

Anemos Probabilistic Wind Power Predictions and beyond

Dr. Igor Waldl et al.
Overspeed GmbH & Co. KG, Germany
for the Anemos team



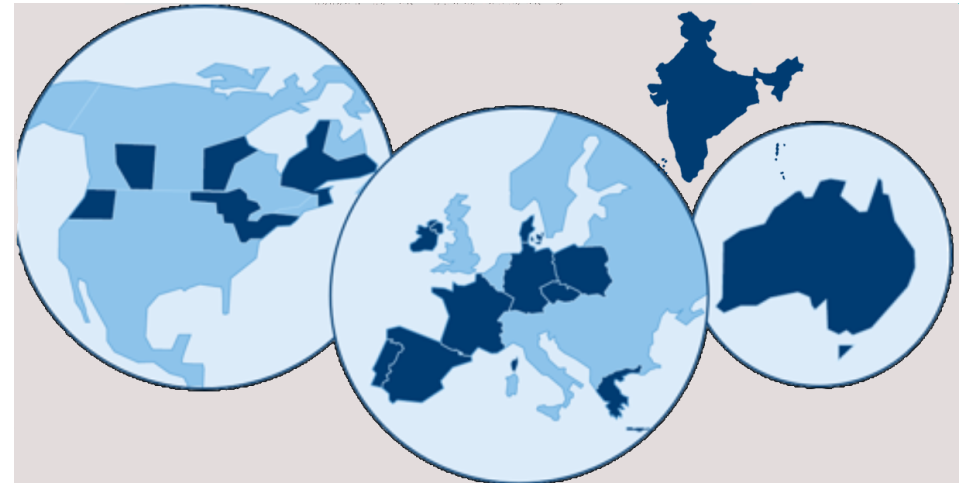
ELSAM AS





What is Anemos?

- Leading edge research and development
- Prediction models and modules
- High-availability IT platform
- Prediction system
- Partnership
- Commercial activity world-wide





Leading edge research



Wind Power Prediction
State of the Art



Smart usage of
uncertain information
in end-user business
processes



Detection, prediction
and handling of
extreme events





What is Anemos?

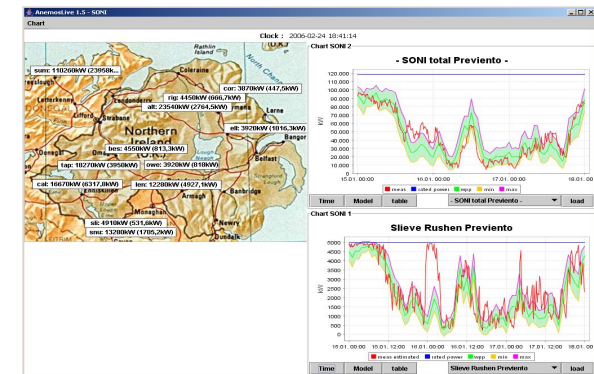
The Anemos prediction system

AWEFS/Australia

Extreme events: SafeWind

Shut-down events



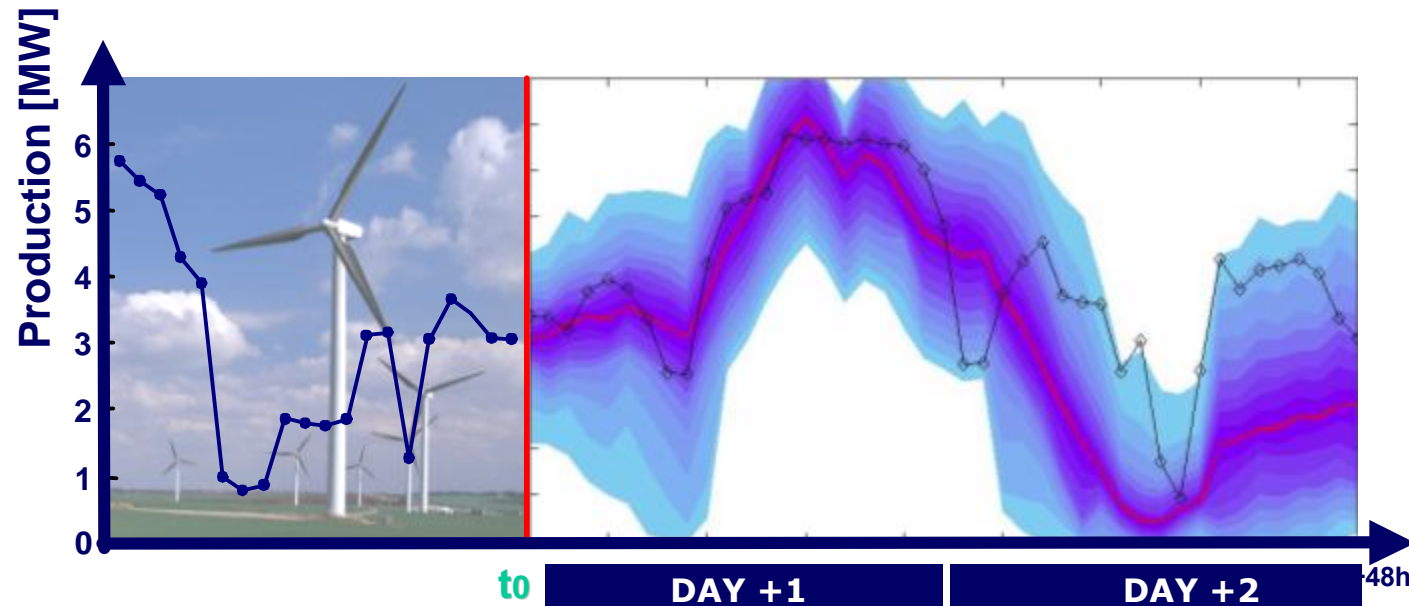


Anemos prediction system



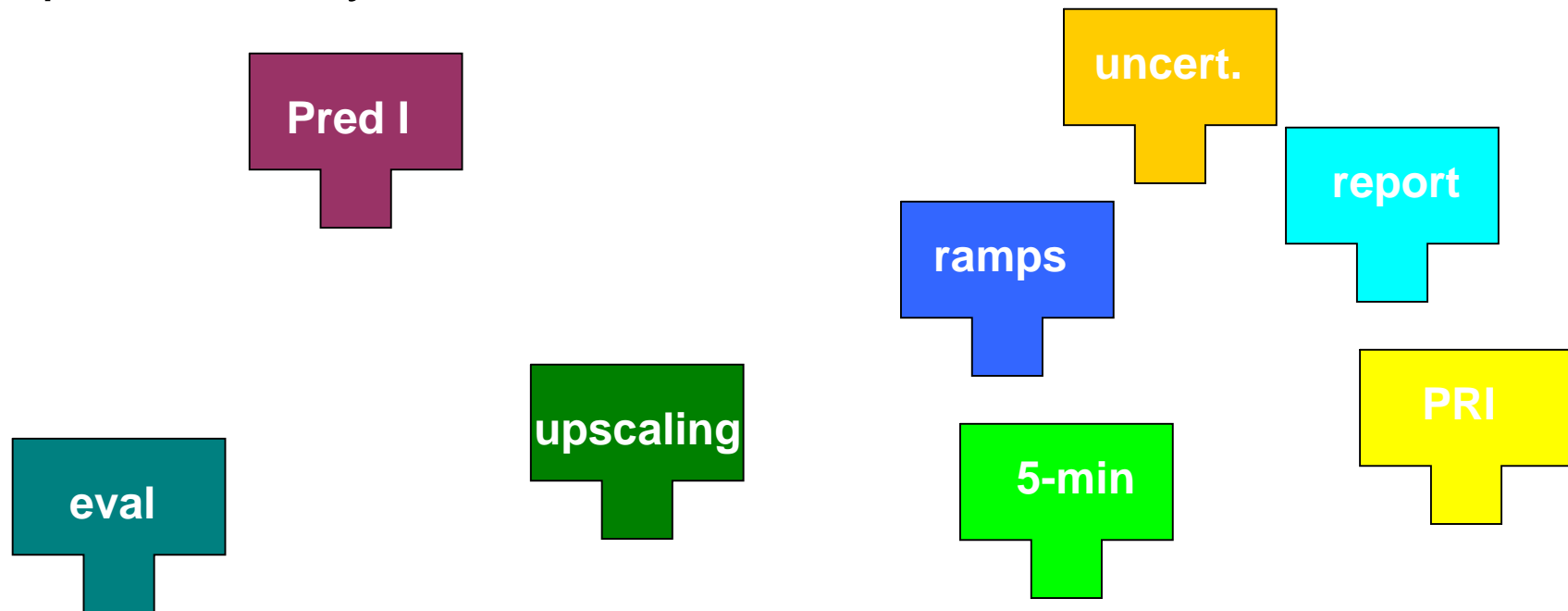
Prediction models ...

