

## The advanced ANEMOS prediction system and high-penetration grids. Experiences from Australia, India, and SafeWind demonstrations

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for the Anemos team



# *What is Anemos?*

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





*What is Anemos?*

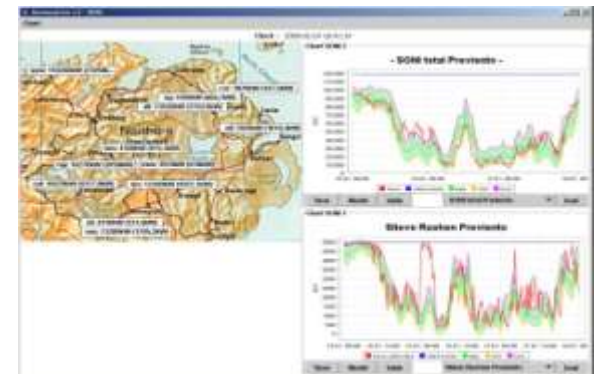
*The Anemos prediction system*

*AWEFS/Australia and India*

*Extreme events: SafeWind*

*Shut-down events*



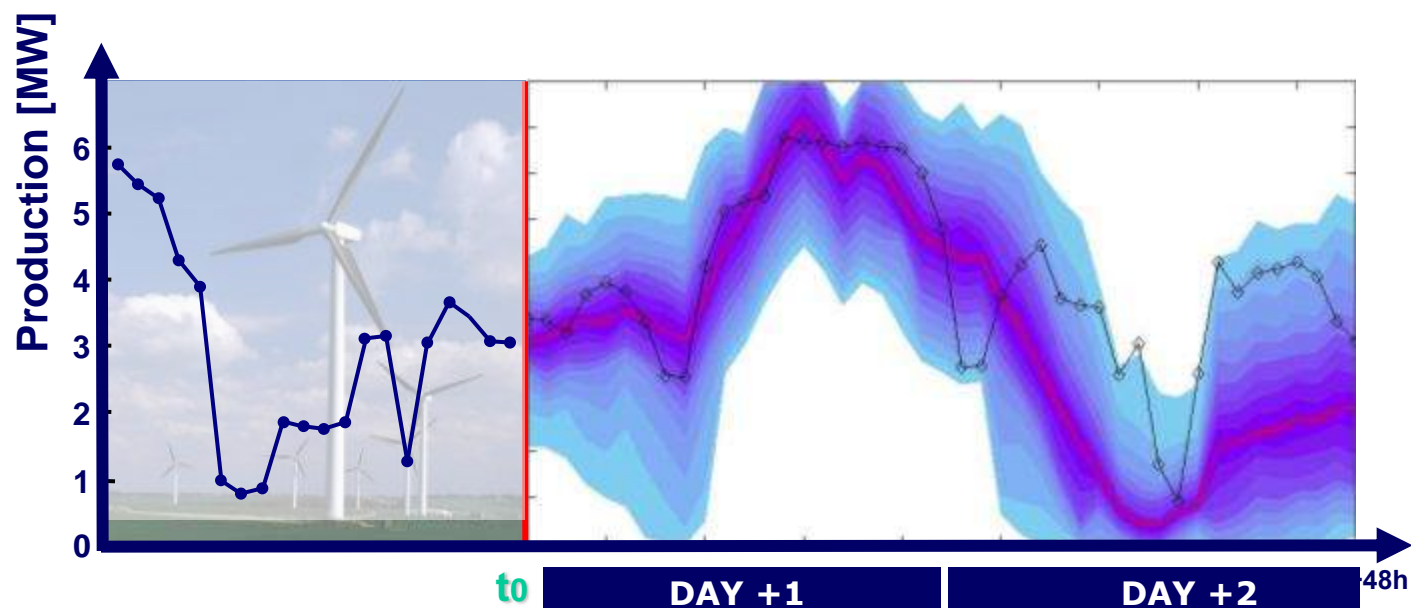


## *Anemos prediction system*



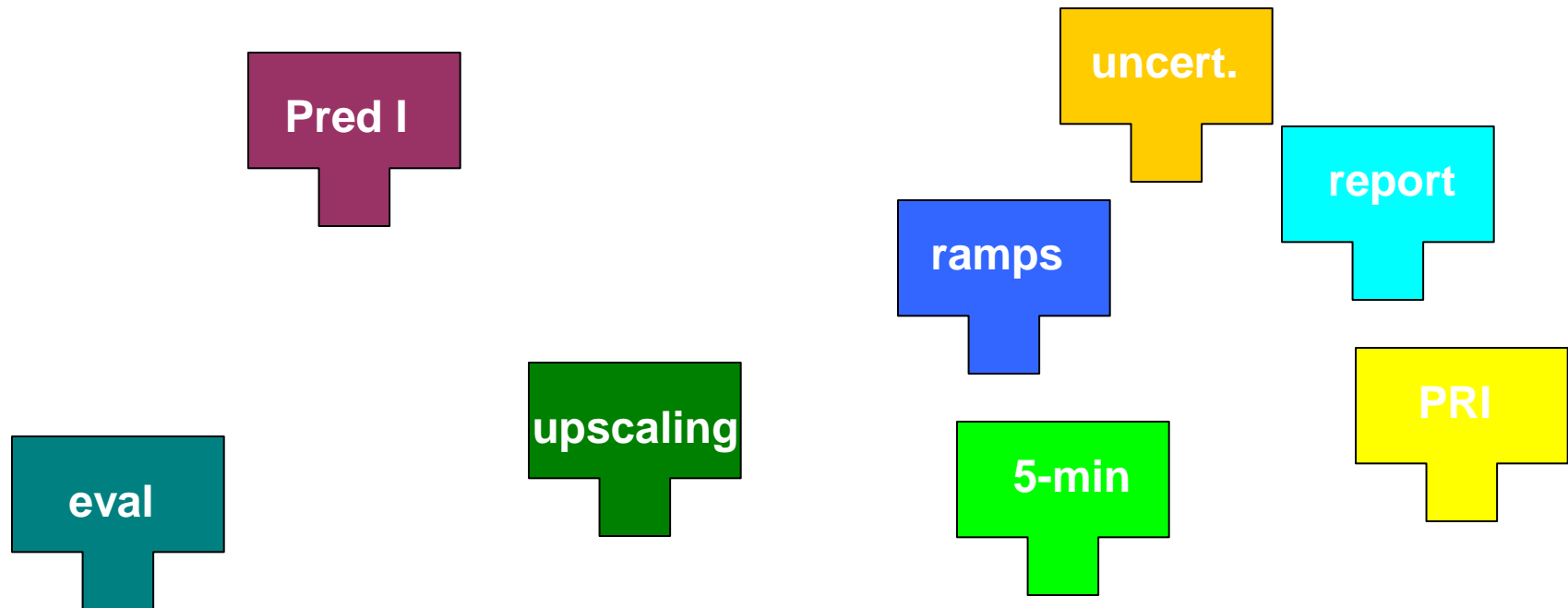
# Prediction models ...

