic forecasts, and one or more benchmark studies both for purely meteorological test cases as well as for power applications. Additionally, the communication of relevant information regarding state of the art and progress in both the forecasters and the end-users community is paramount.

Participation is open for all institutions in member states of the IEA Annex on Wind Power. See up-to-date list is at ieawind.org and the flags to the right.

Activities

NWP Improvements

This WP brings together global leaders in NWP models as applied to the wind industry to exchange information about future research areas. The emphasis will be on improvements of the wind-related forecast performance of these models especially in typical rotor heights.

Two lists of up-to-date data are mentioned under Results (tall met masts and experiments). Additionally, this WP discusses how to verify and validate the improvements through a common data set to test model results upon and discuss at IEA Task meetings.

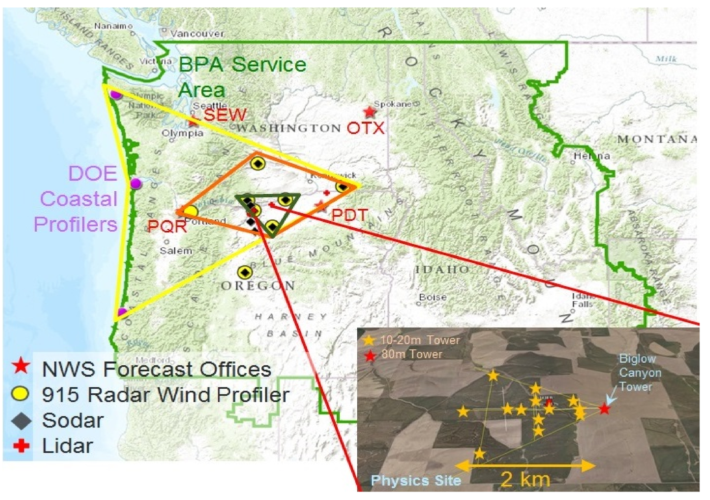


Figure 1: The instrumentation of WFIP2, in the Northwest of the USA. Source: Joel Cline.

Benchmarks

This second WP reviews the state-of-the-art for error and uncertainty quantification for wind and wind power forecasting models, with a special emphasis on the underlying NWP forecasts. This activity will further engage both NWP and field measurement researchers to develop guidelines, best practices, and perhaps standards, for forecasting trials and benchmarks, but also for real-time forecasting applications, where meteorological measurements are becoming necessary for operations of wind farms and handling of grid issues, e.g. at high-speed shut down wind ranges or at times of curtailment.

A review paper on forecasting error metrics is underway. Besides the well-known metrics for deterministic forecasts (such as MAE, RMSE or correlation coefficient), quality measures for probabilistic forecasts are handled as well.

