On the performance of ice detection methods used in wind energy: a long-term field study

Winterwind 2023

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NERGICA
Renewable Energy Research and Innovation

Andermatt, 2018

Task 19 General Meeting

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Task 19 2019-2021 Work Plan

Performance evaluation guidelines for ice detection systems

The research project

Performance of ice detection methods used in wind energy

3-year project, 2019-2022
Total project value 96 000 $

More details about the project here: https://nergica.com/en/un-projet-de-recherche-sur-la-performance-des-methodes-de-detection-du-givre/

Funded by

Fonds de recherche Nature et technologies Québec

Experimental setup

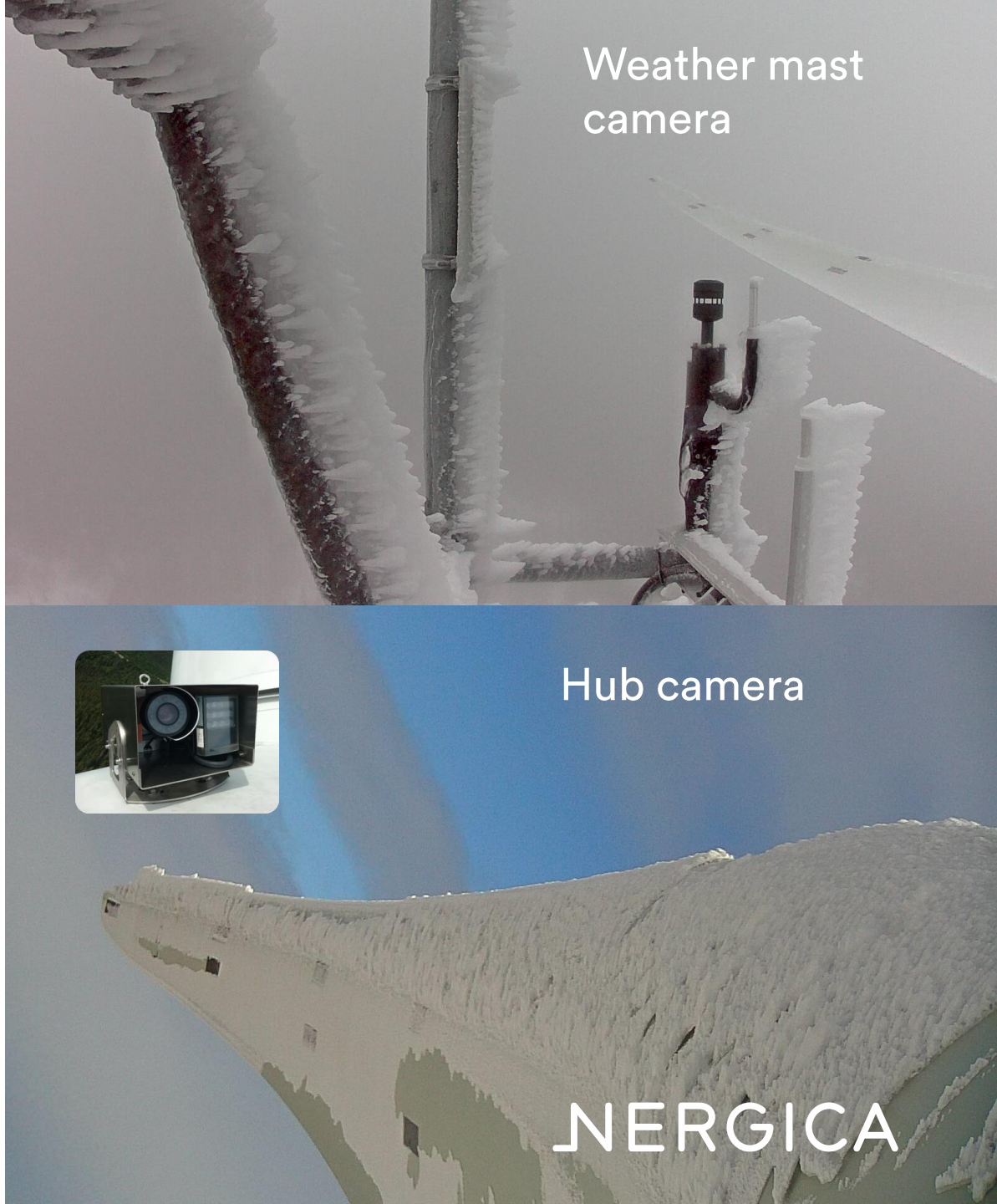
Two Senvion MM92 2 MW wind turbines

Rotor icing detection

- Power curve
- Eologix
- Fos4x (Polytech) fos4Blade
- Weidmüller BLADEcontrol
- Hub camera (Reference)