## Models from current research



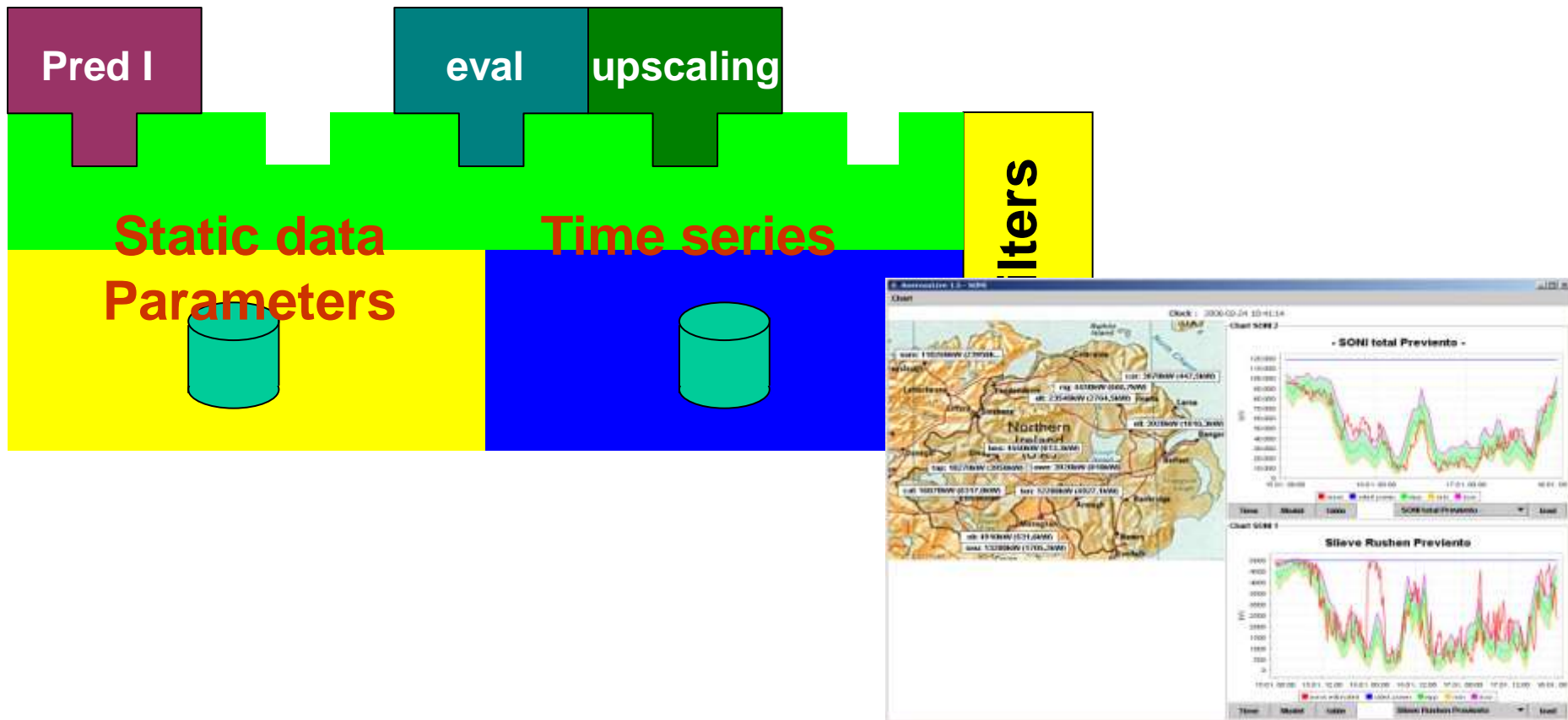
## ... and modules

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



*... running on a prediction platform*

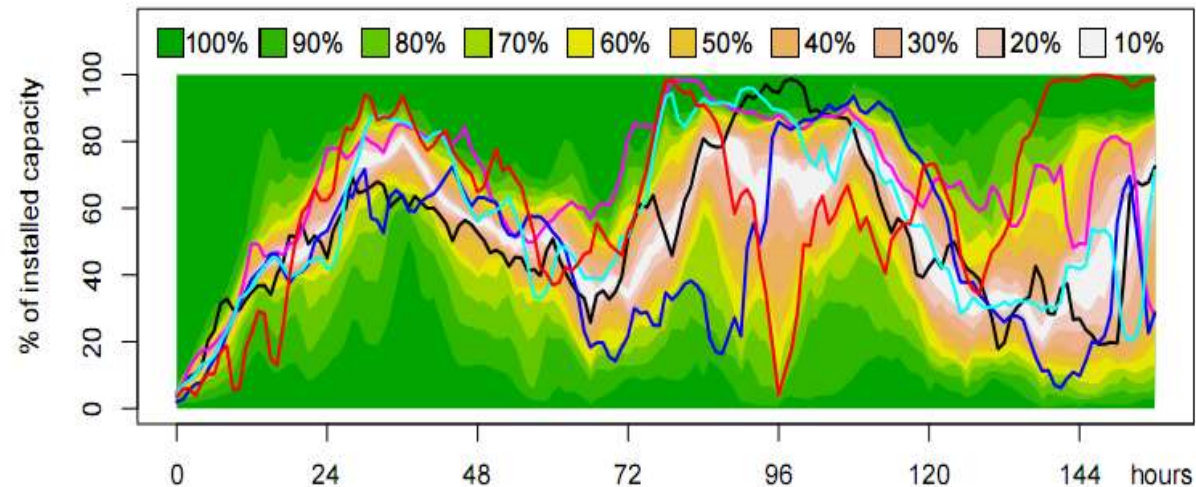
Standardized solution of data handling, logging, user interfaces,...





