

IEA Wind Task 51 Workshop: Data and Forecasting Challenges for the Transition to an Increasingly Weather-driven Electric System

All times are Eastern Time (ET)

Tuesday, October 29, 2024 Zimmerli Art Museum, Rutgers University	
1:00 pm – 1:30 pm	Overview of IEA Wind Task 51 Structure and Activities John Zack, Meso Inc.
1:30 pm – 3:00 pm	Panel Discussion: Meteorological Datasets for Grid System Planning Facilitator: John Zack, Meso Inc. <ul style="list-style-type: none">• Julia Gottschall (Fraunhofer IWES): Overview of IEA Wind TEM #111 meeting at DTU (Renalyses for wind energy) and follow-up activities• Caroline Draxl (EPRI): Overview of NREL workshop <i>Bridging the gap between atmospheric sciences and grid integration</i> and follow-up activities• Justin Sharp (EPRI): Overview of current datasets and challenges, future steps• Victoria Rojo (ISO-NE): User perspectives Short presentations will be followed by a guided discussion with all workshop participants.
3:00 pm – 3:30 pm	Networking Break
3:30 pm – 4:50 pm	Open Space Discussions Facilitator: John Zack, Meso Inc. <ul style="list-style-type: none">• Current and Future State-of-the-Art• Matching applications and evaluation• Standards for Energy Data Collection, Assessment, and Access• Topics for Extreme Power System Event workshop in spring 2025
4:50 pm – 5:00 pm	Wrap up & Adjourn Ideas for the next phase of IEA Wind Task 51

IEA Wind Task 51 Workshop:
Data and Forecasting Challenges for the Transition to an
Increasingly Weather-driven Electric System
Rutgers University
New Brunswick, NJ, USA
29th October 2024

Overview of IEA Wind Task 51: “Forecasting for the Weather Driven Energy System”

John Zack
MESO, Inc.
Troy, NY

Task Leaders: C. MöhrLEN, G. Giebel, H. Frank, C. Draxl,
J. Browell, G. Kariniotakis, R. Bessa, D. Lenaghan

What is the IEA (International Energy Agency)?



- International organization with 30 members countries and 8 associates within the Organization for Economic Cooperation and Development (OECD)
- Promotes global dialogue on energy, providing authoritative analysis through a wide range of publications
- For more information: www.iea.org
- **One activity: convenes panels of experts to address specific topics via its “Technology Collaboration Programmes (TCPs)”**



International Energy Agency History

The IEA was founded in 1974 to help countries co-ordinate a collective response to major disruptions in the supply of oil.



Image source: dpa

Specific Technology Collaboration Programs (in renewable energy):

- Bioenergy TCP
- Concentrated Solar Power (SolarPACES TCP)
- Geothermal TCP
- Hydrogen TCP
- Hydropower TCP
- Ocean Energy Systems (OES TCP)
- Photovoltaic Power Systems (PVPS TCP)
- Solar Heating and Cooling (SHC TCP)
- **Wind Energy Systems (Wind TCP)**



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IEA Wind TCP Research Tasks

Technology Collaboration Programmes

Environmental Co-Design

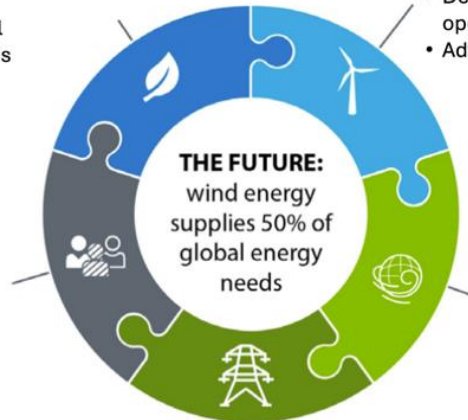
- Avoiding, minimising, compensating for environmental impacts
- Incorporating environmental costs, benefits into decisions
- Addressing both immediate concerns, future impacts

Tasks 42, 45, 59 & 60

Social Science

- Acknowledging the transformational nature of development
- Creating just processes
- Valuating benefits, effects, burdens

Tasks 39, 53 & 62



Tasks 25, 41, 50, 55, 58 & 61

The Plant and Grid

- Improving modelling
- Optimising plant design for multiple objectives
- Readying wind plants for grid support

The Turbine

- Incorporating holistic design
- Developing intelligent controls, operation, maintenance
- Advancing industrialisation

Tasks 44, 49, 52, 54 & 57

The Atmosphere

- Increasing atmospheric observations
- Expanding, validating universal predictive capability
- Integration, adopting improved models

