ENERGY

Identifying and Forecasting Icing Energy Loss

Trends in Wind Farm Performance

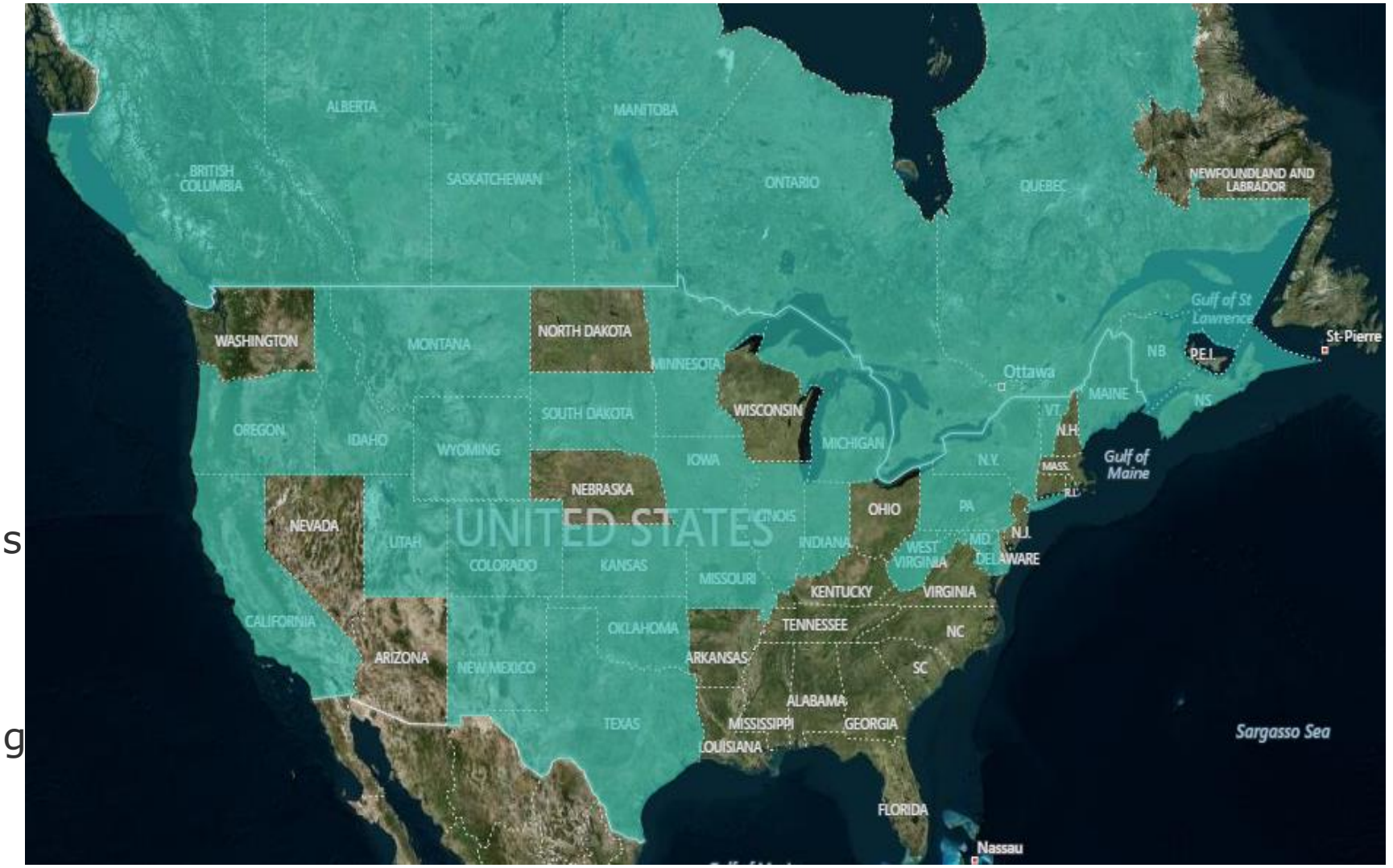
CanWEA 2018

Josiah Chamberlain

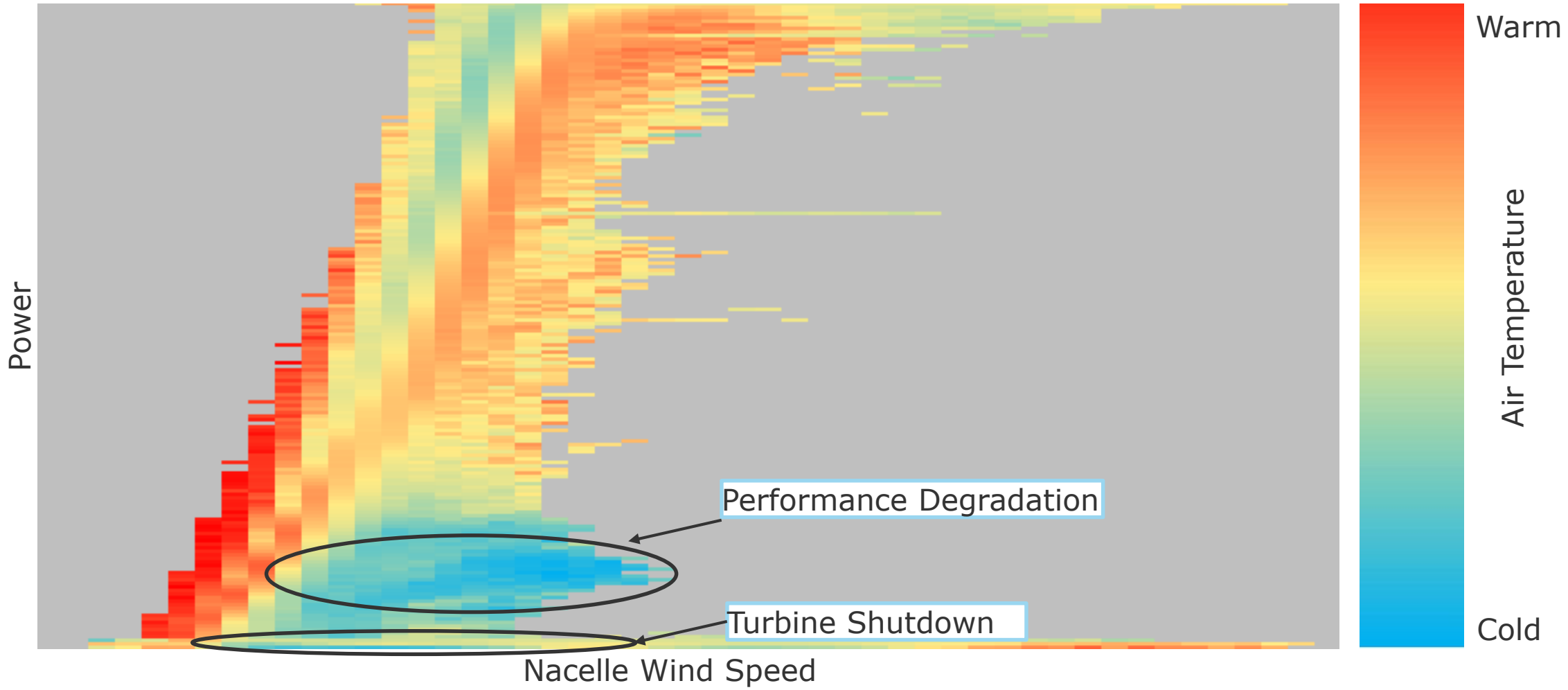
25 October 2018

