Short term forecasting of wind power plants

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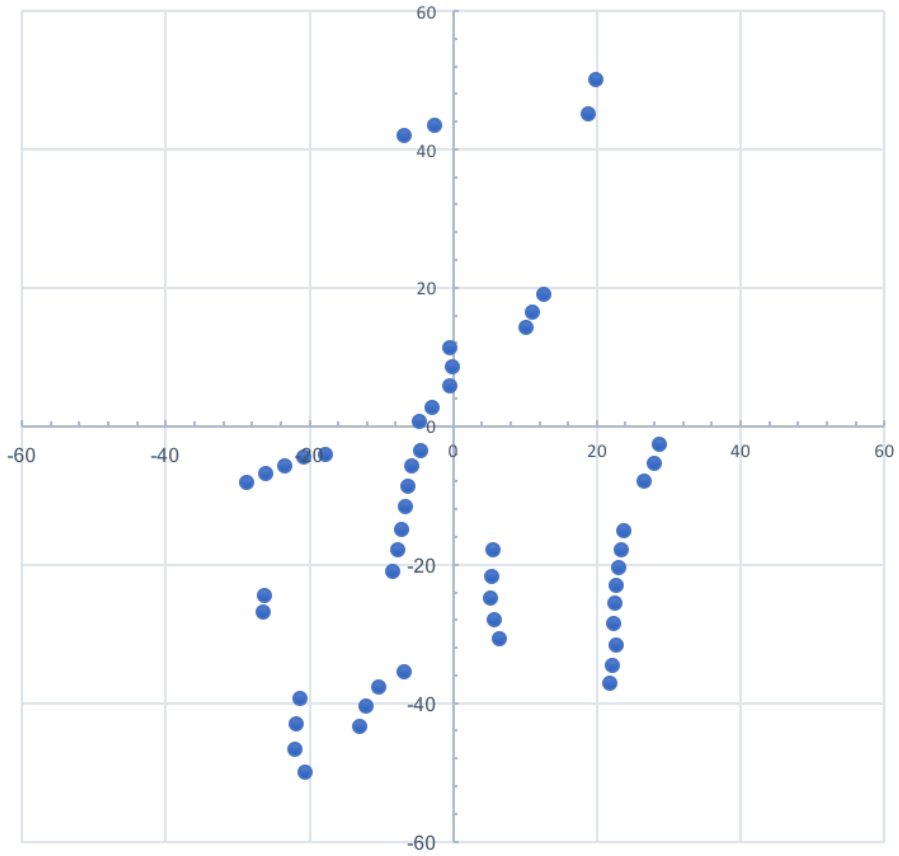
What is “short term” forecasting

Time horizon	Range	Applications	Forecast technologies
Very short term	A few seconds to 30 mins ahead	Electricity market clearing Regulation actions	Persistence, ML
Short term	0 minutes to 6 hours ahead	Economic load dispatch planning Load increment/decrement decisions	Persistence, NWP, hybrid, ML, statistics
Medium term	6 hours to 1 day ahead	Generator online/offline decisions Operational security in day ahead markets	NWP, hybrid, statistics
Long term	1 day to 1 week or more ahead	Unit commitment decisions Reserve requirement decisions Maintenance scheduling	NWP, statistics

Modelled wind power plant

- Located in South East NSW in the Australian National Electricity Market
- 21 Vestas V90 2 MW turbines
- 21 Vestas V100 1.8 MW turbines
- 9 Vestas V90 3 MW turbines
- Total capacity of 51 turbines and 107 MW
- Topology includes both hill top ridges & flat plains
- Vertical distance of 90 m between lowest & highest turbines

