

Supported by:



on the basis of a decision
by the German Bundestag



Universität Stuttgart
Stuttgarter Lehrstuhl für Windenergie (SWE)
am Institut für Flugzeugbau



Minute-scale forecasting of wind power using a long-range lidar in alpha ventus

RAVE-Workshop 2021

28.01.2021 | Ines Würth, Maayen Wigger,
Linda Menger, Martin Felder, Anton Kaifel

Why minute-scale forecasting?

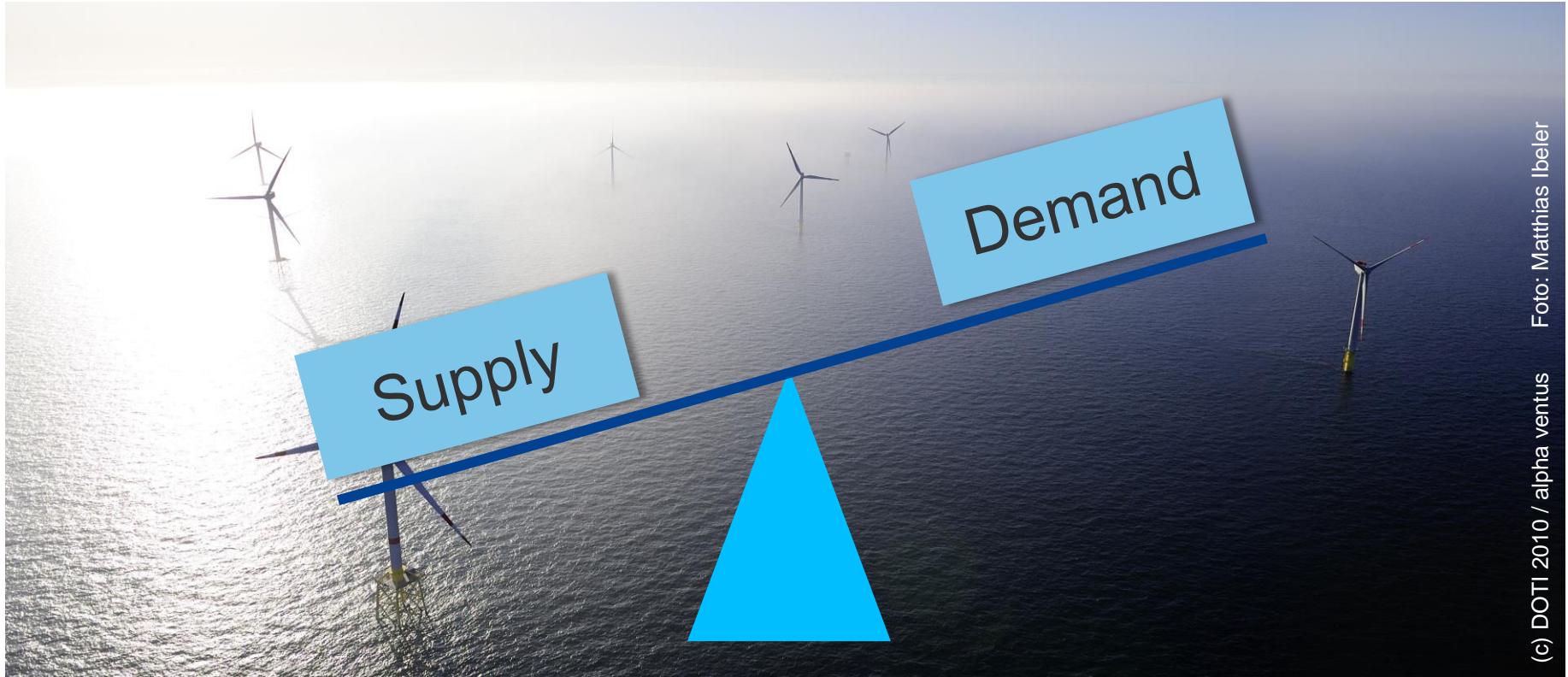
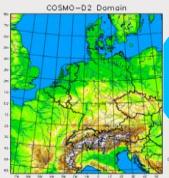


Foto: Matthias Ibelser

(c) DOTI 2010 / alpha ventus

How do we want to forecast in ParkCast?