Studying Icing Across DNV GL's Legacy SCADA database in North America

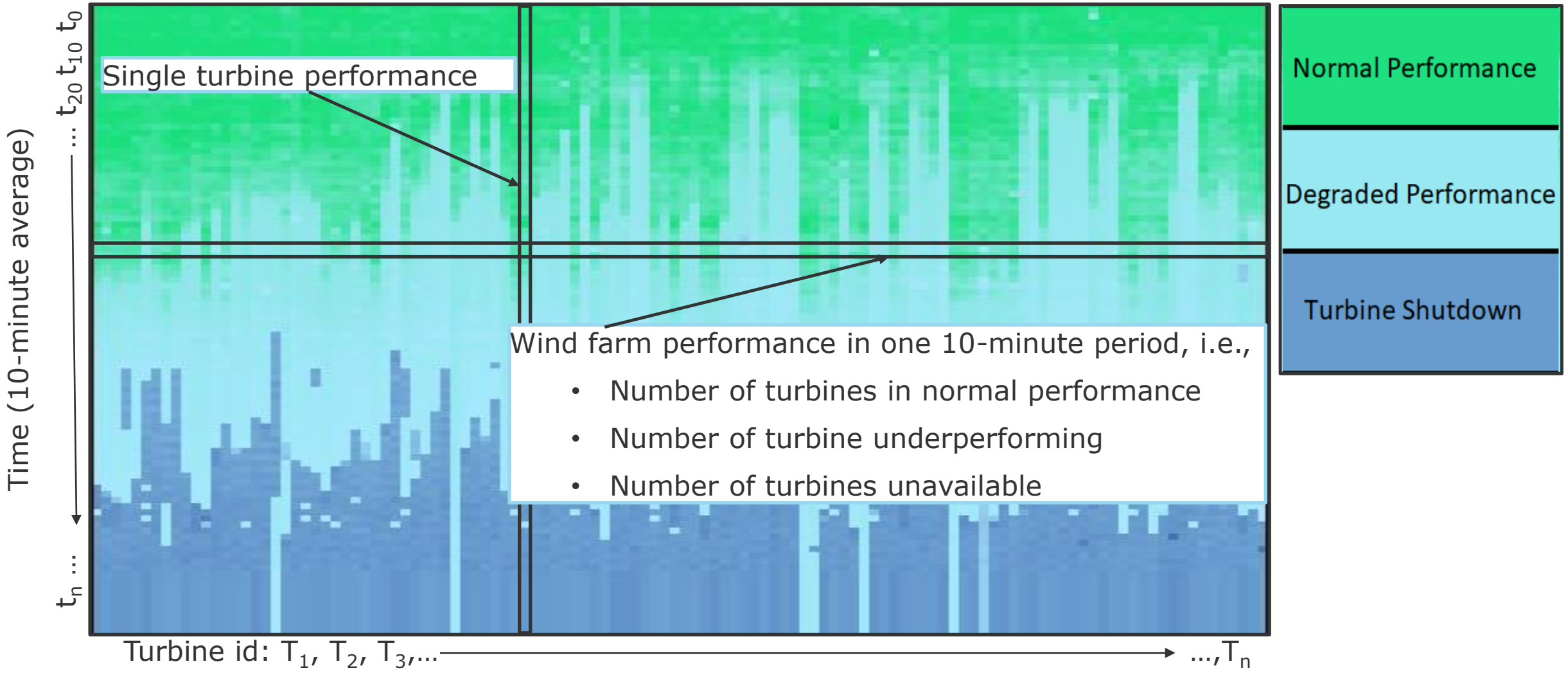
- DNV GL's legacy SCADA projects
  - 500 Wind farms-years
  - 35 Provinces and states
  - 40,000 Turbines-years
