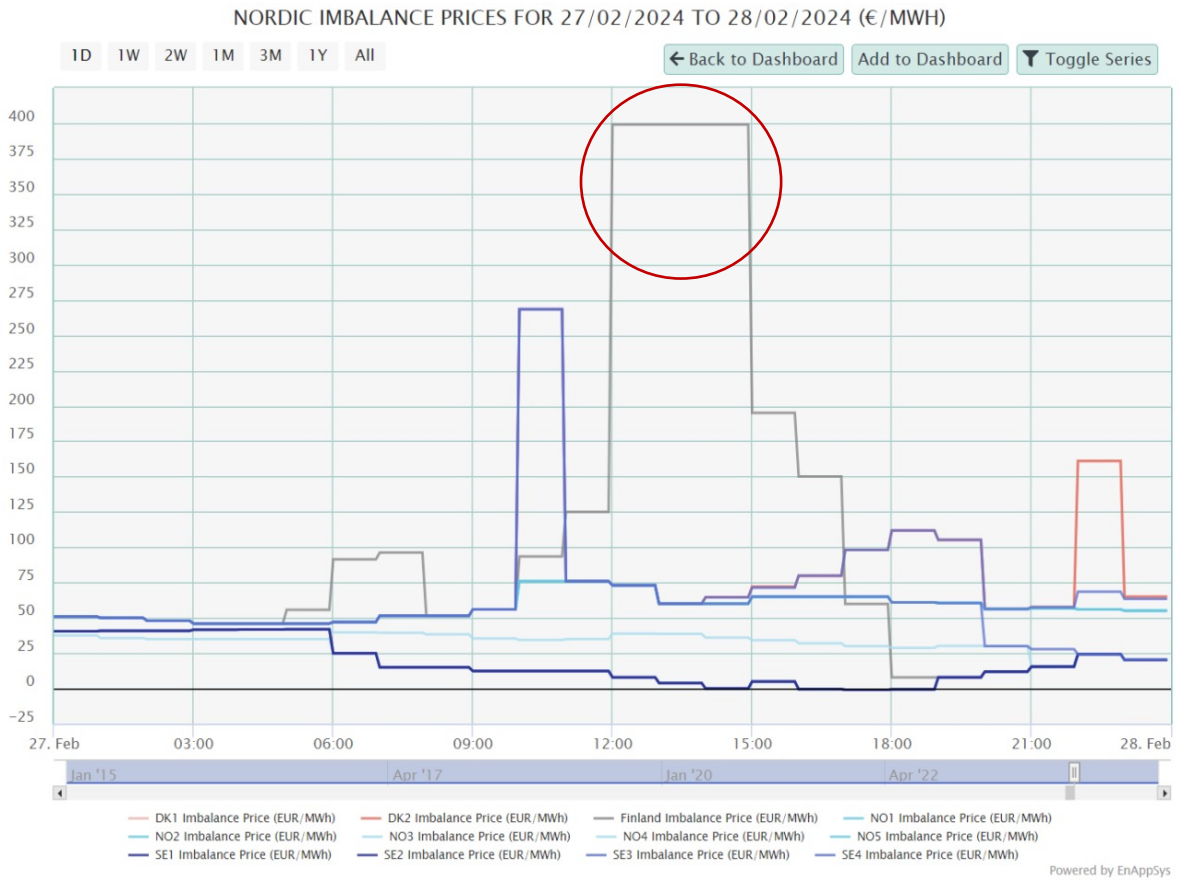
ConWX

Data Driven Modelling of Icing Events and Power Loss for Wind Parks

Li Bai

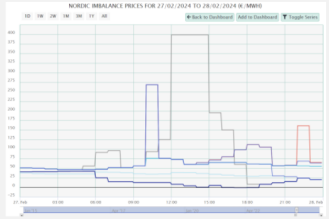
Why icing forecasts?



Most relevant

Priyanka Shinde Author
PhD | Nordics Market Expert at Montel Analytics
1w

Nordic imbalance prices in CET for 27th Feb:



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Lasse Hietikko • 2nd
Senior Wind Power Specialist, Ramboll
1w (edited)

On Tuesday there was rather big amount of Finnish wind power missing due icing. The constantly updated wind power forecast showed increasing numbers while the realized production was decreasing. At 13.00 EET the difference between updated forecast and realized production was 450 MW and one hour later 521 MW.

