Using Wind Plant Production Changes to improve Neighboring Plant Forecast

ConWX ApS

June, 2019

ConWX history – how it all started

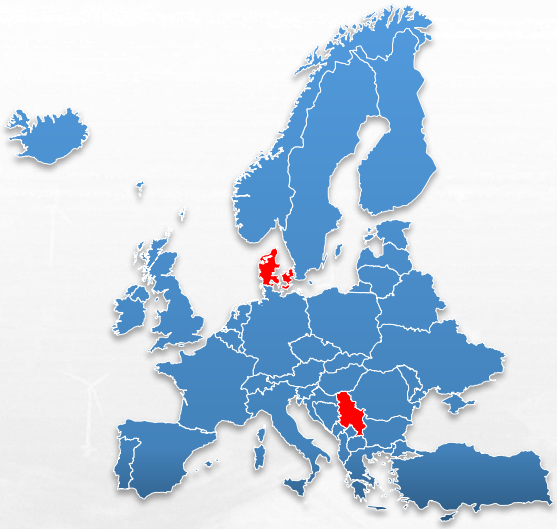
Dec 2008

ConWX founded by Jesper Thiesen & Erik Østergaard Madsen – with 20+ years experience in the field

First products:

MetOcean/O&M; hindcasts

Followed by NWP and data modelling



TODAY:

A large range of products

Global customer outreach

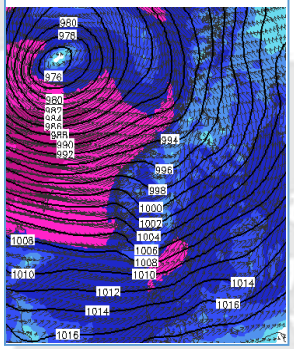
Main focus: wind & PV power production forecasts

Team of 30 – in Denmark and Serbia

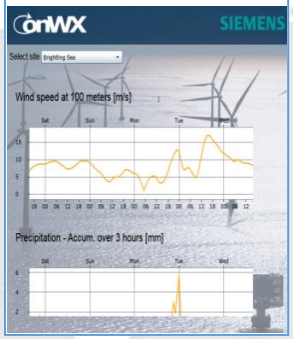
ConWX products

Wind & PV Power Forecasts

Weather Data



Metocean Services



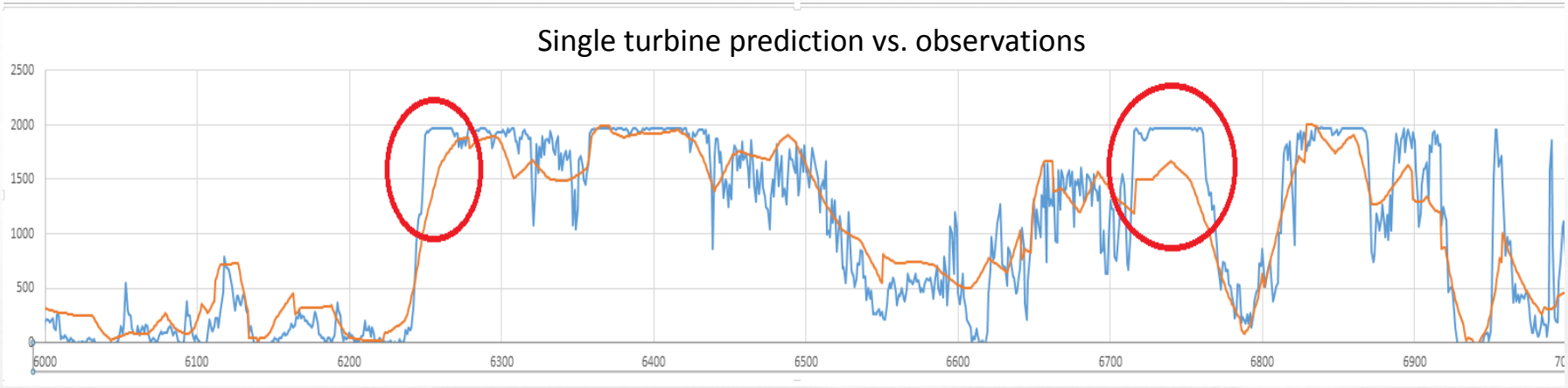
- *Wind and PV **power production forecasts** on single unit, park, portfolio, region & country level – ID, DAH+, middle and long term, incl. energy briefings and long term renewable reports*
- *Direct forecasting responsibility for **+110GW Wind** and **6GW PV globally***
- *Historical, statistical weather data for **site assessments** and data validation*
- *Advanced 5-10 days **offshore weather**, waves and current forecast for any global position; incl. routing forecast, lightning warnings and weather reports*