Models from current research



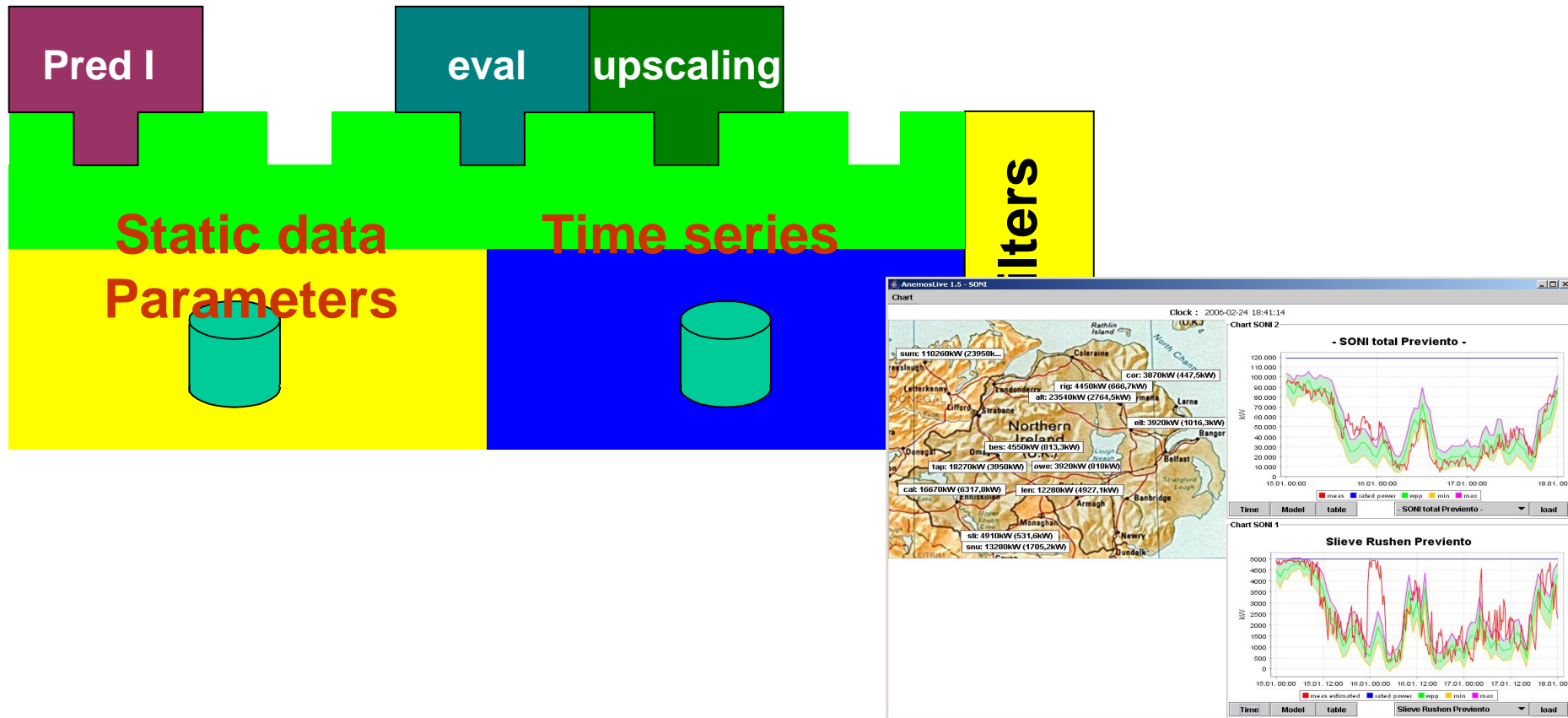
... and modules

... implemented as software modules for the Anemos prediction system



... running on a prediction platform

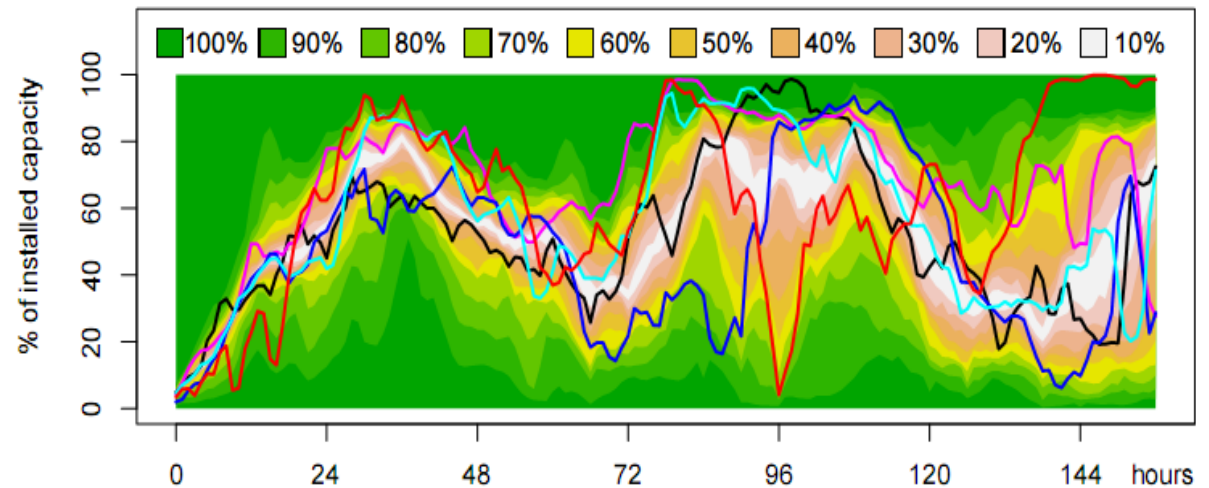
Standardized solution of data handling, logging, user interfaces,...