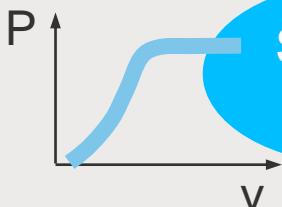
External Data Sources



Drive data



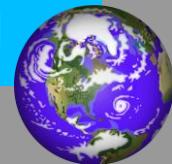
FINO I



SCADA data

Propagation of wind conditions

High resolution NWP model



Lidar data

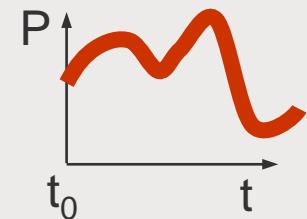


Farm performance model



Conversion to power

Optimization in ParkCast

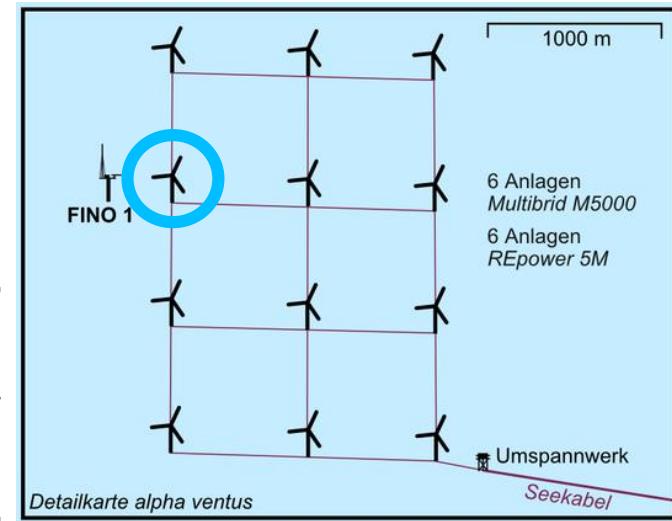


Minute-scale forecasting

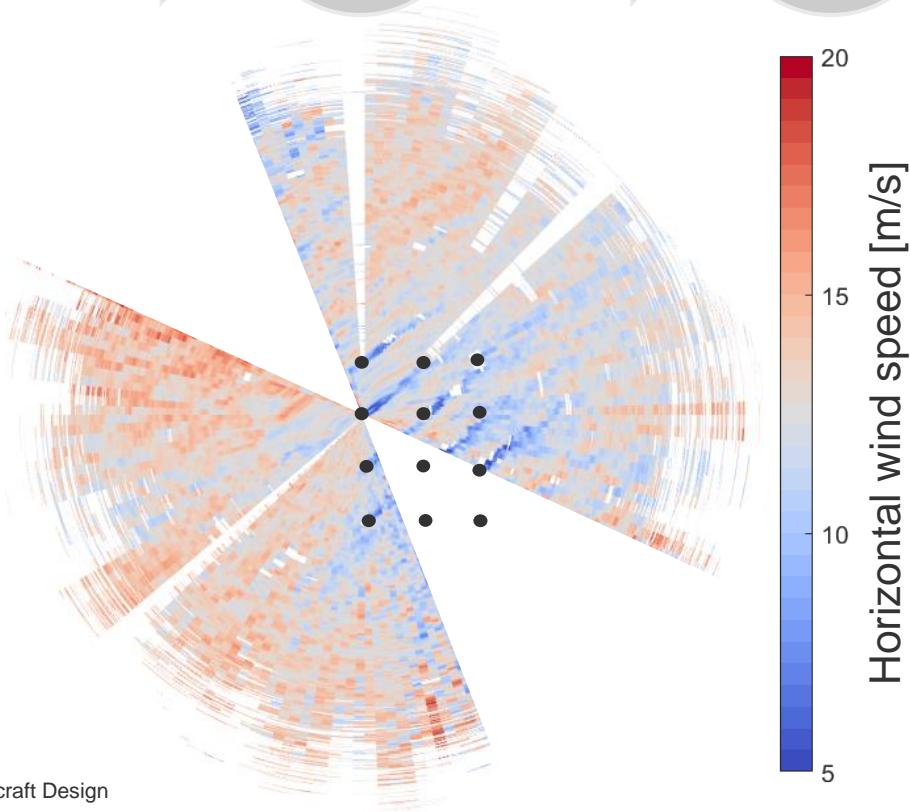
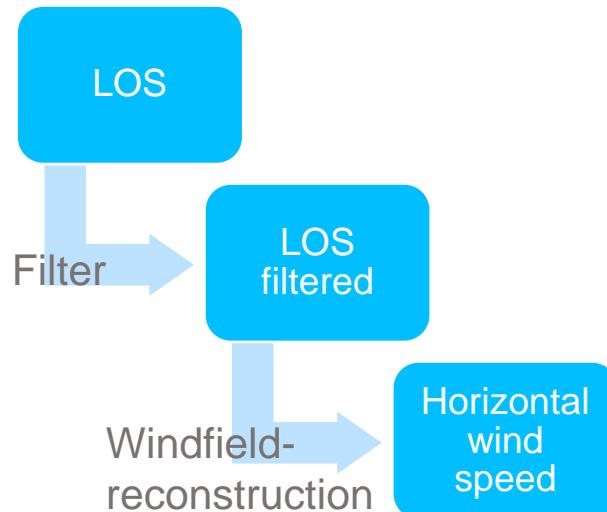
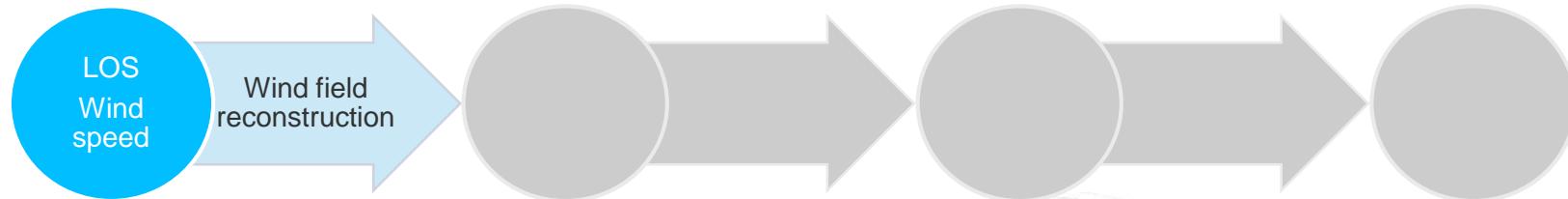
Lidar measurements on alpha ventus

Since October 2019:

