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Importance of evaluating forecasts at relevant heights when selecting optimal model setup for wind energy.

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09/12/2020

ESIPP Webinar

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Background

source: www.ecaf.org

- Increasing levels of renewables require accurate modelling of resources.
- Weather Research & Forecasting (WRF) model used to forecast day-ahead wind. (24-48 hr ahead)

Numerical Weather Prediction Models

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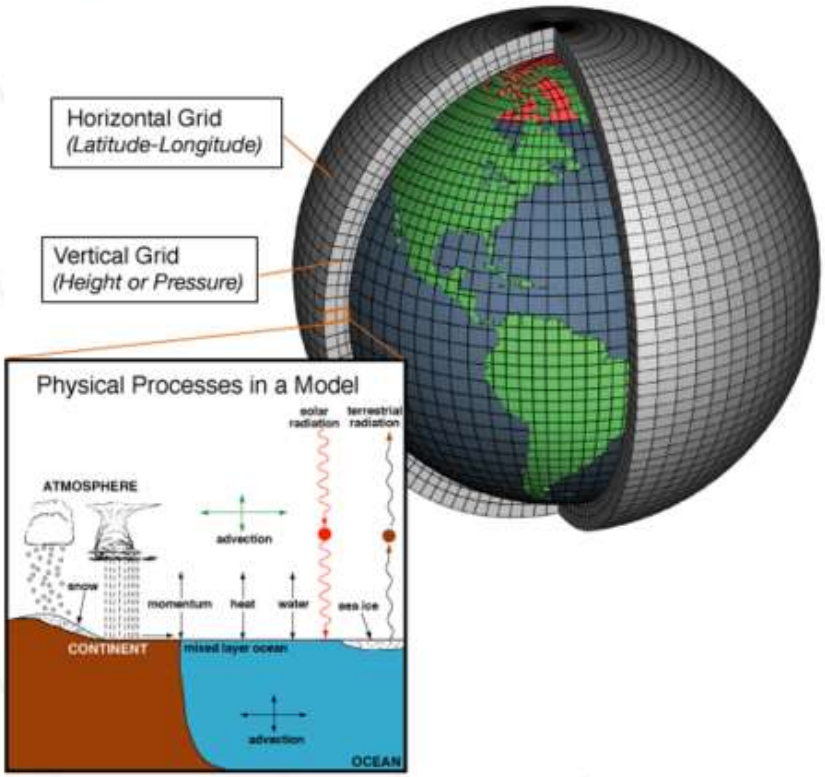