- DNV GL is utilizing these data to
  - Better understand operations
  - Improve our energy models
- Requires automated processing of data



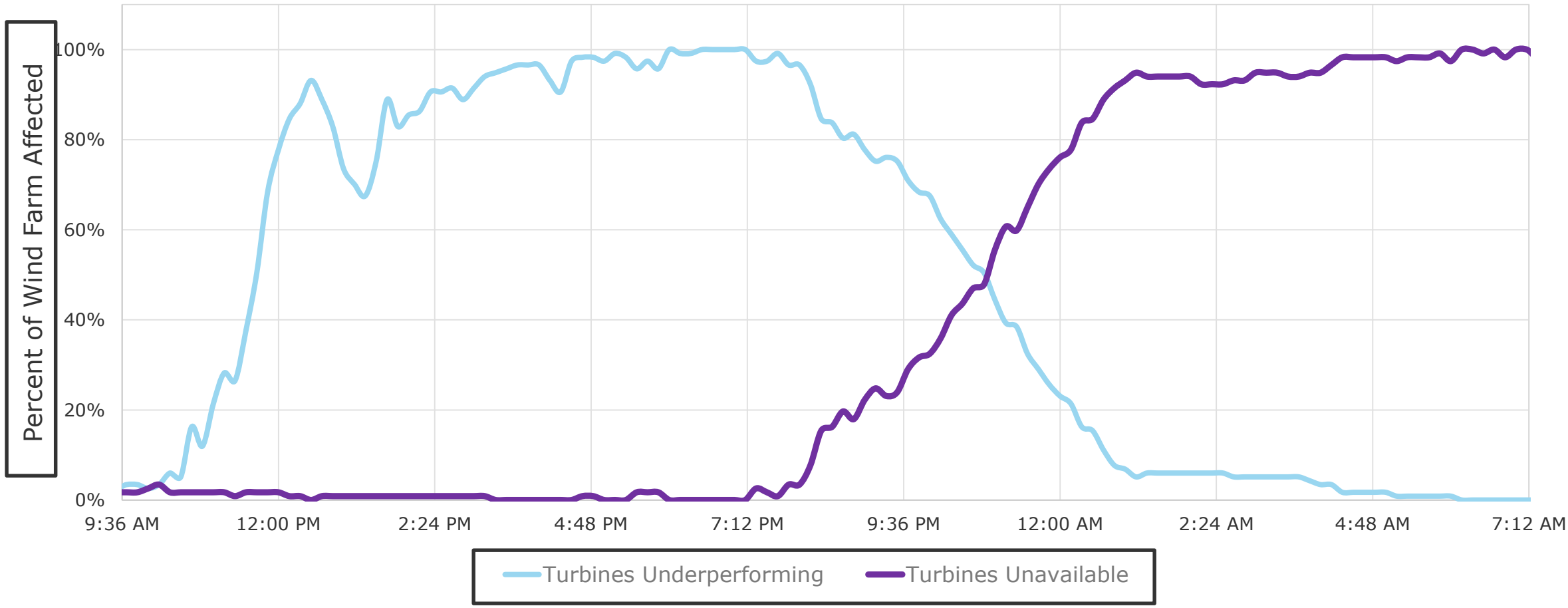
Identifying Icing Degradation (Single Turbine)