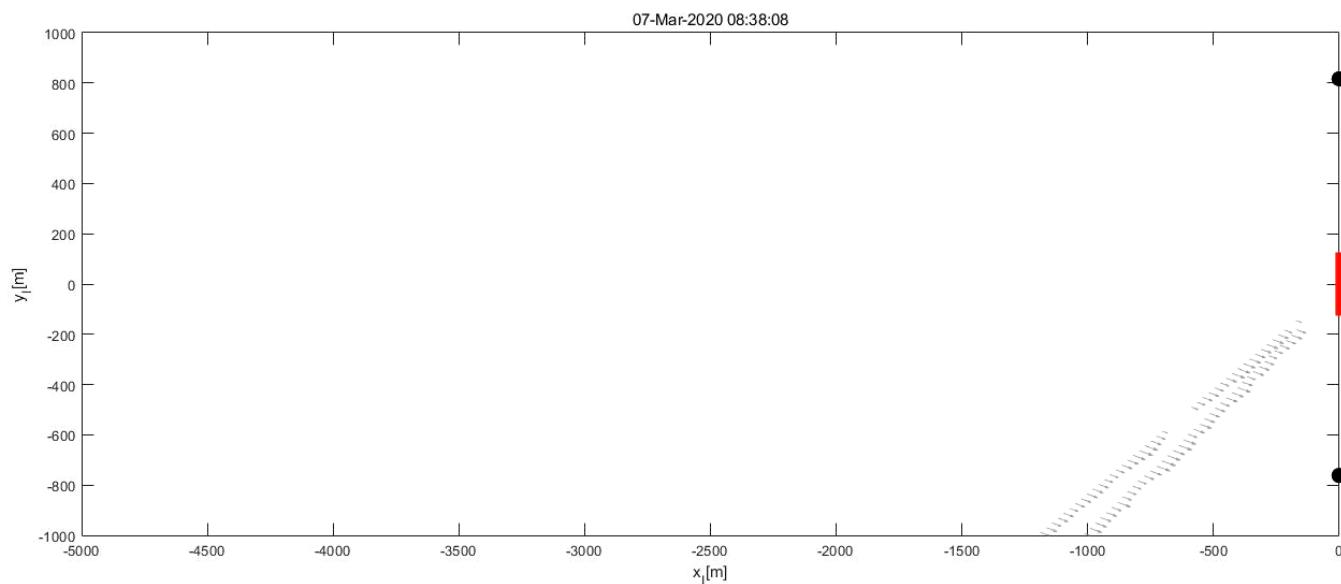
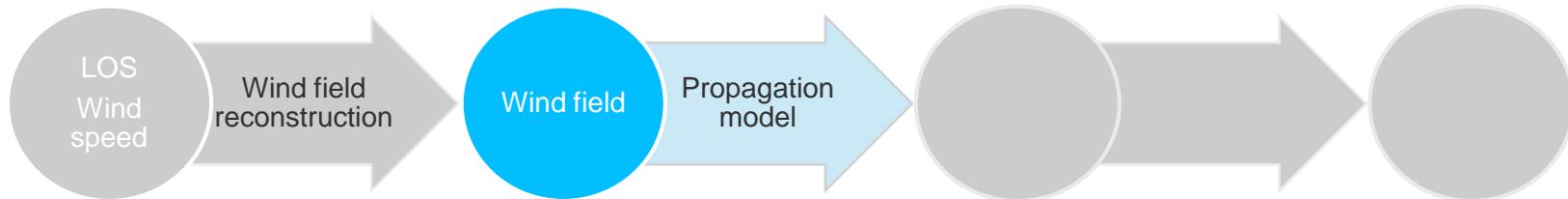
Wind field measurements
using long-range lidars
StreamLine XR