New prediction modules

- Probabilistic focus
- Very short-term predictions (from 5 minutes)
- Ensemble prediction models
- Ramp predictions
- Spatio-temporal optimisation of predictions
- Scenario generation:

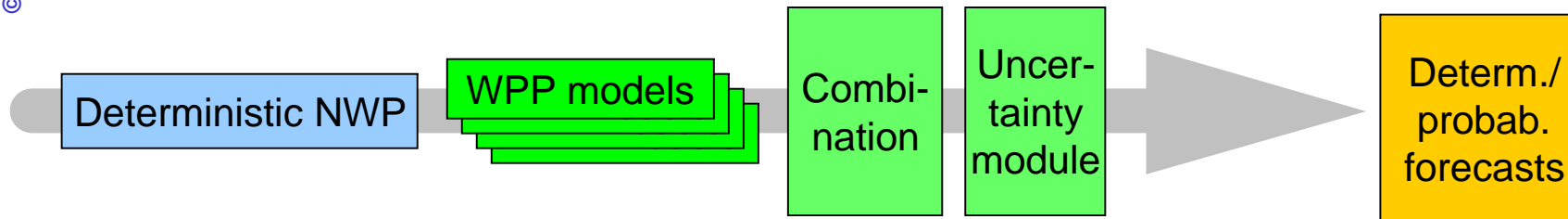


Principle: Application focused model selection and development



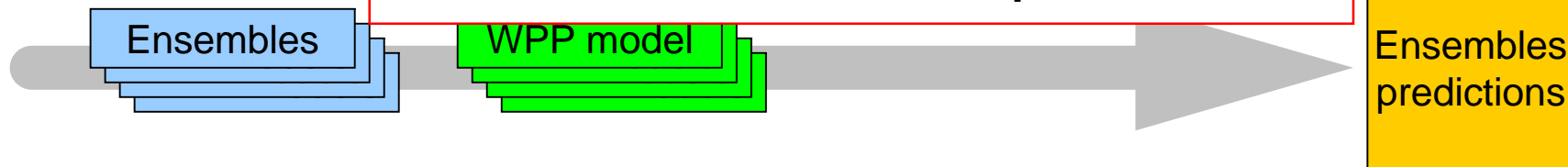
Example model chains

Standard deterministic, probabilistic post-processing

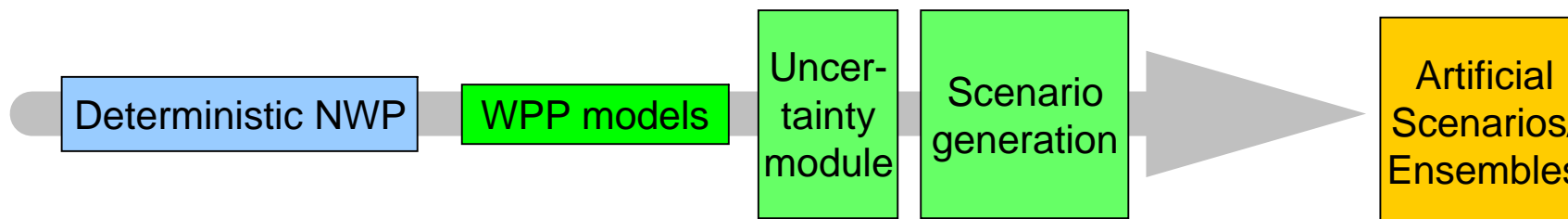


Ensemble prediction

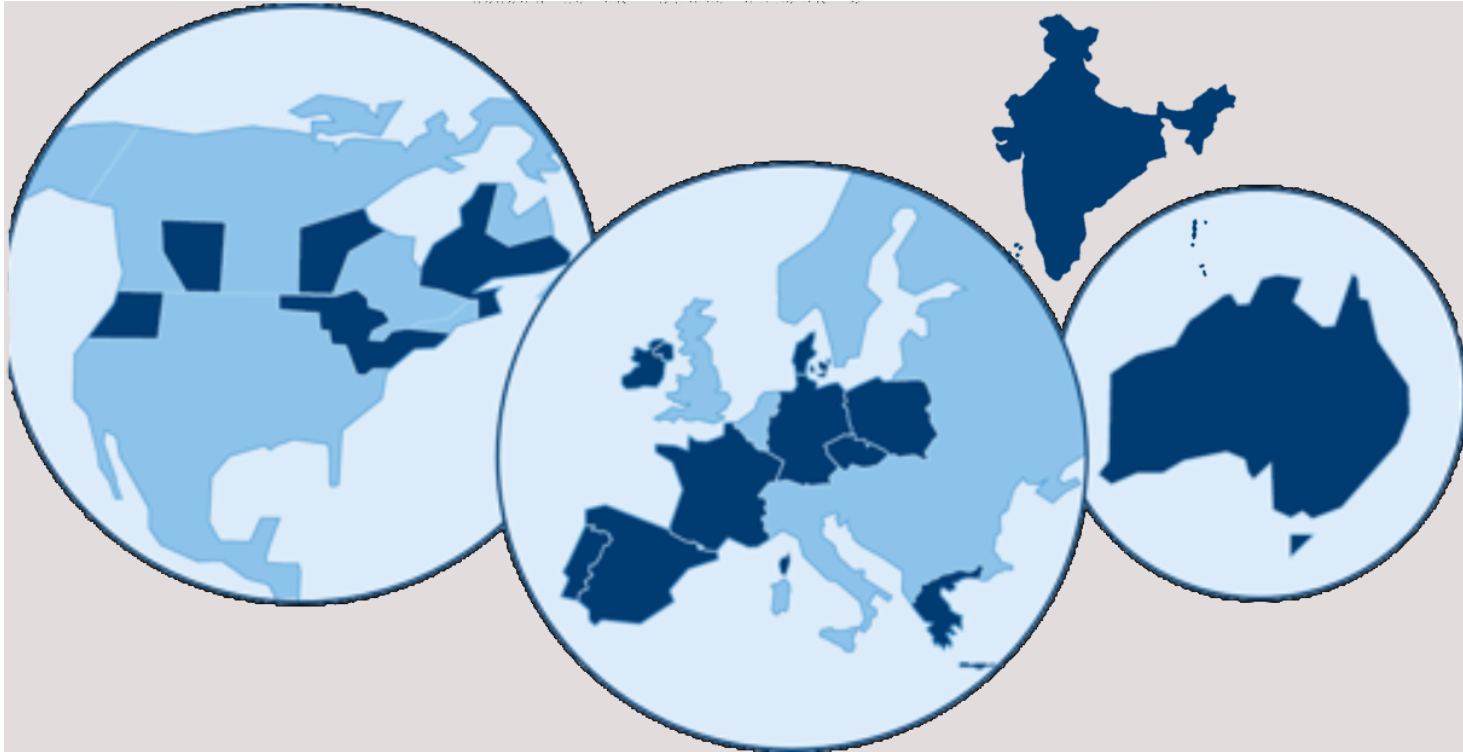
Principle: Application focused model selection and development