Your power is to know

Short Term Forecasting Challenges

There are numerous challenges in short term power forecasting:

- Online data has very limited durability
- +90 minutes NWP are in general better
- Data 15 minutes delayed and 45 minutes to market gives a delay up to 60 minutes
- Online data often represents only the local production
- Perturbation spread depends on topography, atmospheric stability, wind speed and system flow
- No online wind speed measurements at hub-height



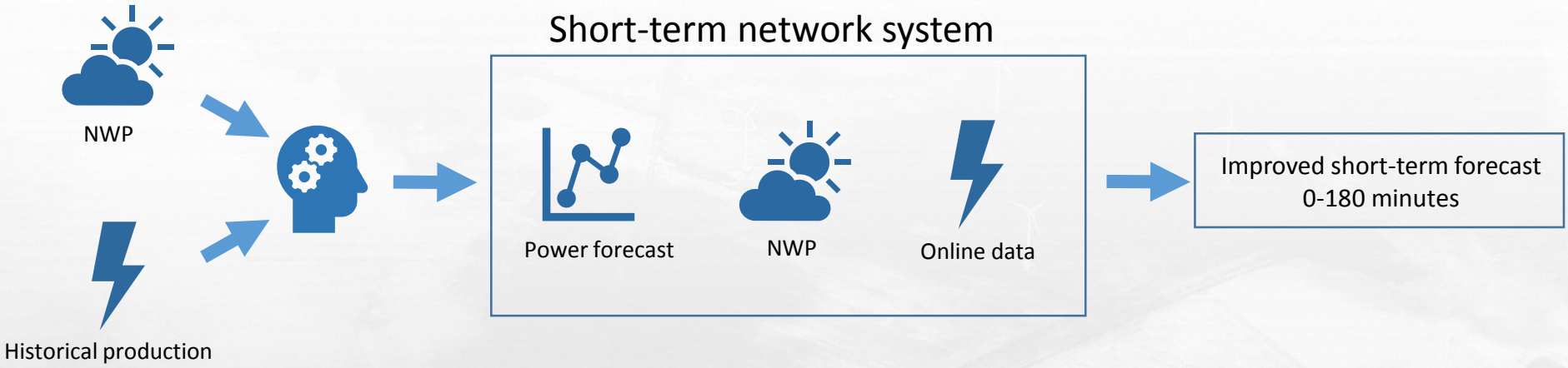
Figure; Typical prediction. Blue is observation, orange is prediction and the red circles indicate large differences in observation and prediction for a single turbine