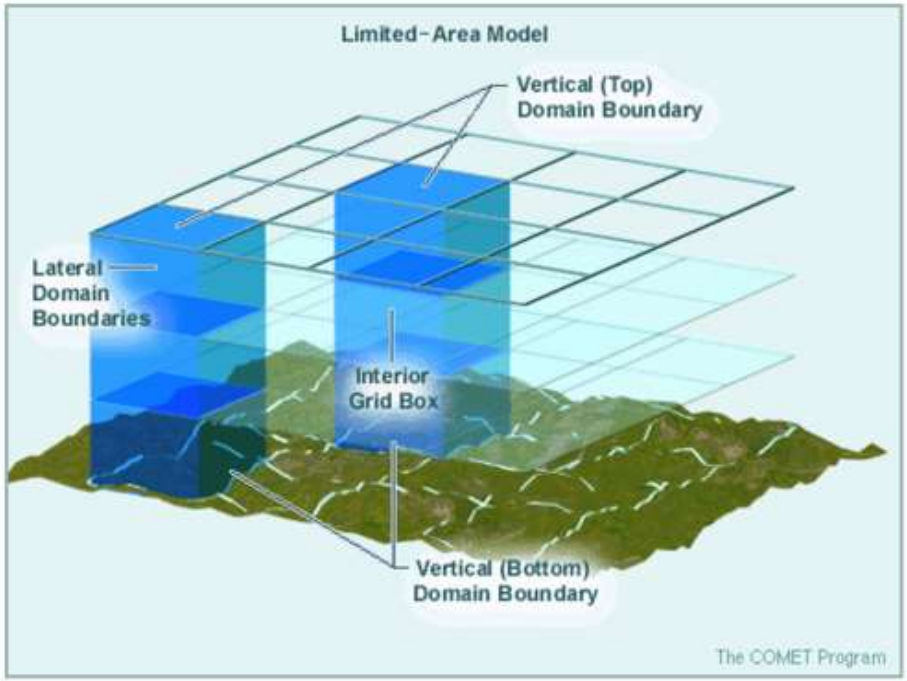

- Global model
- Limited area model

source: www.noaa.gov, www.nesi.org.nz

Physics/Parametrization

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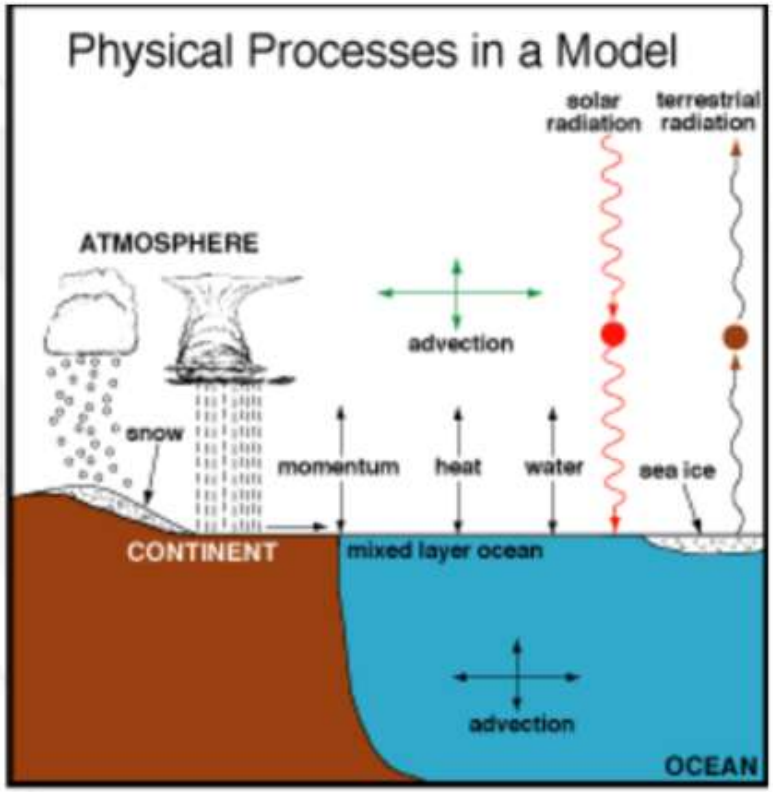

- Represent sub-gridscale weather features.
- Planetary Boundary Layer (PBL) scheme

source: www.noaa.gov

Model Setup

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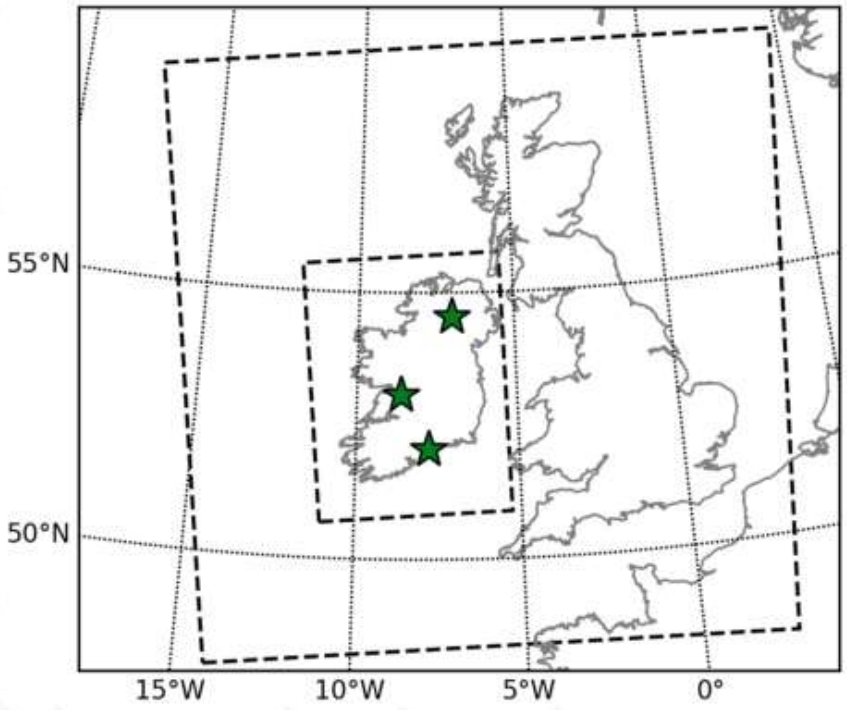

- WRFv4.0
- 01/10/2017 - 30/09/2018.
- ECMWF IFS forecast data on pressure levels.
- 9km and 2.25km.
- 51 vertical levels, 5 below 100m AGL.
- 24-48h forecasts.