Scenarios from deterministic NWP predictions



Anemos predictions world wide



More then 50 GW world-wide predicted by Anemos group

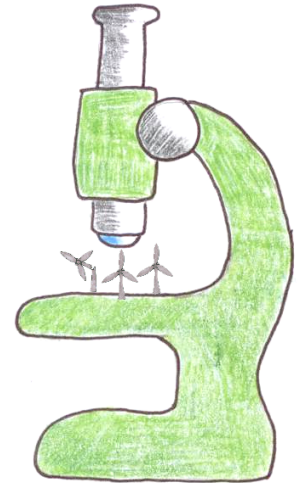
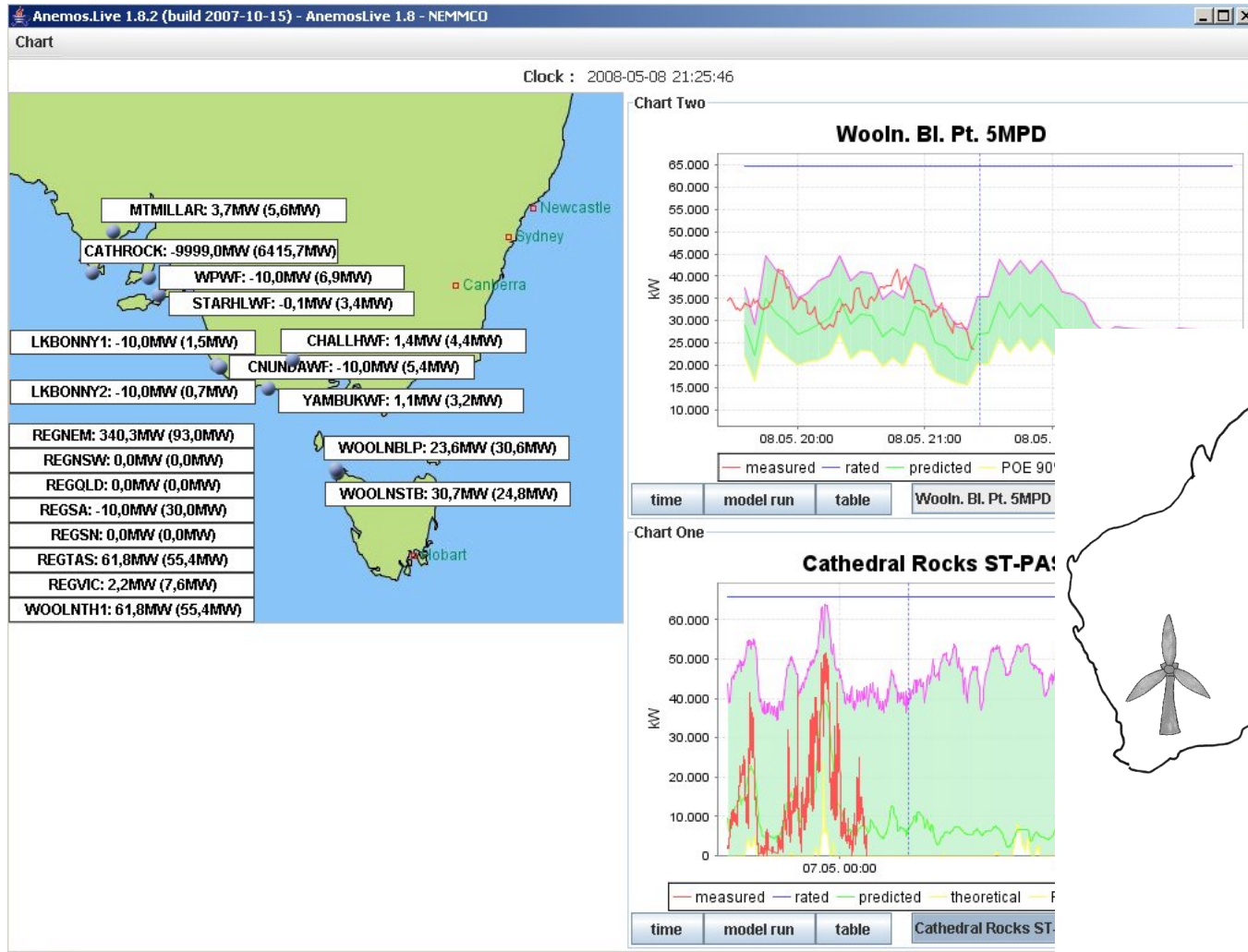




