Using machine learning to classify LE erosion

Loek van der Linde

lecturer & researcher

manager Data Science lab @ Joint Research Centre Zeeland

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Work Package 6.2 – Classification of arbitrary data into categories

Class	Name	Depth (mm)	Area (mm)
1	Small pits	< 0.2	< 2
2	Pits	< 0.2	2 - 5
3	Small gouges	0.3 – 0.5	5 - 20
4	Gouges	0.5 – 0.8	20 - 50
5	Delamination	> 0.8	> 50

Images from
Gaudern, *A practical study of the aerodynamic impact of wind turbine blade leading edge erosion*.
Doi: 10.1088/1742-6596/524/1/012031

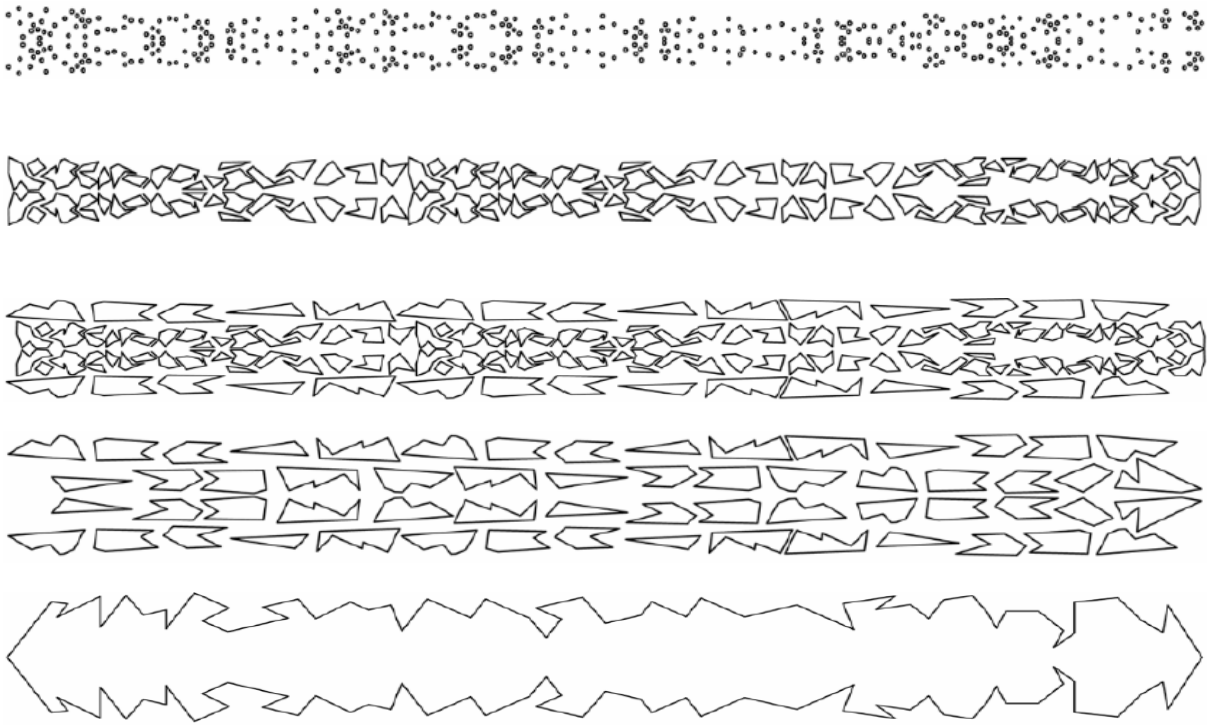

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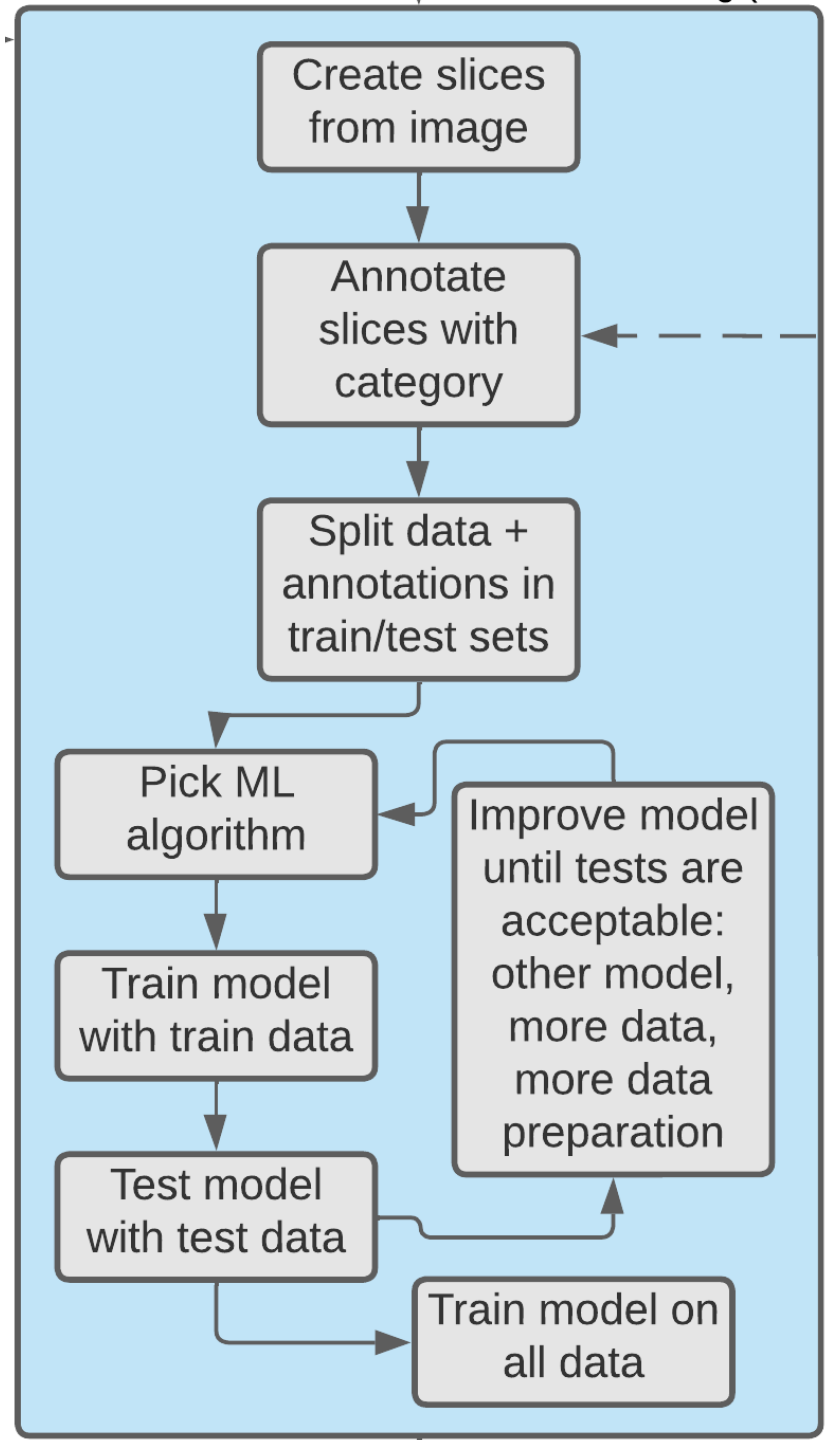
Image: https://www.windpowerengineering.com/fraunhofer-researches-prevent-rain-erosion-turbine-blades/



Approach

- Slices of 10 laser lines

  +/- 10 millimeter

- Three machine learning models:

1. Logistic regression
2. Support Vector Machine
3. Random Forest

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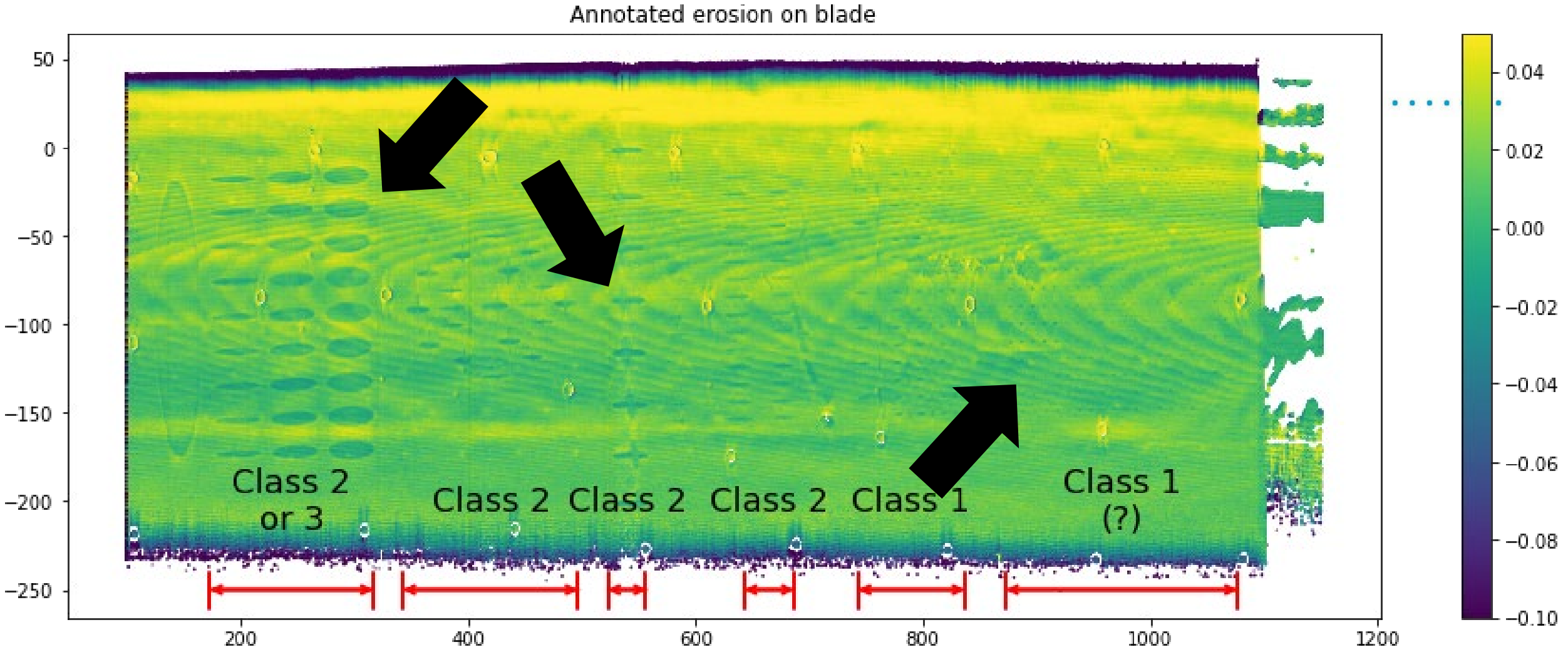

