

High-risk Scenarios for wind power forecasting in Australia

Nicholas Cutler (n.cutler@unsw.edu.au), Merlinde Kay, Hugh Outhred and Iain MacGill - University of NSW, Sydney

ABSTRACT

• **Objective:** To characterise high-risk scenarios in wind power output for power system security and market stability in Australia.

• **Preliminary results on the following topics are presented:**

◇ A study of the wind climate affecting wind power output at various wind farms. →

◇ Identification of potential high-risk wind events. ↓

◇ Assessment of the performance of 2 contrasting, commercially available forecasting techniques. ↘

• **Future work:** developing ramp forecasting techniques as a complement to traditional approaches. ↘

Distinct pattern for wind farms in South Australia

Two common weather regimes are observed over one year.

1. High pressure systems lie south-west and south-east of Australia. The power varies during these periods depending on if a low/frontal system in the southern ocean moves north enough so that the wind farms receive some high winds.

2. A high lies in the Bight. The wind farm power is typically near zero except Jan-March when sea breezes can give some periodic power to some of the wind farms.

A ramp in wind power is much more likely in regime 1 than in regime 2.

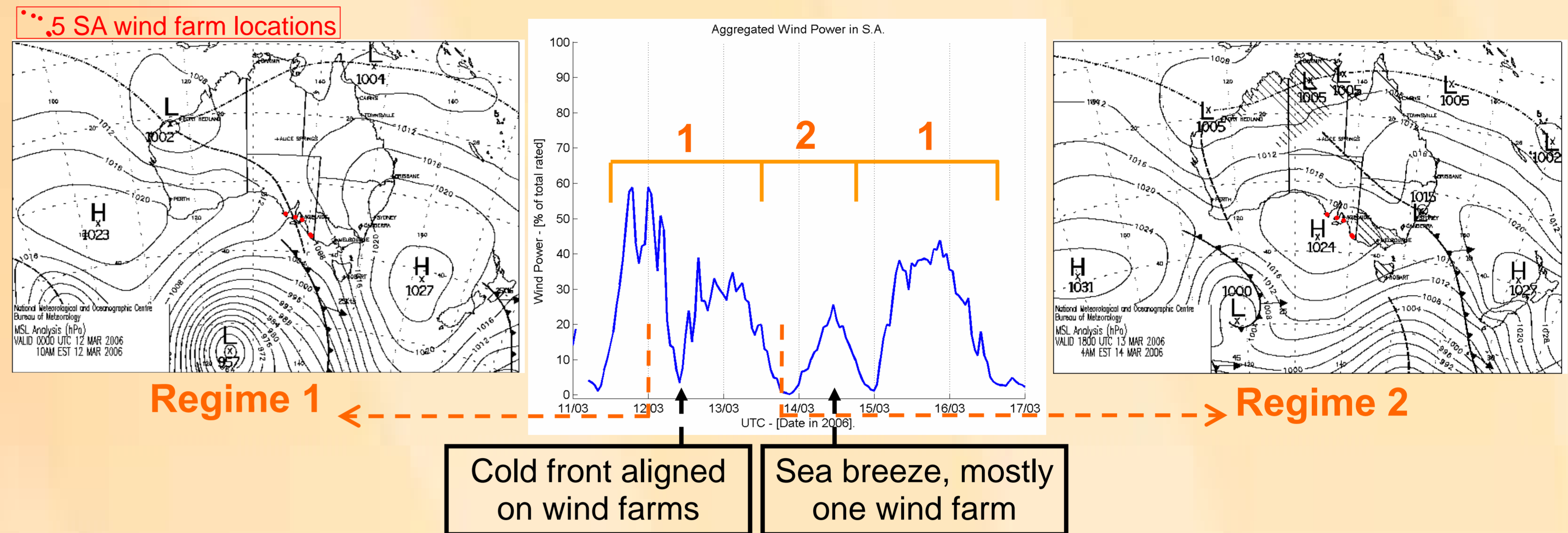


Figure 1: Aggregated wind power from 5 wind farms in South Australia for 6 days in March 2006. Two MSLP charts shown, with corresponding times.