Met/Instrumental icing detection

- Double anemometry
- Weather mast camera (Reference)



Experimental setup

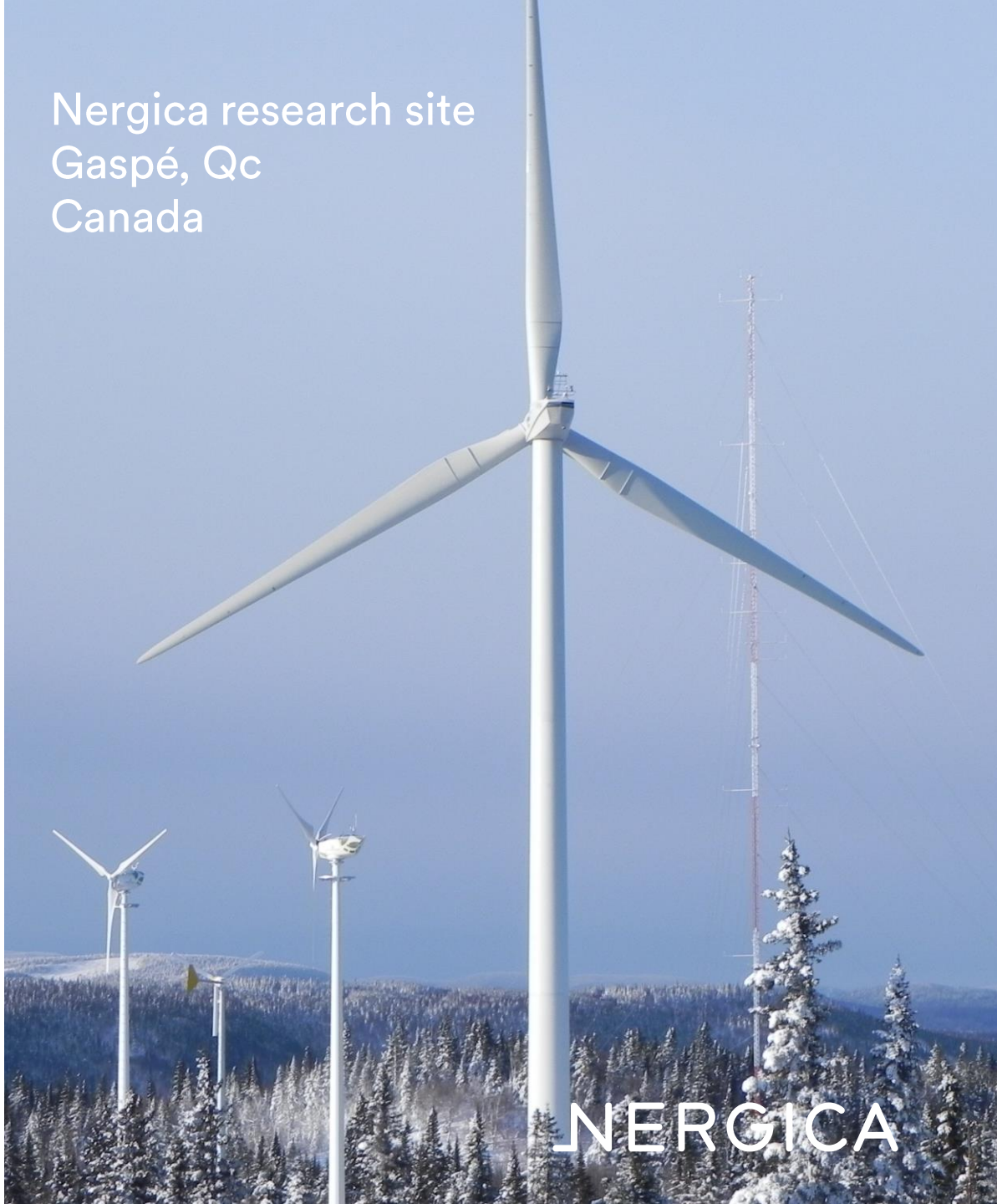
Two 126 met masts

Meteorological icing detection

- Labkotec LID-3300 IP
- Combitech IceMonitor
- Goodrich 0871LH1
- Goodrich 0872F1