Tasks 43, 46, 47, 48, 49, 51, 56



Evolution of Task 51



Task website: <https://iea-wind.org/task51>

Forecasting for Wind Energy
2016-2018

2019-2021

T36 Phase 1

T36 Phase 2

Redefinition

T51 Phase 1

2022-2025

Forecasting for the
Weather Driven
Energy System

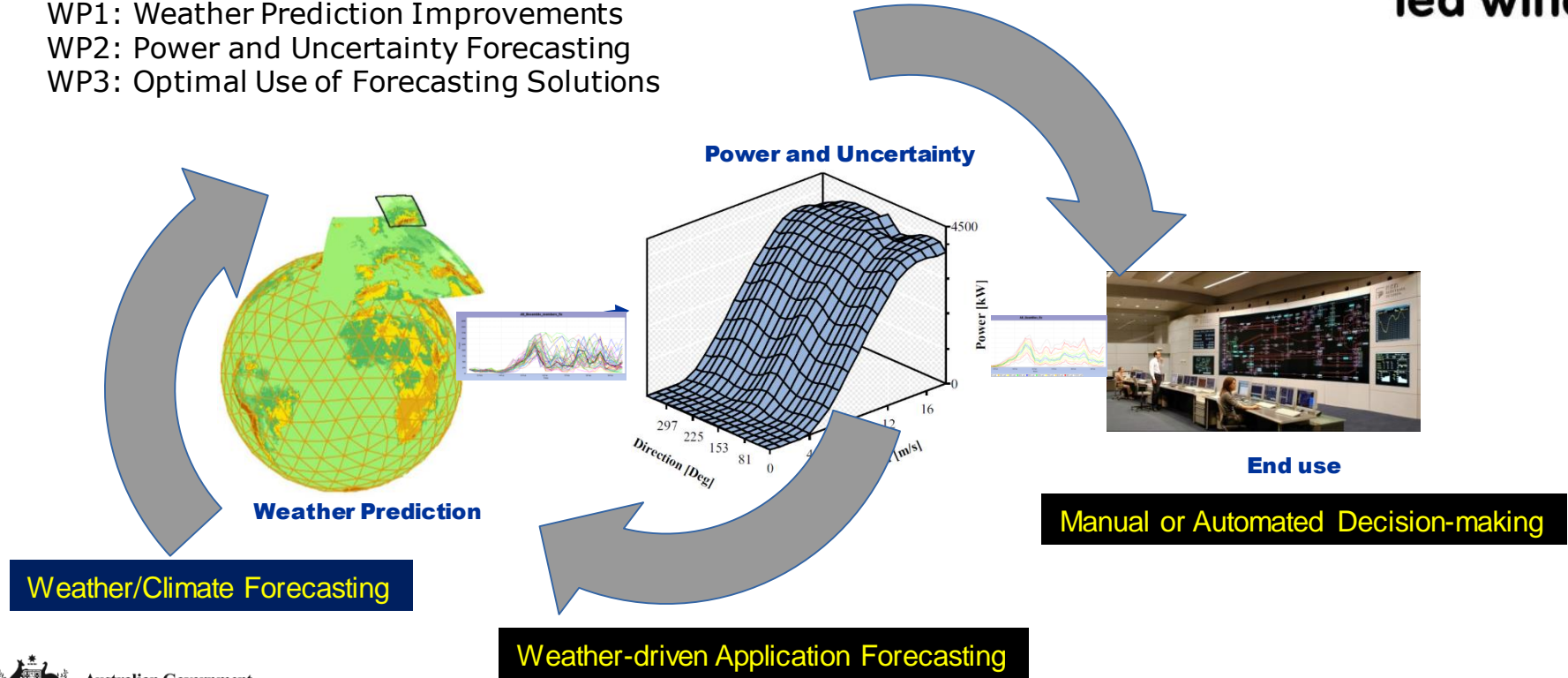
IEA Wind Task 51 Work Distribution

Task Work is divided into 3 work packages:

WP1: Weather Prediction Improvements

WP2: Power and Uncertainty Forecasting

WP3: Optimal Use of Forecasting Solutions

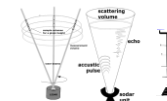


IEA Wind Task 51 Work Distribution: 11 Work Streams (WS)



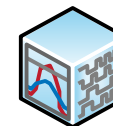
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Work Streams:	WP1 Weather	WP2 Power	WP3 Applications
1 Atmospheric physics and modelling (WP1)	★		
2 Airborne Wind Energy Systems (WP1)	★		
3 Seasonal forecasting (WP1)	★		
4 State of the Art for energy system forecasting (WP2)		★	
5 Minute scale forecasting (WP2)		★	
6 Data science and artificial intelligence (WP3)			★
7 Extreme power system events (WP3)			★
8 Uncertainty / probabilistic forecasting (WP3) & for underserved areas			★
9 Decision making under uncertainty (WP3)			★
10 Privacy, data markets and sharing (WP3)			★
11 Value of forecasting (WP3)			★



Modelling & data assimilation

Workshops

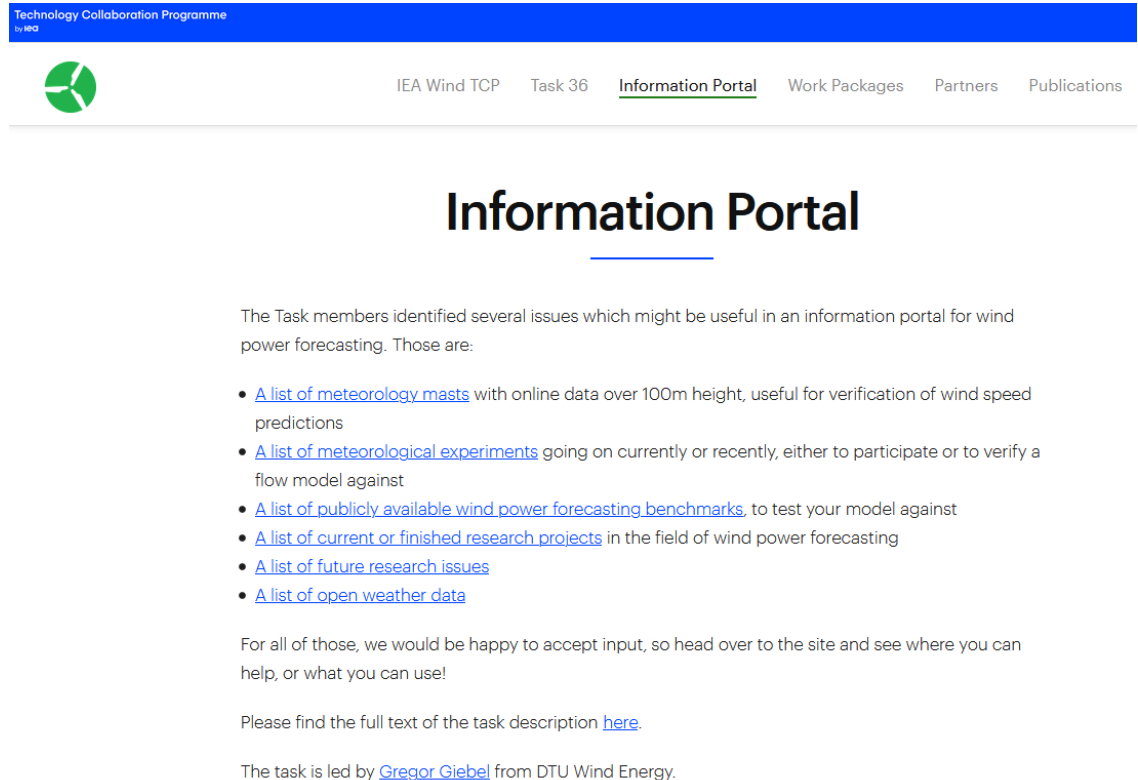


Verification Platform

Publications

WS1: Atmospheric Physics and Modeling: Information Portal

- Designed to be a useful resource for people in forecasting, especially providing links to publically available data for model development.
- Can be accessed at:
<https://iea-wind.org/task-51/t51-information-portal/>



The screenshot shows the IEA Wind TCP Information Portal website. At the top, there is a blue header with the text "Technology Collaboration Programme by IEA". Below the header is a navigation bar with the IEA Wind TCP logo on the left and links for "IEA Wind TCP", "Task 36", "Information Portal" (which is underlined), "Work Packages", "Partners", and "Publications". The main content area features a large heading "Information Portal" with a blue underline. Below the heading, a paragraph states: "The Task members identified several issues which might be useful in an information portal for wind power forecasting. Those are:". This is followed by a bulleted list of five links: "A list of meteorology masts", "A list of meteorological experiments", "A list of publicly available wind power forecasting benchmarks", "A list of current or finished research projects", and "A list of future research issues". Below the list, a paragraph says: "For all of those, we would be happy to accept input, so head over to the site and see where you can help, or what you can use!". Another paragraph follows: "Please find the full text of the task description [here](#).". The final paragraph states: "The task is led by [Gregor Giebel](#) from DTU Wind Energy."