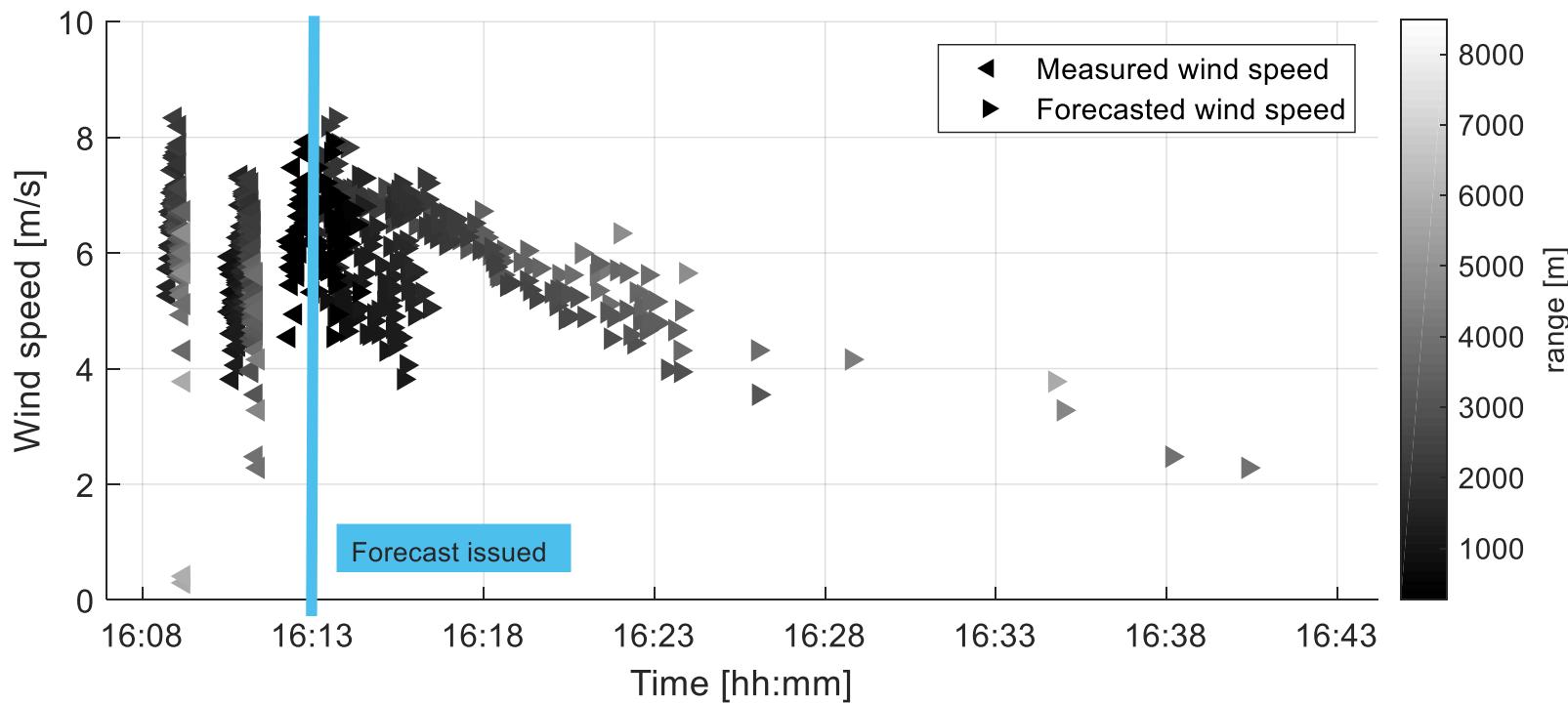
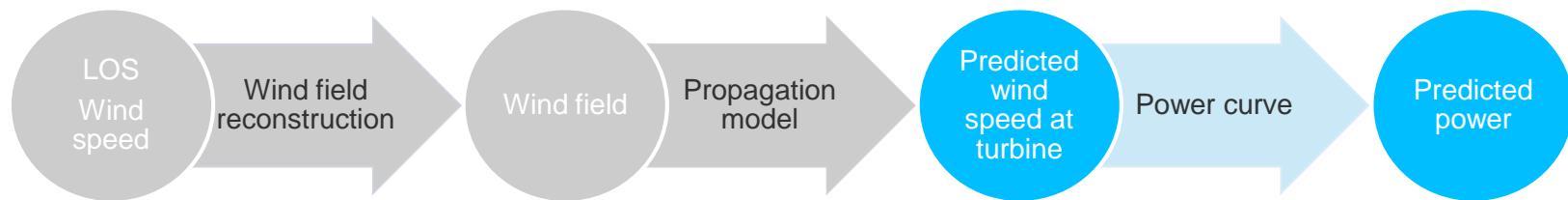
Forecast Process