Instrumental icing detection

- Double anemometry
- Combitech IceMonitor



Data analysis

3 years

11 ice detection methods

13 performance metrics

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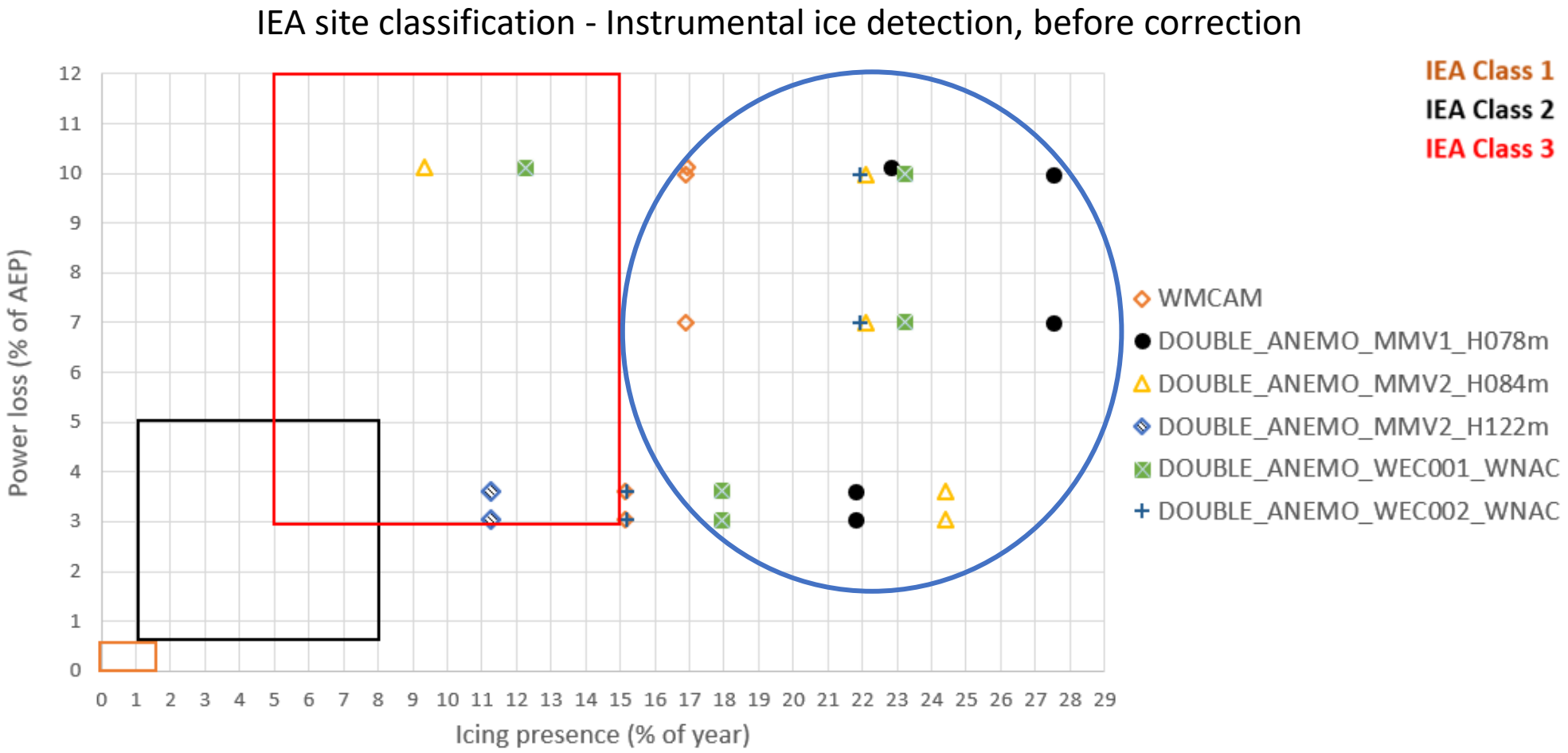
Key result 1 – Redefinition of IEA Ice Classes