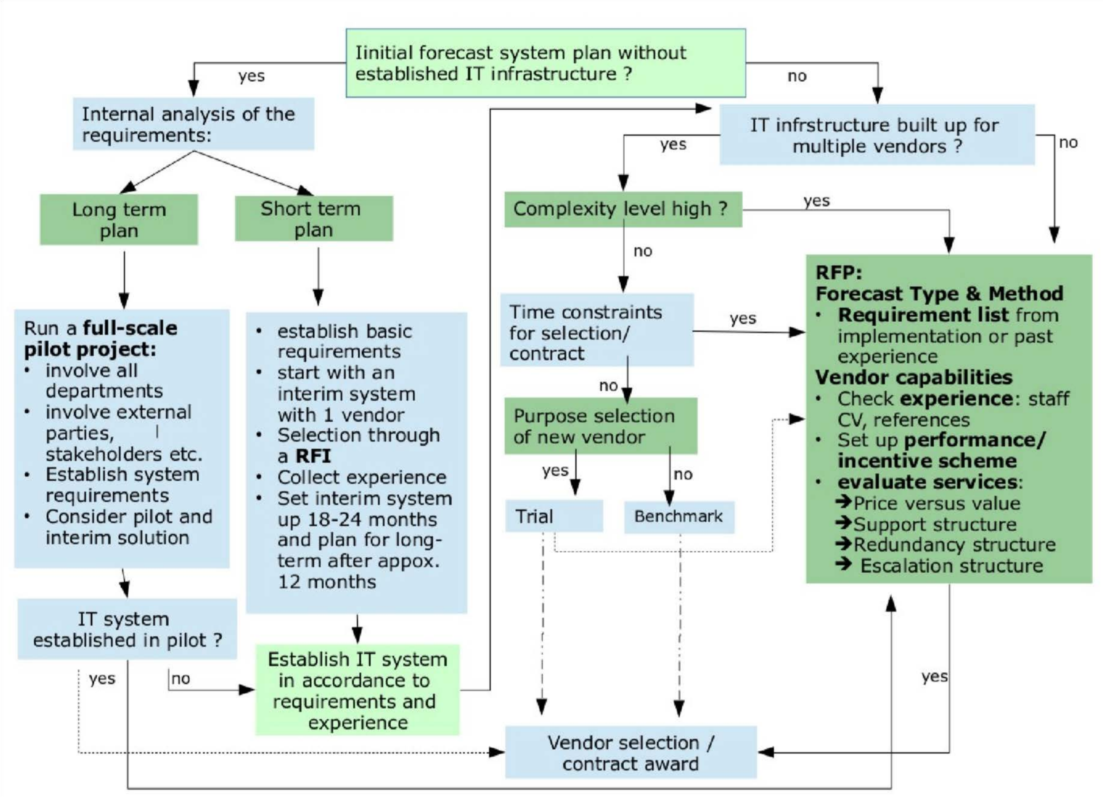


Figure 2: Overview of a decision support scheme illustrating common difficulties when deciding for or against trials or common procurements. Cost, validity and output of trials are often over estimated in their usefulness, because fair evaluation requires a lot of resources, and complex problem solving can often not be verified by simple tests. A guideline for decision making is therefore under preparation by the task.

Advanced Usage

The third WP surveys the current state of use of forecast uncertainties by the power systems sector and documents and publishes results in reports and publications. It engages both actors of the wind industry and the research communities to identify how current and emerging capabilities to determine uncertainties can be used to address the variety of decision-support needed by the industry. Indicators of which forecast approach serves which requirements are being developed.

A very general conclusion from our study regarding the use of uncertainty forecasts in the power industry is that as wind penetration increases, the interest for uncertainty forecasts increases. This trend is evident once penetration goes beyond 20% of energy consumption and installed wind capacity is at times capable of delivering the bulk of power demand. While it seems like the interest and demand for uncertainty forecasts is not that large yet, we can conclude from our study that it is only a matter of time until this demand will rise. The most common applications for uncertainty forecasts today are:

- reserve allocation
- trading and dispatch processes using a best guess from uncertainty forecasts
- situational awareness and risk assessment

Results

Public Lists

5 lists were published:

A list with **masts** useful for validation of the forecasts is underway, measuring at least 100m. The list currently contains more than a dozen masts on- and offshore.

A list of **meteorological experiments** going on currently or recently, either to participate or to verify a flow model against.

A list of **publicly available wind power forecast benchmarks**, e.g. on Kaggle.

A list of current or finished **research projects** in the field of wind power forecasting.

A list of **future research topics** in forecasting.

Site name	Coordinates	altitude above MSL	Tower height	Data policy	Obs. period	Other
Cabauw, NL	4.926° E, 51.97° N	-0.7 m	200 m	Cesar data policy	2000-04-01 to previous month	
IJmuiden, NL	52.848° E, 3.436° N	0 m	92 m		since 2012	offshore North Sea
Risø, DK	12.088° E, 55.694° N	0 m	125 m	Ask nicely	1995-11-20 -	Data measured since 1958; some months break in 2008.
Østerild, DK	12.088° E, 55.694° N	0 m	250 m	Ask nicely	2015-01-28 -	Two 250m masts in 4.3 km distance, both instrumented. Additionally, 7 smaller masts up to turbine hub heights.
Taggen, SE	14.519° E, 55.8726° N	0 m	100 m		2014-07-29 -	Owned by Vattenfall.
Stora Middelgrund, SE	12.1047° E, 56.5613° N	0 m	120 m		2008-11-28 - 2015-12-22	Offshore.
FINO 1, DE	54.015° E, 6.588° N	0 m	100 m	FINO project	since 01/2004	offshore North Sea, INNWIND.EU report Deliverable 1.11 (pages 10f)
FINO 2, DE	55.0069° E, 13.1542° N	0 m	100 m	FINO project	since 08/2007	offshore Baltic Sea, INNWIND.EU report Deliverable 1.11 (pages 10f)
FINO 3, DE	55.195° E, 7.158° N	0 m	100 m	FINO project	since 09/2009	offshore North Sea, INNWIND.EU report Deliverable 1.11 (pages 10f)
KIT, DE	49.0925° E, 8.426° N	110.4 m	200 m		since 1972-12-01	
Hamburg, DE	53.51992° E, 10.105139° N	0.3 m	280 m	Data policy (in german)	since 1995	Description of mast in Brümmer et al.
Falkenberg, MOL-RAO, DE	52.17° E, 14.12° N	73 m	98 m		since 2003	Data from CEOP
National Wind Technology Center, USA	105.23° W, 39.6° N	1835 m	135 m	NWTC 135-m Meteorological Towers Data Repository	M4 from 2012 to 2015, M5 since 2013	There is another 80 m tower measuring since 1996.
Boulder Atmospheric Observatory (BAO), USA	105.0° W, 40.05° N	1584 m	300 m	README_BAO.pdf	1977 to 2016	Unfortunatelly the tower was decommissoned on 2016-07-31.