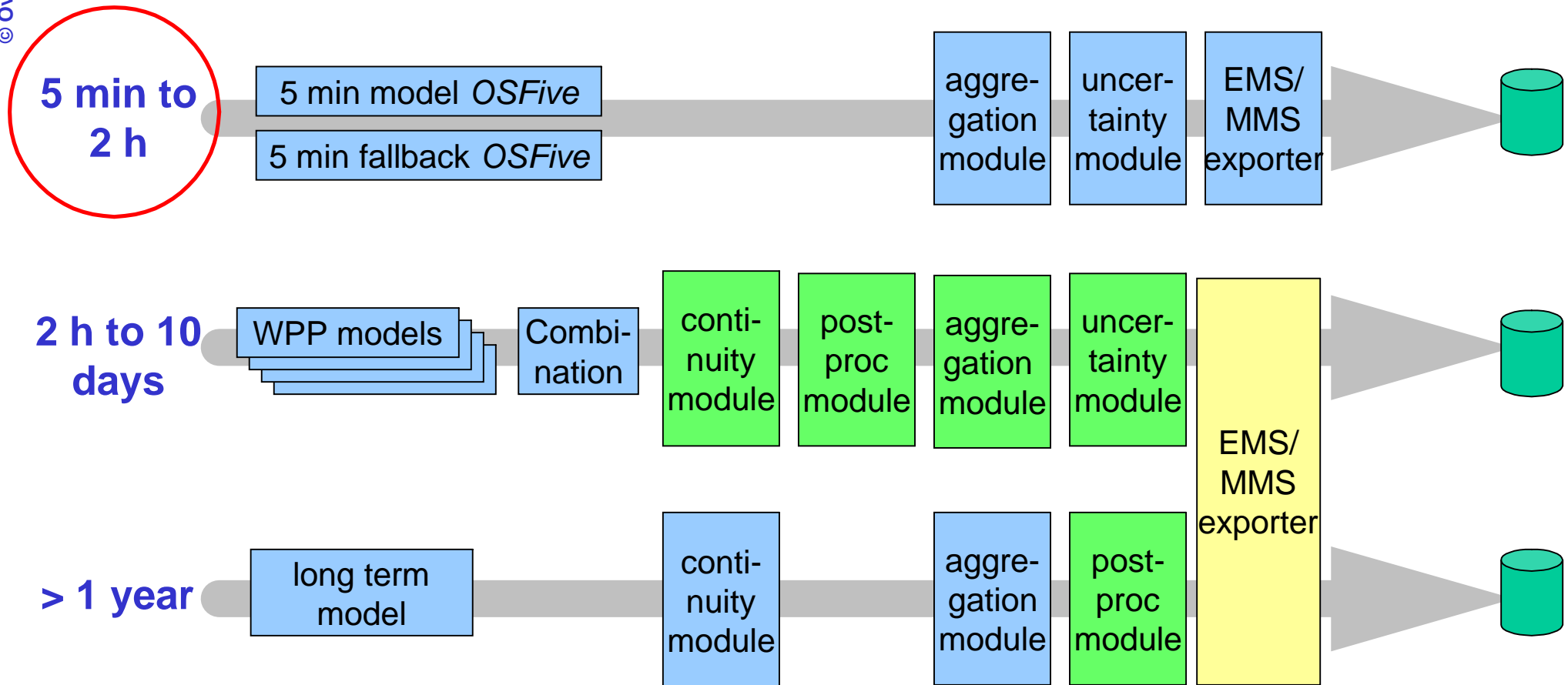
AWEFS/Australia



Australian Wind Energy Forecasting system



Prediction horizons and data sources



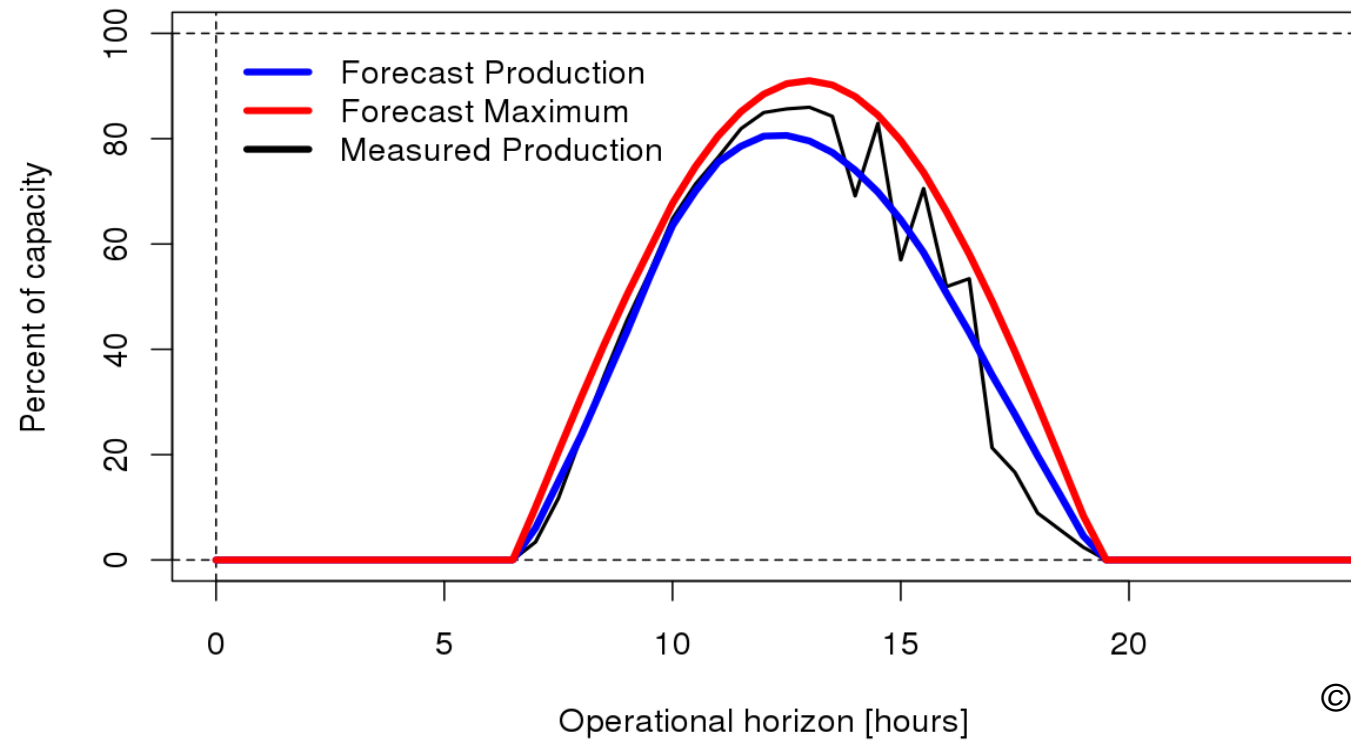


Australian Wind Energy Forecasting System

- High availability
- Fully integrated in market system
- „Market-system-proof“:
 - No single point of failure test
 - 8-fold redundancy
 - 24/7 operation
- Support Australian researchers

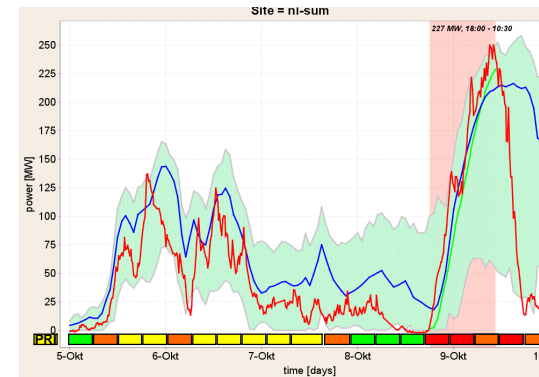


Coming next: Solar predictions at Australia



© ENFOR





Extremes: SafeWind





SafeWind: Extreme event predictions

Ramp Forecasting

Cut-off Event Forecasting

Prediction of Wind Power Fluctuations

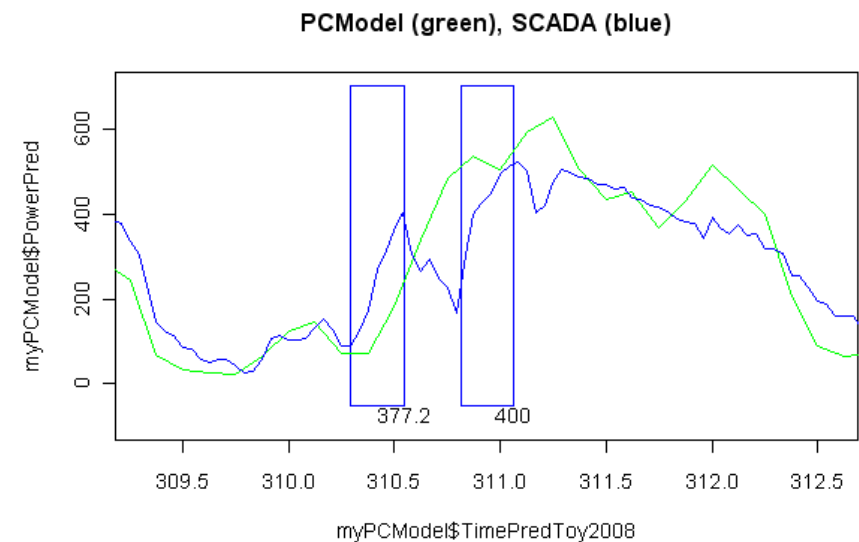
Alarming for Forecast Deviations

Forecast Corrections

Scenario Forecasting

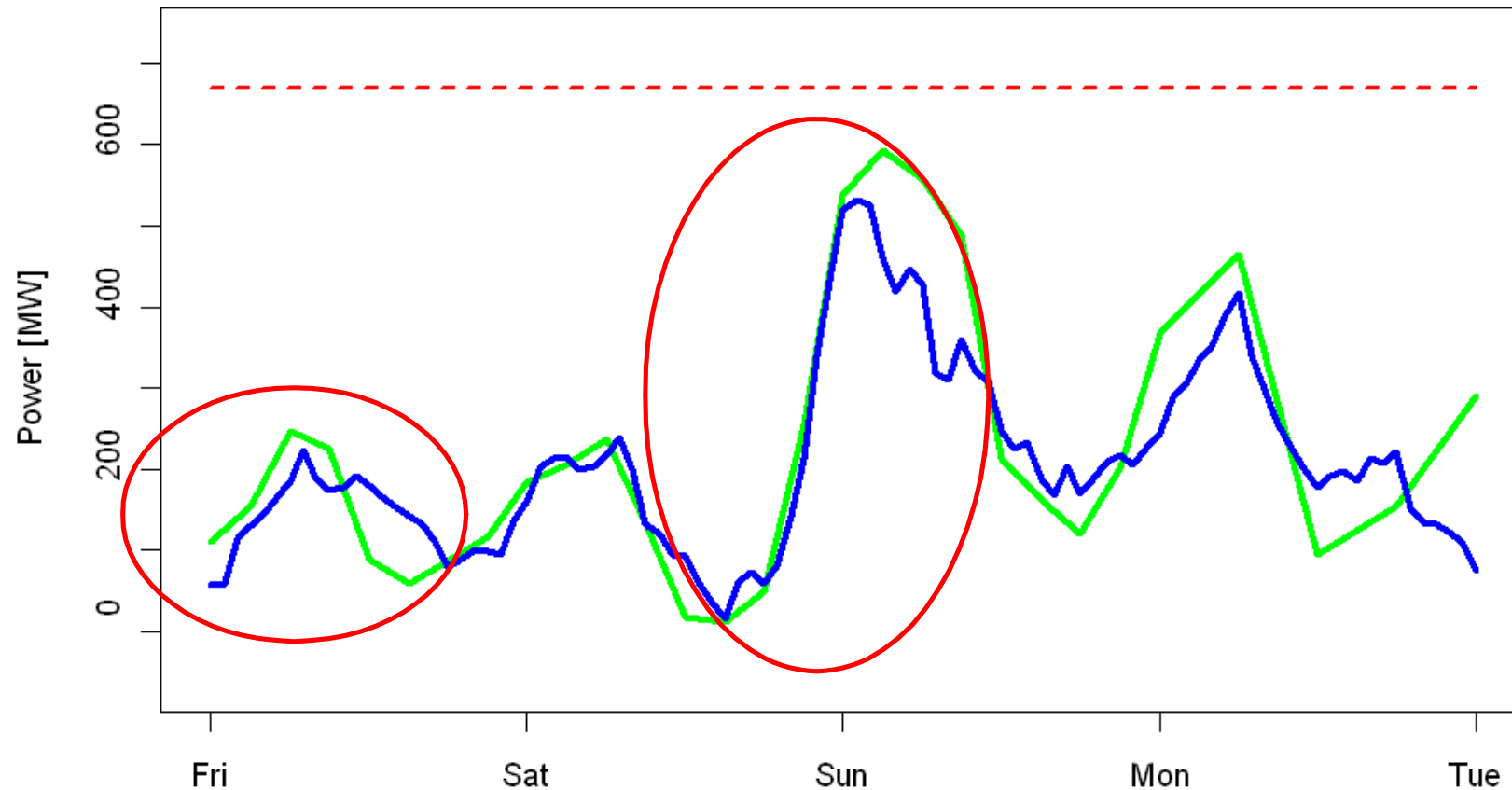
Quantile Regression

Ensemble Forecasting



When do you call it a ramp ?