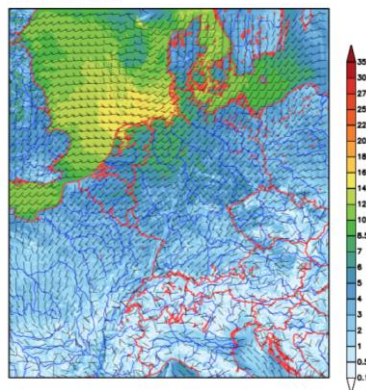


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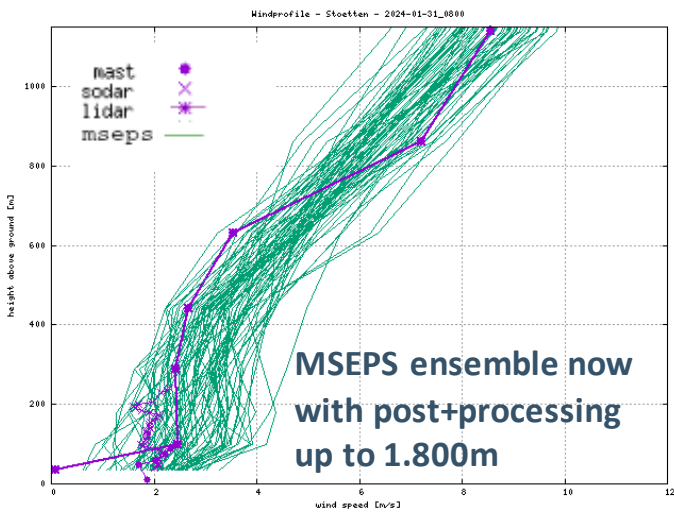
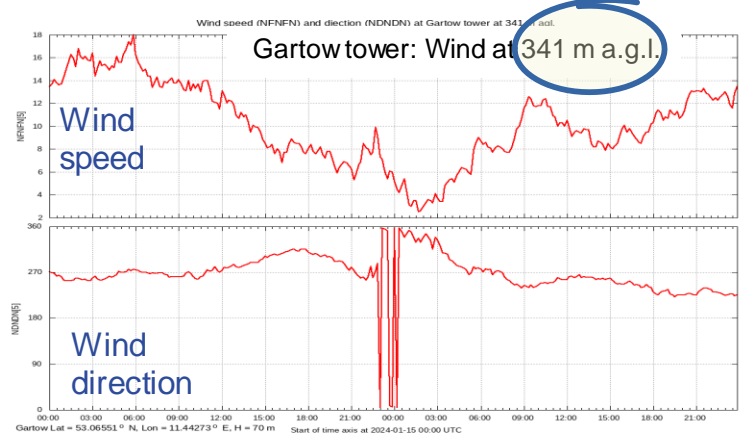
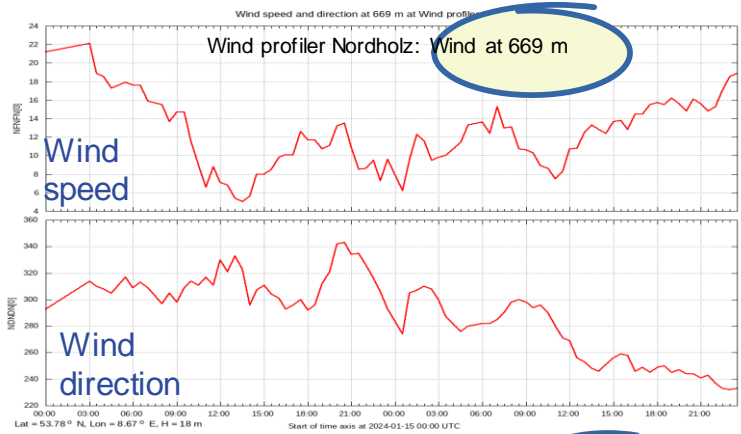
WS 1&2: Development of Forecasts for Airborne Wind Power



Start time: 02.11.2022 00:00 UTC
Forecast time: 02.11.2022 08:00 UTC
[x] in 10 m [m/s] (shaded)



ICON-DE model now in 15min resolution every hour



MSEPS ensemble now with post-processing up to 1.800m

WS3: S2S Forecasting for Energy Systems

- Held S2S Workshop at University Reading in May 2023



Stakeholders in the electric energy system have expressed a growing interest in sub-seasonal to seasonal (S2S) forecasting information in their applications. Therefore, to facilitate the dissemination of information about S2S forecasting products, skill, applications, issues, and best practices to members of the electric energy community, the team of the International Energy Agency's (IEA) Wind Task 51 (<https://iea-wind.org/task51/>), entitled "Forecasting for the Weather Driven Energy System", would like to invite you to a S2S forecasting workshop with the goal of gathering information about methods used to produce S2S forecasts, the current state-of-the-art skill in S2S forecasting for variables relevant for energy system applications, current and planned research activities intended to improve the current level of skill, types of public and private sector operational S2S forecasting products, the range of S2S applications in the energy community and the quantified or perceived value obtained from those applications, the sensitivity of user's application performance to variations in forecast skill, and the unmet S2S-forecasting-related needs or desires of the energy user community.

MAY 17–19, 2023 | University of Reading, UK
All times are British Summer Time (UTC+1)

DRAFT AGENDA

- Preparing review paper for submission in 2025

Workshop Agenda

Session	Title
Keynote	History, Current Status and Challenges of S2S Forecasting
1	Forecasting Techniques
2	Forecast Evaluation
3	Public Forecast Providers and Products
4	Commercial Forecast Providers and Products
5	Forecast User Experiences
6	Open-space Discussion
7	Research Issues and Projects: Current and Envisioned

S2S Forecasting Workshop: Key Points

• Objectives/Focus

- Predictions typically focus on anomalies vs “climatology”
- Usually expressed as a probability of an anomaly

• Current Techniques

- Ensemble of long-term (weeks to months ahead) NWP runs with postprocessing statistics
- Statistical teleconnections to atmospheric circulation indices (e.g. ENSO) and “slow-changing” ocean (e.g. SST anomalies)/earth’s surface (e.g. snow cover) variables

• Evaluation

- Anomaly prediction has considerable skill vs climatology from 3 weeks to multi-seasons ahead
- skill is strongly episodic** - i.e. when strong signals are detected (e.g. ENSO)
-

• Products

- Forecasts of temperature and precipitation are most widely available – especially from public sources
-
- Wind & solar forecasts have much more limited availability** – mostly private sources

WS 4: State-of-the-Art for Energy System Forecasting

- Held Workshop in Dublin, Ireland in September 2022
- Refinement of the **Recommended Practice for the Implementation of Renewable Energy Forecasting Solutions**



Workshop

State of the Art and Research Gaps in
Forecasting for the Weather Driven Energy System

September 12/13 2022, University College Dublin

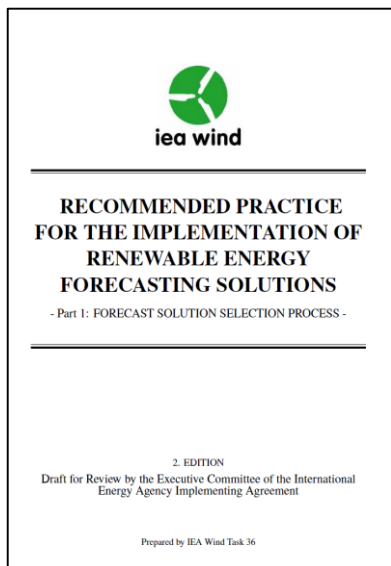


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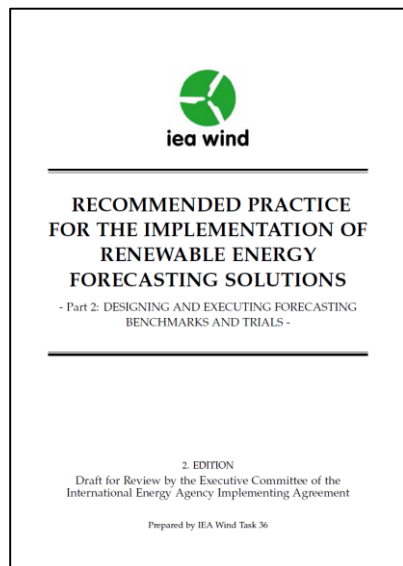


