

# Wind forecasting for energy management in Croatia

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- Understanding how much wind farm will produce in the next hours is crucial to make the right decisions, either in the energy market or for maintenance planning

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## Why do wind forecasting?

- Unforecasted wind fluctuations increase requirements for spinning reserves and raise electricity system production costs
- Unforecasted large ramp events can affect electricity system reliability
- Wind forecasts become essential for effective grid management with high wind penetrations
- State-of-the-art forecasts have high economic value compared to their cost (but potential savings are not always realized)

2009. - operational wind speed and direction forecast at wind farm locations for the Croatian Transmission System Operator

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# Wind forecasting

## ALADIN operational numerical weather prediction model

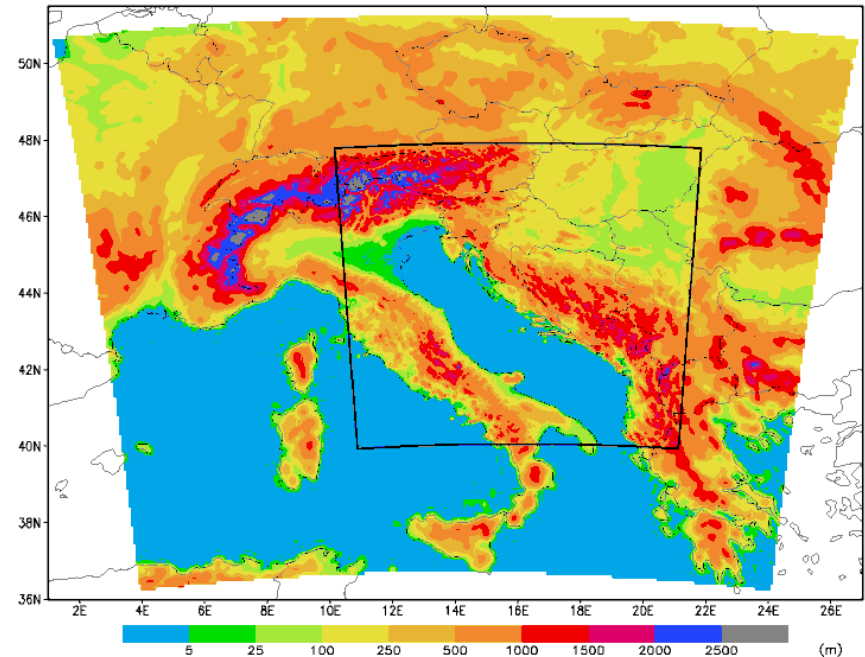
### 1. full-physics model

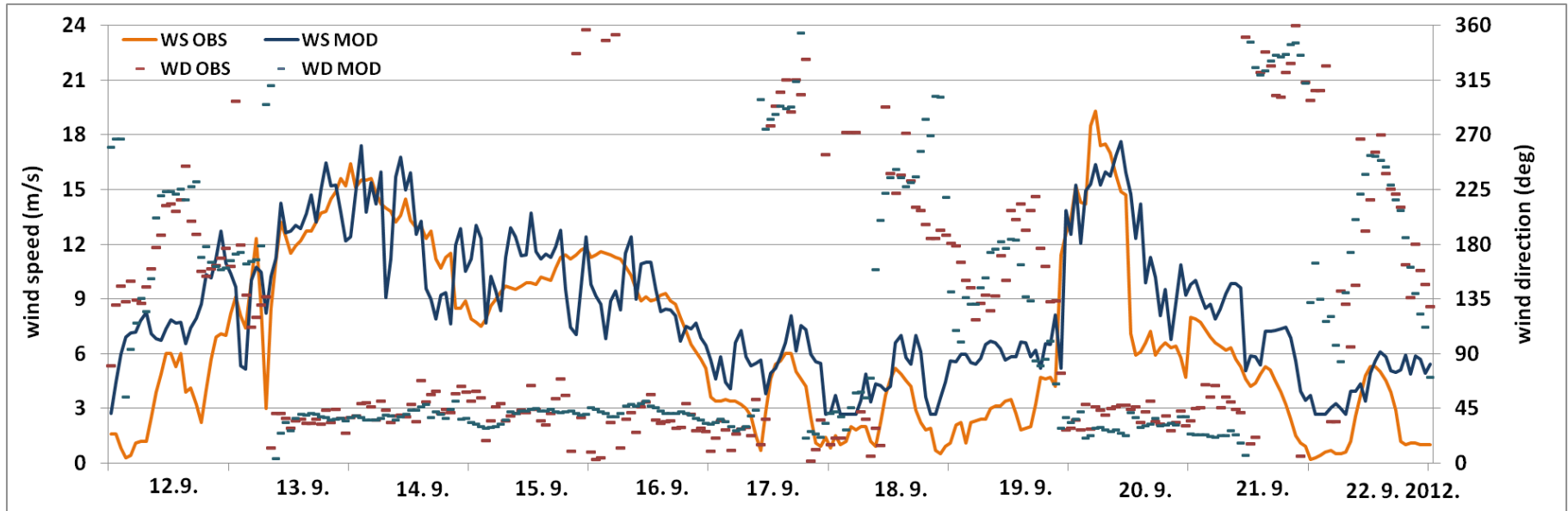
spectral model - hydrostatic mode  
with 37 vertical levels