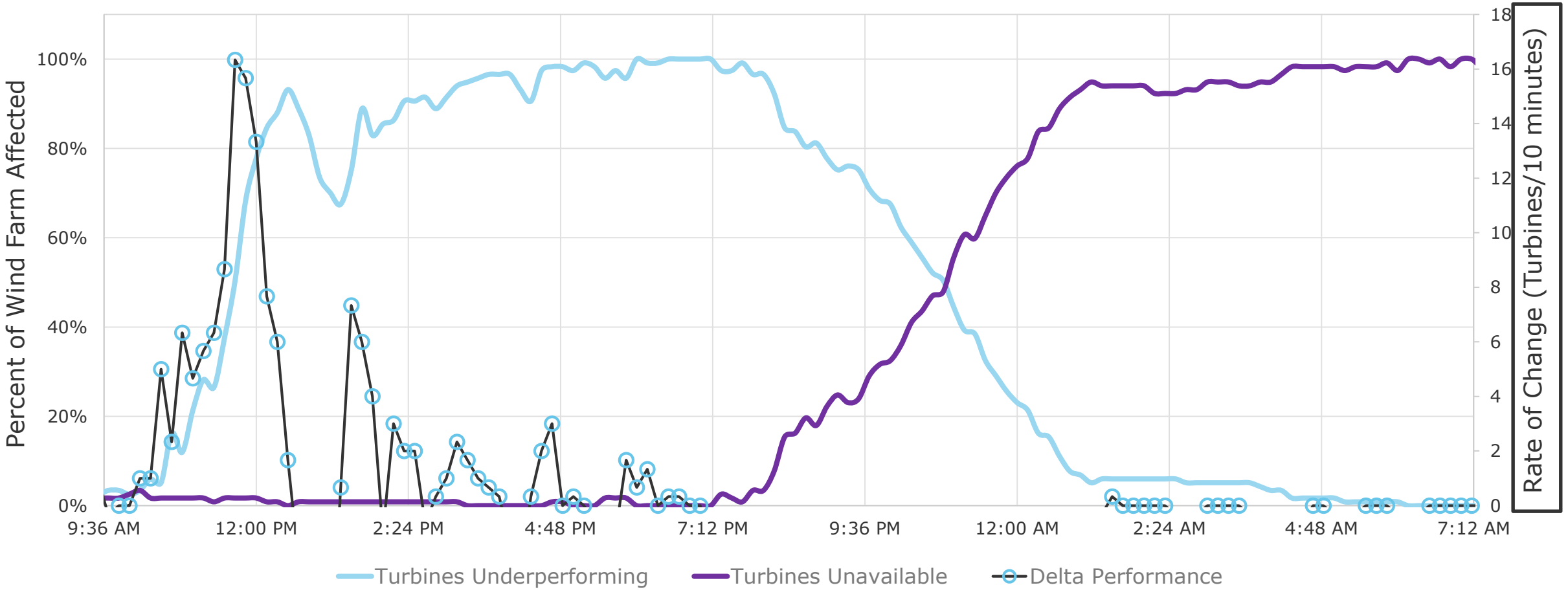
Identifying Wind Farm Icing Event



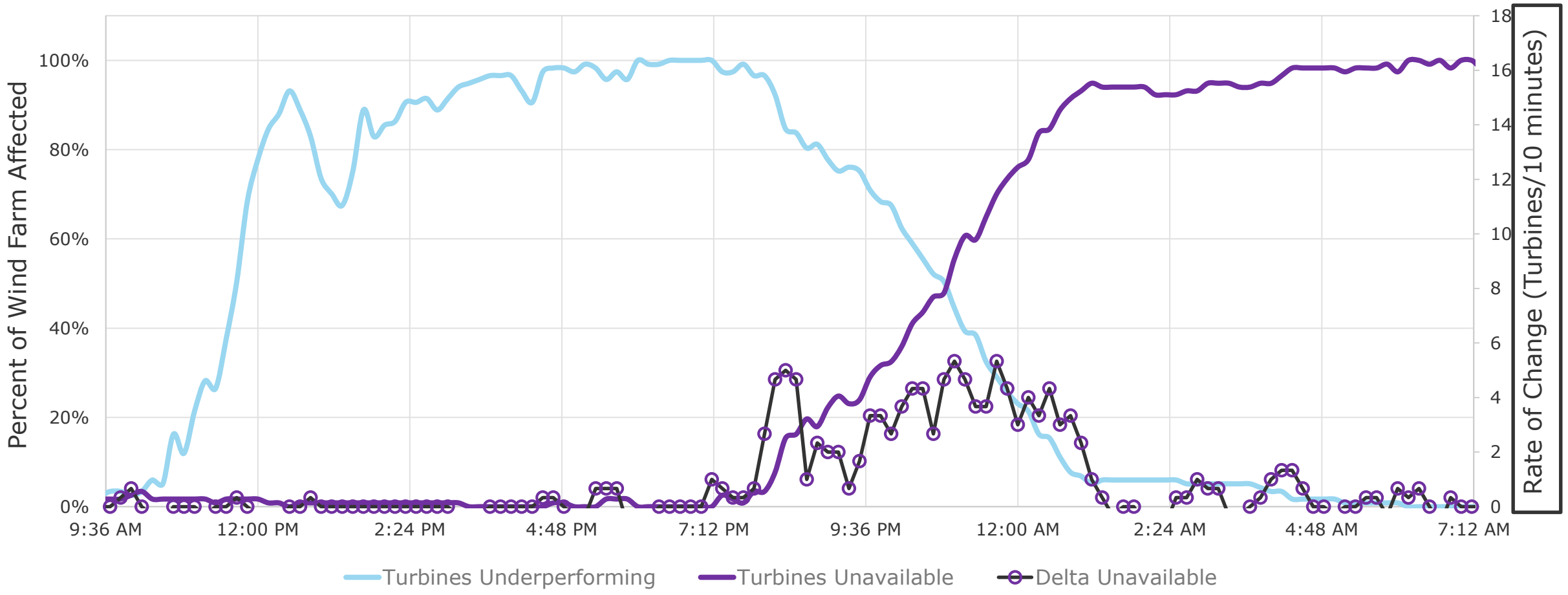
Time Sequence of a Wind Farm Icing Event