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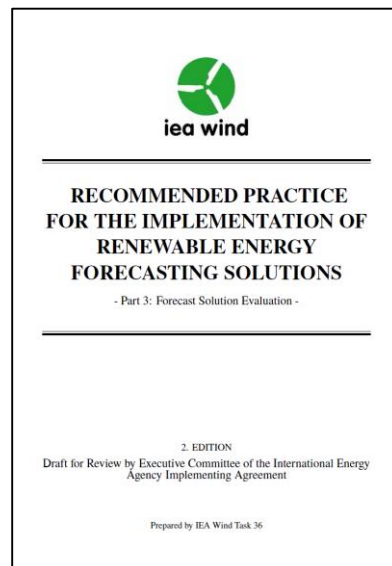
Version 2 of the Recommended Practice for the Implementation of Renewable Energy Forecasting Solution



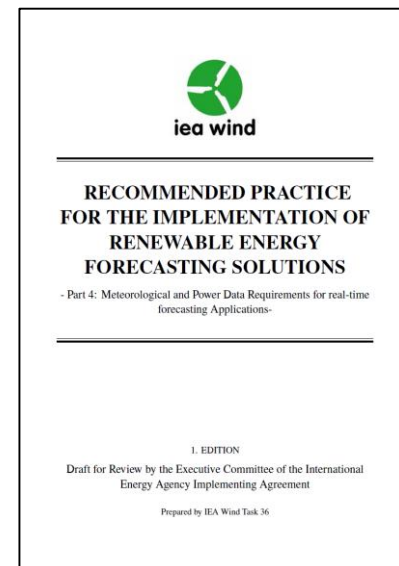
Part 1: Selection of an Optimal Forecast Solution



Part 2: Design and Execution of Benchmarks and Trials



Part 3: Evaluation of Forecasts and Forecast Solutions



Part 4: Data Requirements for Real-time Applications

Now as [OpenAccess book!](#)

Introduction: <https://www.youtube.com/watch?v=XVO37hLE03M>



iea wind

Elsevier OpenAccess Book

ORDER or DOWNLOAD NOW!

ISBN: 978-0-443-18681-3

PUB DATE: November 2022

DISCOUNT: Non-serials

FORMAT: Paperback

Editors: Corinna Möhrle, John W. Zack, and Gregor Giebel

<https://www.elsevier.com/books/iea-wind-recommended-practice-for-the-implementation-of-renewable-energy-forecasting-solutions/mohrlen/978-0-443-18681-3>

Online OpenAccess:

<https://www.sciencedirect.com/book/9780443186813/iea-wind-recommended-practice-for-the-implementation-of-renewable-energy-forecasting-solutions>

IEA Wind Task 51 Information

iea-wind.org → Task 51 → Publications → [Recommended Practice](#)



IEA Wind Recommended Practice for the Implementation of Renewable Energy Forecasting Solutions



Corinna Möhrle
John W. Zack
Gregor Giebel



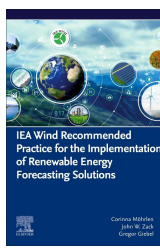
Validation & Verification



IEA Wind Recommended Practice for the
Implementation of Renewable Energy
Forecasting Solutions

Wind Energy Engineering

2023, Pages 321-322



Examples developed within the IEA Wind Task 36 and Task 51:

WE-validate

Available on GitHub: <https://github.com/joejoejoseph/i-validate/>

Use Case: Demo Jupyter Notebook (U.S. Mountain Wave case):

https://nbviewer.jupyter.org/github/joejoejoseph/i-validate/blob/main/notebooks/demo_notebook.ipynb

Existing metrics: RMSE, cRMSE, mean bias, mean absolute error

Existing plots: time series, histogram, scatter plot

WE-validate-prob – R-package for probabilistic verification

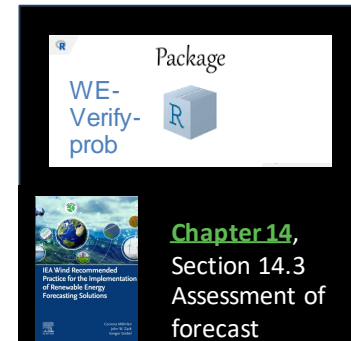
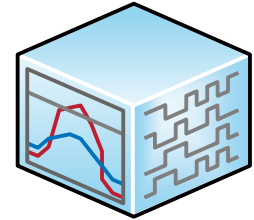
Existing metrics: CRPS, Brier Score, ROC curve, Histograms, Reliability Diagram, Contingency table

Existing plots: time series, histograms, ROC curve, CRPS

See also our workshops & conference page:

<https://iea-wind.org/task51/task51-publications/task51-works-hops-and-special-sessions/>

Appendix G - Validation and verification code examples



WS5: Minute-scale Forecasting: April 2024 Workshop



Forecasts of wind and clouds are important inputs for the control and value of renewable power plants. The forecasts on a time resolution of minutes or seconds are typically data driven, looking at upstream plants, all-sky images of clouds or direct measurements of wind by lidars. Therefore, to facilitate the dissemination of information about minute scale forecasting products, skill, applications, issues, and best practices to members of the electric energy community, we invite you to a Minute Scale Forecasting workshop with the goal of gathering information about methods used to produce the forecasts, the current state-of-the-art skill and uncertainty in forecasting for variables on high temporal resolution, current and planned research activities intended to improve the current level of skill, types of public and private sector operational forecasting products, the range of minute scale applications in the energy community and the quantified or perceived value obtained from those applications, the sensitivity of user's application performance to variations in forecast skill, and the unmet minute-scale forecasting-related needs or desires of the energy user community.

The workshop takes place as the collaboration of the International Energy Agency's (IEA) [Wind Task 51](#), entitled "Forecasting for the Weather Driven Energy System", [IEA Wind Task 52 Lidars](#), [IEA Wind Task 50 Hybrid Power Plants](#), [IEA Wind Task 44 Wind Farm Flow Control](#) and IEA Photovoltaic Power Systems Programme (PVPS) [Task 16 Solar Resource](#).

The venue is Risø, Denmark, on the campus of the Technical University of Denmark (https://www.dtu.dk/om-dtu/kontakt-og-besoeg/find-vej/dtu_risoe_campus).

- Venue: Risø, Denmark.
- Attendance: 70+ in-person, 20 online.
- Collaboration of multiple IEA tasks:
 - [IEA Wind Task 51](#) "Forecasting for the Weather-driven Energy System"
 - IEA [Wind Task 52 Lidars](#)
 - IEA [Wind Task 50 Hybrid Power Plants](#)
 - IEA [Wind Task 44 Wind Farm Flow Control](#)
 - IEA [PVPS Task 16 Solar Resource](#).

