Task 19 Ice Loss Tool – v2020

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Who

- Timo Karlsson
- IEA Wind Task 19 Operating Agent
- Research Scientist @ VTT
- Lot of experience with cold climate wind

What is IEA Wind Task 19?

- Task 19 – Wind Energy in Cold Climates – international expert group
- Mission: *Boost safe and cost efficient wind power deployment in cold climates*
- Activities included:
  - Exchange information on international research collaborations and projects
  - Create recommendations, guidelines & best practices
  - Collect overview of available technologies and market potential
  - Disseminate reports, tools and findings
  - No research projects!
- Task active since 2001
- Funded through participating countries

Ice Loss Tool history

- Icing causes issues with turbine aerodynamics
  - Detectable as turbine output power dropping from the power curve
- Questions remained
  - How large of a drop evidence of icing?
  - How to define limits, how to deal with differences between turbine models?
  - How to make sure people use the same definition for ”an icing event”

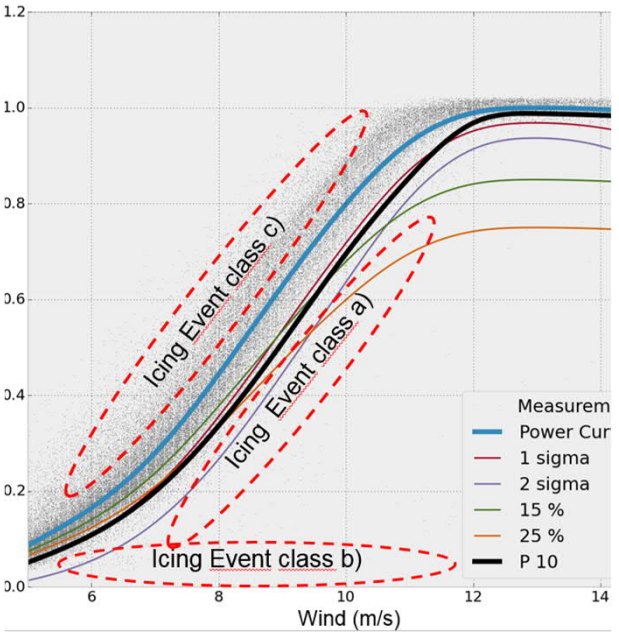
➔ Make software available, using a robust, easy to understand, sensible definition of an icing event

T19 Ice Loss Tool

- Software to count icing lossess for SCADA data
  - Python 3 script
- Reference method and one, Task 19 recommended, definition of an icing event
- No external measurements needed just the variables that are usually available in SCADA data

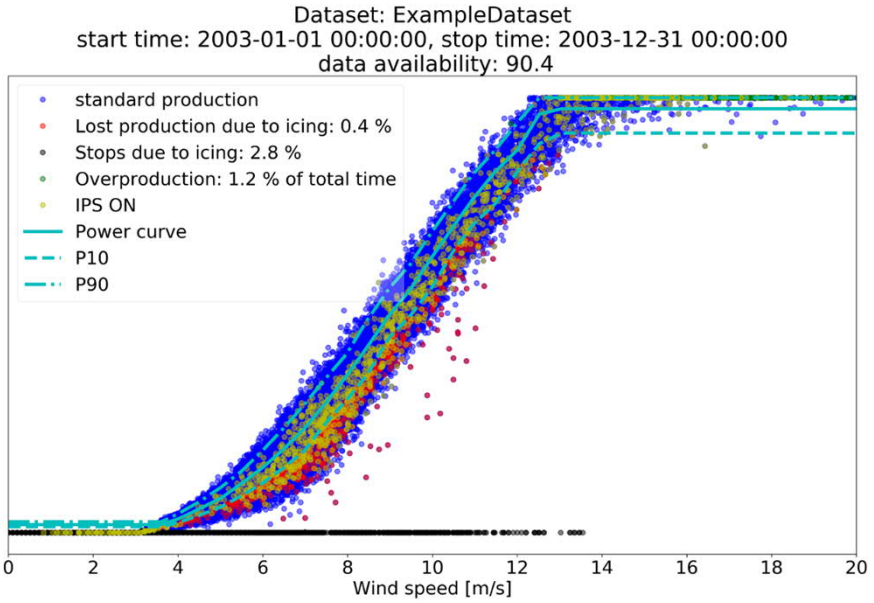
Ice detection method

- Splits a reference dataset from the data
  - No faults, no stops, temperature > 3 °C
- Puts the data in bins according to wind speed (and direction)
  - Calculates limits for alarm
    - P10 for icing
    - P90 for overproduction
- Runs the full dataset against the power curve and limits and flags possible icing events