- 6 PBL schemes tested.
  - 3 local
  - 3 non-local
  - Results shown for 3 of the 6 schemes.

- 3 validations sites with wind farm and weather station: S, W and N.

10m mast vs Hub Height mast

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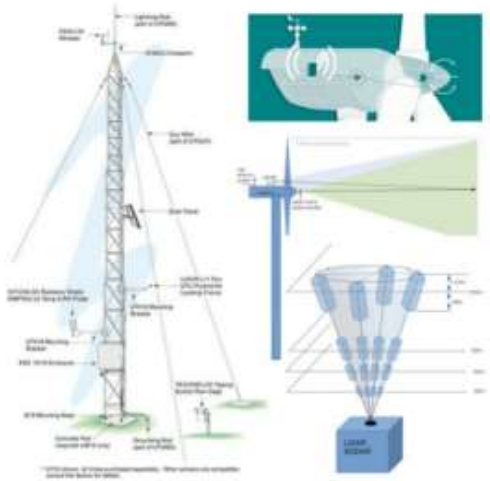
source: www.met.ie

EIRGRID Met Mast and Alternatives Study

Version 2

Final Report



source: www.eirgridgroup.com/

Differences between 10m & hub height

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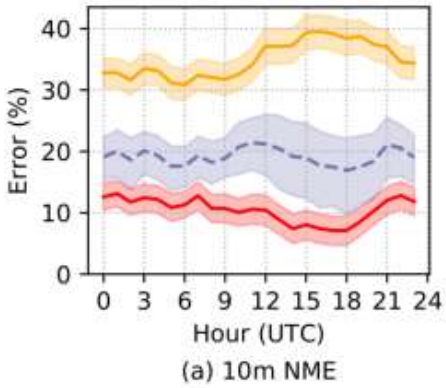
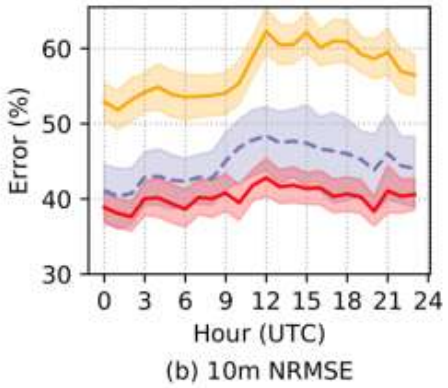
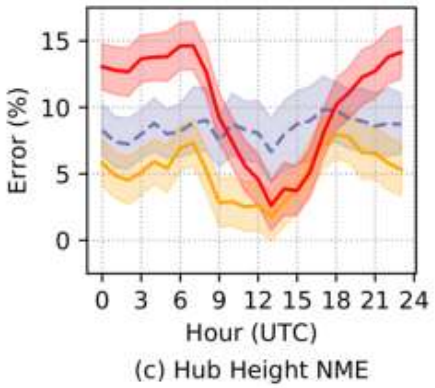