See talks at iea-wind.org/task51 → Workstreams →

[Minute Scale Forecasting](#)

& videos at our YouTube Channel "[IEAWind Forecasting](#)"



Task 51 Minute-Scale Forecasting Workshop

Two aspects of Minute-scale

1) Forecasts for the minutes-ahead (i.e. 0-1 hour look-ahead time)

Applications use data-driven or hybrid algorithms such as:

Data-driven algorithms: Machine Learning, dynamic graph ML, neural networks (e.g. GNN), feature engineering, generator models, graph convolutional long-short-term memory models etc.

Hybrid algorithms: can include heterogenous data sources from satellite or NWP images improve predictions, use cloud-scale dependent auto-regressive advection or deep learning radiative transfer emulators, Kalman filters

2) Longer term (hours or longer) forecasting in time-scales of minutes

e.g. high-time resolution NWP, Interpolation algorithms using AI methods

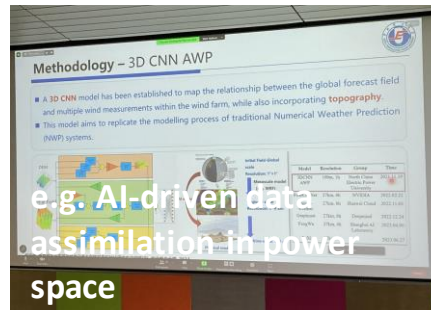
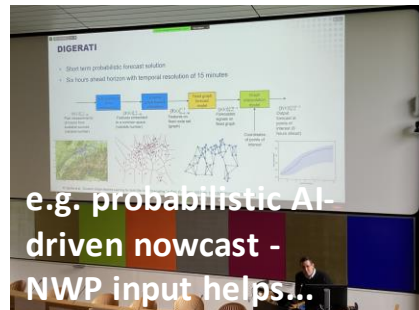
Observational Data Sources:

- WIND: scanning LIDARs, sonic anemometers, sodars
- SOLAR: ASI (all sky imaging, fish-eye cameras pointed at the sky) and satellite observations

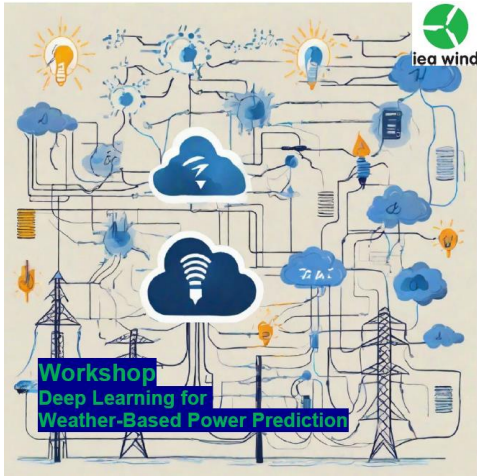


IEA Minute-Scale Forecasting Workshop

- Key points from Research & Development presentations:
 - Feature engineering methods need "engineering" in the sense of knowing the atmosphere and its development to be useful
 - High-resolution NWP with high-time resolution of the order 5-10 min are enabling NWP models to be used for minute-scale forecasting
 - AI weather forecasting system 3D-CNN is mapping relationship between global analysis and local measurements and aims to replace the modelling process of NWP with local measurements
 - The need for remote sensing is driving the development of instruments to solve current short-comings



WS 6 (Data Science and AI): January 2024 Webinar



Webinar now
available in
our YouTube
channel

IEAWindForecasting

<https://youtu.be/t6H7diavQdg>

- Webinar in **Deep Learning for Weather-Based Power Prediction** was held in January 2024 to help address stakeholders' concerns about the impacts of incorporating AI and Machine Learning into weather and power prediction models,
- Webinar brought together the **Energy Meteorology and Machine Learning/ Deep Learning (ML/DL) communities** to showcase the latest advancements in ML/DL for weather prediction.

Some Lessons Learned from the webinar:

Positive developments:

- ↑ The models show considerable skill
- ↑ The models suggest a new approach to meteorological questions
- ↑ Fast hypothesis testing and scope narrowing for simulations with physics models
- ↑ The models develop fast due to large resources put into new features
- ↑ Huge ensembles (>1000 members) are on the horizon
- ↑ There is work underway to start the AI models from measurements alone


Challenges to be solved:

- ↓ Quality control of input data is not yet handled - outliers, missing or corrupt data
- ↓ High complexity and variety of data to train models is a challenge
- ↓ Feature engineering needs features – without physics this will be difficult
- ↓ Data-driven models require new look at data sharing, which has been an ongoing challenge



IEA Wind Task 51 Workshop on Extreme Power System Events Boulder CO , April 2025

- What should be addressed in this workshop?
 - Topic in the OpenSpace Discussion in the 2nd half of today's workshop



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IEA Wind TCP Task 51
"Forecasting for the weather-driven energy system"
Österreich-Workshop
6. November 2024, NH Danube City Hotel, Wien
Veranstaltet von
GeoSphere Austria | austro control DIGITAL SERVICES
W.E.B.

IEA Wind Task 51 Austria Workshop at the NH Danube City Hotel in Vienna on November 6, 2024

GeoSphere Austria, Austro Control Digital Services GmbH and WEB Windenergie AG are organizing the IEA Task 51 Austria Workshop on...

<https://iea-wind.org/2024/07/31/iea-wind-task-51-austria-workshop-in-vienna-on-6th-nov-2024/>

Collaboration



DestinE Digital Twins

From the OpenSpace Digital Twin

On-demand extremes forecasting system for renewables - The Destination Earth Extremes digital twin

Collaboration with
Subtask: *On-demand digital twin extremes forecasting system for renewables - The Destination Earth Extremes digital twin*

<https://destine.ecmwf.int/news/meteo-france-led-international-partnership-wins-bid-to-develop-destination-earths-on-demand-extremes-digital-twin/>

WS 8 & 9: Uncertainty Propagation through the Modeling Chain with Real Data

PHASE I 2022-2023

tool
1

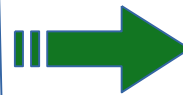
tool
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tool

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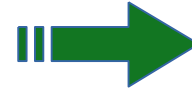
Uncertainty
Quantification
with test data
sets
according to
2022 UQ
publication*

PHASE II 2024

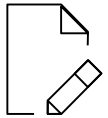


Discussion & testing of
verification platform

PHASE III 2025



Publication



Discussion & writing of
publication with most
suitable test cases

* Uncovering wind power forecasting uncertainty sources and their propagation through the whole modelling chain
<https://www.sciencedirect.com/science/article/pii/S1364032122004221>



WS 8 & 9: Review of Uncertainty Propagation

Work Program Part I

- **Qualitative** description of the origins and propagation of uncertainty through the forecasting chain

→ Published in *Renewable and Sustainable Energy Reviews* in 2022

Work Program Part II (2023-2025)

- **Quantification** of the origins and propagation of uncertainty through the forecasting chain

Uncovering wind power forecasting uncertainty origins and development through the whole modelling chain^{*,**}

Jie Yan^a, Corinna Möhrlen^b, Tuhe Göçmen^c, Mark Kelly^c, Arne Wessel^d and Gregor Giebel^{e,*}