High met masts useful for verification of hub height wind forecasts. Source: ieawindforecasting.dk. There is more information available, for example how to access the data.

Forecast Solution Selection

The Task is currently preparing an IEA Recommended Practice for Selecting Renewable Power Forecasting Solutions. The document is divided into two parts, part 1 deals with the Forecast Solution Selection Process (see Figure 2 for an overview), while part 2 gives recommendations for Designing and Executing Forecasting Benchmarks and Trials. Part 1 is written from the experience that conducting a trial is not always in the best interest of the client, and often does not end in results leading to contracts.

In part 2 typical errors in the design and the execution leading to invalid trial results and often in a lot of wasted resources (typically the client and 3-8 forecasters) have been collected and analyzed. Recommendation how to avoid pitfalls are provided. Those pitfalls include too short trials, non-concurrent timing, different parks for different forecasters to work on, insufficient communication of details of the data, and many other issues.

Forecast Trial Checklist

--Preparation--

- ☐ Determine outcomes / objectives
- ☐ Consult expert with experience
- ☐ Establish timeline and winning criteria
- ☐ Decide on live or retrospective trial
- ☐ If live trial with datafeed, begin datafeed setup
- ☐ Gather metadata (use IEA checklist spreadsheet)
- ☐ Determine if adequately resourced to carry out
- ☐ Obtain historical data
- ☐ Invite forecast service providers
- ☐ Distribute historical and meta-data
- ☐ Finalize datafeed configuration (if applicable)
- ☐ Allow two weeks Q&A prior to start
- ☐ Begin

--During Trial--

- ☐ Develop validation report
- ☐ Check interim results
- ☐ Provide interim results (if no live data being provided)
- ☐ End