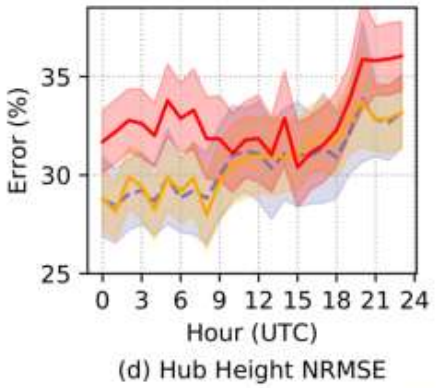
(a) 10m NME



(b) 10m NRMSE

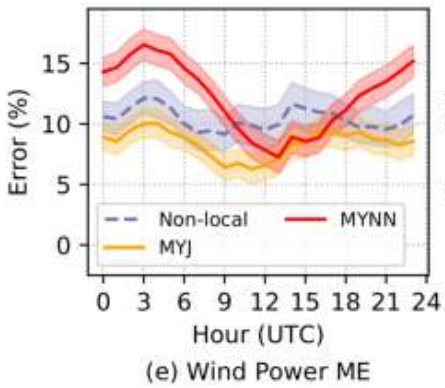


(c) Hub Height NME

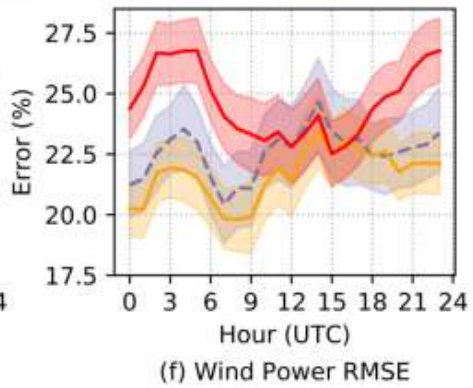


(d) Hub Height NRMSE

- MYNN (red) PBL scheme is best for 10m wind speed but worst for both hub height wind speed and power.
- Large errors in power due to compounding of larger errors for wind speeds on the ramp.



(e) Wind Power ME



(f) Wind Power RMSE

Extension to more wind farms

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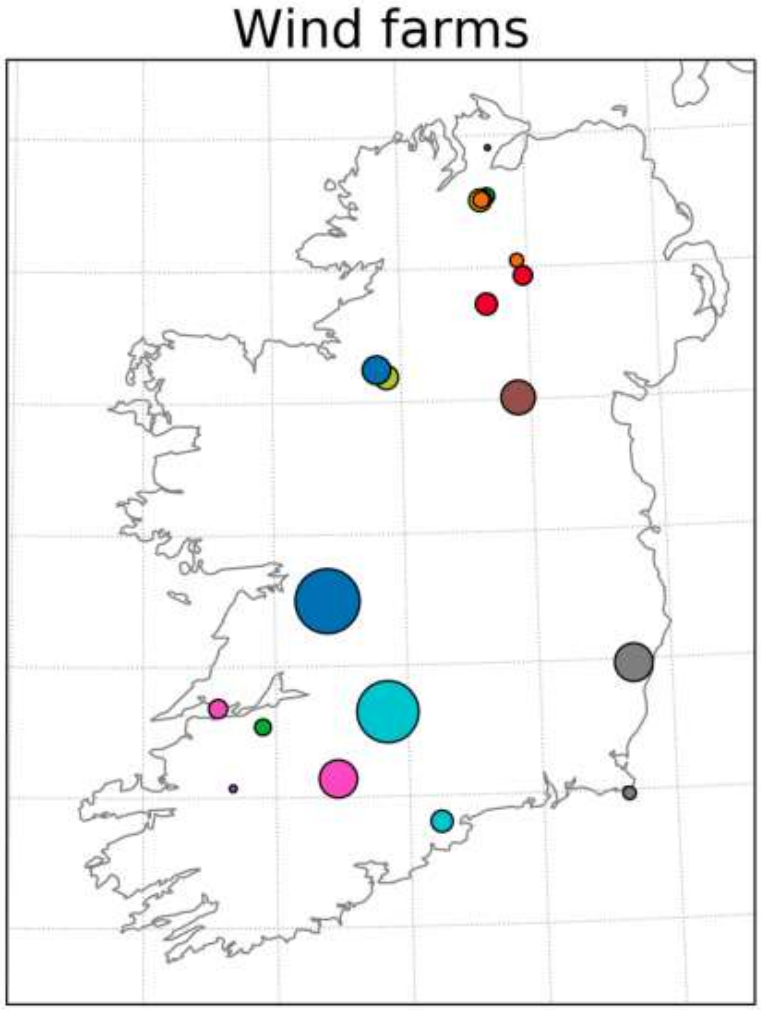
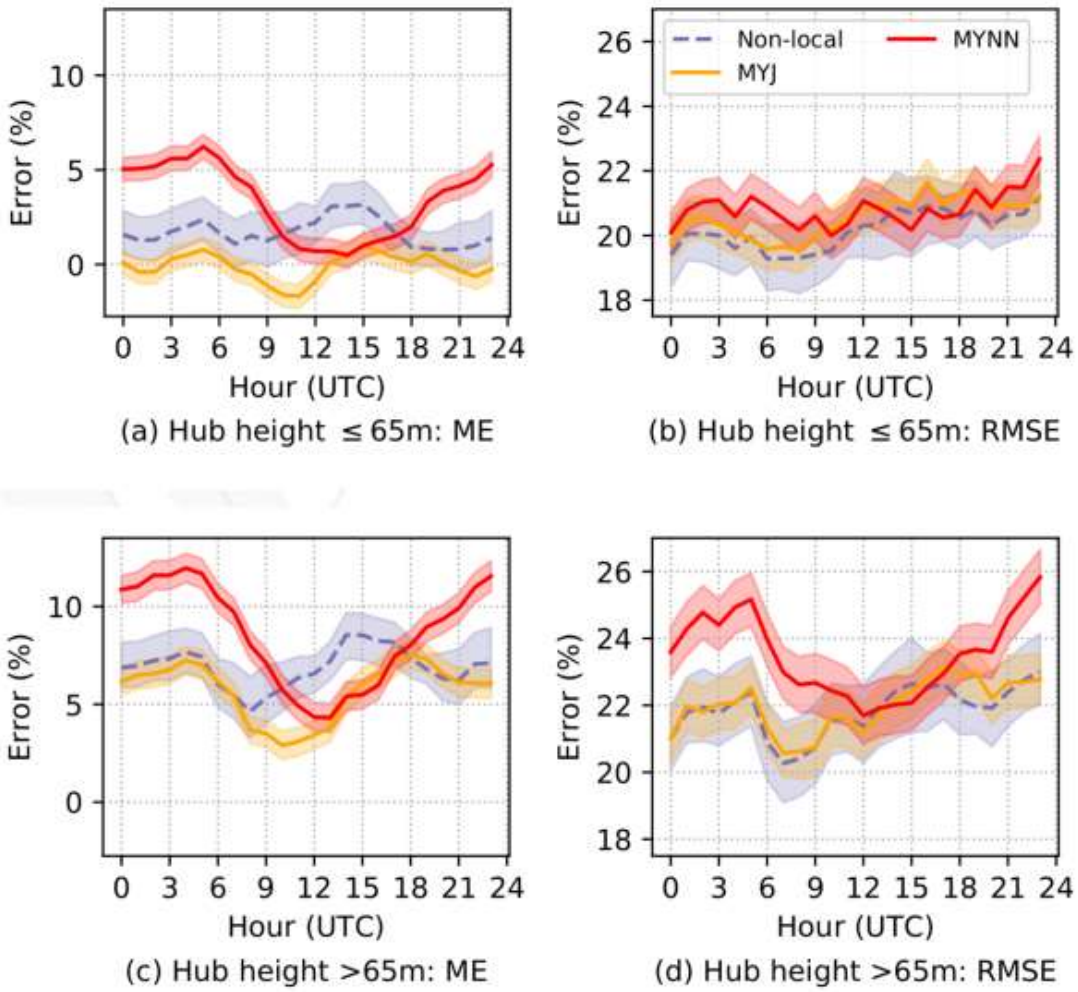