## *New prediction modules*

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

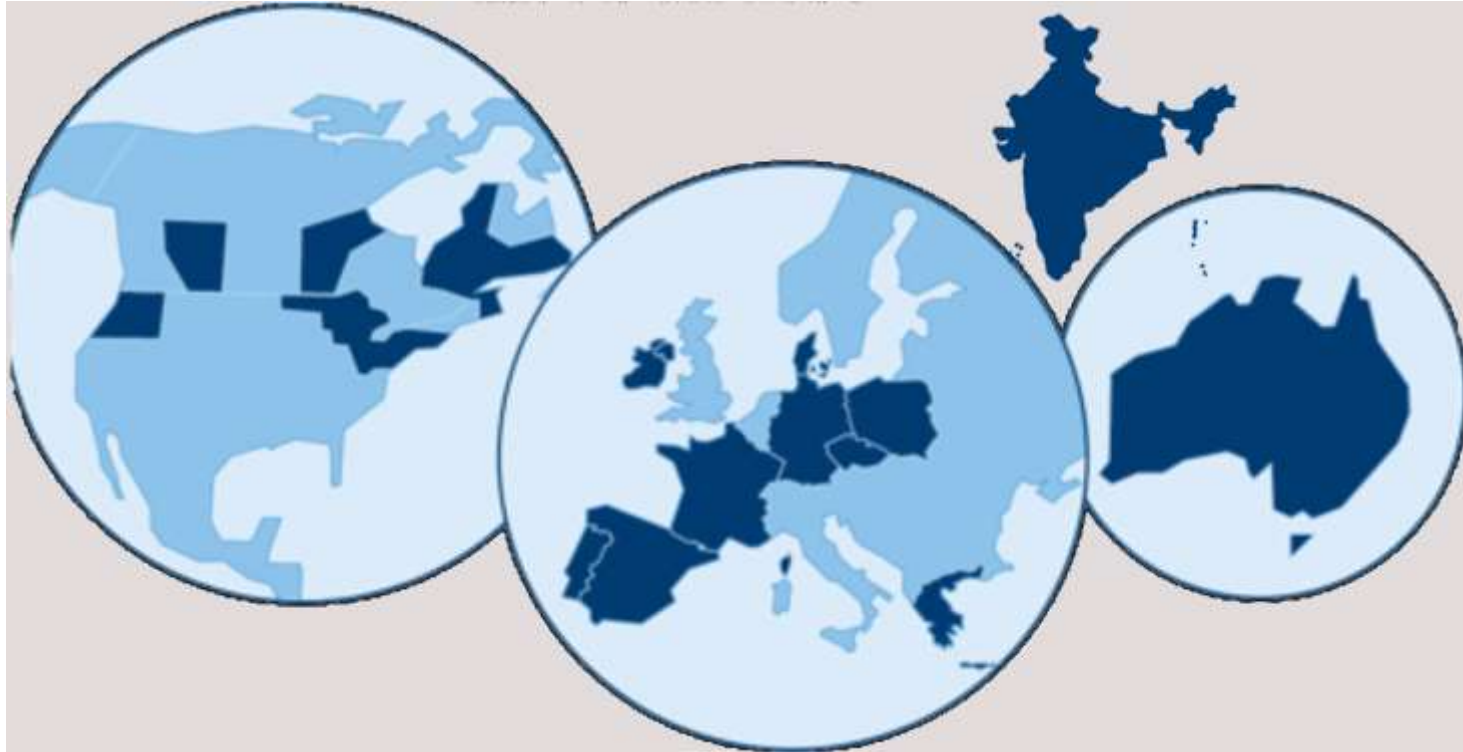


**Principle: Application focused model selection and development**





## *Anemos predictions world wide*



More than 65 GW world-wide predicted by Anemos group

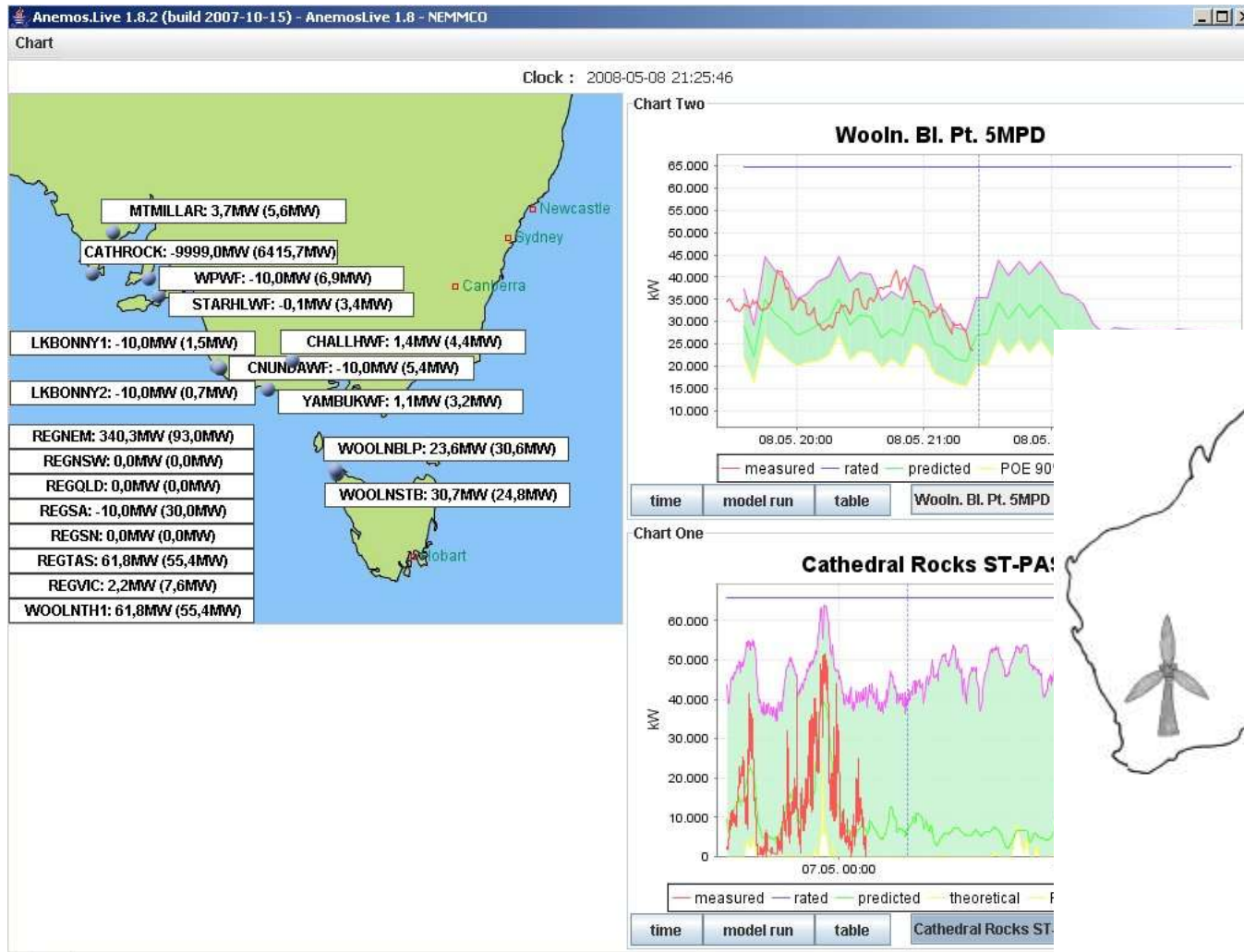




## *AWEFS/Australia*



# Australian Wind Energy Forecasting system



# Australian Wind Energy Forecasting System

- Fully integrated in market system
- Fully automated market, 5-min bids
- „Market-system-proof“
- 24/7 operation
- 100% availability (4 years)
- Support Australian researchers → Standardisation



