

A new approach for the assessment of ice induced power losses

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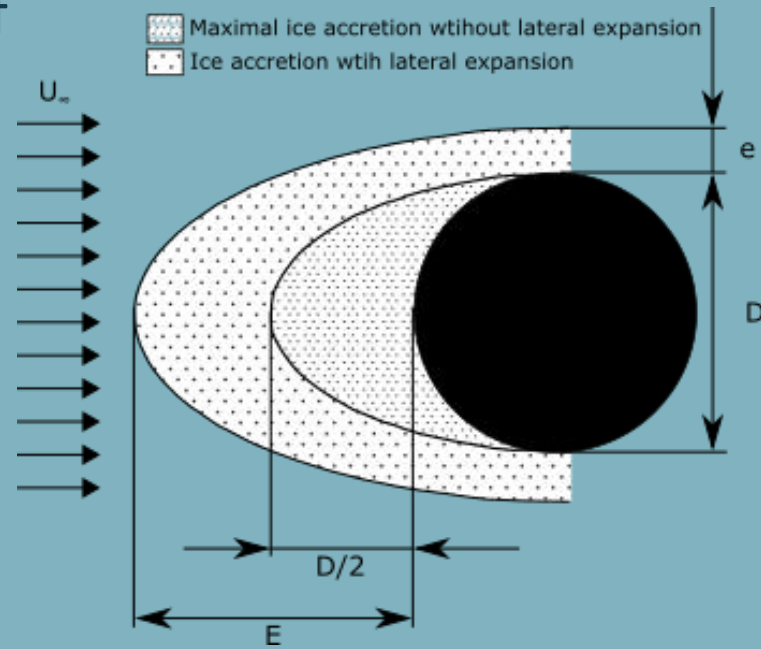
Meteorological conditions measurement station: MCMS

- Wind chill analogy
- Severity = $f(\text{LWC}, U, \text{MVD})$
- Droplet impingement flux
- Other measurements
- Time series data