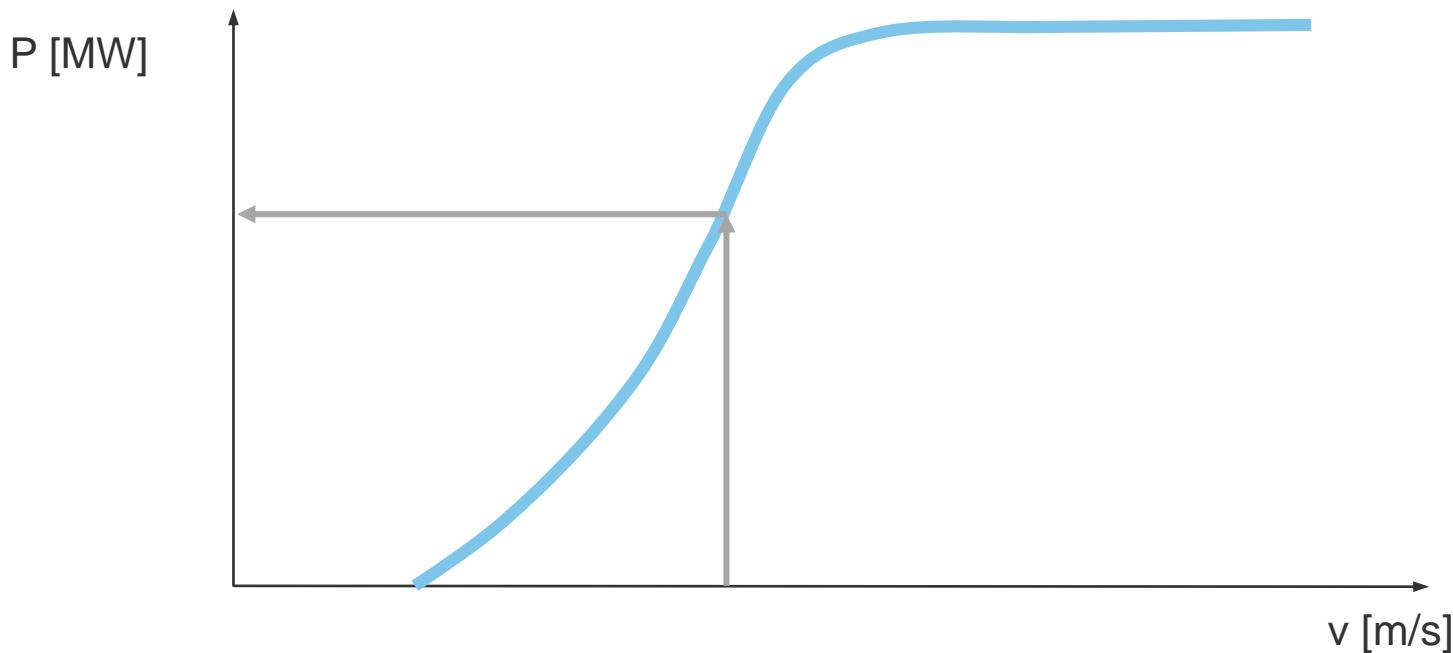
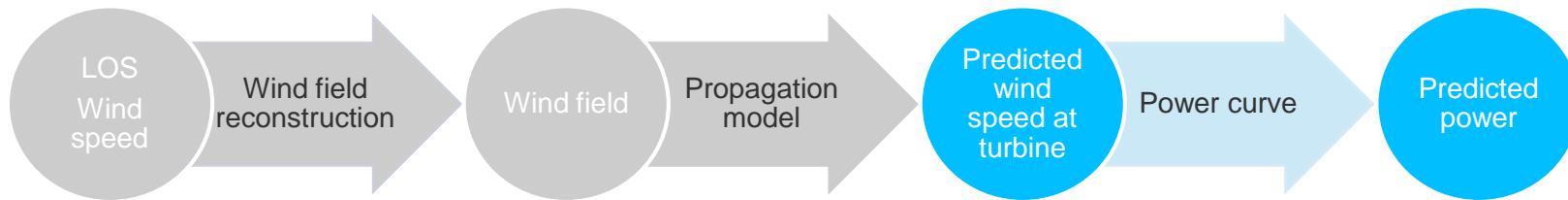
Forecast Process