- Full set of 21 wind farms.
- Variety of capacities and hub heights.
- Median hub height of 65m

Extension to more wind farms



(a) Hub height ≤ 65m: ME

(b) Hub height ≤ 65m: RMSE

(c) Hub height >65m: ME

(d) Hub height >65m: RMSE

Ensemble forecasts

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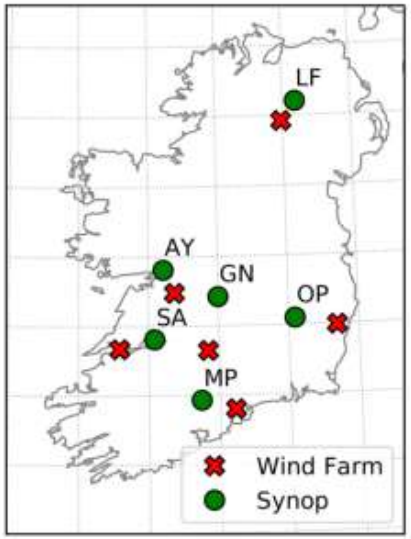
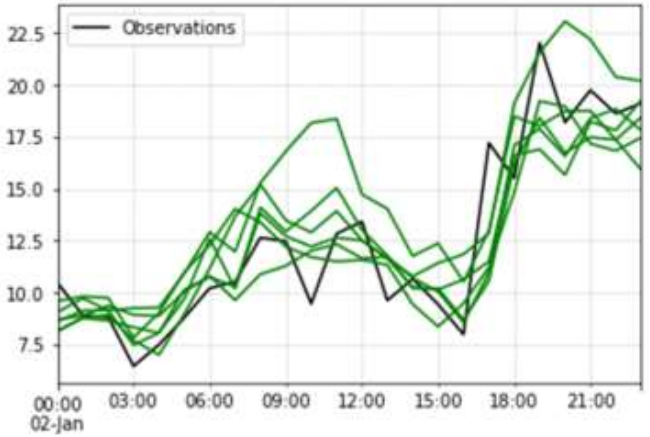
Different method for generating uncertainty.