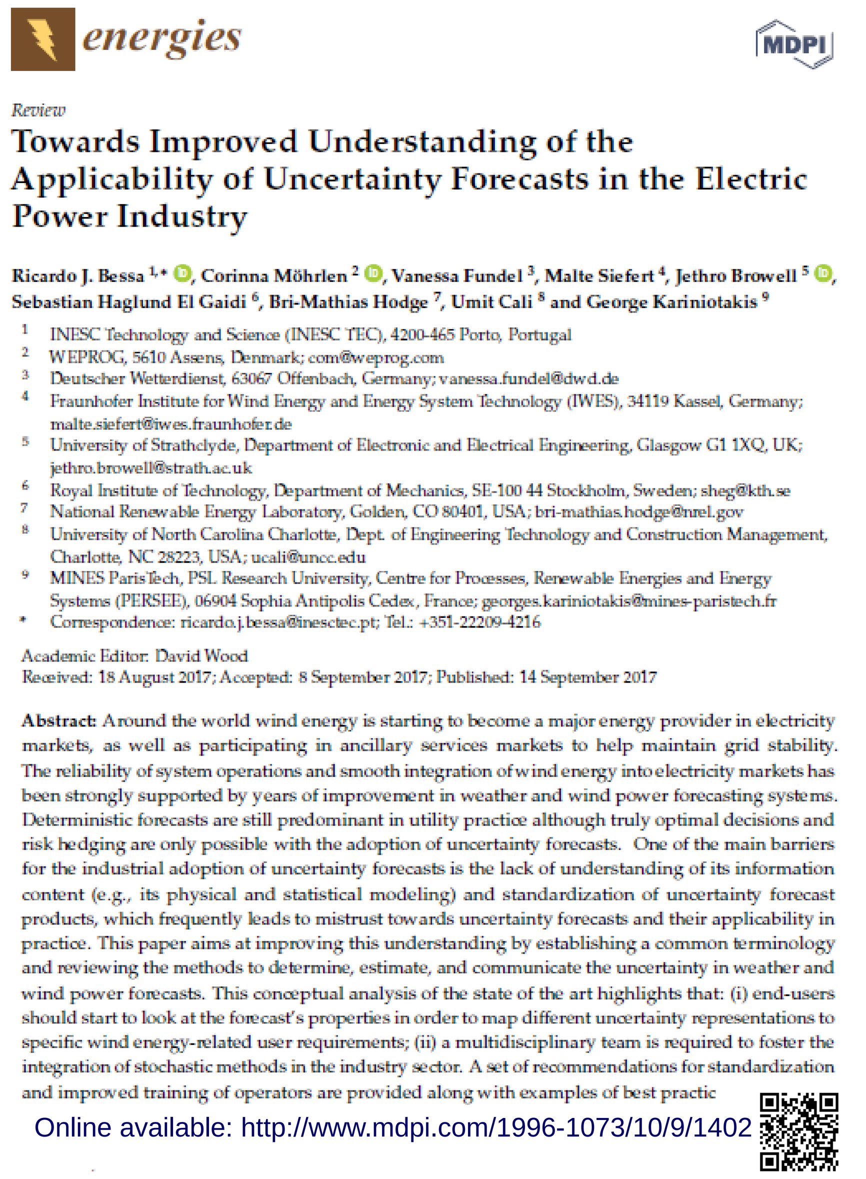
--Post Trial--

- ☐ Provide final results
- ☐ Notify winner(s)
- ☐ Contract with winner(s)
- ☐ Start Service

Figure 3: The Forecast Trial Checklist (from the Best Practice Guide part 2).

Use of Probabilistic Forecasts

The IEA Task published two papers on the use of probabilistic forecasting, a scientific overview and a more popular note. While probabilistic forecasts have existed for more than a decade, and while their use has been shown to be beneficial, the industry is still struggling to make use of the information that can be provided today.



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Review

Towards Improved Understanding of the Applicability of Uncertainty Forecasts in the Electric Power Industry

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Abstract: Around the world wind energy is starting to become a major energy provider in electricity markets, as well as participating in ancillary services markets to help maintain grid stability. The reliability of system operations and smooth integration of wind energy into electricity markets has been strongly supported by years of improvement in weather and wind power forecasting systems. Deterministic forecasts are still predominant in utility practice although truly optimal decisions and risk hedging are only possible with the adoption of uncertainty forecasts. One of the main barriers for the industrial adoption of uncertainty forecasts is the lack of understanding of its information content (e.g., its physical and statistical modeling) and standardization of uncertainty forecast products, which frequently leads to mistrust towards uncertainty forecasts and their applicability in practice. This paper aims at improving this understanding by establishing a common terminology and reviewing the methods to determine, estimate, and communicate the uncertainty in weather and wind power forecasts. This conceptual analysis of the state of the art highlights that: (i) end-users should start to look at the forecast's properties in order to map different uncertainty representations to specific wind energy-related user requirements; (ii) a multidisciplinary team is required to foster the integration of stochastic methods in the industry sector. A set of recommendations for standardization and improved training of operators are provided along with examples of best practic

Online available: http://www.mdpi.com/1996-1073/10/9/1402

J. Dobschinski, R. Bessak, P. Du, K. Geisler, S.E. Haupt, M. Lange, C. Möhrlen, D. Nakafuji and M. de la Torre Rodriguez: Uncertainty Forecasting in a Nutshell: Prediction Models Designed to Prevent Significant Errors. IEEE Power and Energy Magazine, vol. 15, no. 6, pp. 40-49, Nov.-Dec. 2017, doi: 10.1109/MPE.2017.2729100

www.IEAWindForecasting.dk