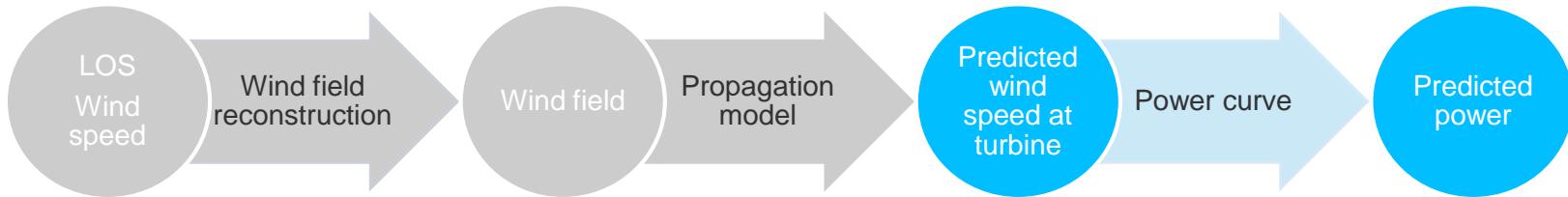
Forecast Process



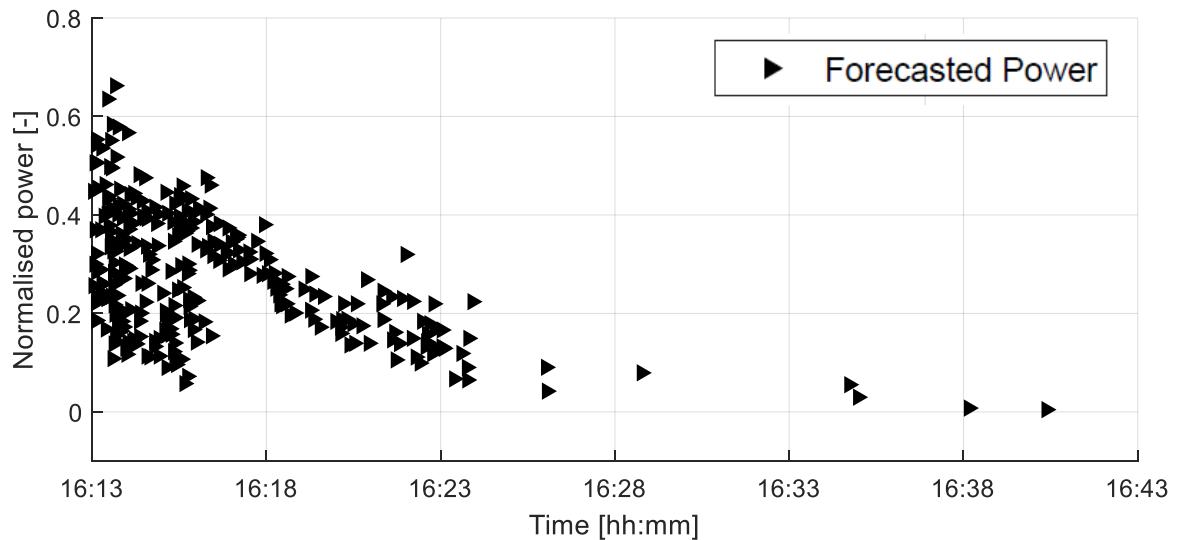
Forecast Process



Forecast Process

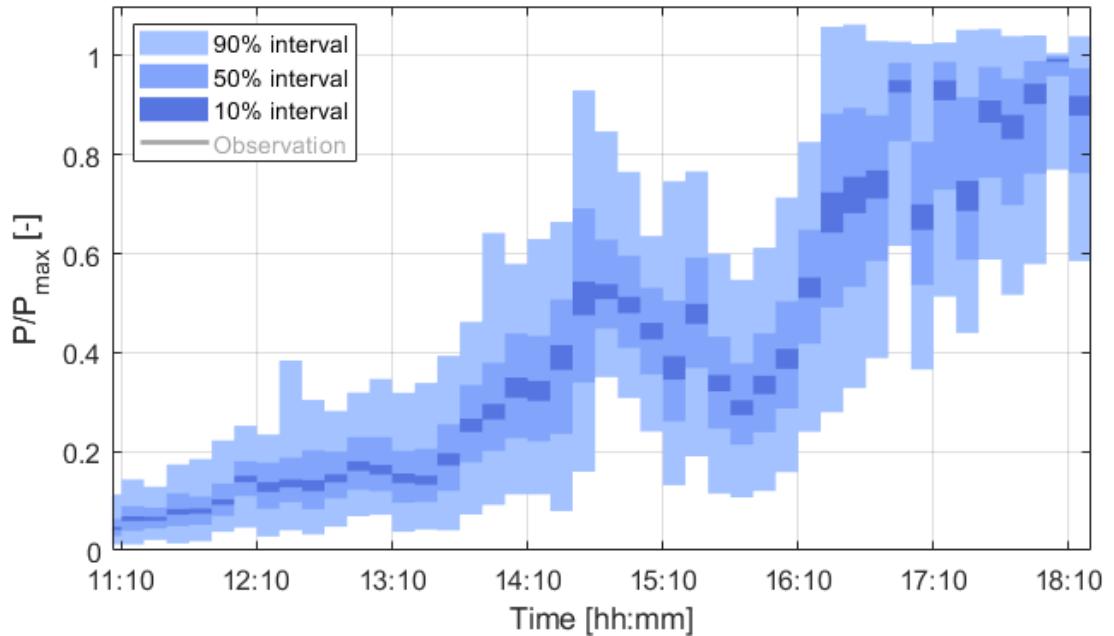


- Power spread
- Uncertainty in the forecast
- Probabilistic forecast quantifies the uncertainty