horizontal resolution 8 km

### 2. dynamical adaptation – dynamically adjusting near-surface wind

horizontal resolution 2 km



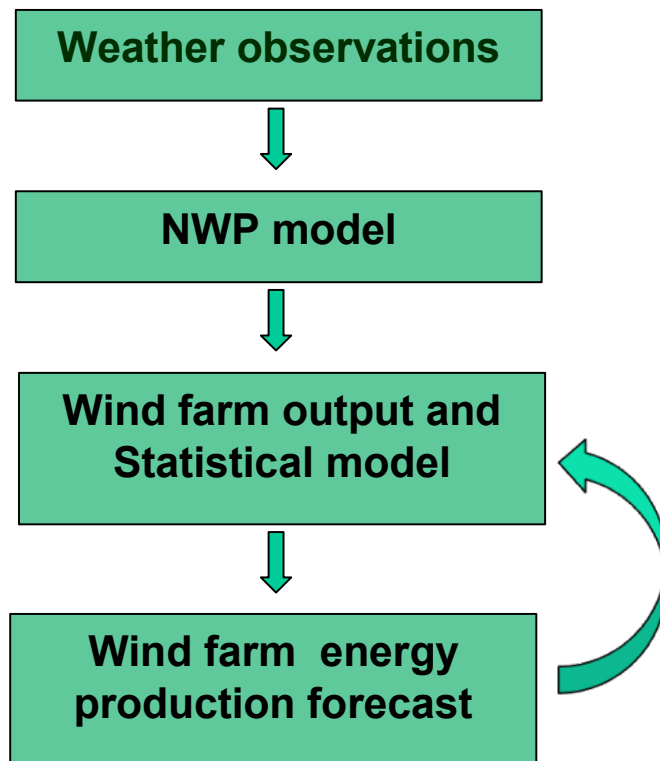


Observed (OBS) and modeled (MOD) wind speed (WS) and wind direction (WD) at 80 m above ground level at the ZD2 wind farm

Acknowledgement to the Eko d.o.o. for mast measurements

# Energy production forecasting system

Wind Power Planning Tool (WPPT) (Giebel and Nielsen, 2008)