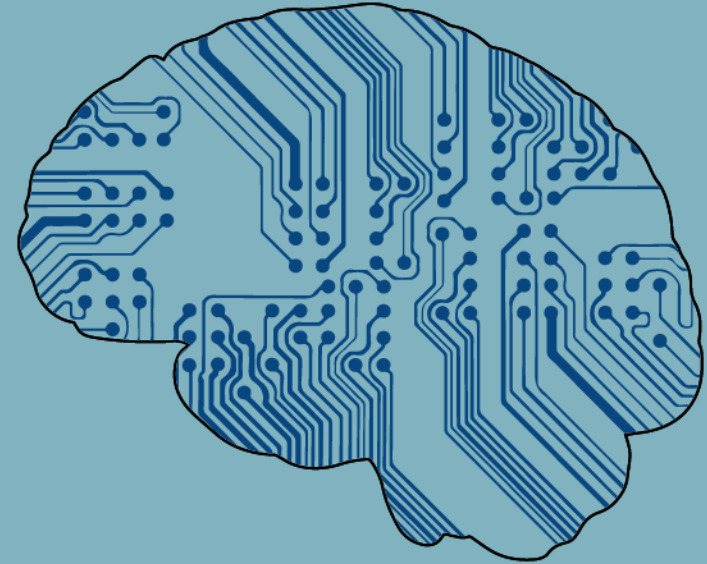
Calibration

- Based on the equations of ISO-12494
- Backed by visual measurements



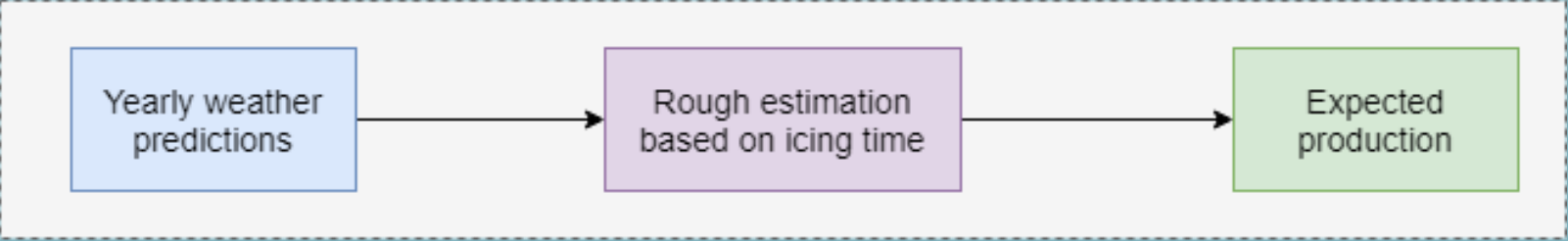
Objectives

- Virtual wind turbine
- Time dependent phenomena
- Machine learning
- Practice on actual wind turbine

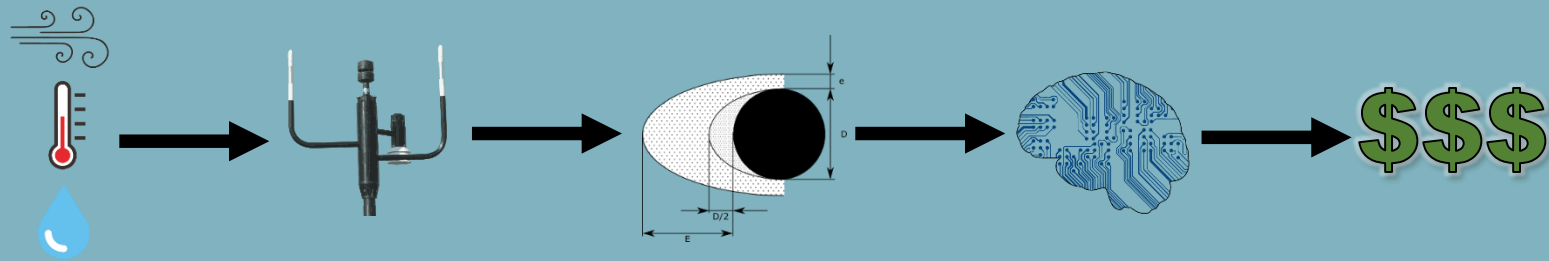
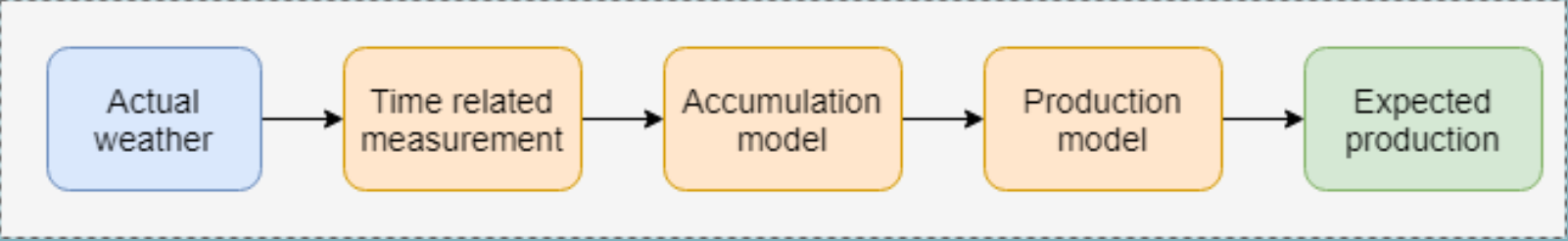