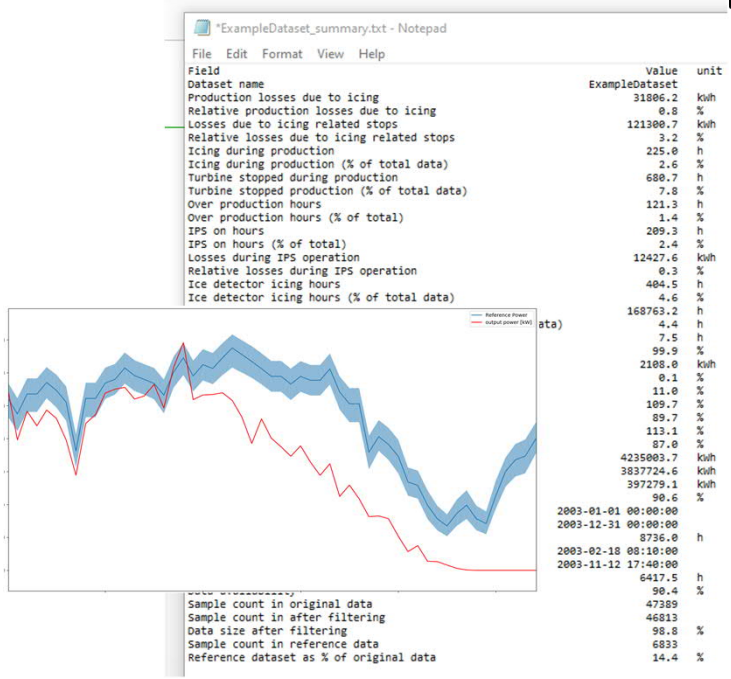
Ice detection method

- Icing event definition:
  - If temperature below a limit (+ 1 °C) and power below P10 for 30 consecutive minutes ➔ icing event starts
  - If temperature above the limit for 30 minutes ➔ icing event stops
- Code flags stoppages separately
- Apparent overproduction is flagged with a similar criteria
  - If temperature below a limit (+ 1 °C) and power above P90 for 30 consecutive minutes ➔ icing event starts
  - If temperature above the limit for 30 minutes ➔ icing event stops



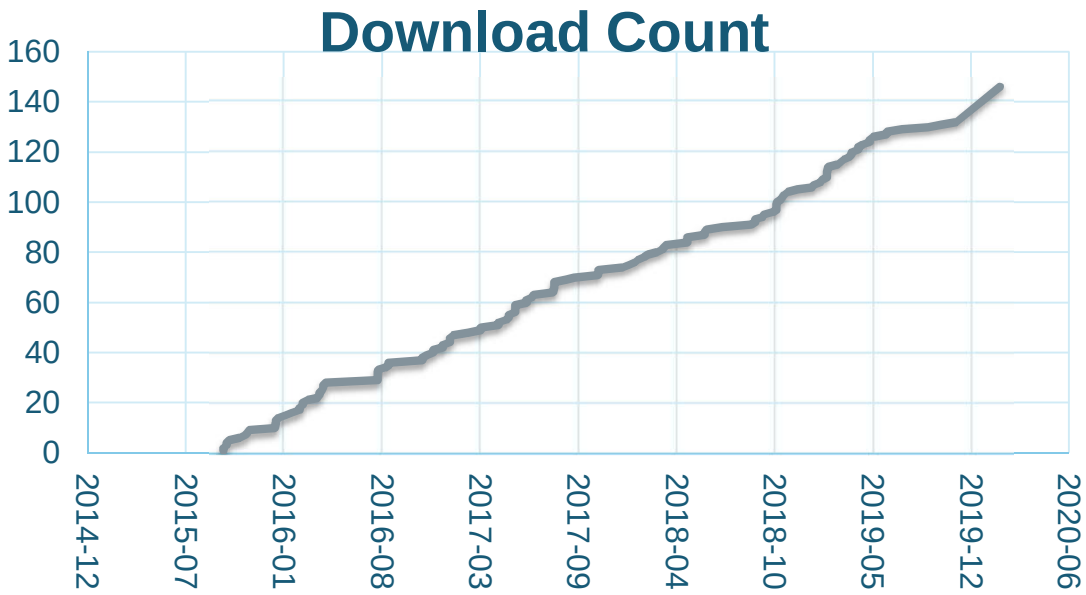
Tool outputs

- Outputs:
  - Summary
  - Alarm time series
  - Power curve, with lith limits and uncertainty
  - Filtered full time series with Alarm limits, for plotting
  - Icing event statistics