Short Term Network System

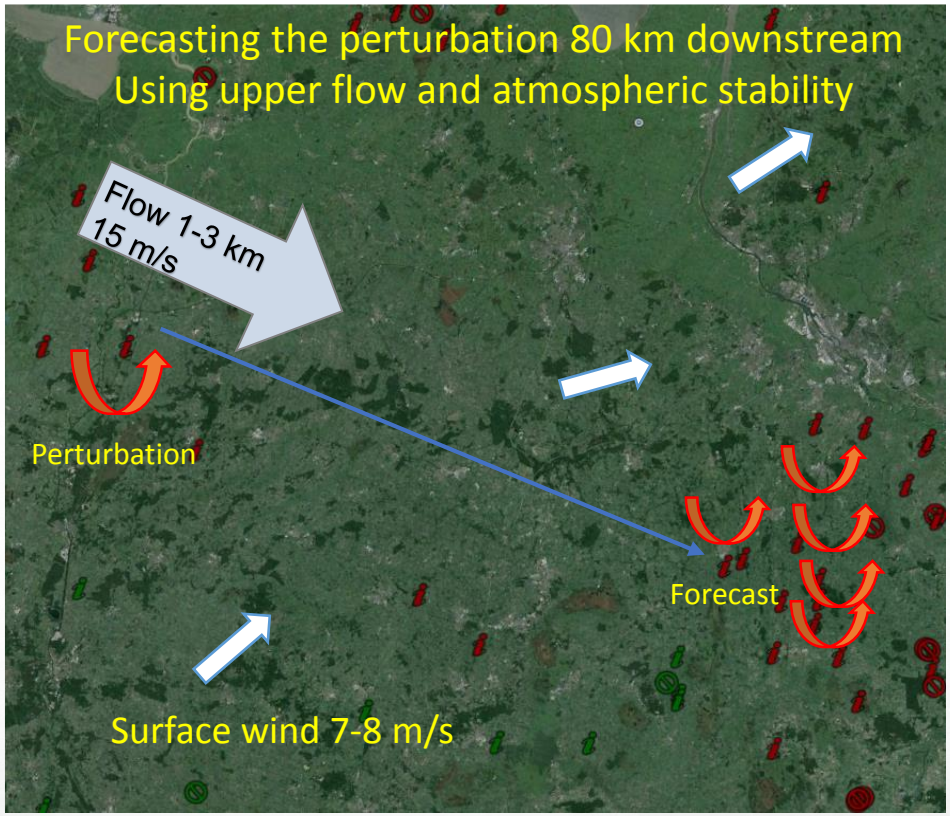
Making the most of data already available across a portfolio

Necessary input data:

- Numerical weather prediction data (ConWX & External)
  - Wind speed, wind direction, pressure
- Wind power forecast (ConWX)
- Historical production data (Client)
- Online data for selected sites (Client)



How we optimize on Short Term



Uncertainties and challenges in forecasting perturbations:

- Surface wind is not representative for the perturbation movement
- Winds in 1.5-10 km transport the changes
- Is the perturbation local or regional?
- Damping or growing perturbations?
- The influence of atmospheric stability?

Short Term Network System Methodology

Method steps:

- Frontal passage detection for individual plants
  - **Fronts** = Zones of transition between two different air masses, with different characteristics including: temperature, wind direction, density and dew point
  - **V-shape detection** = Detection of a passing front done by analysing the difference in modelled wind direction over a moving window

- Calculate bias between modelled power and online data over the analysis period
  - **Frontal passage errors** in forecast magnitude and timing (ramps)
  - Select parks where the error value is greater than an imposed threshold and for which the **detection of a passing front** conditions are satisfied

- Cross-correlation of detected fronts
  - **Front tracking** = For neighbouring parks with detected fronts, calculate angular correlation of the modelled wind direction and pressure difference => **Detect influence list for a park**
  - **Influence list** = neighbouring parks that can be corrected using the information from the selected park

- Down-stream short-term calibration
  - **Correct NWP predicted power** for down-stream parks (parks in the influence list) based on parks upstream
  - Correction is applied using with damping depending on scenario and distance/time

Short Term Network System Improvements

Improvements

- With the selected parameters configuration, the method is active for **10-15% of the events in a year**
  - Events with discrepancies in magnitude and timing (ramps) between online data and NWP predicted forecast
- Improvements calculated based on comparison with the traditional short-term calibration approach
- **Evaluated on +60 to +120 minutes** from forecast issued time

Portfolio size	Overall improvements
1 GW	20%
6.5 GW+	25%

Table; Improvements obtained using STNS for different portfolio sizes

Advantages

- **Improved plant – level and aggregated short term forecast** (0-180 minutes) in high-cost situations
- **Improved use of online data** in situations of **low online data availability**