# Prediction horizons and data sources



**5 min to  
2 h**

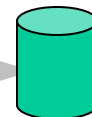
5 min model *OSFive*

5 min fallback *OSFive*

aggre-  
gation  
module

uncer-  
tainty  
module

EMS/  
MMS  
exporter



**2 h to 10  
days**

WPP models

Combi-  
nation

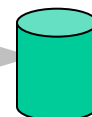
conti-  
nuity  
module

post-  
proc  
module

aggre-  
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module

uncer-  
tainty  
module

EMS/  
MMS  
exporter



**> 1 year**

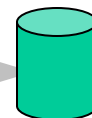
long term  
model

conti-  
nuity  
module

aggre-  
gation  
module

post-  
proc  
module

EMS/  
MMS  
exporter



# *Towards an standard for wind power prediction systems*

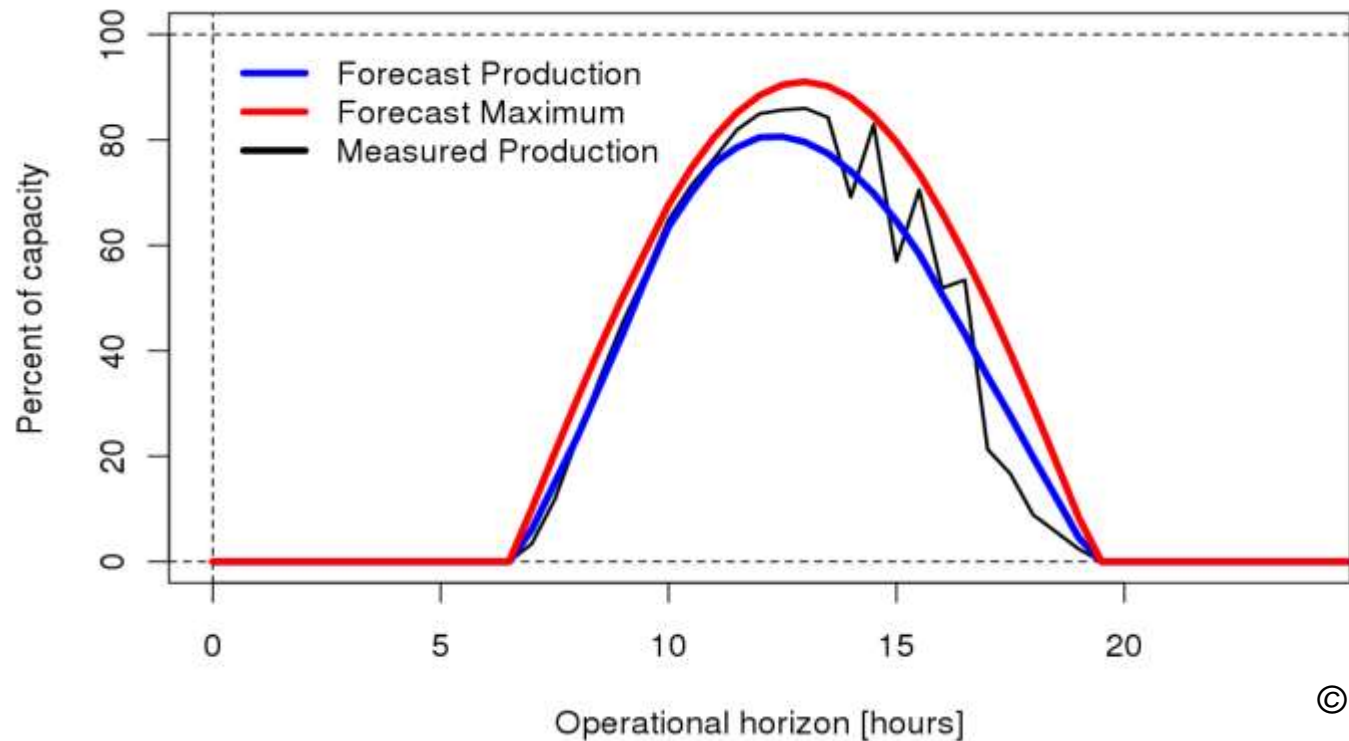


- High standardisation of platform
  - File formats
  - Time series, system configuration, standing data
  - Interfaces are open
- 
- File system: file naming and directory conventions
  - Schema for error messages and logging
  - Model control, configuration and scheduling
  - Operational surveillance
  - Proof: Australian research experience





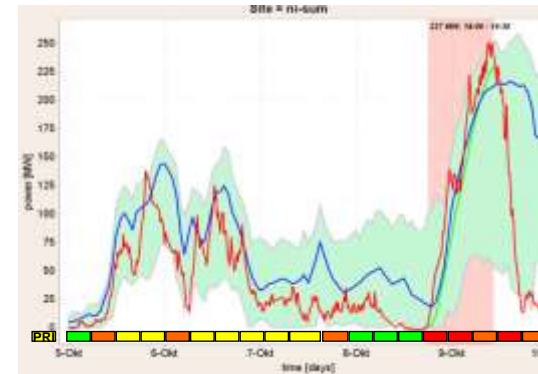
# Coming next: Solar predictions at Australia