This is a good example how difficult it is to forecast wind power production when there is ice on turbine blades.

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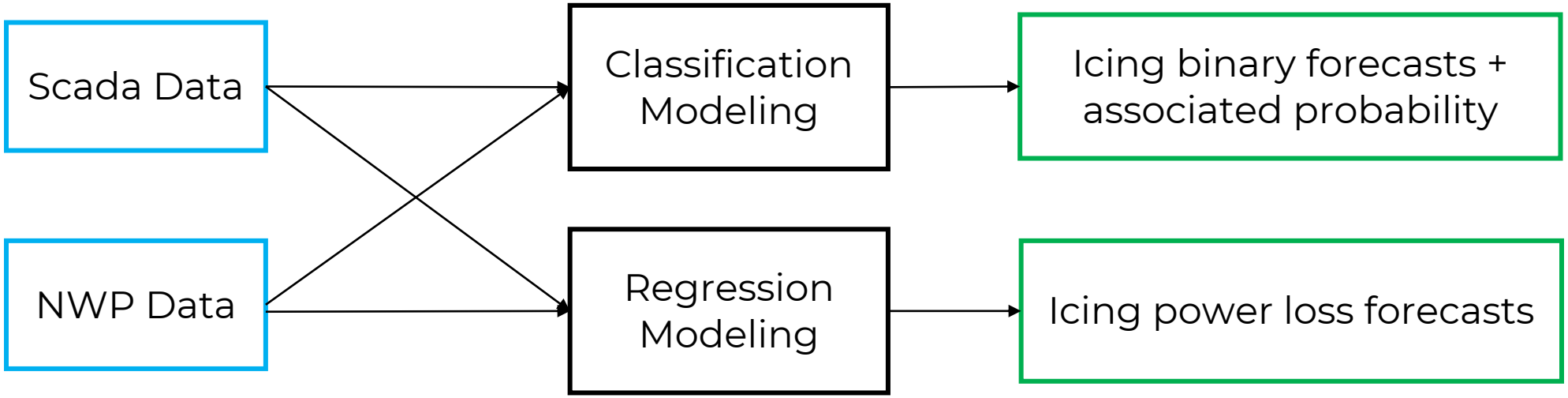
https://media.licdn.com/dms/image/D4D2CAQFfn6cP2CnuoA/comment-image-shrink_8192_1280/0/1709196705537?e=1710867600&v=beta&t=2CfQ_5IbHbgyG6YLE0OtSb5anL2fBc-D_ut4m5mLgzo

Icing modelling - Challenges

What to model?

What are the data?

How to model?



From data to forecasts

Data → Forecasts

What is an icing event?

What is icing power loss?

Turbine? Park!?