Model structure

Traditionnal evaluation

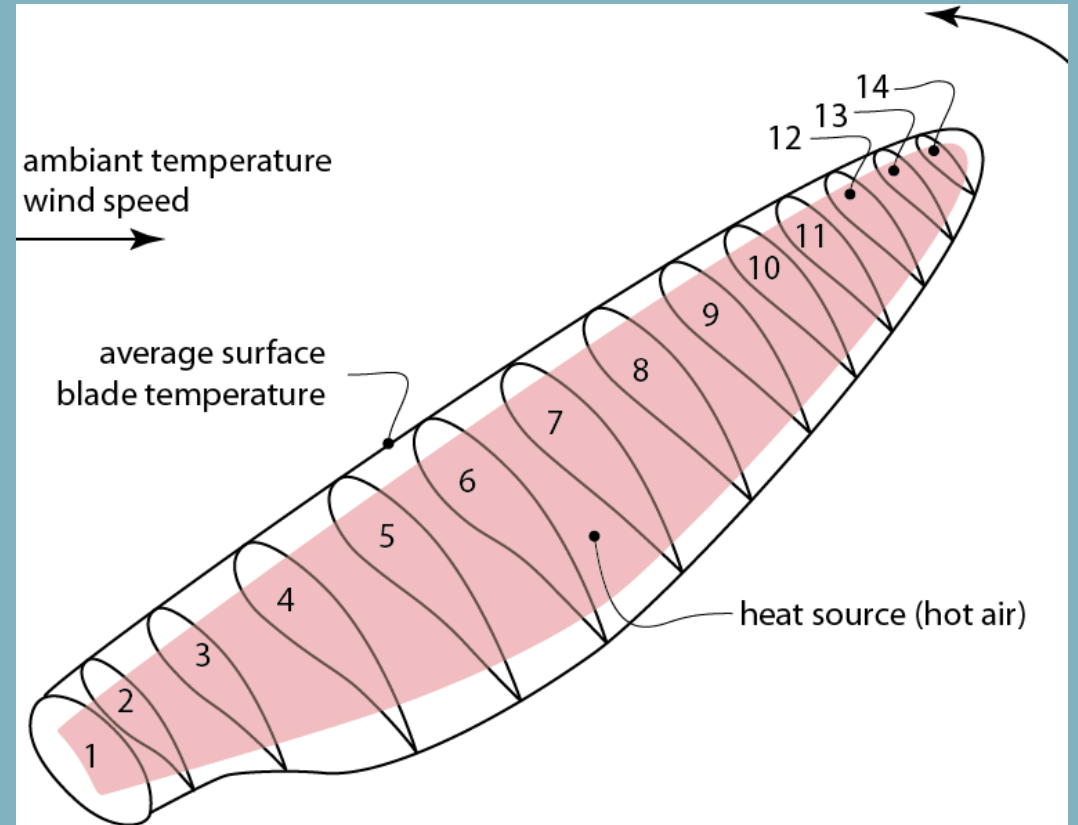


Proposed method



Accretion model

- 1-D model (14 sections)
- Cylindrical blade (upscaling)
- On each section:
 - Heat balance : surface temperature
 - Mass balance : ice thickness

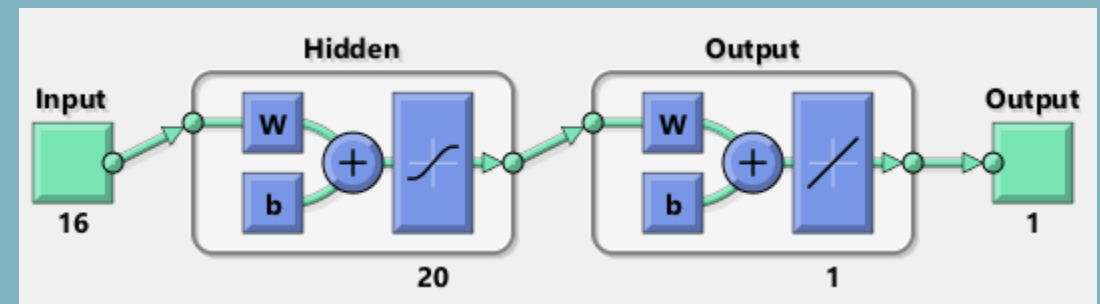


Production model

- Function of:
 - Wind speed
 - Mass of ice on each section
 - Type of ice (density)
- Complex interaction
- Neural network