- Initial condition perturbations.
- **Mixed physics.**
- Stochastic Physics.

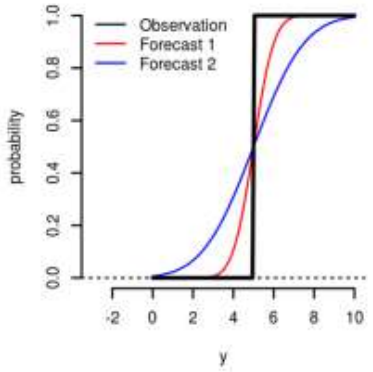


Comparison of WRF ensembles:

- Winter 2017/18
- 6 weather stations and 6 wind farms.



WRF Ensembles



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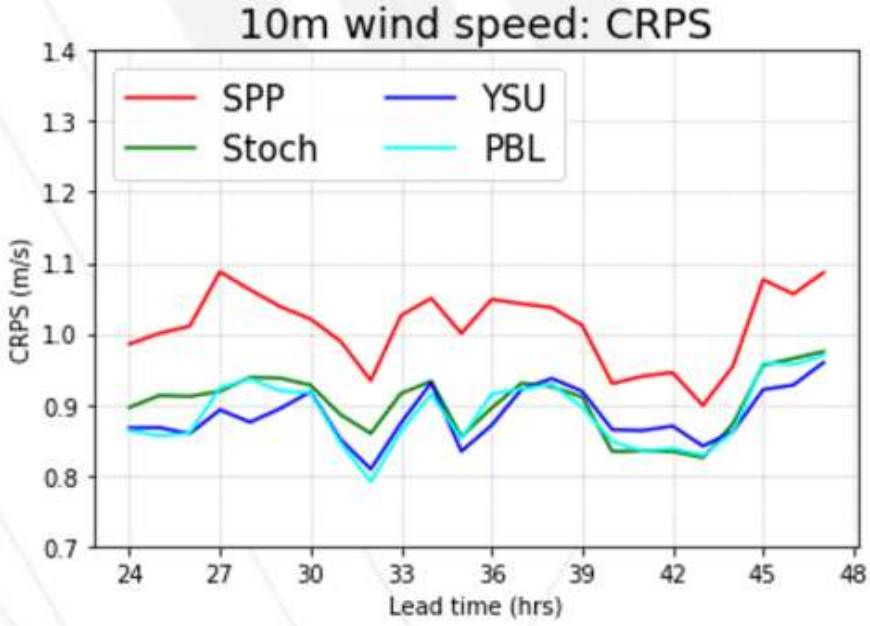