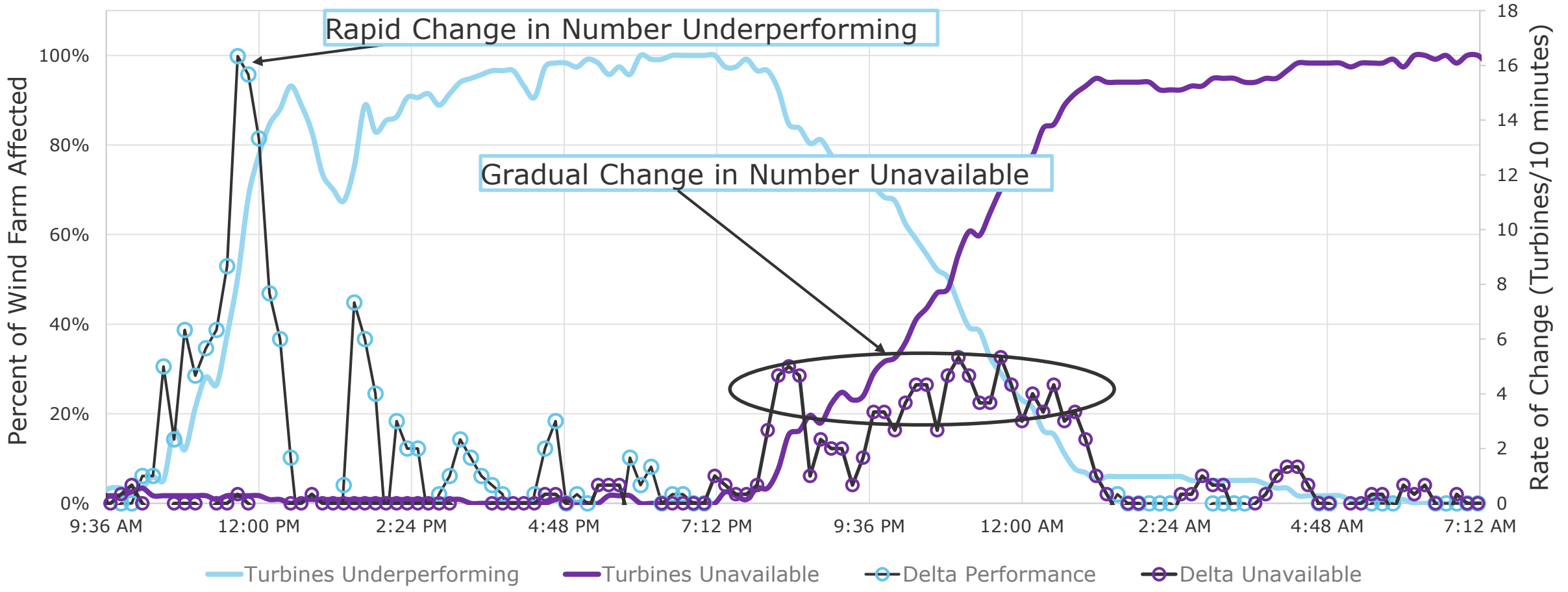
Time Sequence of a Wind Farm Icing Event