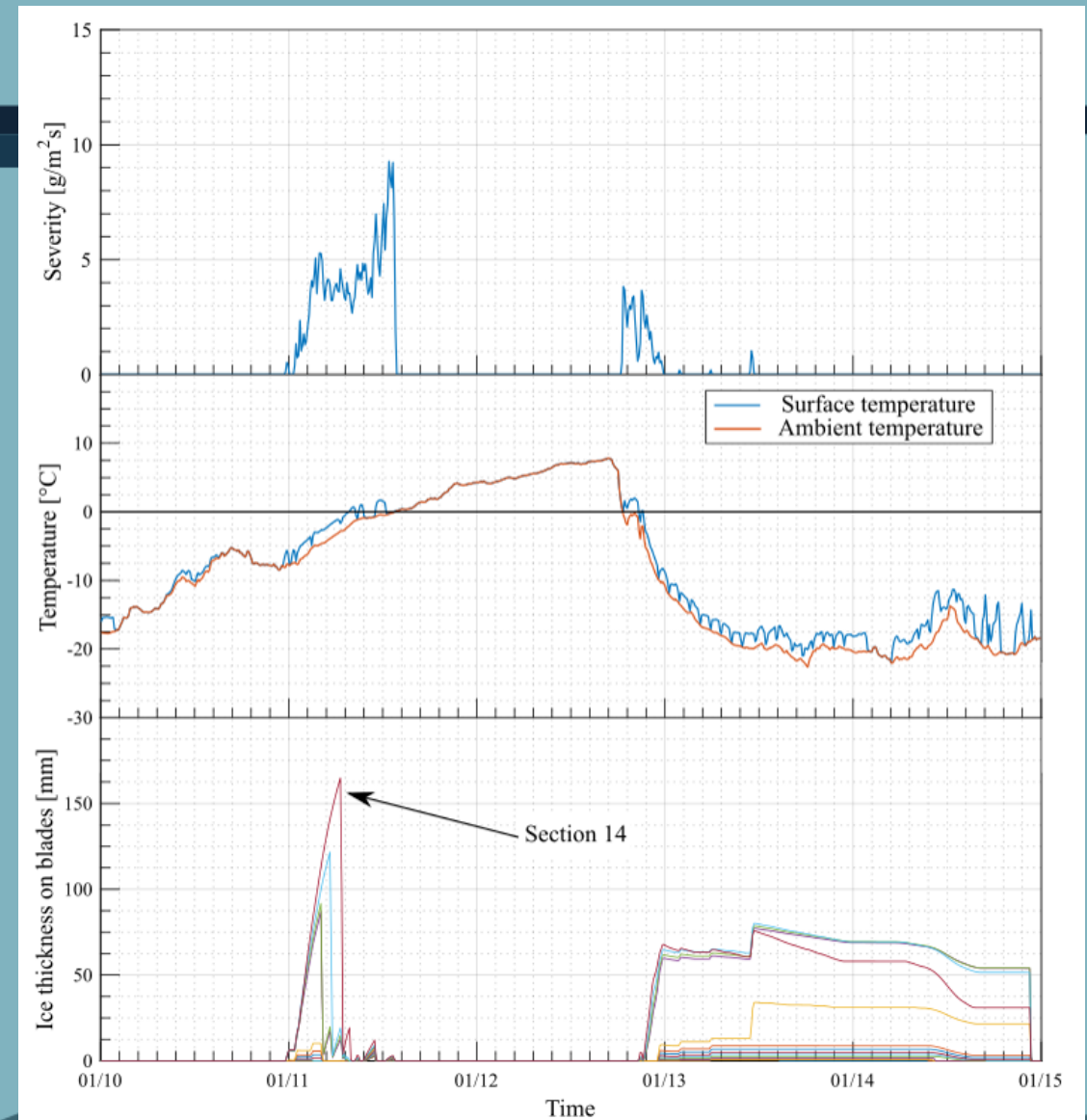


Source : bigdata.black

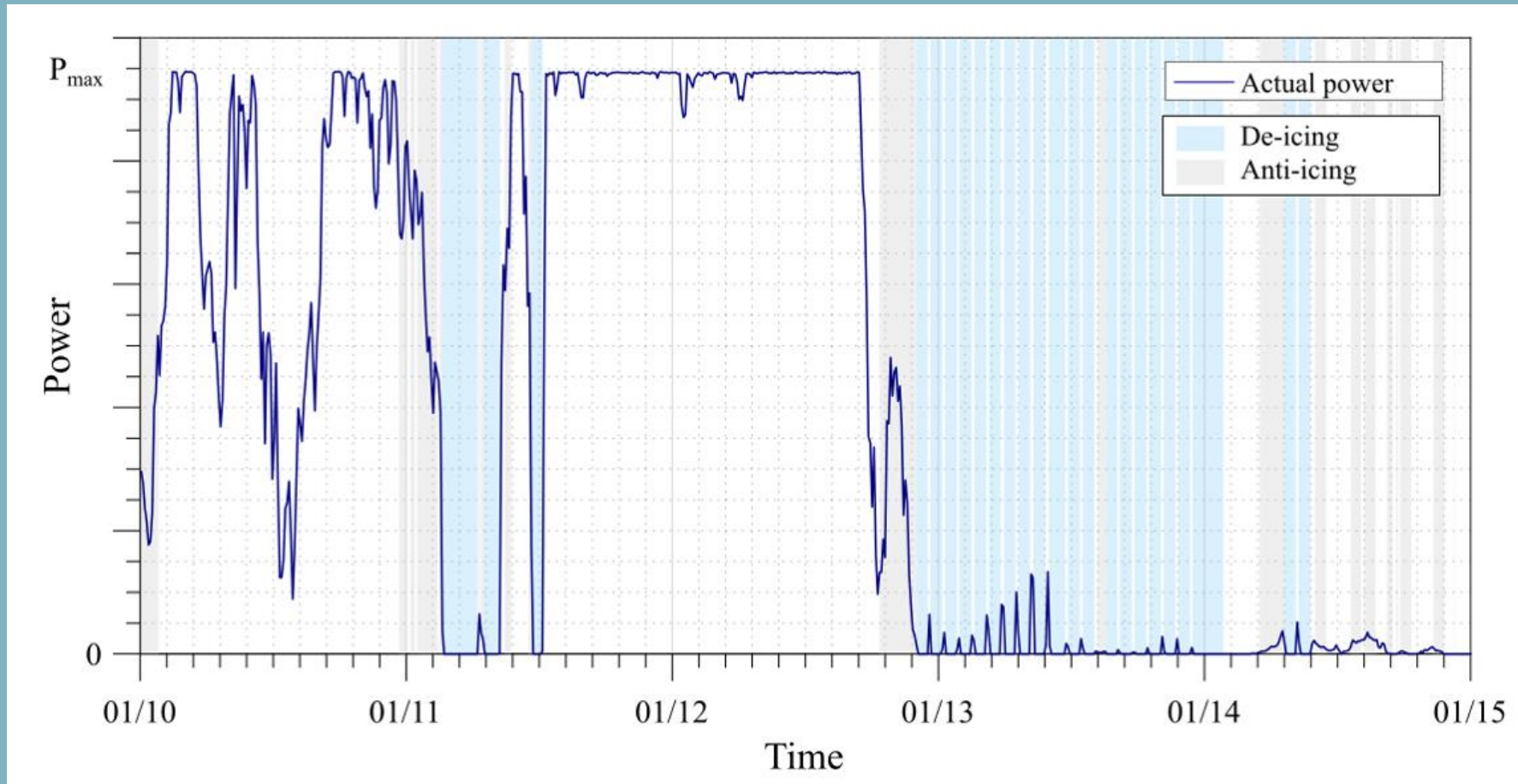