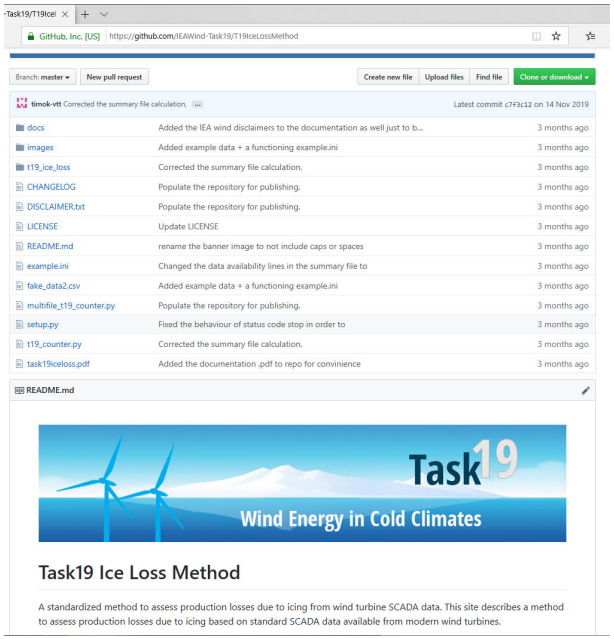
User Base

- Download count since first release
- Widespread interest in the industry
- Steady growth in userbase



New version, out now

- New version on GitHub
- https://github.com/IEAWind-Task19/T19IceLossMethod
- Follow this page for new releases
- Report issues or feature requests here

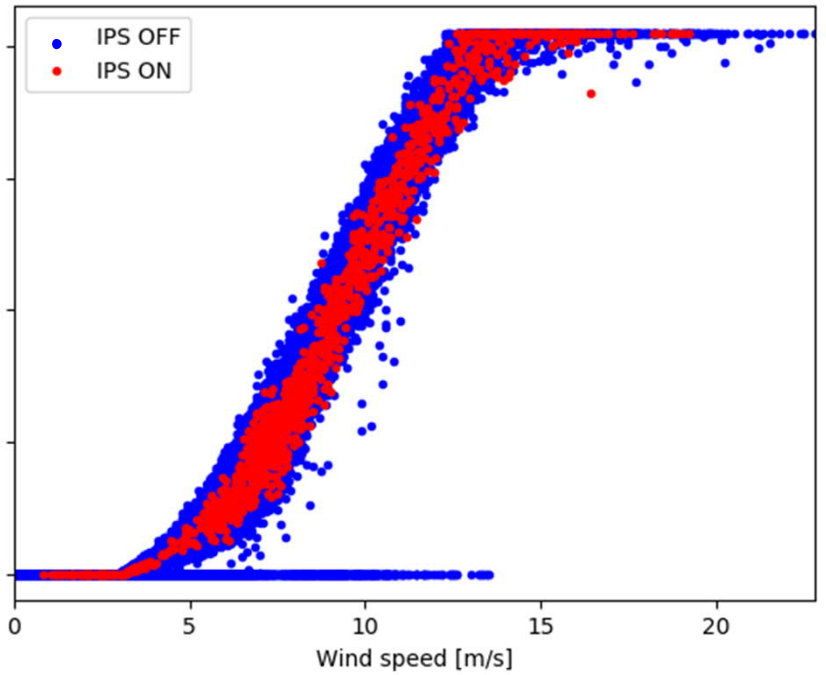


New Since the previous update in 2017

- Added a stop code to the code
  - Stop code can be used to highlight icing caused stops if there is a separate status code in scada for that.
- Added IPS handling capability to loss counter
- Added ice detector as a separate state class
- Added Power curve uncertainty to power curves:
  - uncertainty defined as std_dev/mean
- Added Status code based stops as a separate case for output
  - Allows counting production losses during a certain status code
  - Added IPS and status code stops to summary file
  - Added power curve uncertainty to summary file and printed power curve
- Time Based Availability and Energy Based Availability