Power Predicted (green), Power Measured (blue)

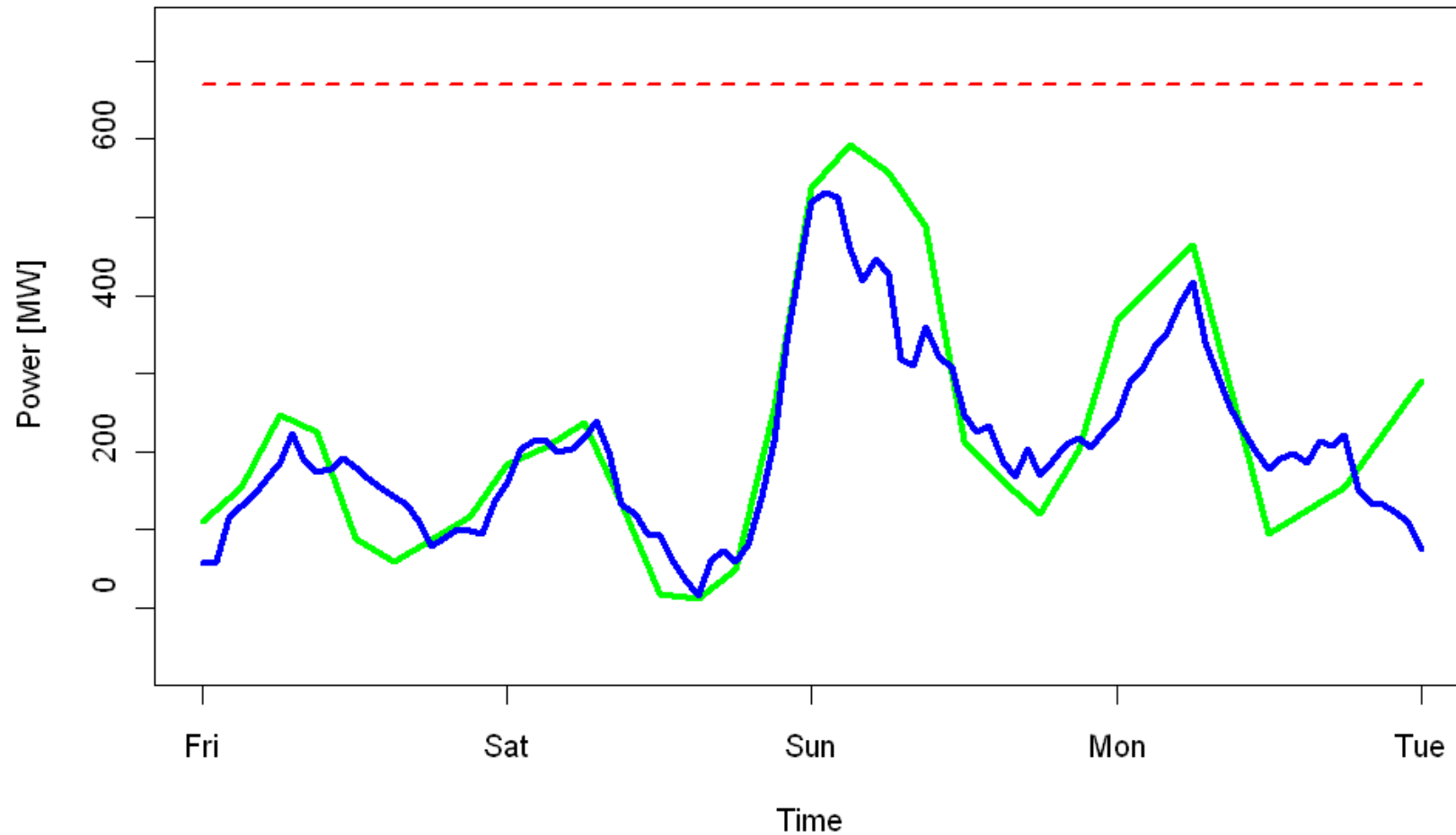


➔ Rules based ramp detection: Anemos.rulez



Example for matching ramp

Power Predicted (green), Power Measured (blue)