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## *Extremes: SafeWind*

# *SafeWind: Extreme event predictions*

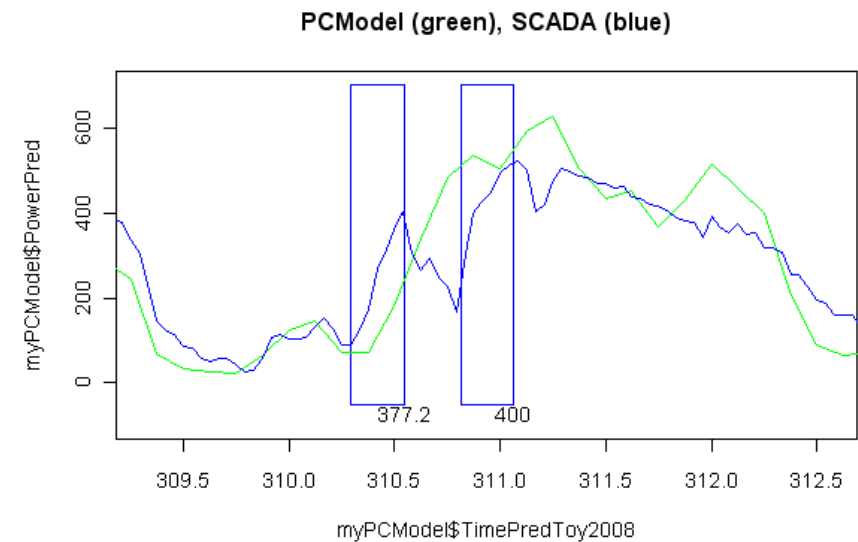
**Ramp Forecasting**

**Cut-off Event Forecasting**

**Alarming for Forecast Deviations**

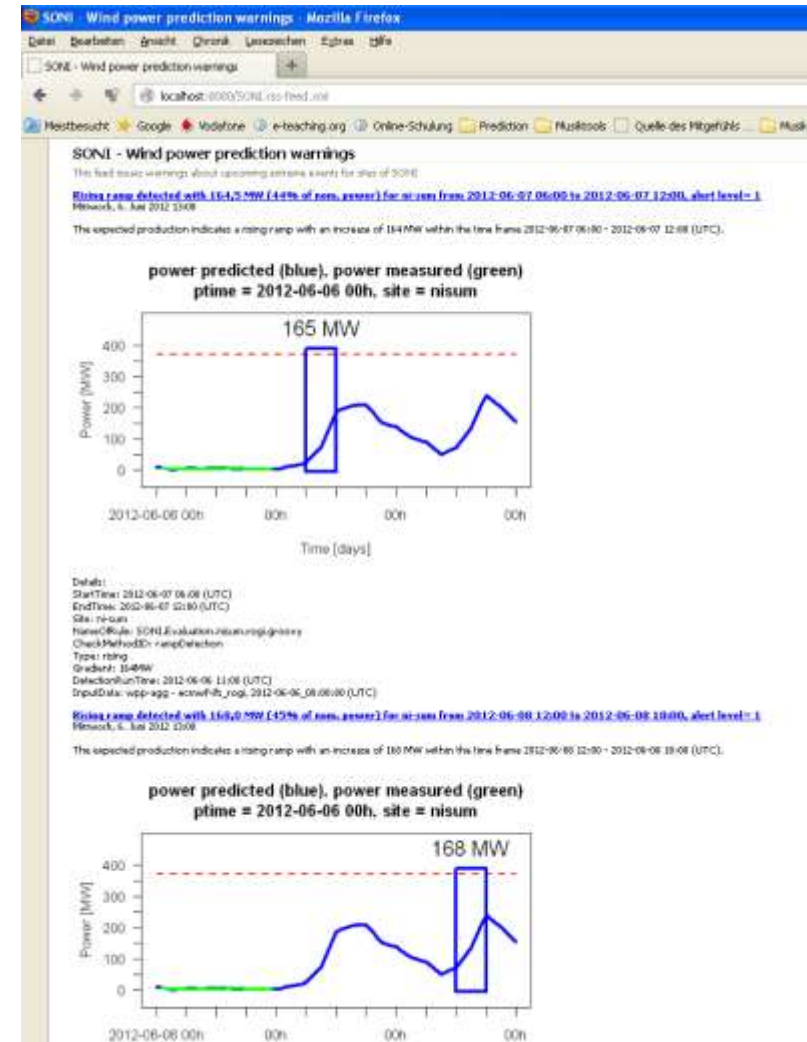
**Forecast Corrections**

**Prediction Scenarios**

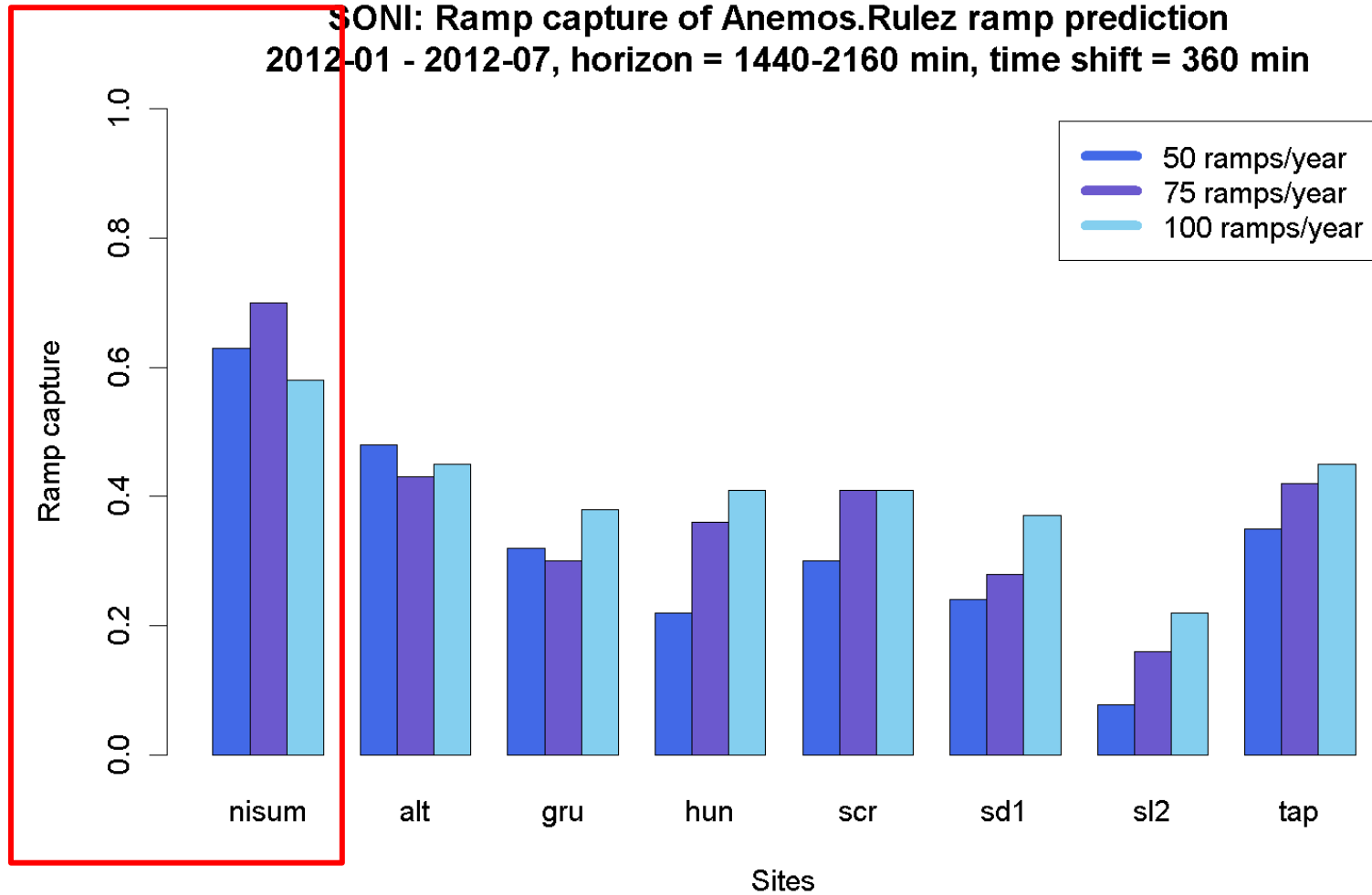


# Ramp predictions: Anemos.rulez

- Specialised prediction model
- Highly configurable
- Detection method and parameter
- Warnings as RSS feed