Several measurements outside of IEA ice class definition

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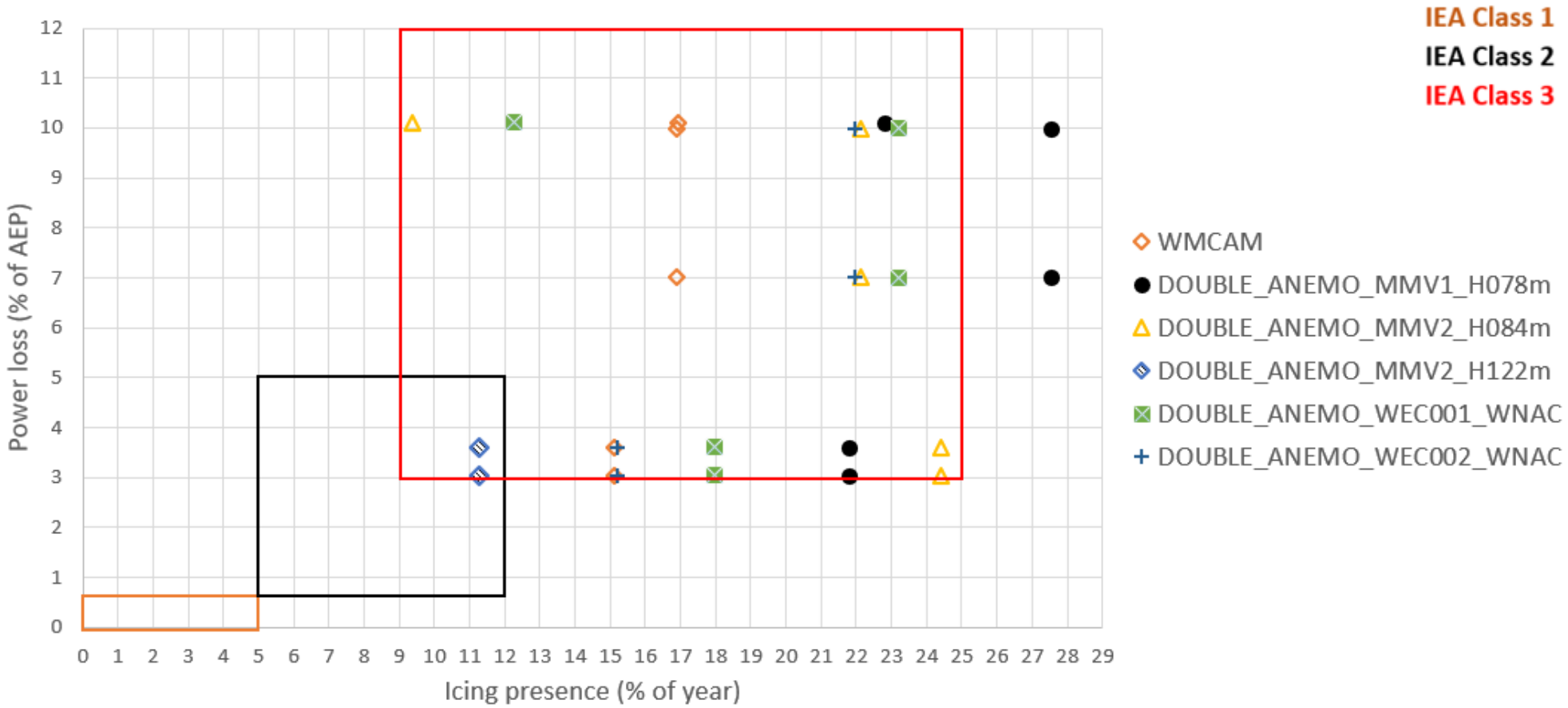
Key result 1 – Redefinition of IEA Ice Classes



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Key result 1 – Redefinition of IEA Ice Classes

New!