SCADA data

- turbines without icing detection
- turbines with icing signals

↓

Labelled data

- turbines/parks icing events
- turbines/parks icing power loss

Turbine level

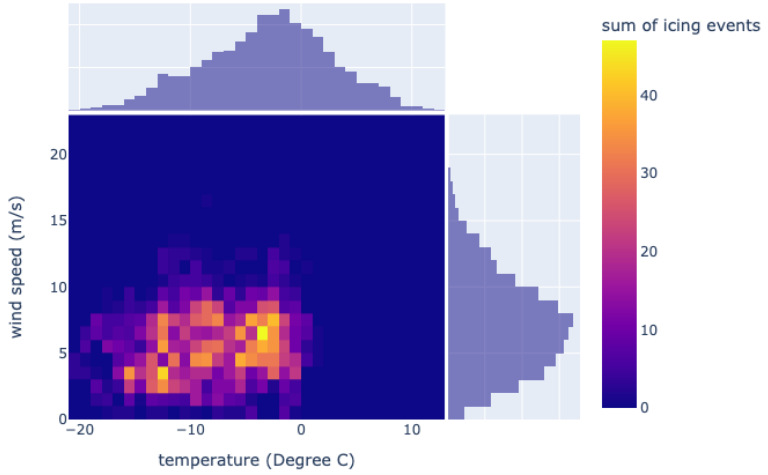
↓

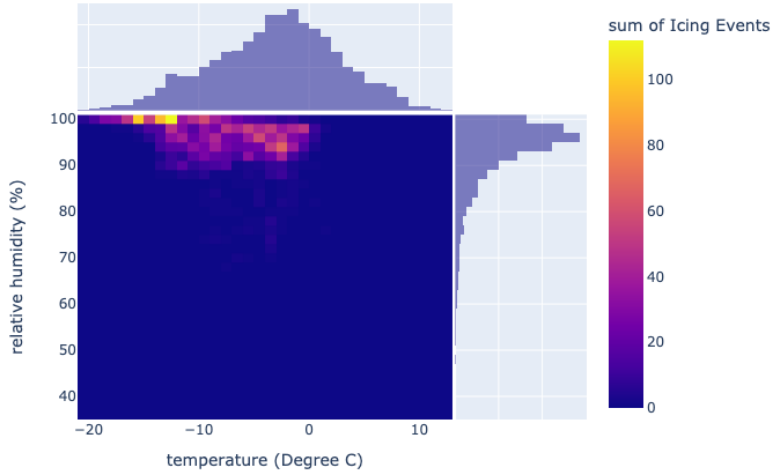
Park level

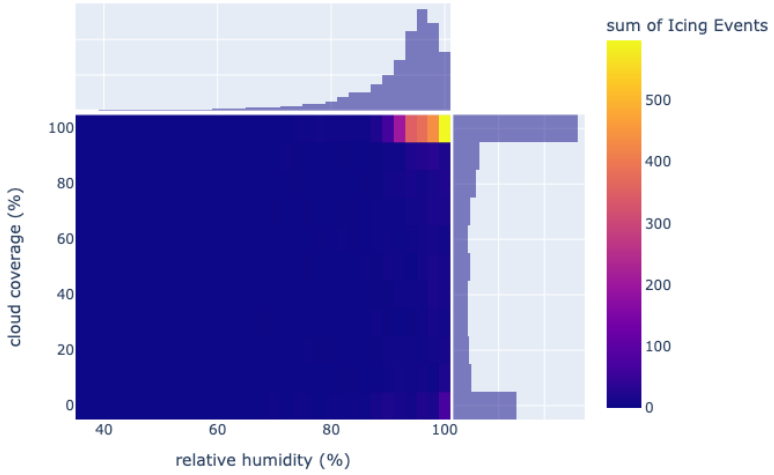
Modelling

Features

- ❑ **wind speed**
- ❑ **temperature**
- ❑ **visibility**
- ❑ **cloud coverage**
- ❑ **humidity**
- ❑ **altitude**