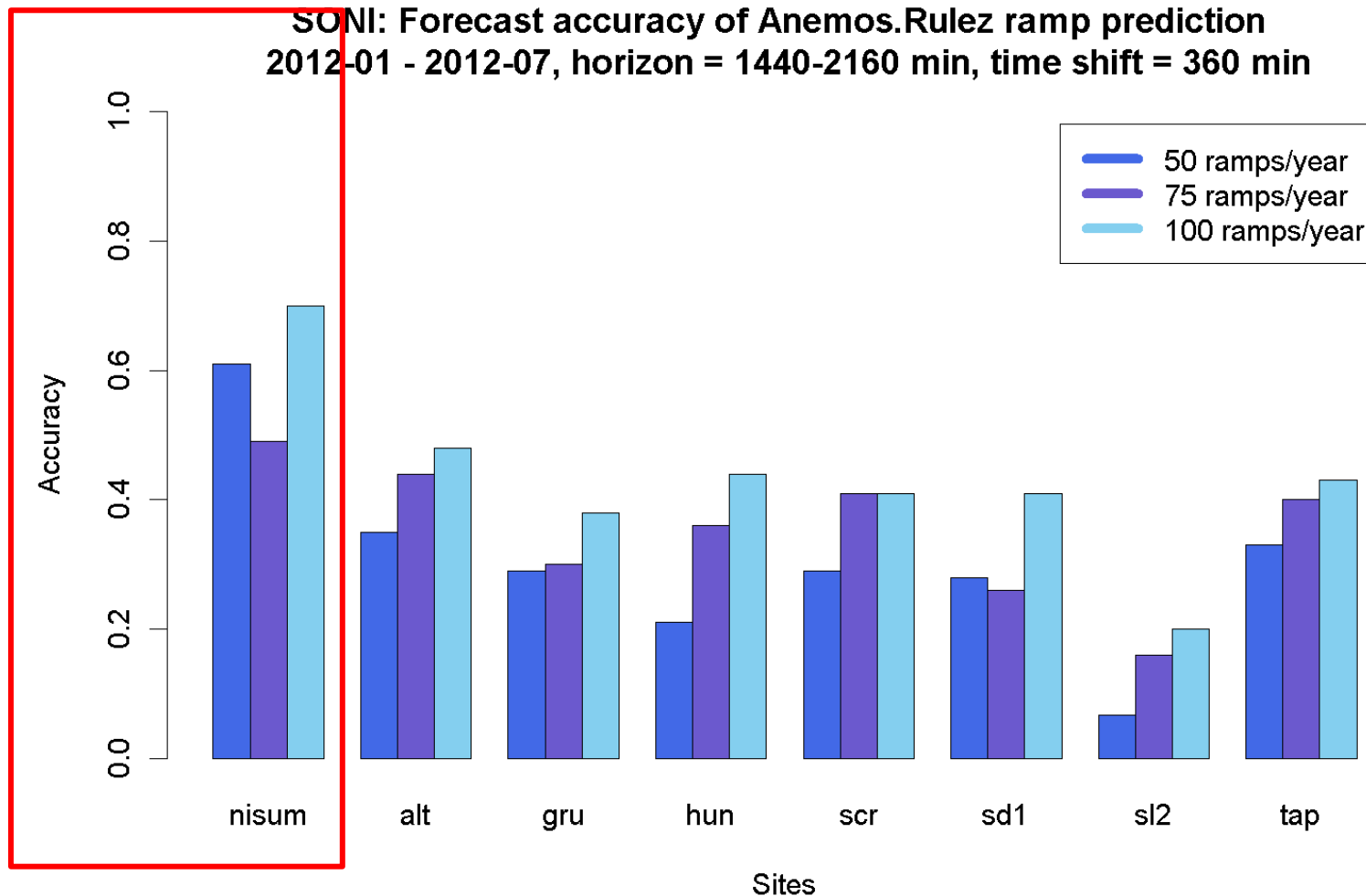
# SONI Anemos.rulez: Ramp capture



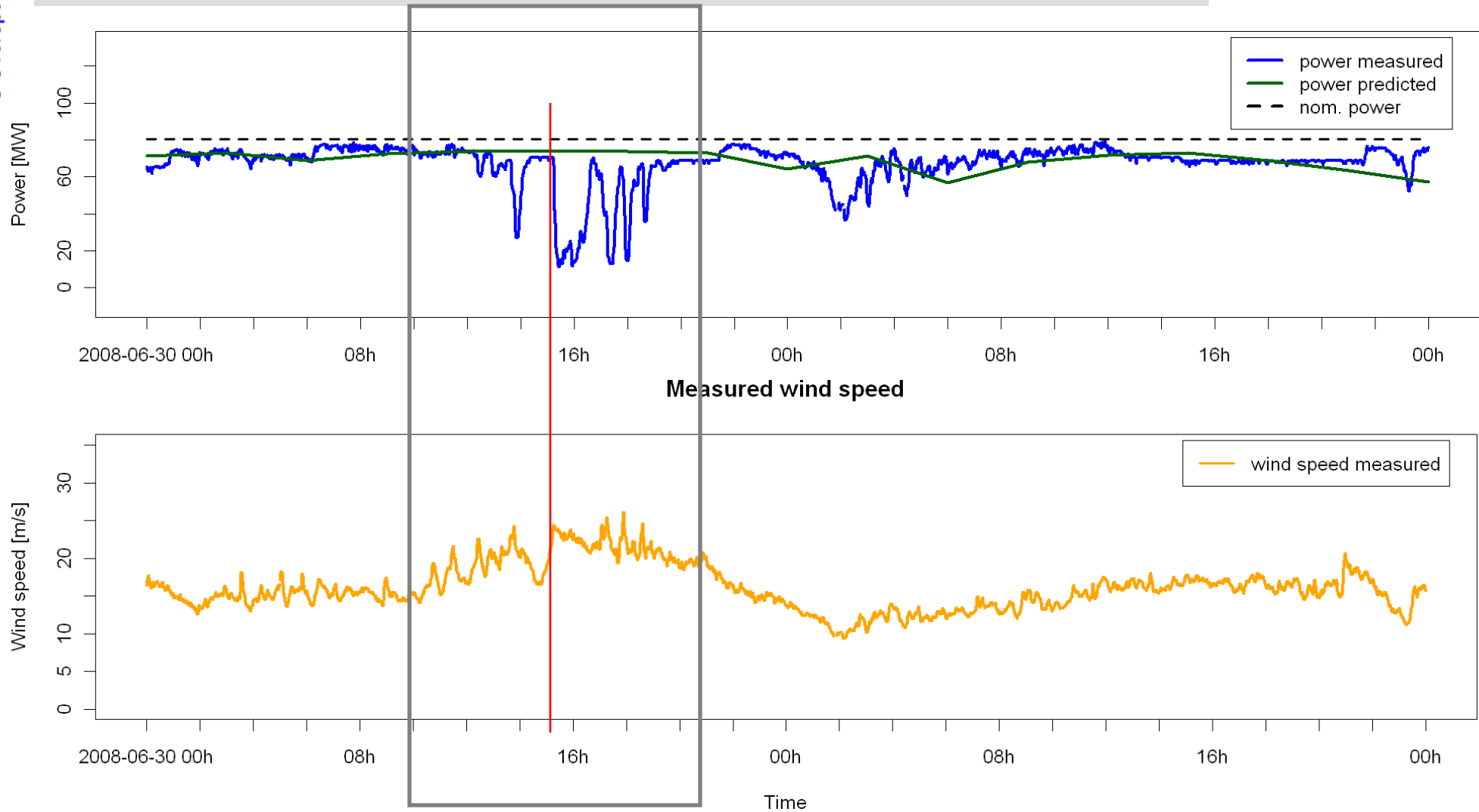
# SONI Anemos.rulez: Forecast accuracy



SONI: Forecast accuracy of Anemos.Rulez ramp prediction  
2012-01 - 2012-07, horizon = 1440-2160 min, time shift = 360 min