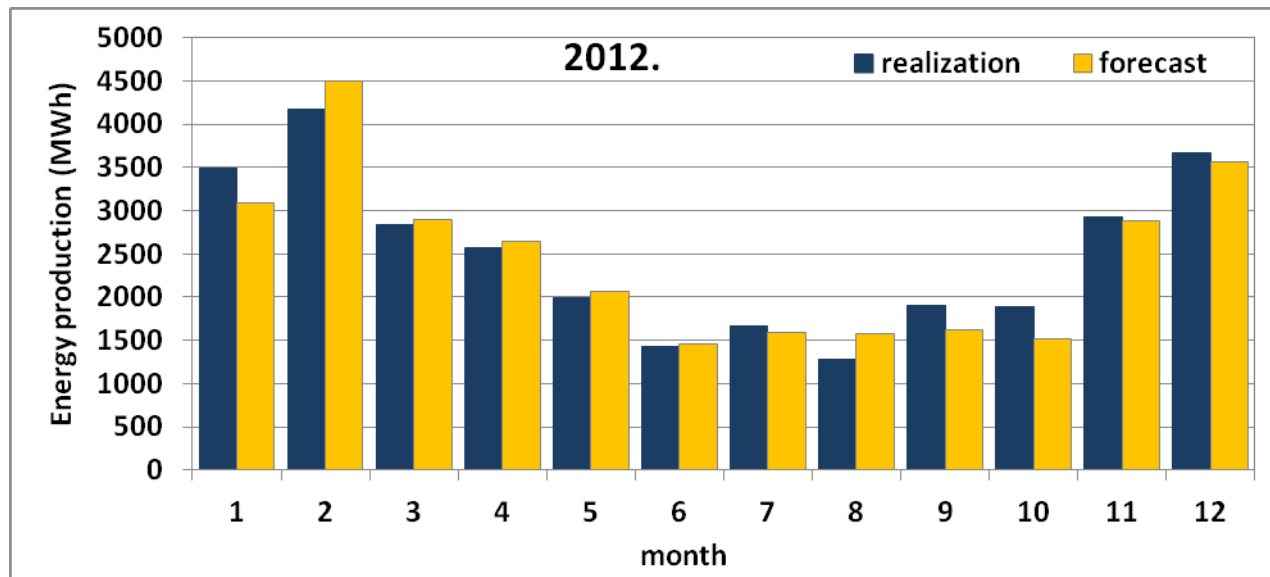
Weather observations at wind farm sets the initial conditions (currently off)

Numerical weather prediction model forecasts evolution of weather system

Statistical model converts wind to power output and corrects for systematic biases and error patterns

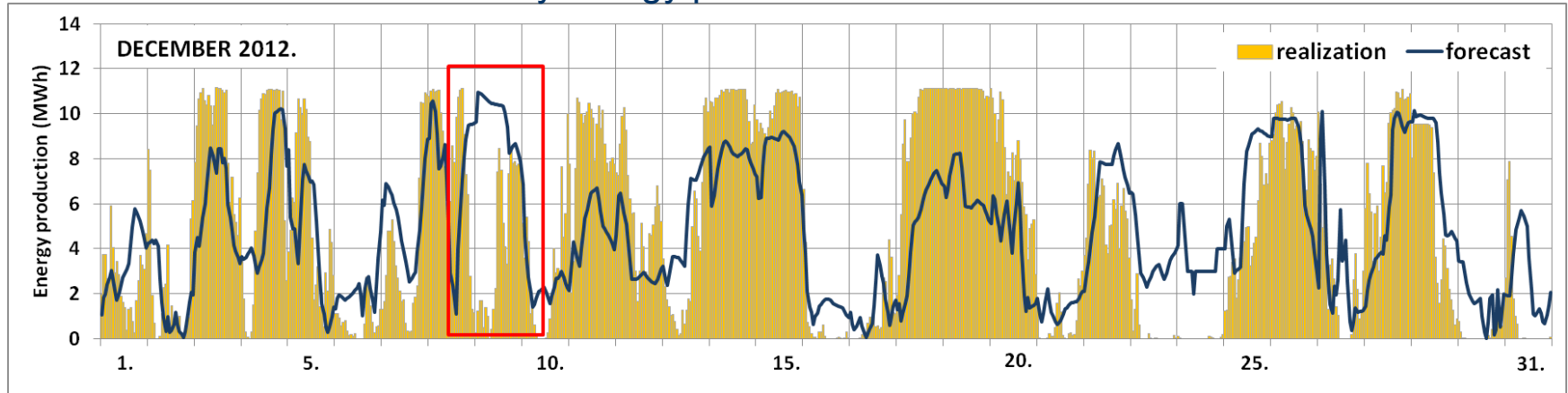
Actual wind farm production data provide feedback to improve the statistical models

## Forecasted and realized monthly energy production at one of the wind farms in the Šibenik-Knin County in for 2012. year.





## Forecasted and realized hourly energy production – December 2012



## Forecasted and measured wind speed at Šibenik – December 2012



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## Summary

- Wind forecasting is becoming ever more important as wind penetration grows
- Current forecasting is not perfect but nonetheless highly cost effective compared to no forecast at all
- Forecast should be customized to the real needs of the users in energy sector
- Improvements lie in better models and better use of models
- **Project – WILL4WIND Weather Intelligence for Wind Energy**