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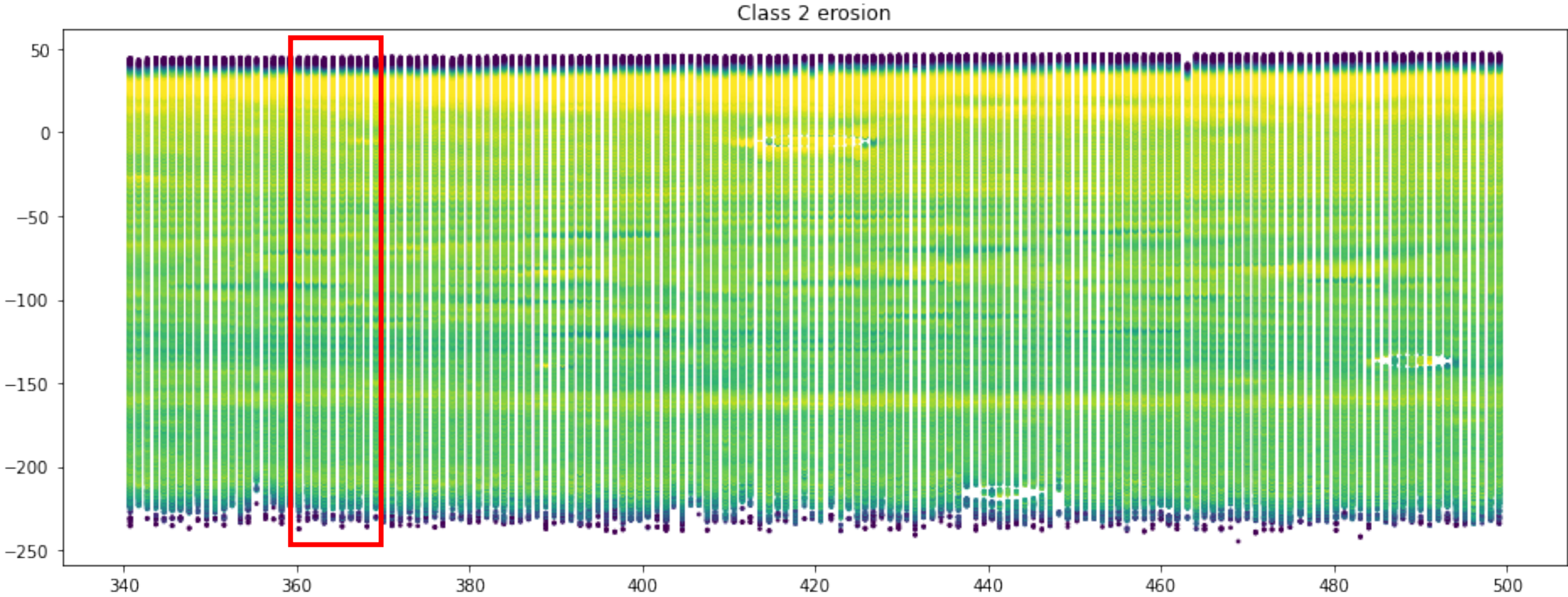

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Results – Support Vector Machine

Sample size: 33 slices

Accuracy: 63.6% ▲
Precision: 64.1% ▲
Recall: 69.1% ▲

ACTUAL \ PREDICTED	Class 0	Class 1	Class 2
Class 0	13	0	1
Class 1	4	0	0
Class 2	7	0	8

Accuracy: how many correct?
Precision: how many predicted classes are actually of that class?
Recall: how many actual classes did we find?

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Conclusions

Machine learning

- Support Vector Machine works best*
- Results aren’t stellar but better than expected
- More data = (very very probably) better results

* Technical questions? Please find me and I’ll share code!

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Conclusions

Process

- Able to classify 5 different categories of erosion
- Able to prove workflow leads to usable results
- Able to prove that machine learning can detect small patches of erosion

- Online processing seems difficult given processing times + energy consumption
- Offline/offloaded processing might be good enough

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Any questions?
Find me here or get in touch!

loek.linde@hz.nl

Want to do a project with us and our students? Let us know!
Martijn.molenaar@hz.nl

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