^aNorth China Electric Power University, State Key Lab of Alternate Electrical Power System with Renewable Energy Sources, Beijing, P.R. China

^bWEPROG, Dreijerveanget 8, 5610 Assens, Denmark

^cTechnical University of Denmark, Department of Wind Energy, Frederiksborgvej 399, 4000 Roskilde, Denmark

^dFraunhofer Institute for Energy Economics and Energy System Technology IEE, Kassel, Germany

ARTICLE INFO

Keywords:
wind power
forecast uncertainty
modelling chain

ABSTRACT

Wind power forecasting has been supporting operational decision-making for power system and electricity markets since 30 years. Efforts of improving the accuracy and/or certainty of wind power forecasts, either deterministic or probabilistic, are continuously exerted by academics and industries. Forecast errors and associated uncertainties, which propagate through the whole forecasting chain, from weather provider to the end user, cannot be eliminated completely due to many reasons; for instance, endogenous randomness of weather systems and varying wind turbine performance. Therefore, understanding the sources of uncertainty and how these uncertainties propagate throughout the modelling chain is significant to implement more rational and targeted uncertainty mitigation strategies and standardise the uncertainty validation. This paper presents a thorough review of the uncertainty propagation through the modelling chain, from the planning phase of the wind farm and the forecasting system through the operational phase and market phase. Moreover, the definition of the uncertainty sources throughout these phases build the guiding line of uncertainty mitigation throughout this review. In the end, a discussion on uncertainty validation is provided along with some examples. Highlights of this paper include: 1) forecasting uncertainty exists and propagates everywhere throughout the entire modelling chain and from planning phase to market phase; 2) the mitigation efforts should be exerted in every modelling step; 3) standardised uncertainty validation practice and global data samples are required for forecasters to improve model performance and for forecast users to select and evaluate the model's output.

1. Introduction

High penetration of wind power has been recognised globally as one of the most important features of current and future sustainable power systems. The natural randomness and variability of the wind itself can aggravate negative impacts of wind power on power system operation and market trading, which strengthens the significance of forecasting technology. Wind power forecasting (WPF) started more than three decades ago [16], with the first operational forecasting tools arriving at system operation level some 10 years later at the Danish transmission system operator ELSAM [10]. Since then, researchers have been making continuous efforts to improve the forecasting accuracy and reliability.

It is impossible to achieve perfect predictions of wind power at any given time or location, due to chaotic atmospheric motions having temporal and spatial scales that typically span more than six orders of magnitude [17, 18, 19]. Along with the complex wind field, wind turbine performance creates nonlinear and time-varying uncertainties in wind power forecasting. To improve the value of forecasts and their usage, we practically consider three questions: why, when and to what extent the forecasting uncertainty will happen [20]. Accordingly, this further guides the mitigation of forecasting uncertainty. There is plenty of literature in this area, and can be clarified into following three categories.

* This paper was coordinated under the auspices of IEA Wind Task 36 'Forecasting for Wind Energy'. Corinna Mörlen, Tuhe Göçmen, Mark Kelly and Gregor Giebel were funded by the Danish EUFP project 'IEA Wind Task 36 Phase II Danish Consortium', Grant Number 64018-0515.

**Corresponding Author: Gregor Giebel

✉ grg1@dtu.dk (G. Giebel)

🌐 www.dtu.dk (G. Giebel)

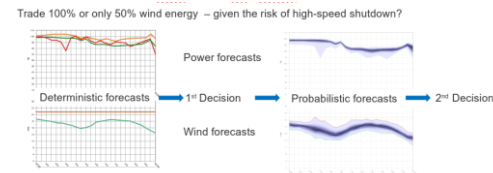
ORCID(iD): 0000-0002-9412-0999 (0000-0002-9412-0999) (J. Yan); 0000-0002-8842-1533 (0000-0002-8842-1533) (C. Möhrlen); 0000-0002-4453-8756 (0000-0002-4453-8756) (G. Giebel)

“Probabilistic Forecasting Games & Experiments” initiative

1. Experiment (2020)

Game: 12 cases

Decision structure: 12 deterministic forecasts followed by a probabilistic forecast
After each decision, possible change of decision based on new information



2. Experiment (2021-2024*)

Game: 40 cases

Decision structure: 20 deterministic cases + decision confidence request
20 probabilistic cases + decision confidence request

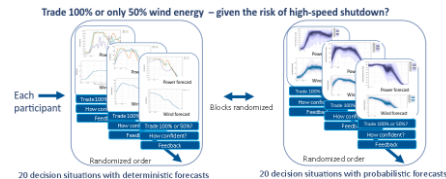


Table and Collection of Forecasting Games:

<https://iea-wind.org/task51/task51-work-streams/ws-decision-making-under-uncertainty/>

* still open...: <https://meteorology.mpib.de/wind-power-decisions/about.html>

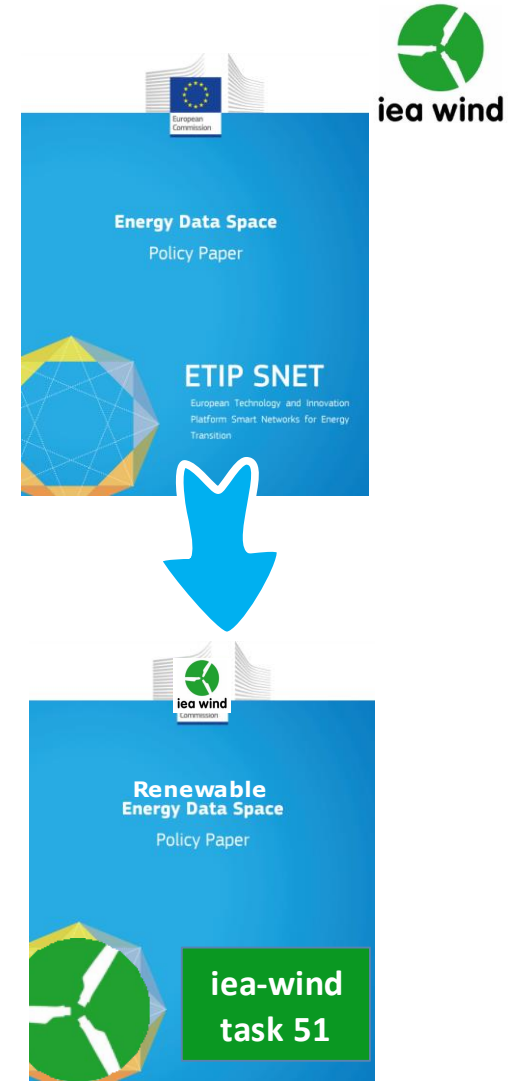
WS 10: Data Sharing

Workplan

A recently [policy paper for the European Commission](#) about the transformation of the energy system covering digitilisation and data sharing addressed general energy sector issues – but only superficially addressed RES topics.

Status: Development of a position paper about data sharing for the renewable energy sector has been started

A group of contributors are covering different aspects of RES: resource assessment/site location, forecasting, trading, O&M, etc.