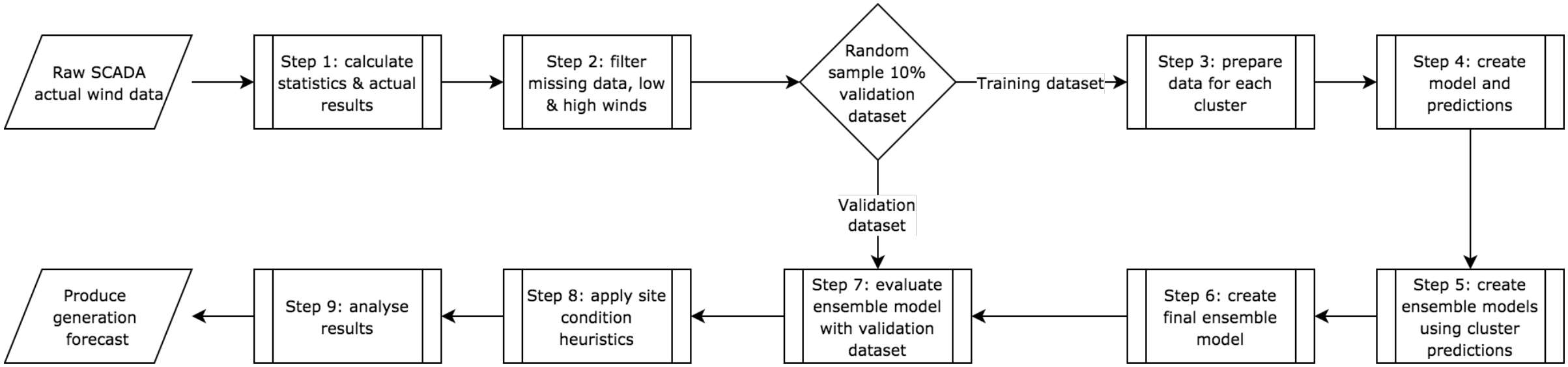


Initial modelling approach

- Exploratory data analysis
  - Variable correlations
  - ML technique effectiveness
  - Feature importance
  - Most techniques performed worse than persistence forecast

- Single generator forecast model
  - Data filtered for wind conditions, data failure & constraints
  - ANN & stochastic gradient boosting models
  - Performed about the same as persistence forecast