IEA Ice Class	Meteorological Icing	Instrumental Icing	Rotor Icing	Reduced Production
	% of year	% of year	% of year	% of AEP
5	≥ 15	≥ 30	≥ 20	> 20
4	8 - 15	20 - 40	10 - 30	10 - 25
3	4 - 8	9 - 25	3 - 10	3 - 12
2	1.5 - 4	5 - 12	1.5 - 5	0,5 - 5
1	0 – 1.5	0 - 5	0 – 1.5	0 - 0.5

Same production loss bands

Wider icing duration periods

Introduction of rotor icing duration

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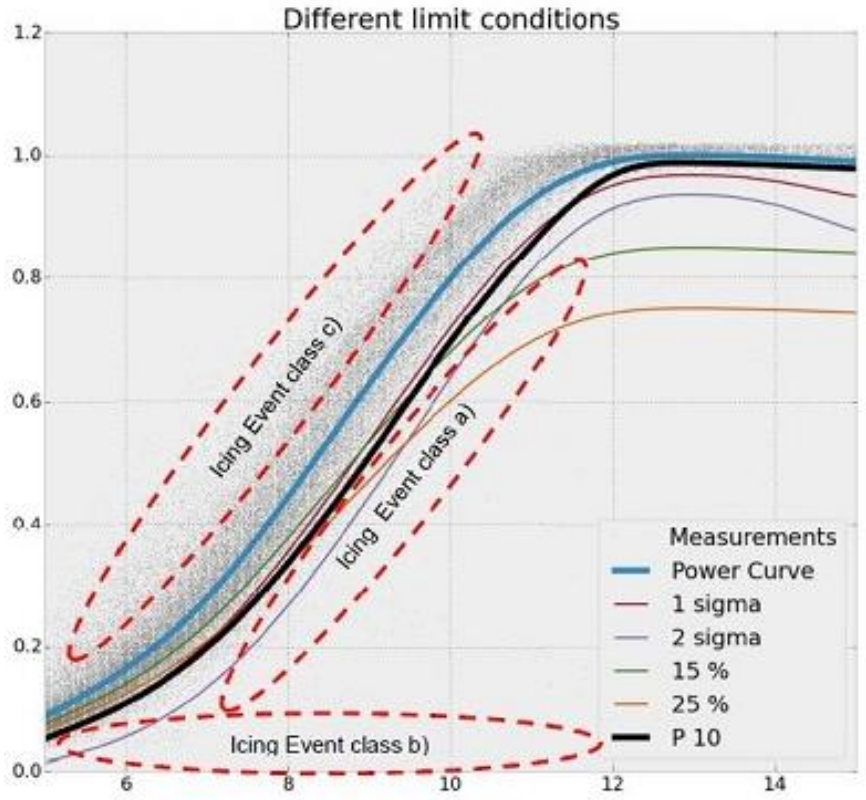
Key result 2 – Change sensitivity in ice loss method

Per measured icing losses, Nergica site is IEA Class 3

Using P10 threshold for power curve ice loss method, rotor icing duration is underestimated when compared to other rotor icing detection methods.

Recommended to use P30 to make rotor icing detection more sensitive and increase rotor icing duration.



IEA Ice Loss Method

Key result 3 – Expand IEA ice class definitions

Reduction of icing time by 20 % can mean 3.3 times less production losses.

Increase of icing time by 5% can translate into 2.8 times more production losses.

Icing duration is not a good indicator for projecting icing losses on a wind site.

Other parameters should be introduced in IEA ice classes definitions to better assess icing losses.

Year	Icing loss [% of AEP]		Instrumental icing presence [hours]
	Turbine A	Turbine B	Double anemometry
Y1	7	10	2400
Y2	3.6	3	1900
Y3	10.1	—	2000

Summary

- 3 year research project
- 11 ice detection methods compared using 13 different performance metrics
- Recommendation to review the IEA ice classes limits and introduce definitions for rotor icing
- Recommendation to use P30 instead of P10 for rotor icing detection threshold with IceLoss Method
- No correlation between icing duration and production losses, other parameters required for site icing categorization
- Full study to be publicly available soon

Thank you for your attention!

Let’s connect!

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References

IEA Wind TCP Task 19, “Available Technologies for Wind Energy in Cold Climates - 2nd Edition”, 2018

IEA Wind TCP Task 19, “Ice Detection Guidelines for Wind Energy Applications”, 2021

IEA Wind TCP Task 19, “Ice Loss Method”, https://iea-wind.org/task19/t19icelossmethod/

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