Preliminary results

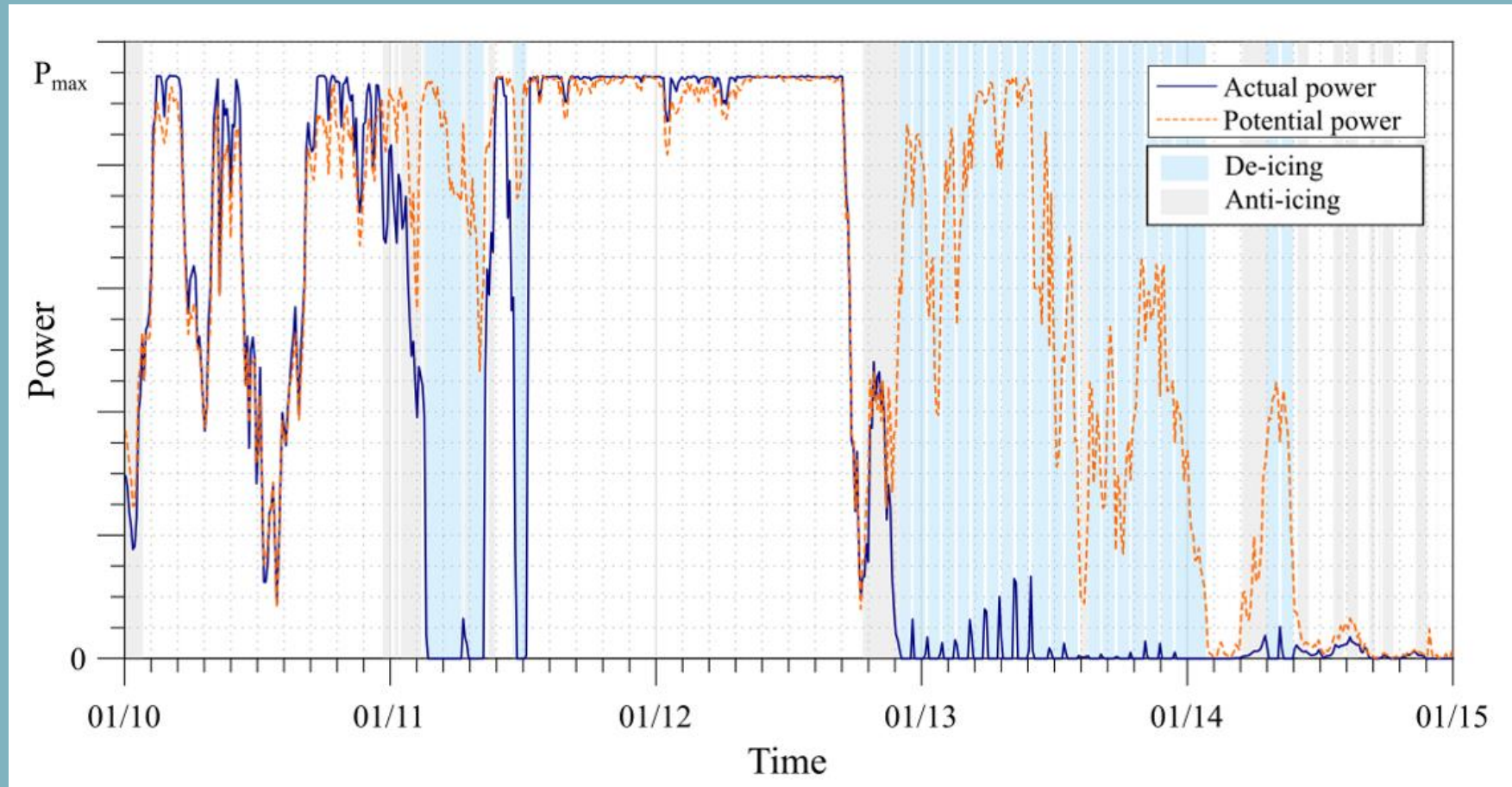
- On the figure:
 - Icing severity
 - Temperatures (blade surface and ambient)
 - Ice thickness on each sections (colors)