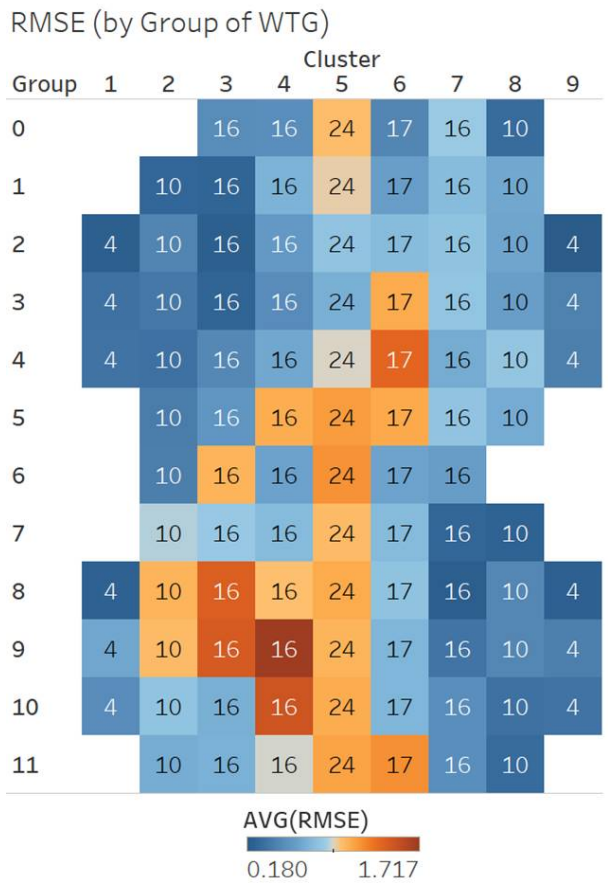
Model development procedure

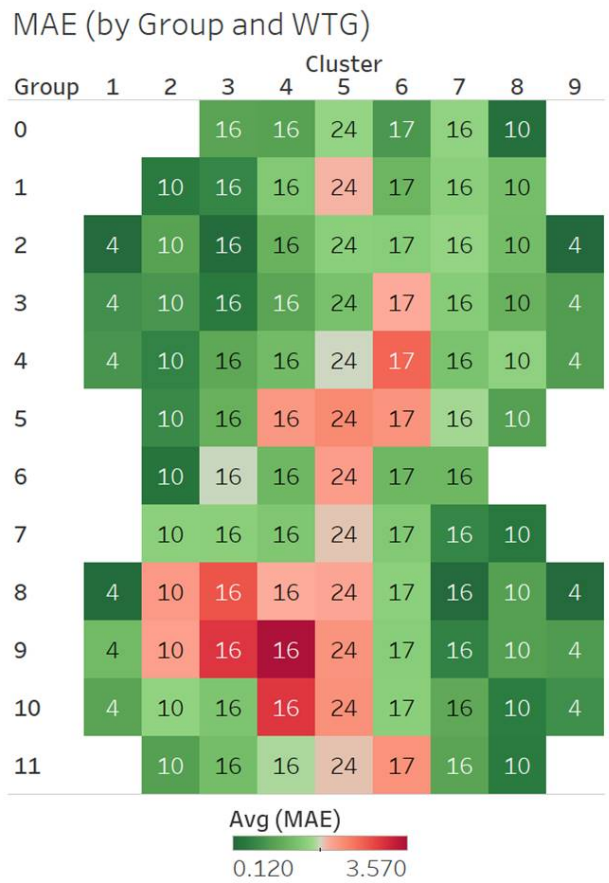


Clustered model approach

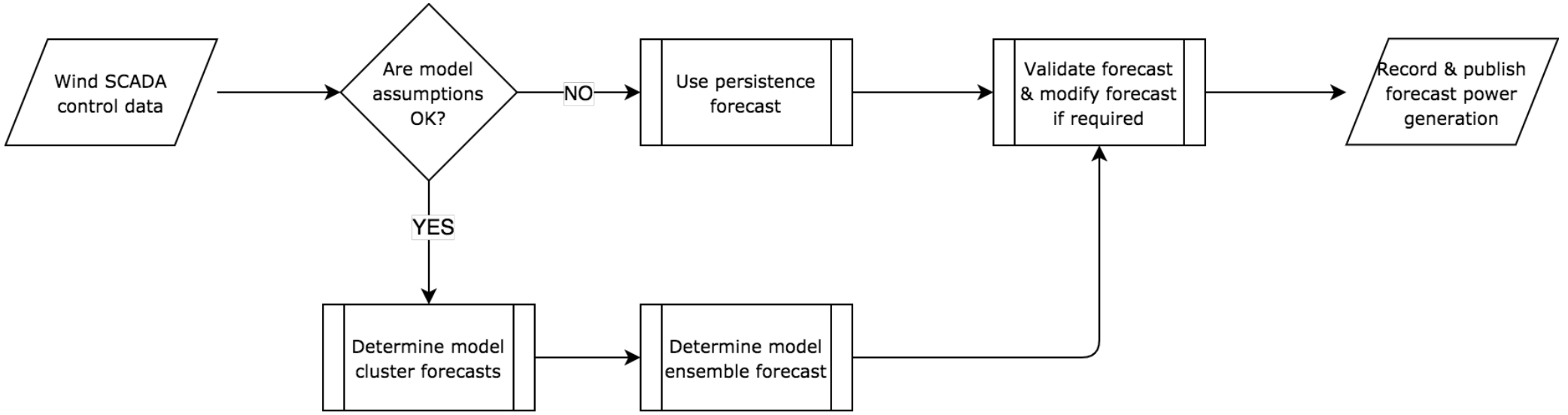
- Turbines clustered based on physical location, topology & dynamic parameters
- Clusters were modelled individually with stochastic gradient boosting (SGB) models using filtered data
- Ensemble model of cluster model forecasts using either SGB or ANN model
- Models produced a range of forecasts under different dynamic conditions:
  - RSME improvement of min -12.9% max 27.1% mean 10.67%
  - MAE improvement of min -7.8% max 18.7% mean 7.5%

Forecast error distribution





Model production procedure



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