Note: False alarms

All variables carry uncertainties and noise

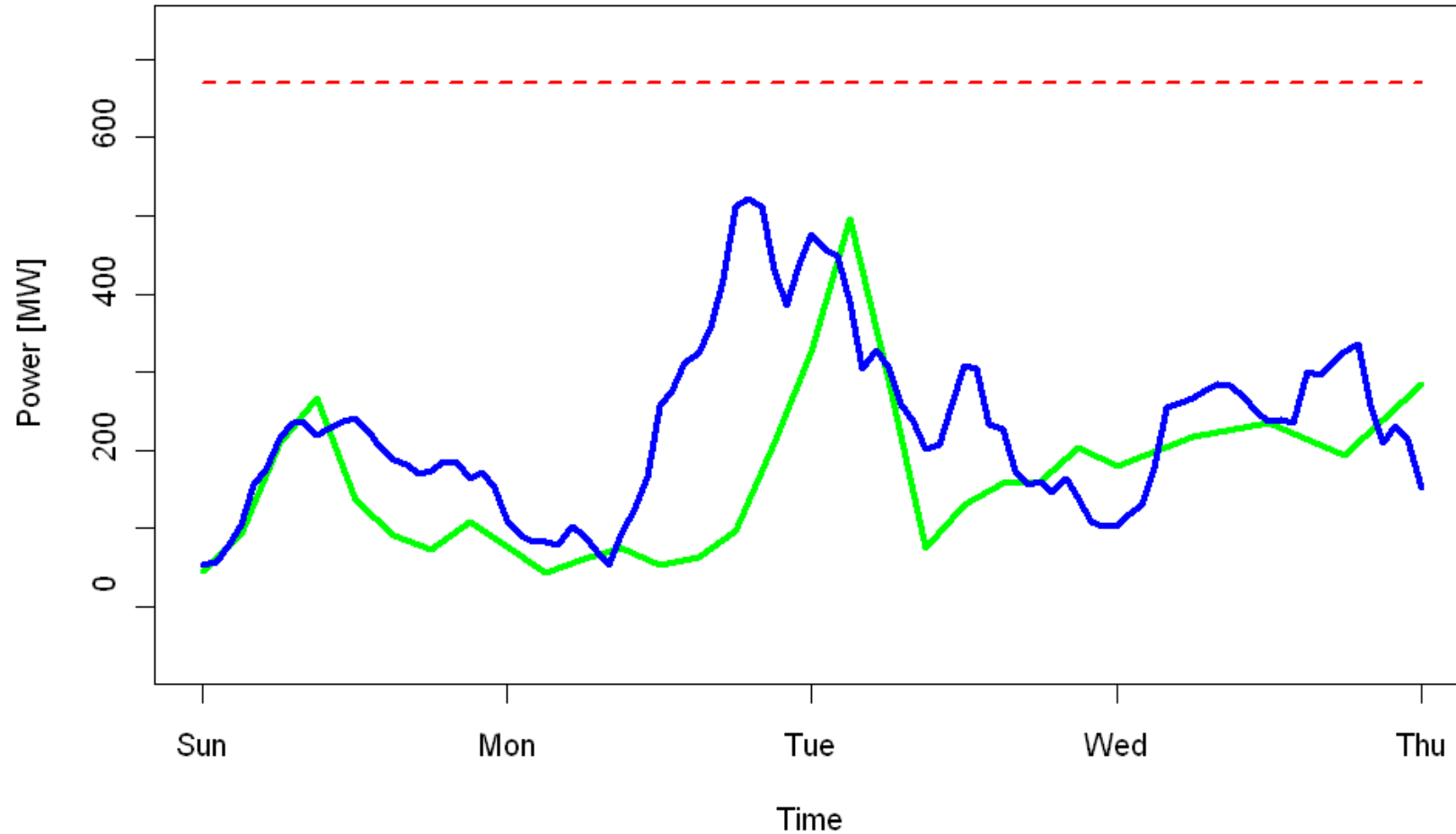
- wind speed
- SCADA data
- predictions

➔ Successful detection of extremes **always**
will also lead to false alarms

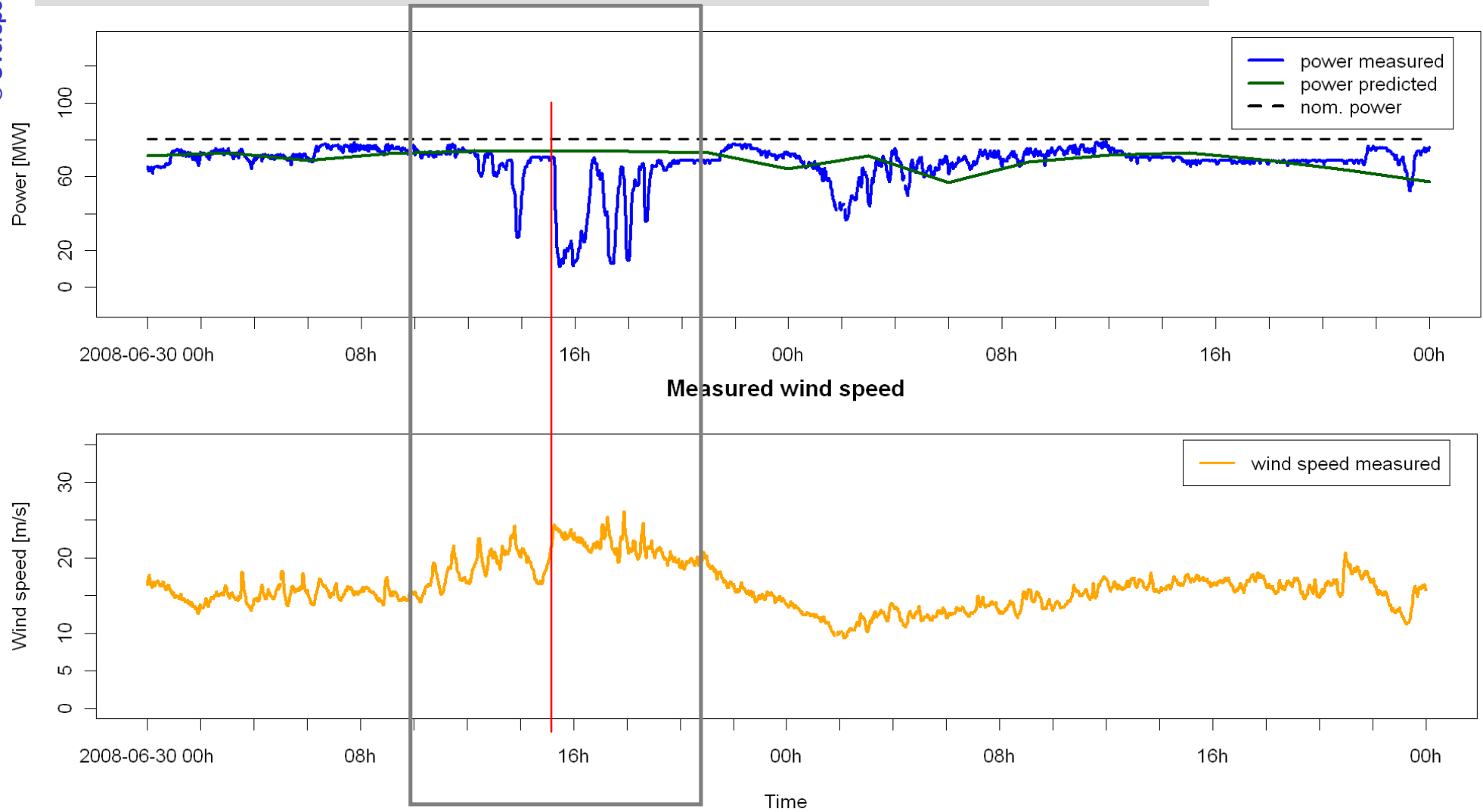


Example prediction error: Phase shift

Power Predicted (green), Power Measured (blue)