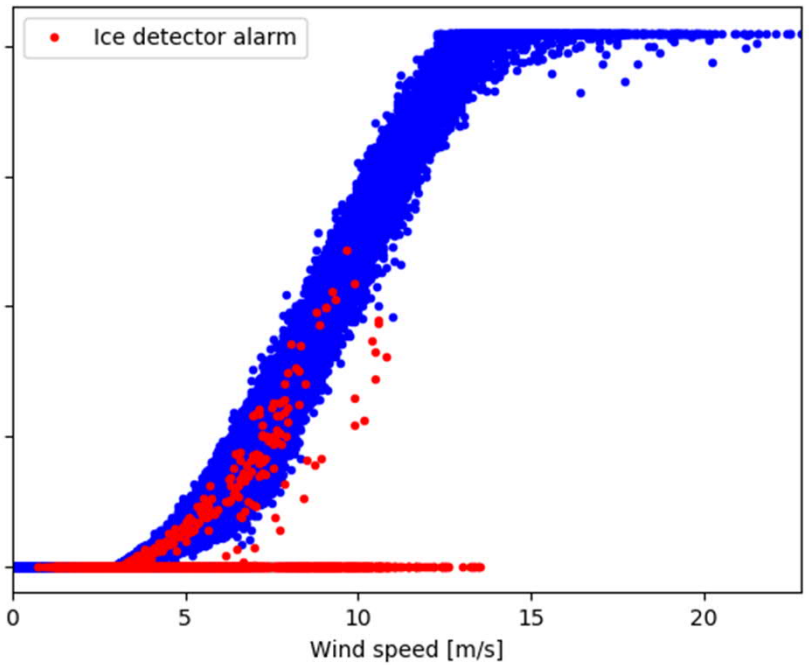
IPS Handling

- Turbine heating is handled as a special case
  - All data points where IPS is on are separated into one special class
  - Production losses during heating are separated into its own set
- Icing losses can still be calculated for the times heating is not on



Ice detector

- If there is an ice detector, possible to flag the moments ice detector given alarm is on
  - Compare to power curve based detection
- Can sometimes have interesting results

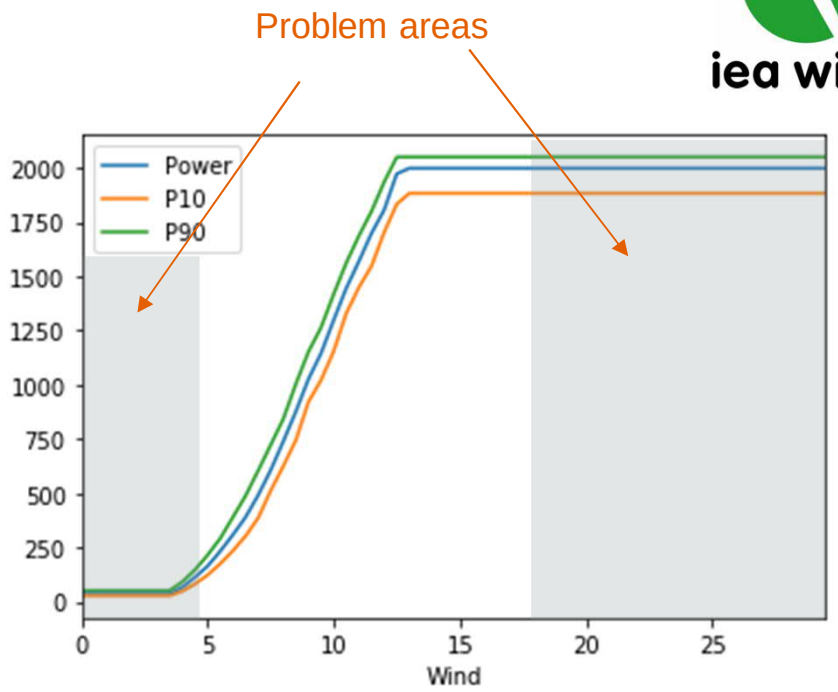


Lessons learned

- State, status, fault codes, data cleanup
  - The more time spent creating a clean, well behaved reference dataset, the better results are
- Anemometry
- Nacelle temperature measurement
  - Bias?
- Variablity in power measurements
  - Power curve sometimes really wide
  - Big differences from turbine to turbine
  - Has an effect on accuracy of method

Lessons learned

- Dataset size
  - Reference dataset size has an effect on results
- Large and small wind speeds
  - Method has issues at above nominal wind speeds
  - Likewise close to cut-in
  - Might make sense to limit the icing event detection by wind speed in the future



Next

- New hosting, more open development updates should be quicker
- More experiences needed
- Feedback, issue reports improvements welcome
- https://github.com/IEAWind-Task19/T19IceLossMethod

beyond
the obvious

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