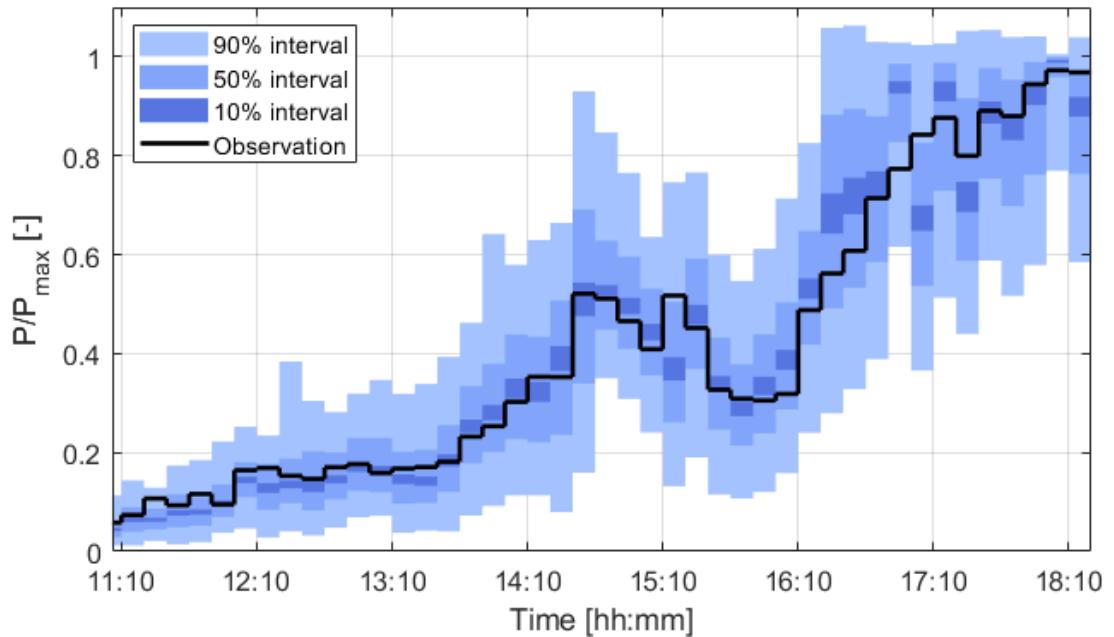
Results for Probabilistic Forecast

- Intervals represent uncertainty in forecast
- For each 10 min bin a forecast is calculated



Results for Probabilistic Forecast

- Intervals represent uncertainty in forecast
- For each 10 min bin a forecast is calculated
- Comparison with observation to evaluate forecast
- Lidar forecast able to detect changes in power output



Conclusions

- Lidars are a valuable tool to produce minute-scale forecasts
- Their strength is to predict power changes

Challenges

- Measurement range
- Lidar data availability

Next steps

- Lidar forecast for the whole wind farm
- Assimilate data into WRF and compare methods



Thank you!



Dipl.-Ing. Ines Würth

E-Mail wuerth@ifb.uni-stuttgart.de

Telefon +49 (0) 711 685-68285

Fax +49 (0) 711 685-68293

Universität Stuttgart

Supported by:



Federal Ministry
for Economic Affairs
and Energy

on the basis of a decision
by the German Bundestag

RAVE - Research at alpha ventus

- Accompanying research initiative at the alpha ventus offshore test wind farm since 2007
- Funded by the Federal Ministry for Economic Affairs and Energy (BMWi) with +50 mill. €
- Essential cornerstone in the development of offshore wind energy in Germany
- A long-term and unique data set of in-situ measurements is accessible in the [RAVE data archive](#) operated by the Federal Maritime and Hydrographic Agency (BSH)
<https://serviceportal.bsh.de/BSHPortalDMZ/userRoles.jsf>
- alpha ventus and RAVE are used as blueprint for offshore wind power demonstration worldwide

For more information: www.rave-offshore.de

Supported by:



on the basis of a decision
by the German Bundestag



© 2020 Fraunhofer IWES