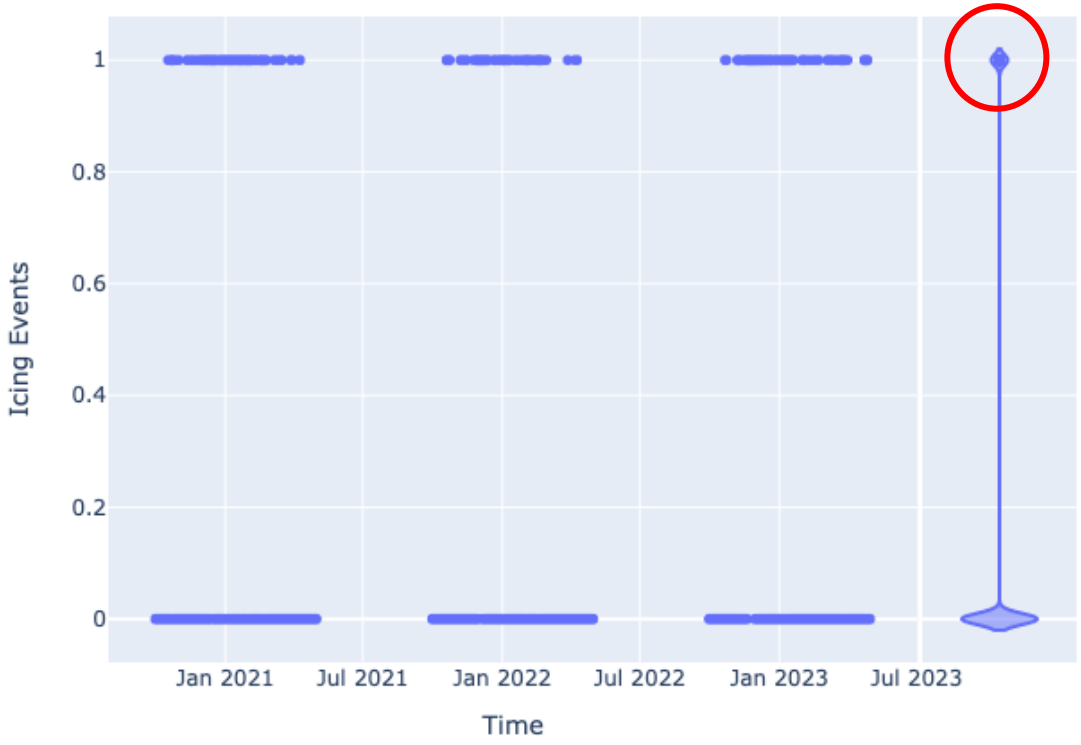


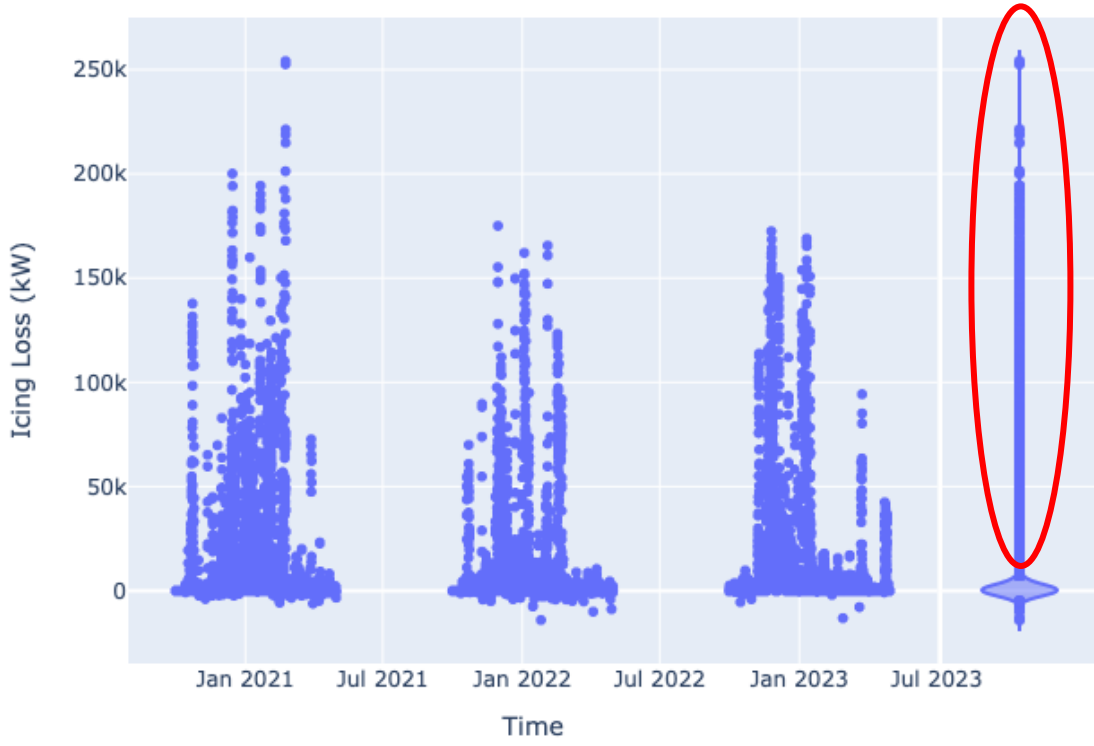




Modelling

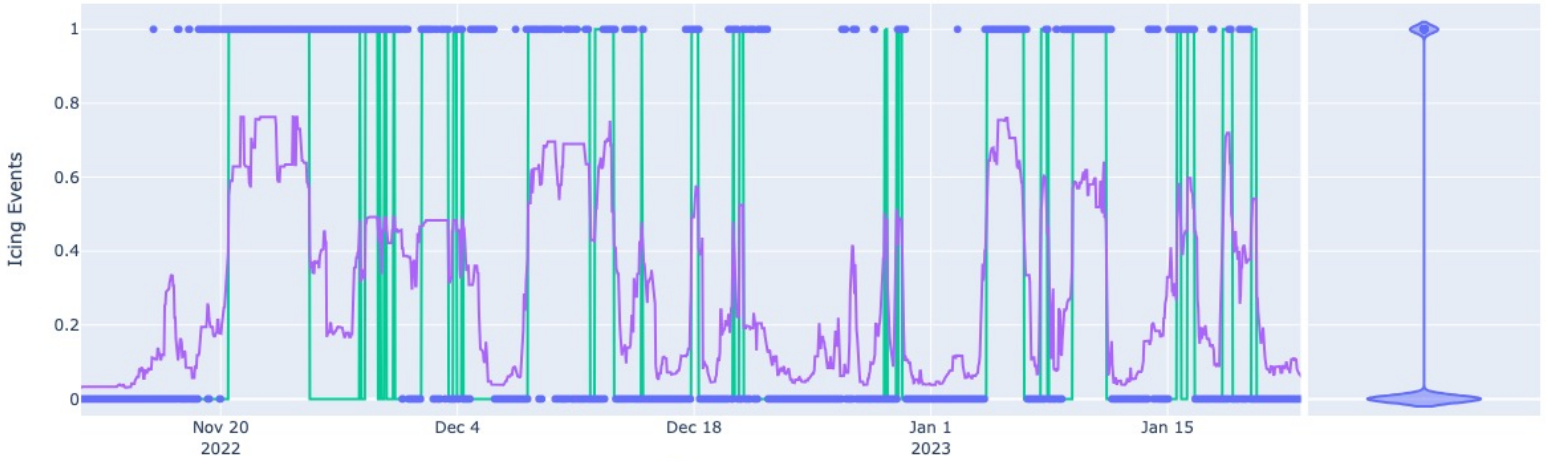
Highly imbalanced/skewed data

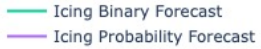




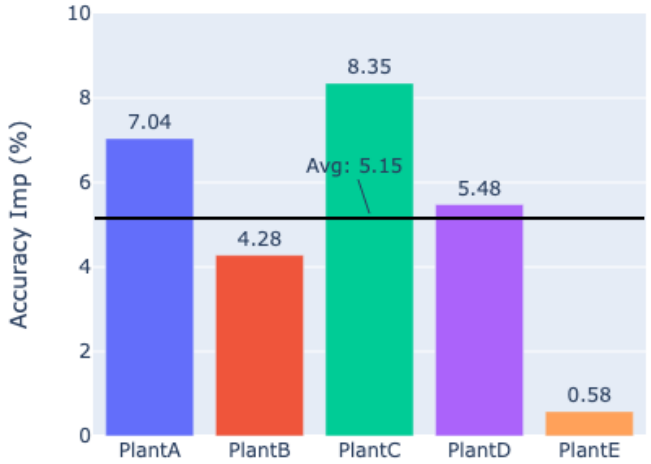
Results

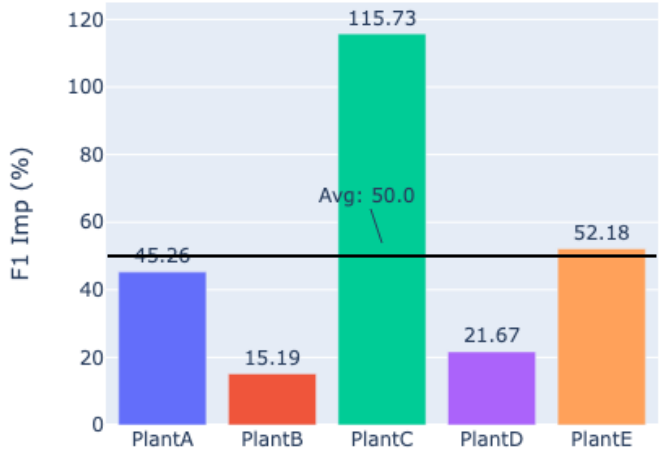
Binary forecasts





Predicted Values	Actual Values: Positive	Actual Values: Negative
Positive	True Positive (TP)	False Positive (FP)
Negative	False Negative (FN)	True Negative (TN)





F1 score

(harmonic mean of precision and recall)