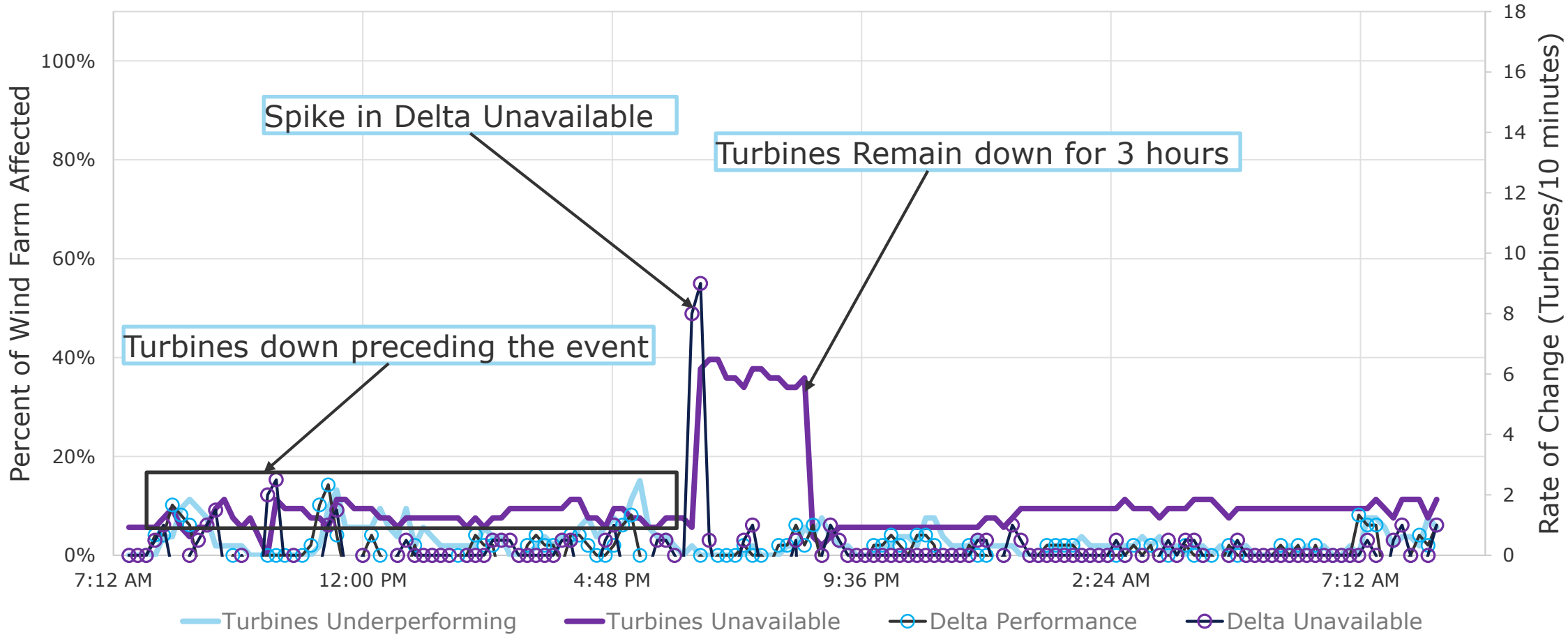
Time Sequence of a Wind Farm Icing Event