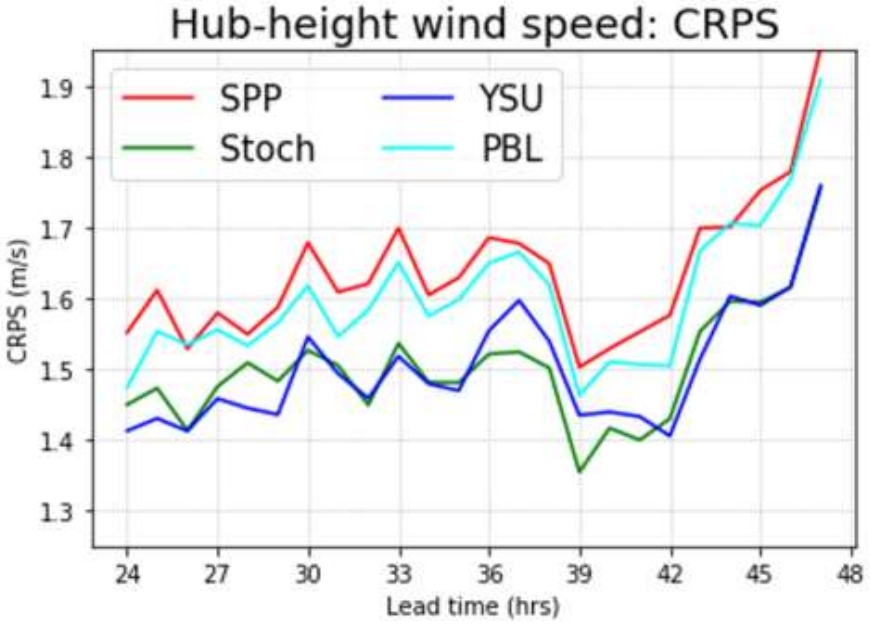

- Comparison of a multi-physics PBL ensemble to stochastic approaches.
- Measures of probabilistic forecast skill also vary with height.

Ensemble Forecasting at Eirgrid

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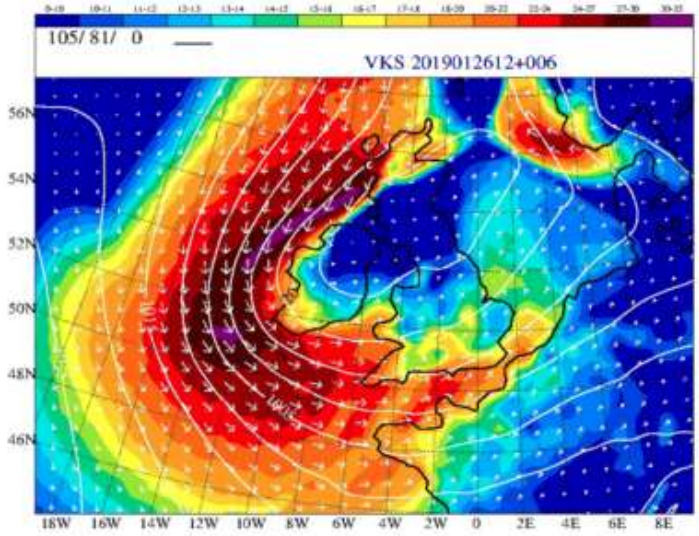
18th Wind Integration Workshop
International Workshop on Large-Scale Integration of Wind Power into Power Systems as well as on Transmission Networks for Offshore Wind Power Plants
16 - 18 Oct 2019
Dublin, Ireland

Probabilistic Forecasting Tools for High-Wind Penetration Areas: An Irish Case Study

SESSION 4C: FORECASTING I



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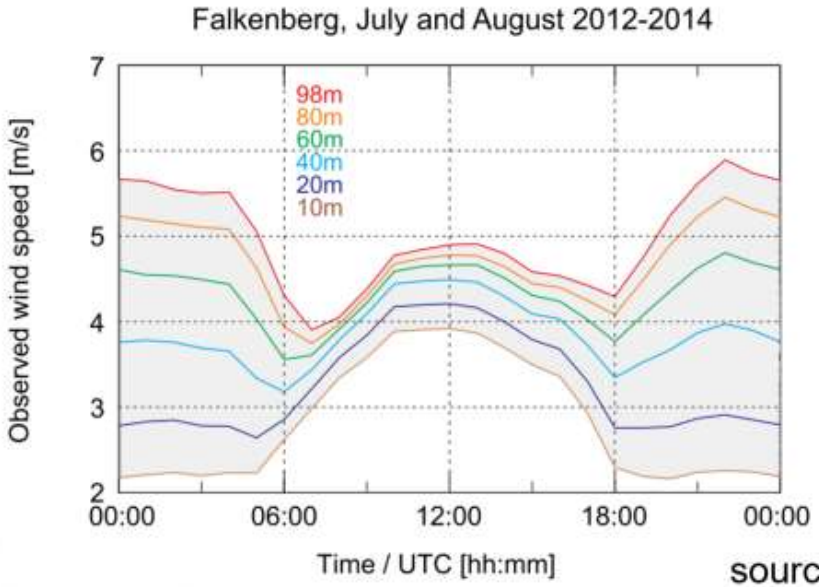
Summary



source: Heppelmann et al,2017

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- WRF PBL schemes have different error patterns for predicting 10m wind speeds and at hub height.
- Differences for wind power forecasts are due to differences relative performance with height and depending on the wind speed in relation to power curve.

- Evaluating WRF ensemble techniques over a winter highlights that a multi-physics ensemble has similar performance to best performing stochastic schemes but suffers from lack of variability at hub height.

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Thank you.

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