* <https://op.europa.eu/en/publication-detail/-/publication/21b0260e-a2d5-11ee-b164-01aa75ed71a1/language-en/format-PDF/source-300344208>

WS11: Value of Forecasting

Status is monitored by looking and discussing the use of wind power forecasts
+++ now in collaboration with Task 50 Hybrid Power Plants +++

User Cases presented at Meetings + Reports

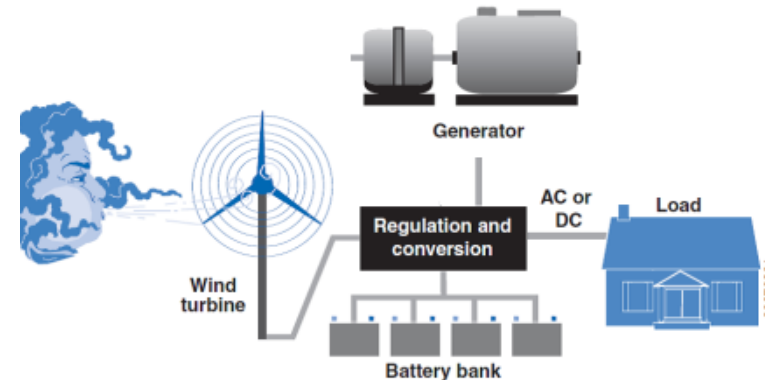
Dimitrios Eleftheriou, Ea Energianalyse: *use of wind power forecasts in scheduling a hybrid energy asset consisting of wind turbines, electrolyser and hydrogen storage*

Honglin Wen, Shanghai Jiao Tong University: *Value-oriented Renewable Energy Forecasting for Coordinated Energy Dispatch Problems at Two Stages*

Antonio Couto, LNEG, Portugal: *Addressing the challenges of wind power plants hybridised with solar power: A generation forecast perspective. (see also [publication](#))*

Rujie Zhu, Technical University of Denmark: *Value of forecasting for hybrid Energy Management*

See iea-wind.org/task51 → Publications
→ [Workshops & Special Sessions](#)



Developing Project: Collaboration and Liaison with IEC Scientific Committee 8A on *Grid Integration of Renewable Energy Generation*

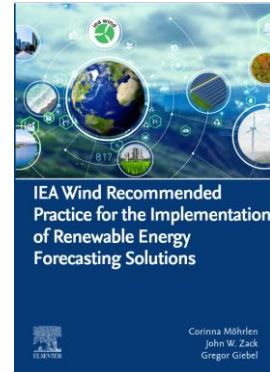
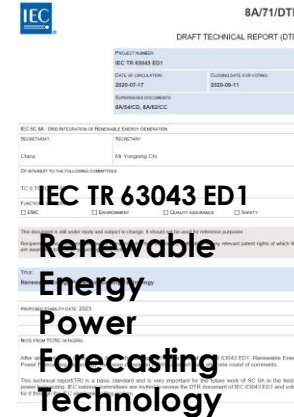


Common work: IEC Technical Report TR63043 - Renewable Energy Power Forecasting Technology

- Technical Report was released in 2020 by IEC Subcommittee 8A Grid Integration of Renewable Energy Generation, Working Group 2 Renewable Energy Power Prediction

<https://webstore.iec.ch/publication/26529> - Link to IEC SC8A WG2

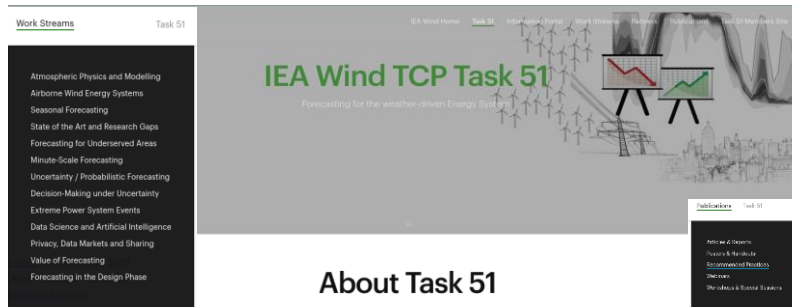
- New Work Item for the development of a **IEC Standard for Renewable Energy Forecasting** in Oct. 2023



Task 51 Web Presence

Website

<https://iea-wind.org/task51>



Forecasting for the Weather Driven Energy System – Improving the value of renewable energy forecasts to the wind industry

The Task 51, under the *IEA Implementing Agreement for Co-operation in the Research, Development, and Deployment of Wind Energy Systems (IEA Wind)* focuses on improving the value of renewable energy forecasts.

There are three distinct areas of challenge in forecasting wind power. The first area is in the continuing effort to improve the representation of physical processes in weather forecast models through both new high performance initializations and tailored parameterizations. The second area is the heterogeneity of the forecasters and end users, the full understanding of the uncertainties throughout the modelling chain and the incorporation of novel data into power forecasting algorithms. A third area is representation, communication, and use of these uncertainties to industry in forms that readily support decision-making in plant operations and electricity markets.

This Task will focus on facilitating communication and collaborations among international research groups engaged in the improvement of the accuracy and applicability of forecast models and their utility for the stakeholders in the wind industry, in the power sector and in the energy system.

This Task has the following specific objectives:

- To establish an active, open forum for sharing knowledge among the participants, related IEA Wind Tasks and other related TCPs through workshops, dissemination and communication measures
- To establish and communicate standards and frameworks for the operation and evaluation of forecast model performance
- To identify paths to increased application and utility of forecast information to the task stakeholders
- To advance the knowledge in the underlying atmospheric physics, in the mathematical models converting the transforming atmospheric quantities to energy system application variables, in the modelling of the uncertainty and in the applications and decision-making
- To identify most promising areas for new research to improve the quality and utility of forecasts
- To provide guidelines for the implementation of optimal forecasting solutions

YouTube Channel

<https://www.youtube.com/c/IEAWindForecasting>



IEA Wind Forecasting
67 Abonnenten

ABONNIEREN

ÜBERSICHT

Uploads ▶ ALLE WIEDERGEBEN

Video Title	Duration	Views	Upload Date
IEAWindTask36 Webinar4 2018	57:26	75 Aufrufe	vor 11 Monaten
Probabilistic Forecasting in Practice	55:13	229 Aufrufe	vor 11 Monaten
Webinar on Wind Power Forecast Solution Selection	1:07:27	139 Aufrufe	vor 11 Monaten
IEA Wind TCP 36 Overview Webinar - Forecasting to Wind Power	29:58	313 Aufrufe	vor 11 Monaten

Handouts

- 2-page handouts: quick overview of major results
- 3 currently available; can be obtained from:

<https://iea-wind.org/task51/task51-publications/task51-posters-and-handouts/>

IEA Wind Task 36 Forecasting for Wind Power

FORECASTING FOR YOU

Setup

Wind power forecasts have been used operationally for over 25 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 IEA Wind 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 accurate datasets. Secondly, we deal with the **conversion to power** and issues affecting the forecast vendors. Thirdly, we will be engaging end users aiming at dissemination of the best practice in the usage of wind power predictions.

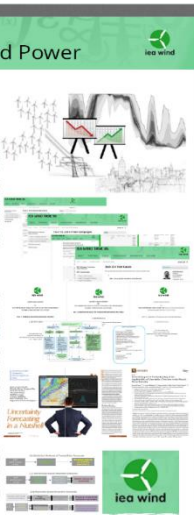
The Task is currently in second phase, 2022-2023.