Example Large portfolio (7GW) - Cold front

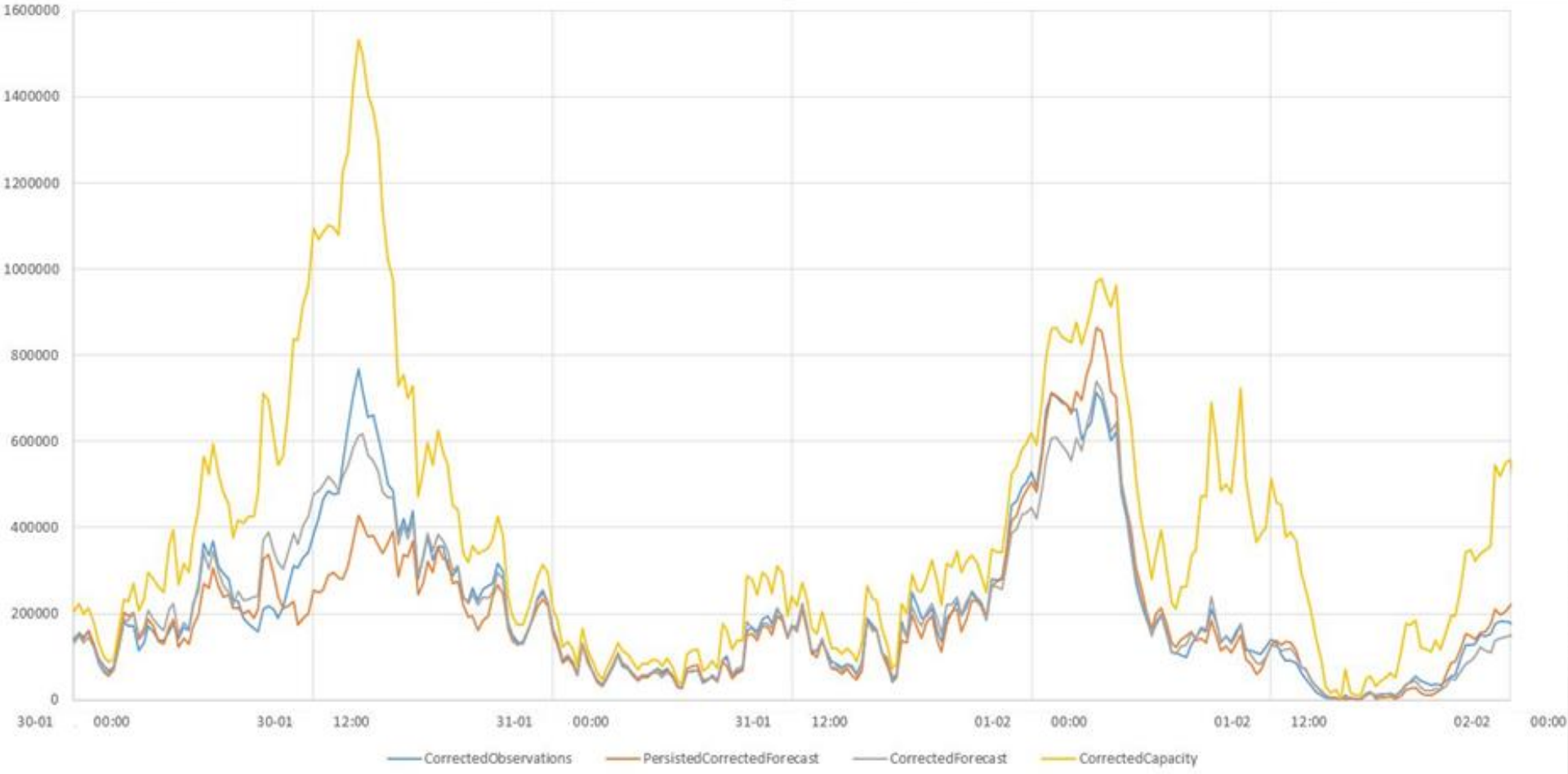


Figure: Short term improvements for a portfolio (blue: measured production, grey: STNS forecast, red: old forecast and yellow: corrected capacity)

Thank you!

Anamaria Marta Sabau

as@conwx.com