Identification of high-risk events

• Detected in hourly averaged power observations as when the power difference exceeds a threshold (eg. 75% of rated power) within 3 hours.

• Main causes: wind speed ramps from fronts, troughs and low pressure systems, as well as high wind speed shut down.

Forecasting high-risk events

• Forecasting systems based on NWP and learning algorithms may not forecast these events well because:

- ◇ The spatial resolution of NWP may be too coarse,
- ◇ The events are too rare to support an effective learning process,
- ◇ Forecasts of these events may mistime or smooth out a ramp, or mask the event completely.

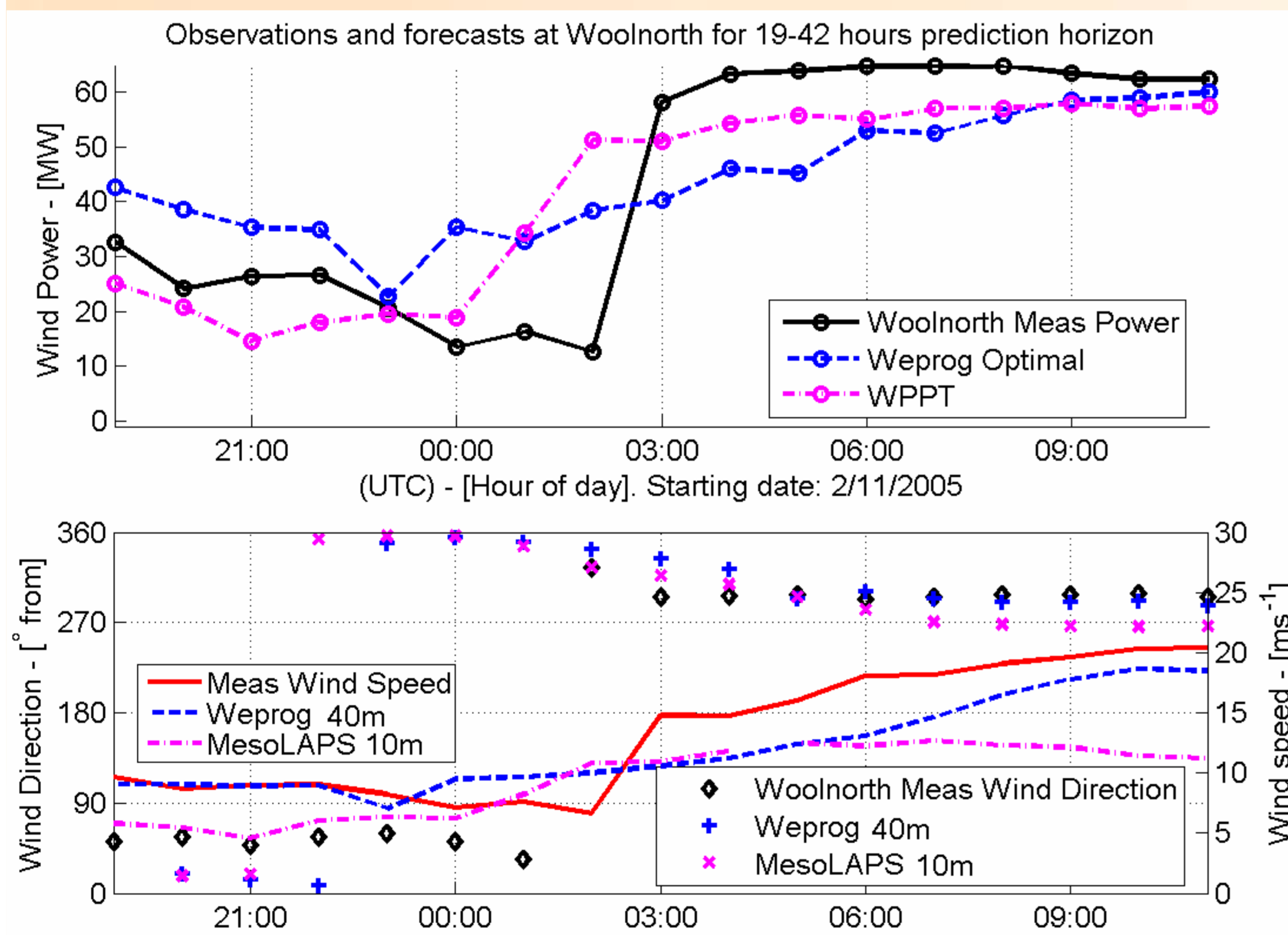


Figure 2: Example of forecasting smoothing of a high-risk scenario at the Woolnorth wind farm in Tasmania, with the forecasts from two commercially available forecasting systems.

References

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Error for whole year compared with during ramps

• RMSE is decomposed so that $RMSE^2 = BIAS^2 + SDBIAS^2 + DISP^2$ [1]. Dispersion (DISP) represents the error that is irremovable with standard statistical techniques.