Time Sequence of a Wind Farm Icing Event



Time Sequence of a Wind Farm BoP Event

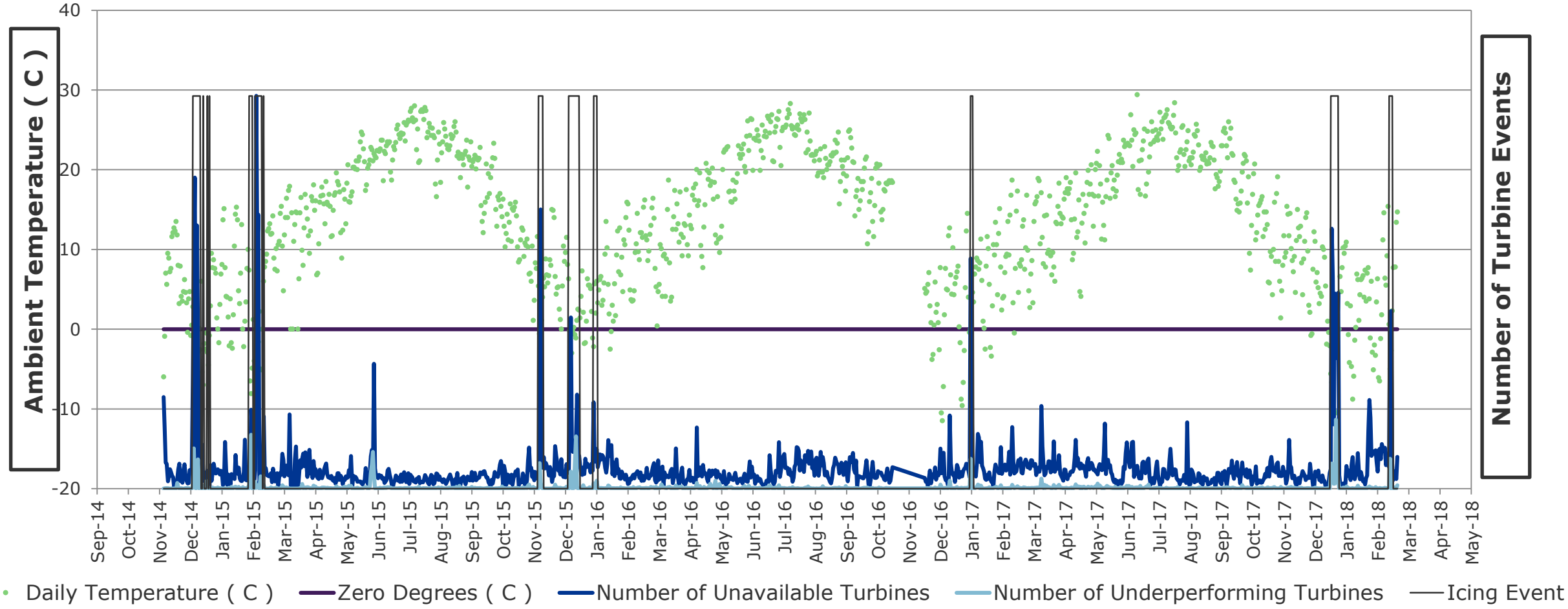


Automated Flagging of Icing Events

- Identifying ‘wind farm’ icing events based on:
  - Count of turbines underperforming
  - Count of turbines unavailable
  - Rate of change in the number of turbines affected
  - Proximity in time to turbines underperforming