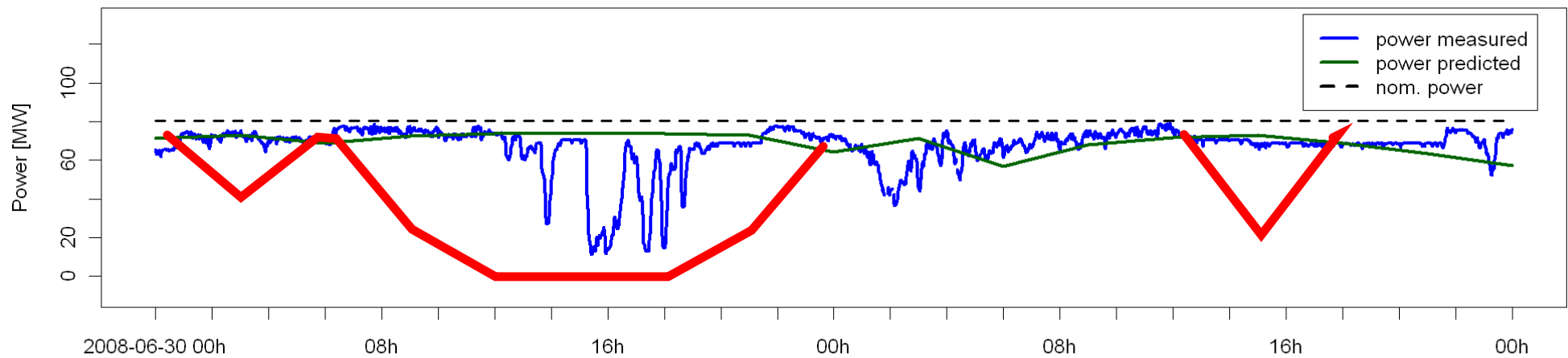


Shut-down events and wind speed



Warning for potential of shut-down events

Measured and predicted power

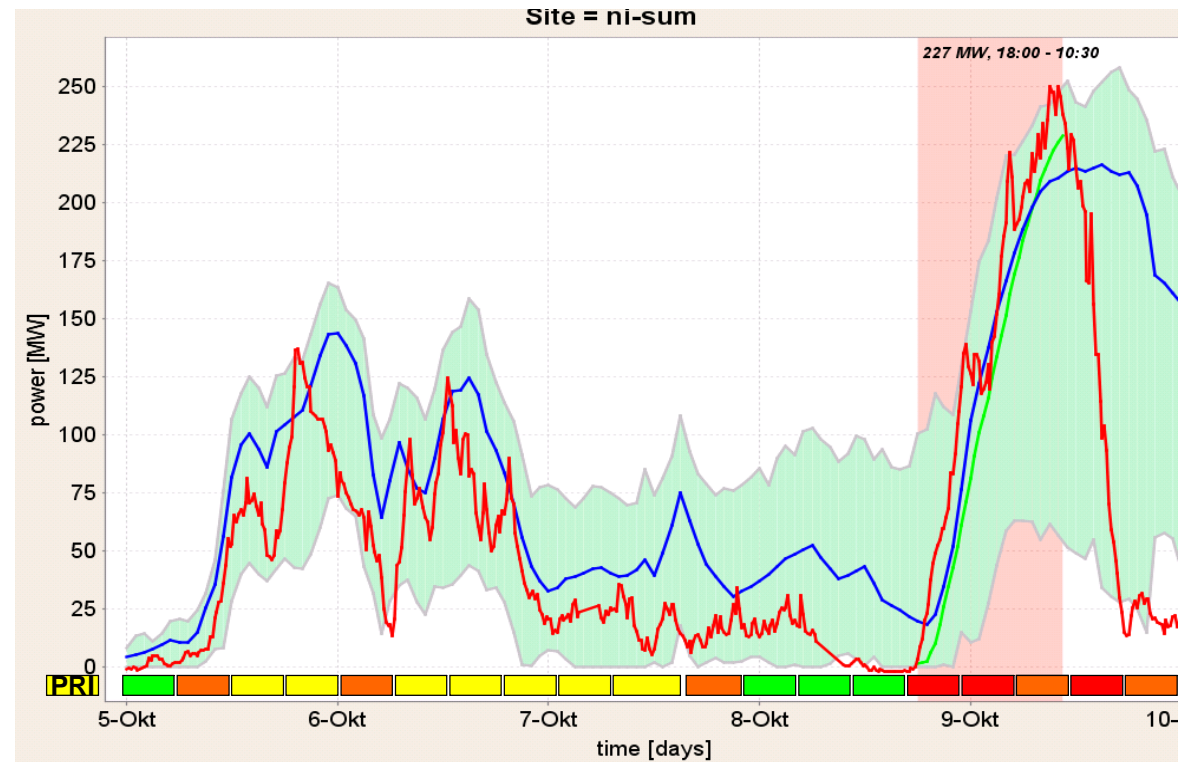




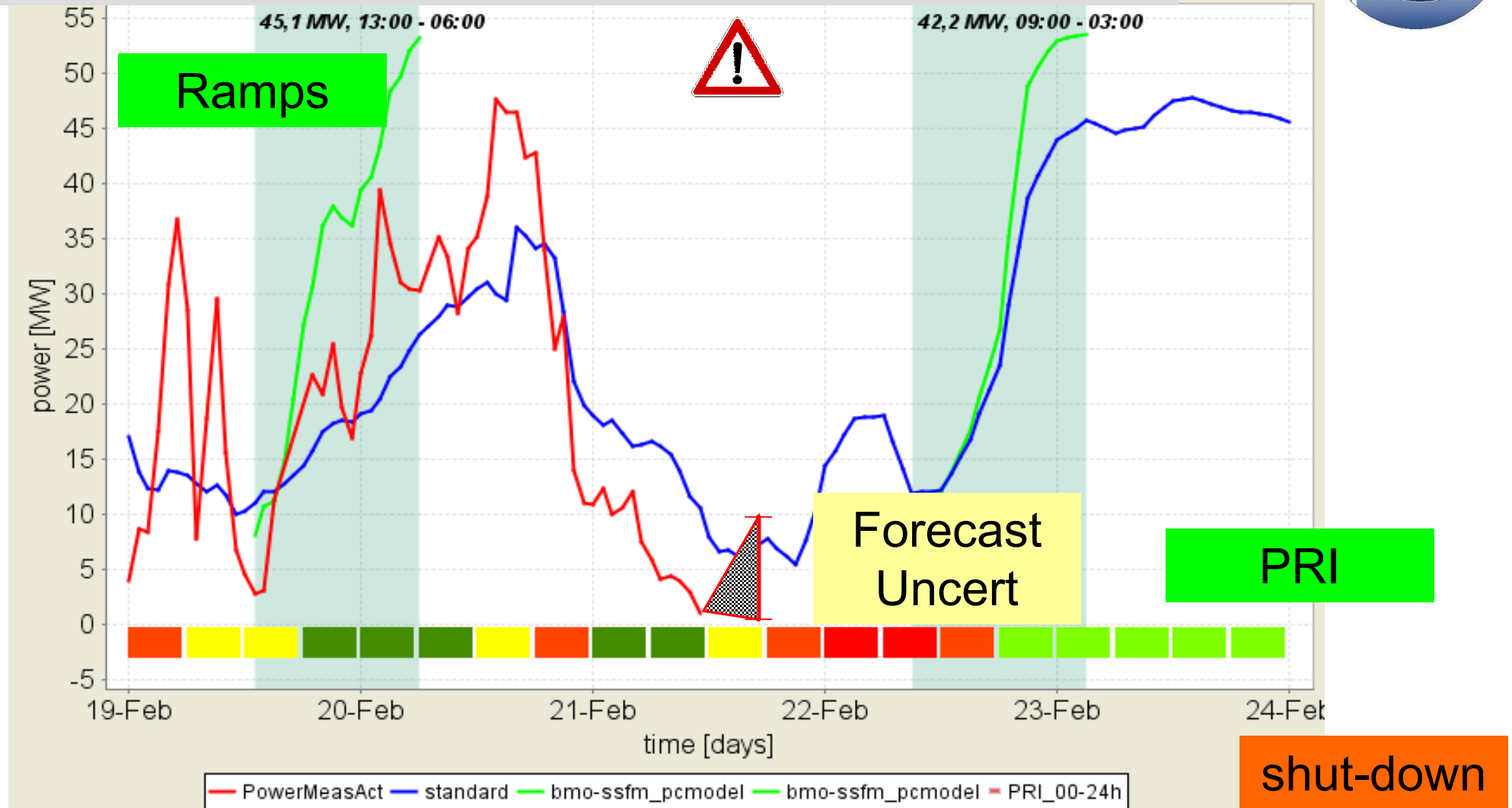
SafeWind operationally

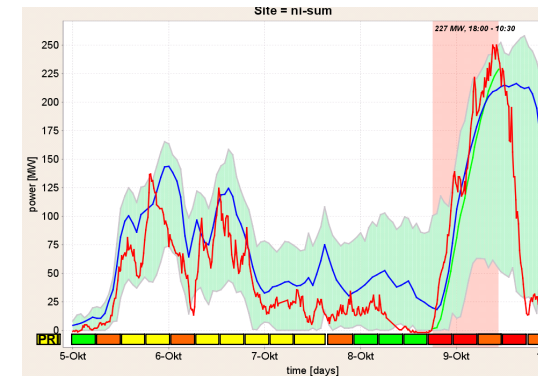
Anemos.eXtreme: operationally

- Ramps, extremes prediction
- Anemos.Rulez: ramp prediction and alarming (commercially operational)
- Prediction Risk Index
- Ramp prediction uncertainty
- Shut-down events



Anemos.eXtremes for SONI





Anemos: from research to operations





Anemos Wind Power Predictions

Research

R&D since 199X

to application

High availability

Robustness

Experience

> 50 GW

High accuracy

Probabilistic

Extremes/ramps

➔ windpowerpredictions.com





Too far... please go back