• Weprog MSEPS [2, 3] and WPPT [4]/MesoLAPS [5] have similar RMSE during ramp periods, but only Weprog improves significantly for periods ± 6 hours.

• Weprog at 7-30 hours prediction horizon has lower RMSE for ramps ± 6 hours than for whole year, probably due to extended periods of zero and full rated periods before and after ramps, which would have a low forecast error.

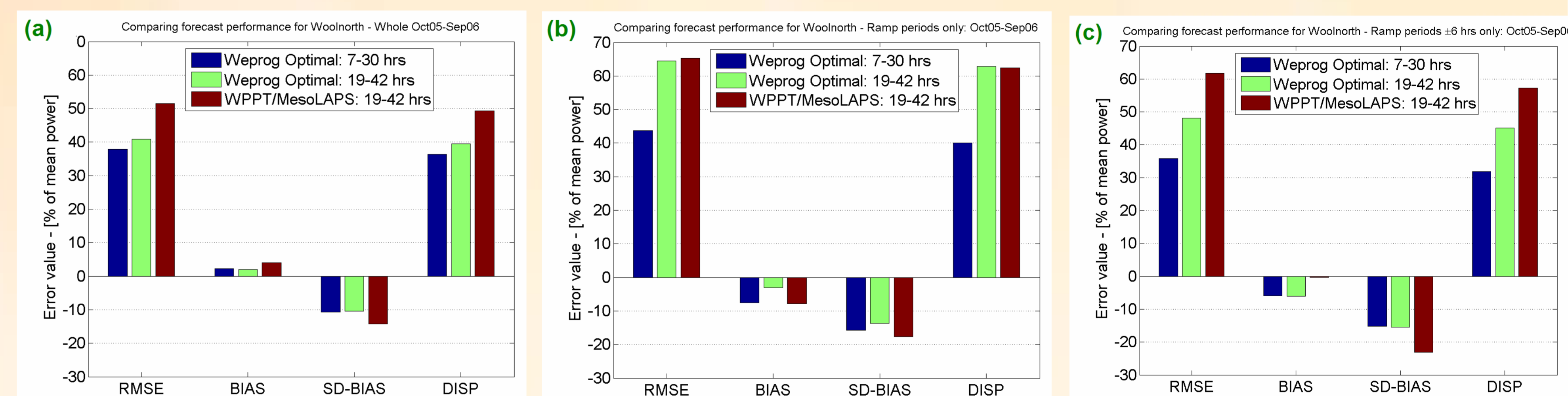


Figure 3: RMSE, BIAS, SD-BIAS and DISP (dispersion) at Woolnorth for 2 different forecasting systems, the first with two different prediction horizon ranges. Tested on whole 1 yr period (a), During periods of 11 ramps (b) and during the 11 ramp periods with 6 hours (c).

Complimentary Forecasting Technique

• Most wind power forecasting systems only utilise the nearest grid point wind speed forecast from a NWP.

◇ We plan to look for information to indicate extreme events in the 3-D field of forecasts of all variables from the NWP.

• Uncertain rapid changes are often smoothed out in NWP forecasts due to its coarse spatial resolution and optimisation algorithms that minimise overall error.

◇ We hope to develop an algorithm to focus solely on the extreme events, as a complimentary forecast.