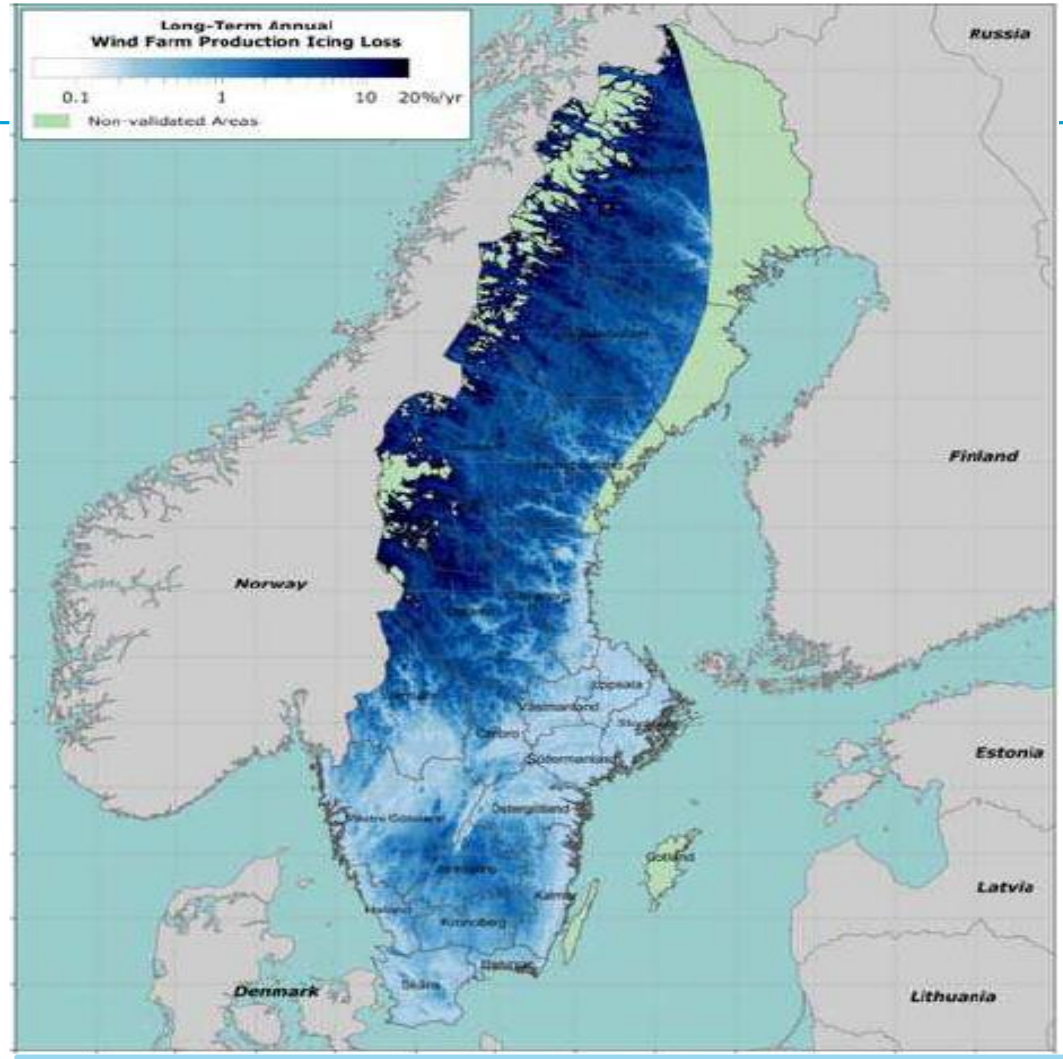
- Exclude:
  - Temperatures above 3 degrees C at start
  - High wind shutdown
  - Turbine derating and curtailment
  - Balance of plant events
  - Extended shutdown on individual turbines

Example of Flagged Icing Events



Refining the Long-term Energy Model Next Steps

- Calibrate and refine filters at high-confidence sites
- Compile localized results by
  - Wind Farm
  - Region
  - Year
- Correlate and predict using meteorological inputs
  - Temperature
  - Humidity
  - Elevation
- Update energy models
  - AEP icing losses
  - Inter-annual variability



DNV GL Validated Icing Map of Sweden
by Carla Ribeiro and Till Beckford

https://windeurope.org/summit2016/conference/allfiles2/51_WindEurope2016presentation.pdf/

Questions?

Josiah Chamberlain
Josiah.chamberlain@dnvgl.com
+1 503-995-6423

www.dnvgl.com

SAFER, SMARTER, GREENER