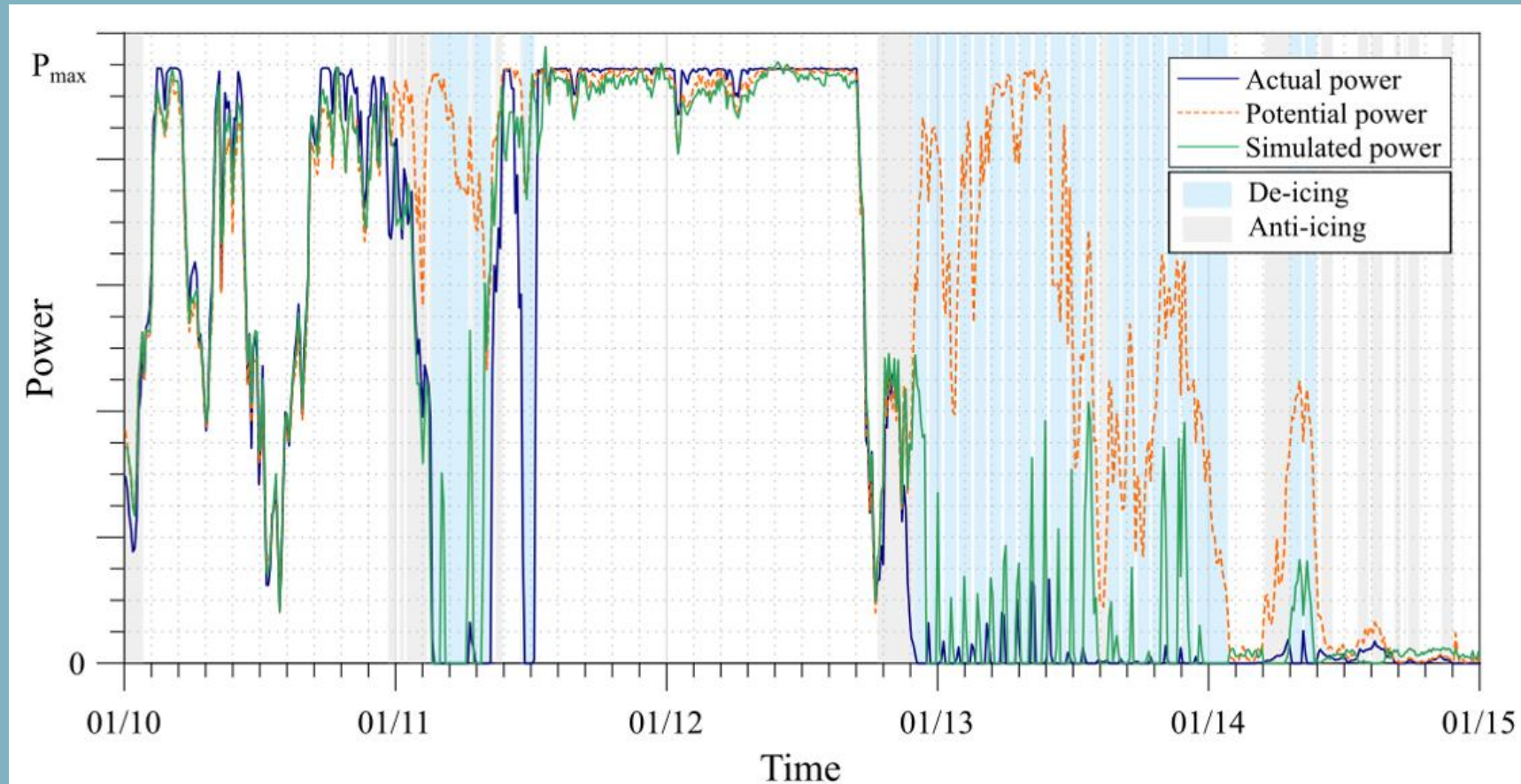
Preliminary results



Preliminary results



Preliminary results



Further work

- Train the model on more events (new version of the MCMS)
- Refine the accretion model
- Investigate on the blade thermal characteristics
- Try a physical approach for the production model



Source: <https://icones8.fr/icon/1538/chapeau-de-dipl%C3%B4me>
<https://www.eon.com/en/new-energy/new-energy-world/5-myths-of-wind-energy.html>