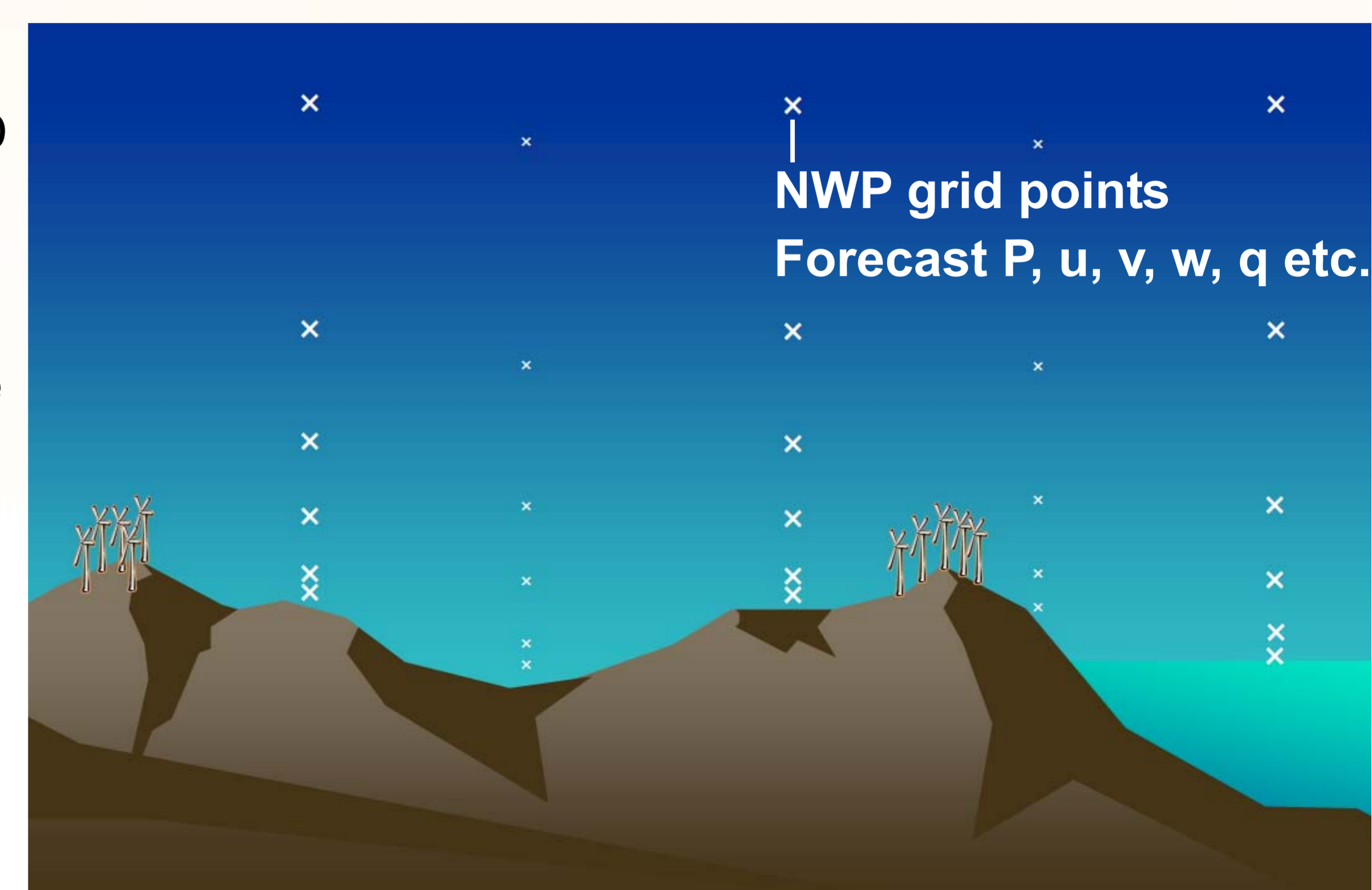


Figure 4: Diagram of the locations of some NWP grid points around a couple of wind farms.