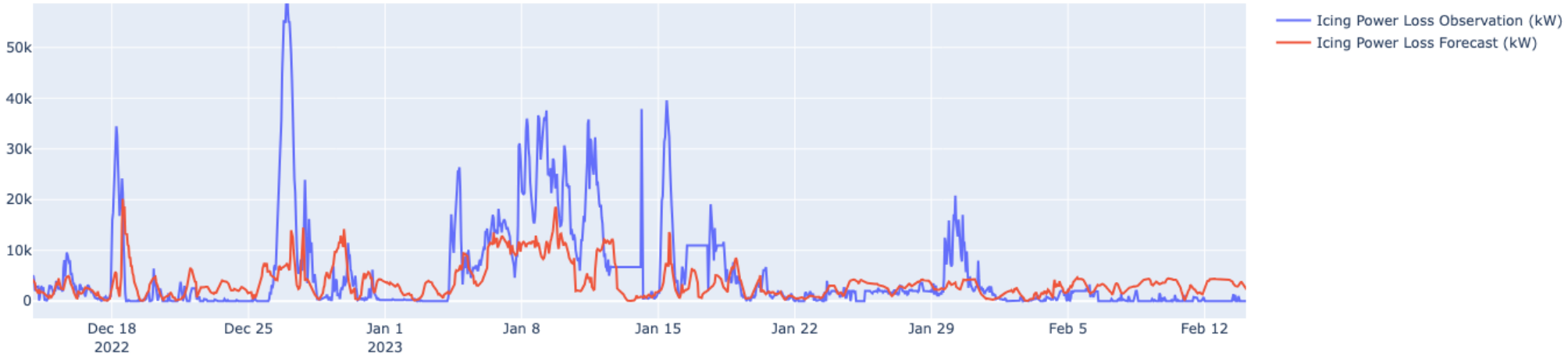
$$\textbf{Precision} = \frac{TP}{TP+FP}$$

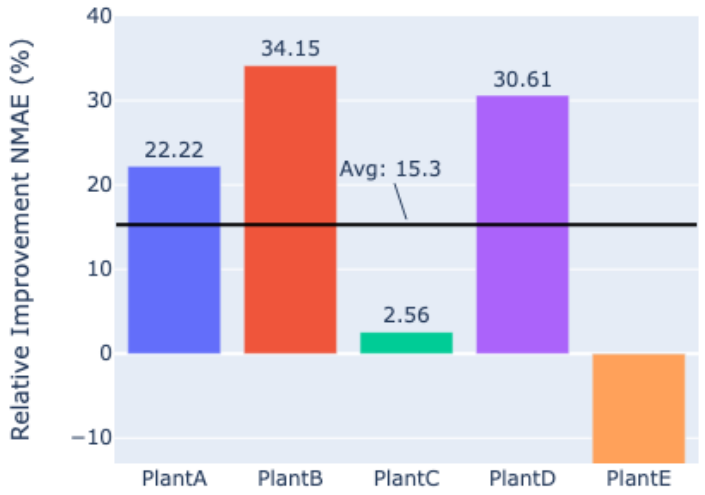
$$\textbf{Recall} = \frac{TP}{TP+FN}$$

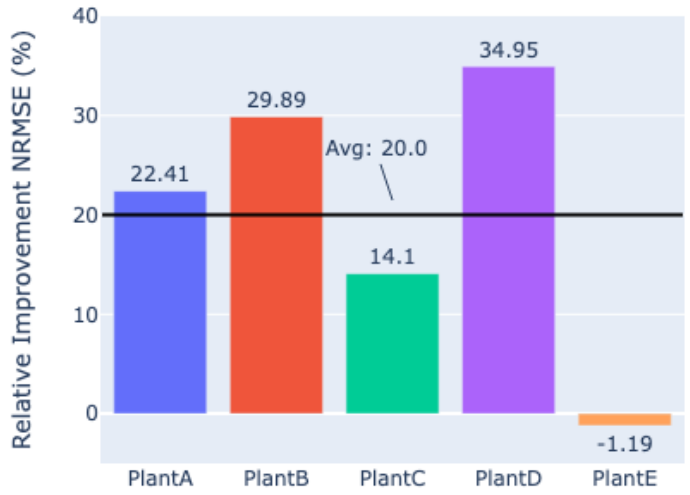
Improvement is compared to last season before we focused on the main challenges!

Results

Power loss







Improvement is compared to last season before we focused on the main challenges!

Next steps

Classification models

convert the probability of binary events to user common sense of probability

Regression models

better modelling towards highly-skewed data

add icing power loss probabilistic forecasts

No SCADA data

build physical alternative models

Modelling (take a step back)

model from turbine to park level

Evaluations

build fair evaluation metrics rather than traditional ones

ConWX

Thank you

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