



Nicholas Cutler. <u>n.cutler@unsw.edu.au</u> 23rd June, 2010

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Centre for Energy and Environmental Markets UNSW Wind power forecasting methods of use Wind power forecasting can be used in two ways: Best guess generation used automatically for commercial optimisation (eg. in electricity markets) Multiple scenarios provided 9 12 15 18 21 24 27 30 33 for visual interpretation to characterise forecast uncertainty and assist decision-making in critical e 40 situations (eq. Managing ຣັລດ power system security and <u>P</u> 20 large rapid changes in aggregated wind power) 4 7 10 13 16 19 22 1 4 7 Local Time [hour] on 20-21 July 2009 at Lake Bonney 1







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Outcomes from the PhD thesis (2)

- Large, rapid changes in wind power in Australia are largely caused by horizontally propagating synoptic weather phenomena:
 - Eg. Cold fronts and low pressure systems
- By their nature, statistical forecasting methods based on past observations will struggle to provide useful information on large rapid changes
- Numerical Weather Prediction (NWP) systems are the best tool available to forecast significant changes in the weather



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NWP systems

- Represent the atmosphere on a coarse horizontal grid (25 km for global ECMWF system) and cannot directly model local, fine-scale detail topographic effects on the wind
- Good at forecasting broad synoptic weather phenomena (such as cold fronts and low pressure systems) and how they affect nearsurface winds out to around 48 hours ahead
- Uncertain in the timing, or more generally the precise position of such synoptic weather phenomena







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Outcomes from PhD thesis

- Identified that conventional single grid point extraction and corresponding time-series forecast may be missing useful information in NWP system
 - Misplacement errors during large rapid changes in wind can cause large differences in single grid point forecast
- Developed technique to display multiple grid point information from NWP systems to characterise wind power forecast uncertainty due to misplacement errors
 - Problem: the wind at each grid point is influenced by the local topography \rightarrow













































































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Animated wind power field versus NWP ensembles

- Both show uncertainty information in wind forecast:
 - Wind power field uncertainty based on multiple grid points, and assuming potential misplacement errors. Field highlights potential chronological behaviour
 - Ensembles are based on different (perturbed) initial states of the atmosphere, or different physical assumptions
- Both reduce uncertainty when scenarios are similar
- Spatial resolution is usually compromised to run the NWP system multiple times for an NWP ensemble
- Wind power fields show chronological behaviour between the NWP system time-stamps, ensemble scenarios could suffer from sampling error



























