Results of phase I (2016-2018)

We developed an **informative portal**, with links to data, projects and knowledge useful for wind power forecasting. This could be a list of full texts useful for online validation of NWP models, a list of field campaigns with open data for model verification, or a selection of benchmarking forecasts with established data sources and existing reference frameworks.

A major result was the IEA Wind Recommended Practice (RP) on **Forecast Solution Selection**, detailing out the necessary steps to get the best adapted forecasts for the individual use case. The RP starts with the initial declarations which might or might not set up with the decision to do a forecast. The second document shows how to conduct such a trial in order to yield acceptable and usable results for both the end user and the participating vendor. The last part shows how to evaluate the trial to get 1 significant, 21 representative and 51 reliable results.

For **probabilistic forecasts**, we published two papers with an overview (for a broader readership) and one with a long list of specific use cases (more technically oriented). We also classified methods for uncertainty forecasting, and tried to establish a common vocabulary. We also mapped the current use of probabilistic forecasts through a questionnaire.



Impact

The Task sends out news a few times a year, is present on conferences and meetings, and has its own YouTube channel. There, alongside video transmissions of the public webinars, we also had **webinars** of half an hour talks plus audience questions on the major results of phase I. The fourth one was an additional one on forecast use in Denmark.

The Task members also try to find a **collaboration** between weather prediction providers and vendors, and between vendors and end users. One activity for the current phase of the Task (2019-2023) is a look into **standardization** of data, to make data exchange more fluent across the industry. Another activity is to estimate the **value of better forecasting**.

We also collaborate with other Wind Tasks, e.g. in the common working on minute scale forecasting we had together with Task 22 **Lider**. In the future, we will also collaborate with IEA PV Task 15 **Solar** resources, which also deals with forecasting and has some of the same issues.

Collaboration

Currently, some 250 people from 12 countries are collaborating on forecasts. There are meetings every half year, often in conjunction with relevant conferences. We also have special sessions at conferences for new entrants, and usually an overview poster, if you are interested to collaborate, or just to be informed about new results, please contact Gregor Gebel!

The International Energy Agency is an intergovernmental organization which seeks to improve energy efficiency and reduce greenhouse gas emissions. It was established in 1974 and is currently the largest of the world's international organizations. The IEA Wind Technology Collaboration Programme supports the work of 36 countries, international groups of experts, the energy community and large energy users in the wind energy sector. The programme is a public-private partnership between the IEA and the wind energy industry. The programme is a public-private partnership between the IEA and the wind energy industry. The programme is a public-private partnership between the IEA and the wind energy industry.

Task Overview



IEA Wind Task 36 Forecasting for Wind Power

RECOMMENDED PRACTICES FOR SELECTING RENEWABLE POWER FORECASTING SOLUTIONS

Challenge

The selection of forecasts to utilize for variable renewable power generation is a complex task. It involves understanding the capabilities of various forecasting solutions, the needs of different users, and the specific requirements of the power system. This document provides a structured approach to this selection process.

Solution

This document provides a structured approach to the selection process. It includes a checklist of key factors to consider, such as forecast accuracy, lead time, and data availability. It also provides a framework for evaluating different forecasting solutions based on these factors.

Forecast Solution Selection

The selection process involves several steps: 1. Define the user's requirements. 2. Identify potential forecasting solutions. 3. Evaluate the solutions against the requirements. 4. Select the best solution. 5. Implement and monitor the solution.

Key points:

- Understand the user's requirements: What is the forecast used for? What is the required accuracy? What is the required lead time?
- Identify potential forecasting solutions: What forecasting solutions are available? What are their capabilities and limitations?
- Evaluate the solutions: Compare the solutions against the requirements. Use the checklist to guide the evaluation.
- Select the best solution: Choose the solution that best meets the requirements.
- Implement and monitor the solution: Implement the selected solution and monitor its performance over time.

Forecast Solution Selection

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Where to get the guidelines:

The guidelines are available in the following languages: English, Spanish, German, French, Chinese, Japanese, Korean, Russian, Arabic, Hindi, Bengali, Portuguese, Italian, Polish, Czech, Slovak, Hungarian, Romanian, Bulgarian, Greek, Turkish, Hebrew, Persian, Urdu, Vietnamese, Thai, Indonesian, Malay, Filipino, Tagalog, Vietnamese, Thai, Indonesian, Malay, Filipino, Tagalog.

IEA Wind Task 36 Forecasting for Wind Power

Understanding Uncertainty: the difficult move from a deterministic to a probabilistic world

Challenge

Uncertainty is a key challenge in wind power forecasting. It arises from various sources, including weather variability, model errors, and data limitations. Understanding and quantifying uncertainty is essential for improving forecast accuracy and reliability.

Solution

This document provides a structured approach to understanding and quantifying uncertainty. It includes a checklist of key factors to consider, such as forecast accuracy, lead time, and data availability. It also provides a framework for evaluating different forecasting solutions based on these factors.

Key points:

- Understand the sources of uncertainty: What are the main sources of uncertainty? How do they affect the forecast?
- Quantify uncertainty: Use statistical methods to quantify the uncertainty in the forecast.
- Communicate uncertainty: Make the uncertainty in the forecast clear to the user.
- Use uncertainty in decision making: Use the quantified uncertainty to make better decisions about wind power generation.

Uncertainty and Probabilistic Forecasting

Uncertainty and Probabilistic Forecasting

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- Use uncertainty in decision making: Use the quantified uncertainty to make better decisions about wind power generation.



Task 51 - "Forecasting for the weather-driven Energy System"

Summary

- Framework conditions changed since first phase of Task 36: **RES is no longer addition to system, but IS the system**; sector coupling to transport, heat, X...
- Has new challenges for **new forecast horizons** (seasonal forecasting...)
- Needs strong **collaboration with related TCPs** (solar, hydro, hydrogen, ...) and related Tasks (Integration, Lidar, Farm Flow Control, Hybrids, ...), standardisation (IEC), data markets, data control & quality assessment (WMO)
- **Uncertainty**, probabilistic Forecasting & data-driven AI modelling is in focus
- **Workshops & Webinars** State of the art, Seasonal Forecasting (2023), Minute Scale Forecasting (2024) and Extreme Power System Events (2025) Webinar on AI in meteorology & energy



iea wind

Task 51 – “Forecasting for the weather-driven Energy System”

iea-wind.org/task51

Get in touch with us...

Task Managers and Workpackage Leads :

Gregor Giebel

Caroline Draxl

Roskilde, Denmark

Golden (CO), USA

grgi@dtu.dk

caroline.draxl@epri.com

Corinna Möhrlen

John Zack

Böblingen, Germany

Troy(NY), USA

com@weprog.com

john@meso.com

The IEA Wind TCP agreement, also known as the Implementing Agreement for Co-operation in the Research, Development, and Deployment of Wind Energy Systems, functions within a framework created by the International Energy Agency (IEA). Views, findings, and publications of IEA Wind do not necessarily represent the views or policies of the IEA Secretariat or of all its individual member countries.