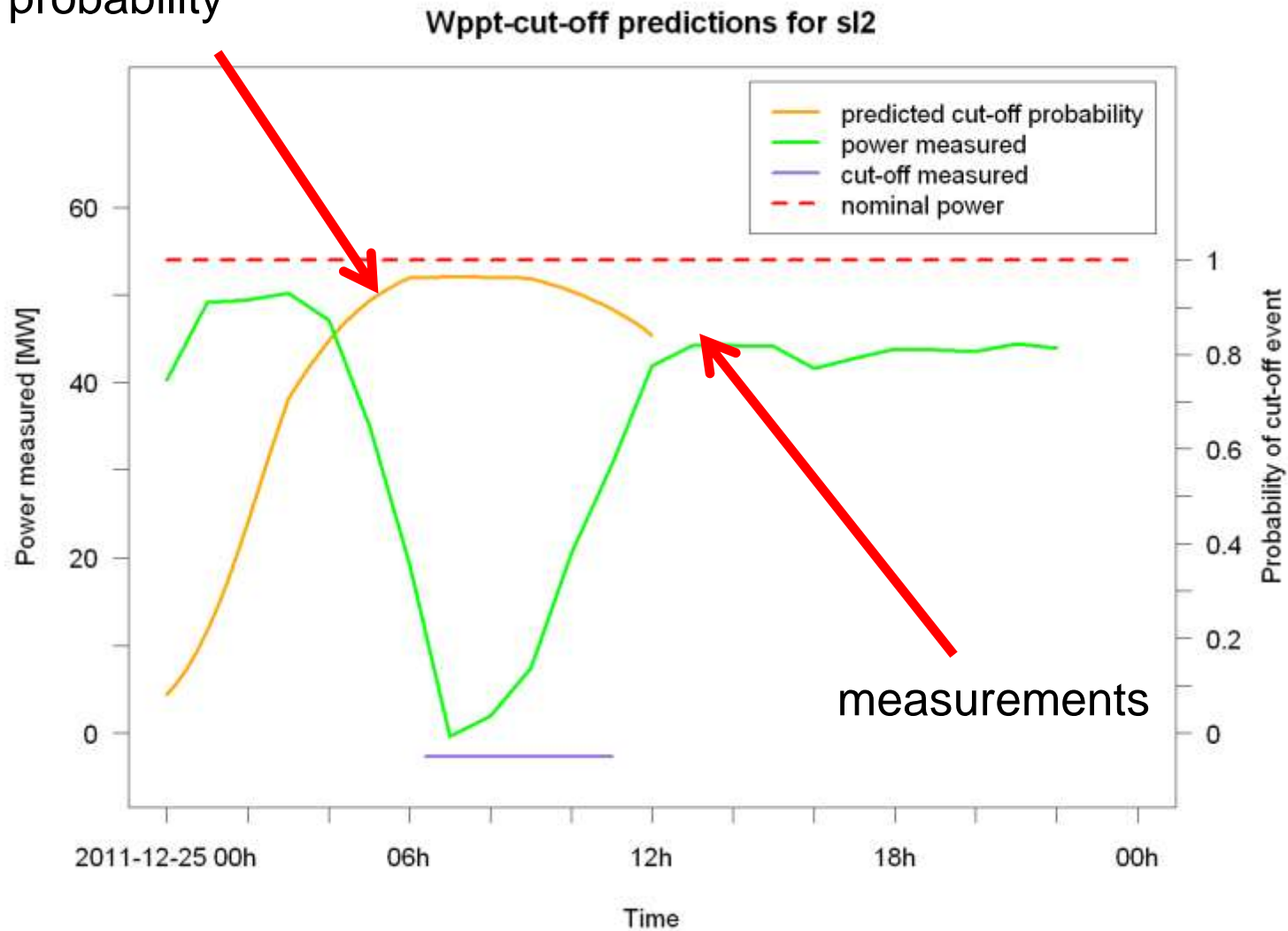
# Shut-down events and wind speed



# SONI WPPT cut-off example



Cut-off probability

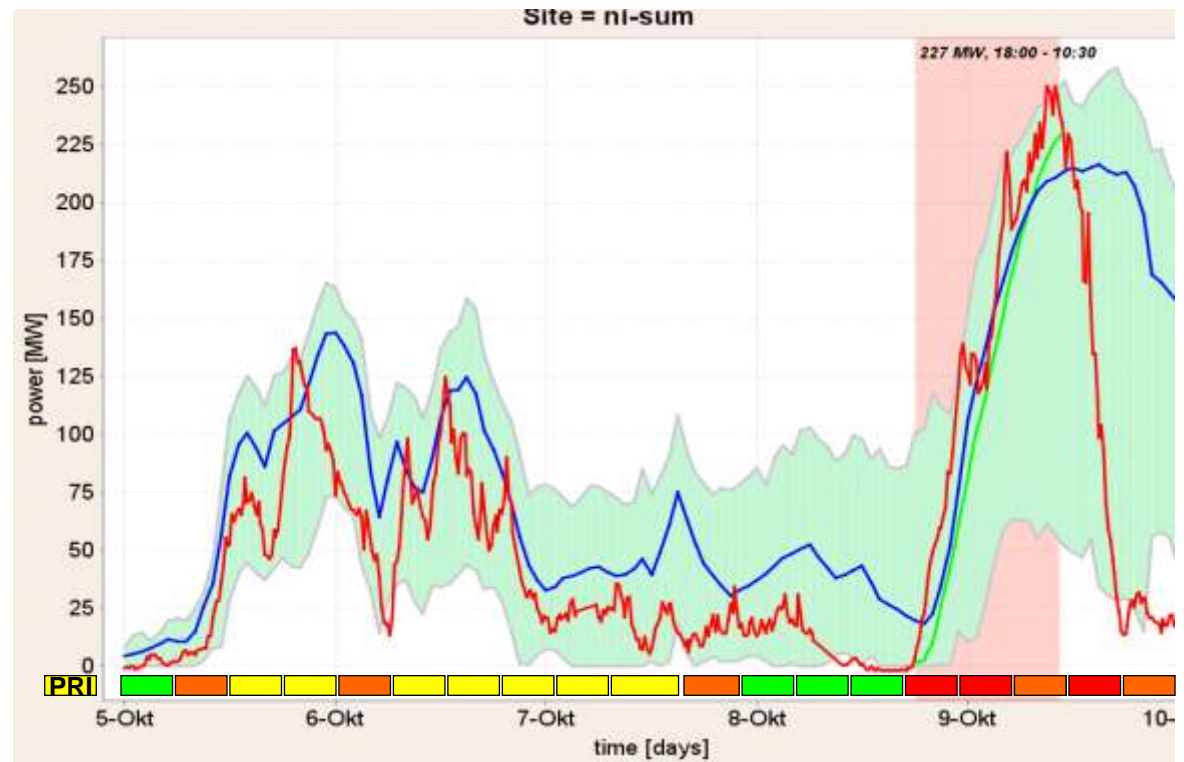




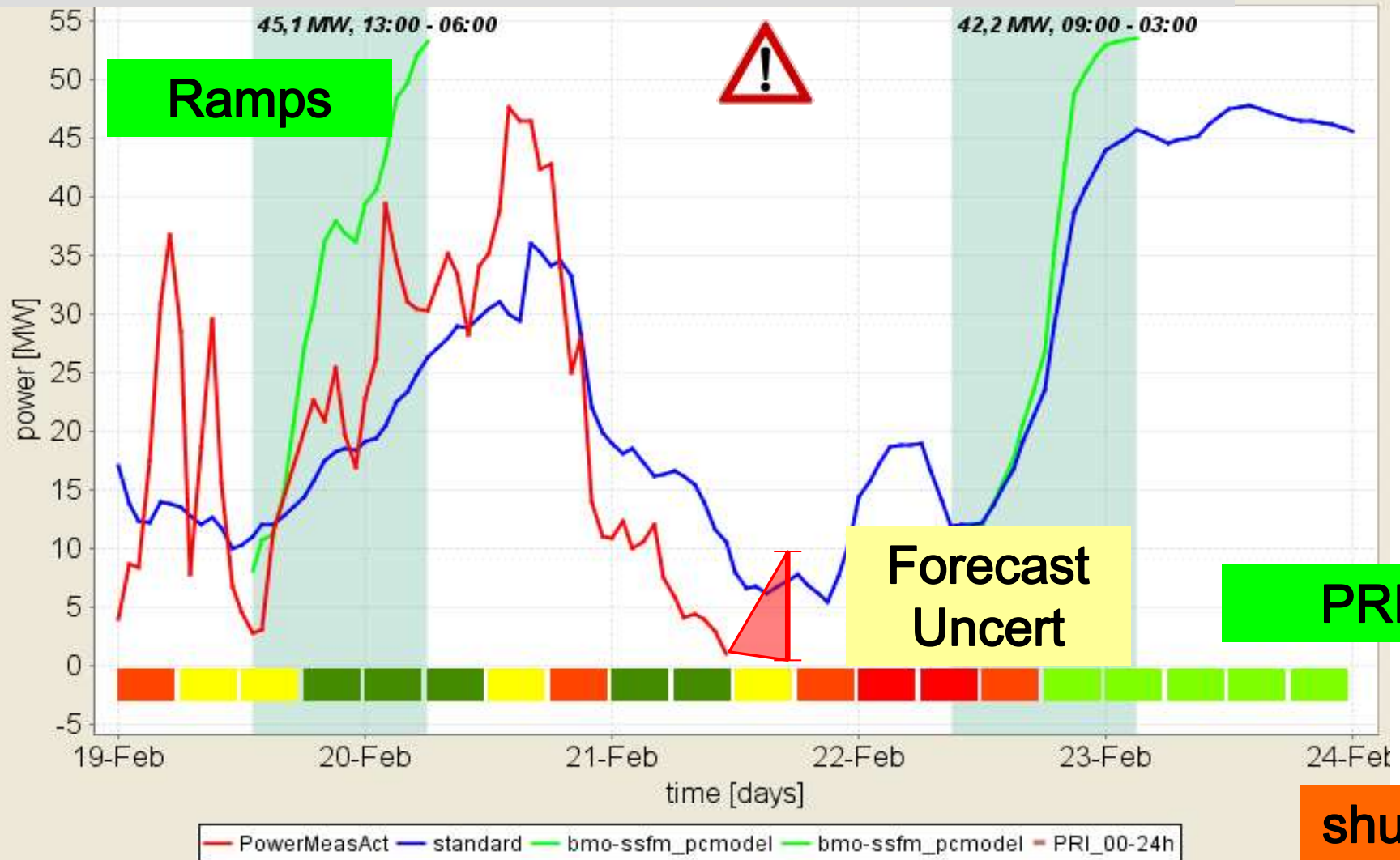
# SafeWind operationally

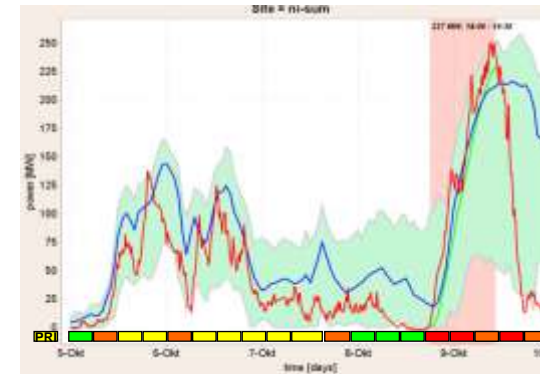
## Anemos.eXtreme: operationally

- 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 to application**

R&D since 199X

## **Experience**

> 65 GW

## **Robustness**

Standardisation

High availability

## **Leading edge** predictions

Extremes and ramps

➔ [windpowerpredictions.com](http://windpowerpredictions.com)

