

Icing intensity evaluation based on LID-3300IP Ice Detector measurements

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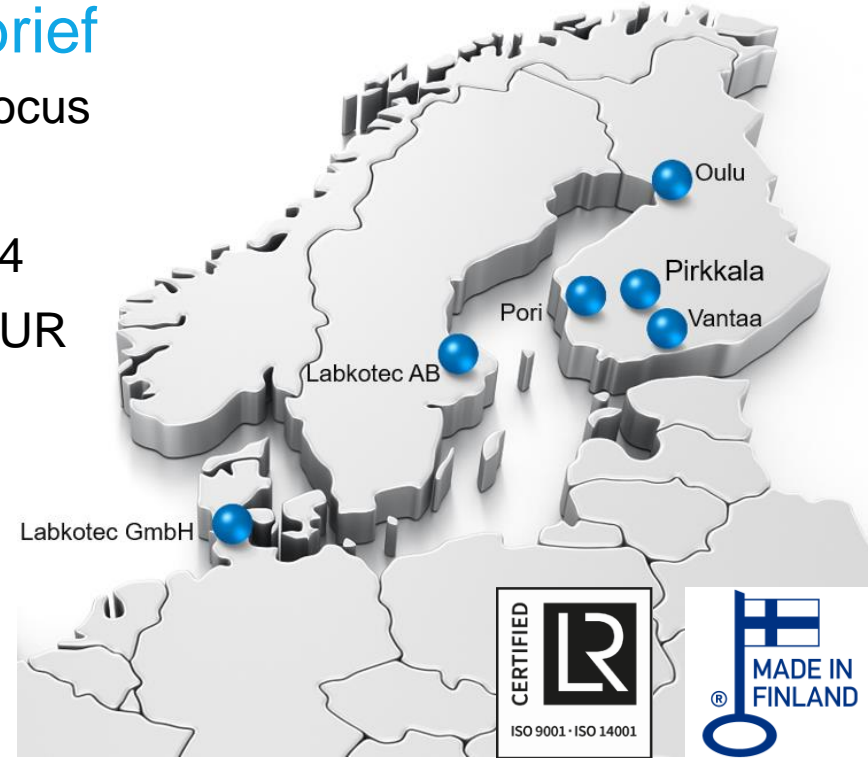


Labkotec in brief

- Environmental focus
- Sustainability
- Established 1964
- Turnover 12 MEUR
- Personnel 50+

Business areas

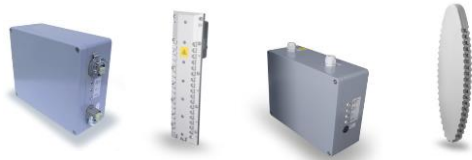
- Ice detection systems
- Oil and grease separator alarms
- Level measuring and monitoring
- LabkoNet[®] remote monitoring system



Ice detector product and system portfolio

←
Past
(since 1990's)

→
Present
(2010 - today)



LID-3210C
LID-3210D



LID-3300IP
Ice Detector



LabkoNet.com
remote monitoring

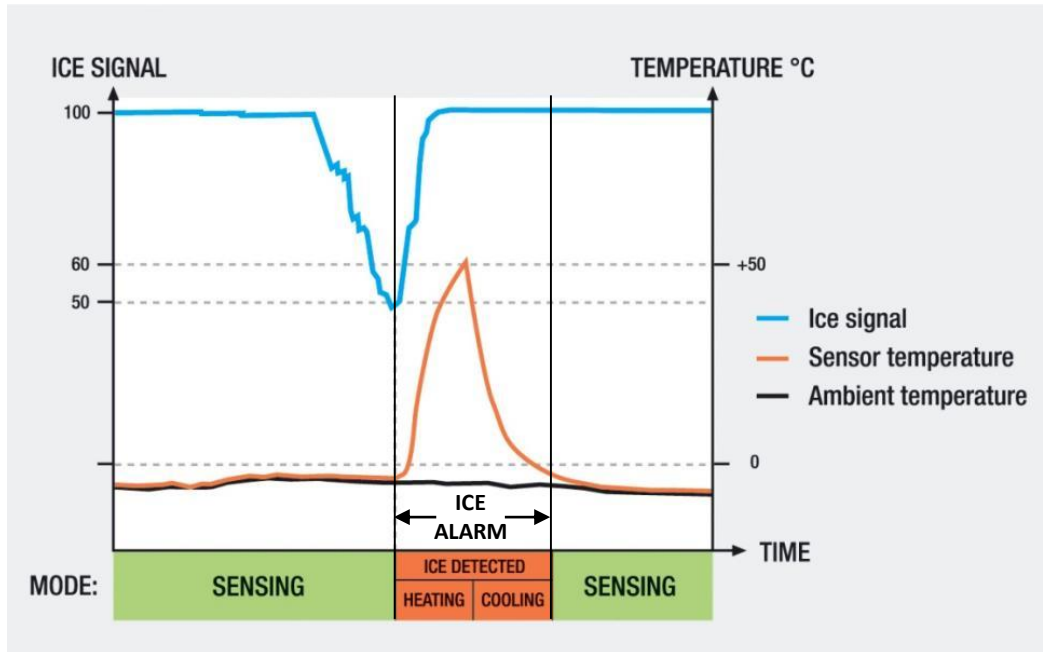


LID-3300IP with
overvoltage protection



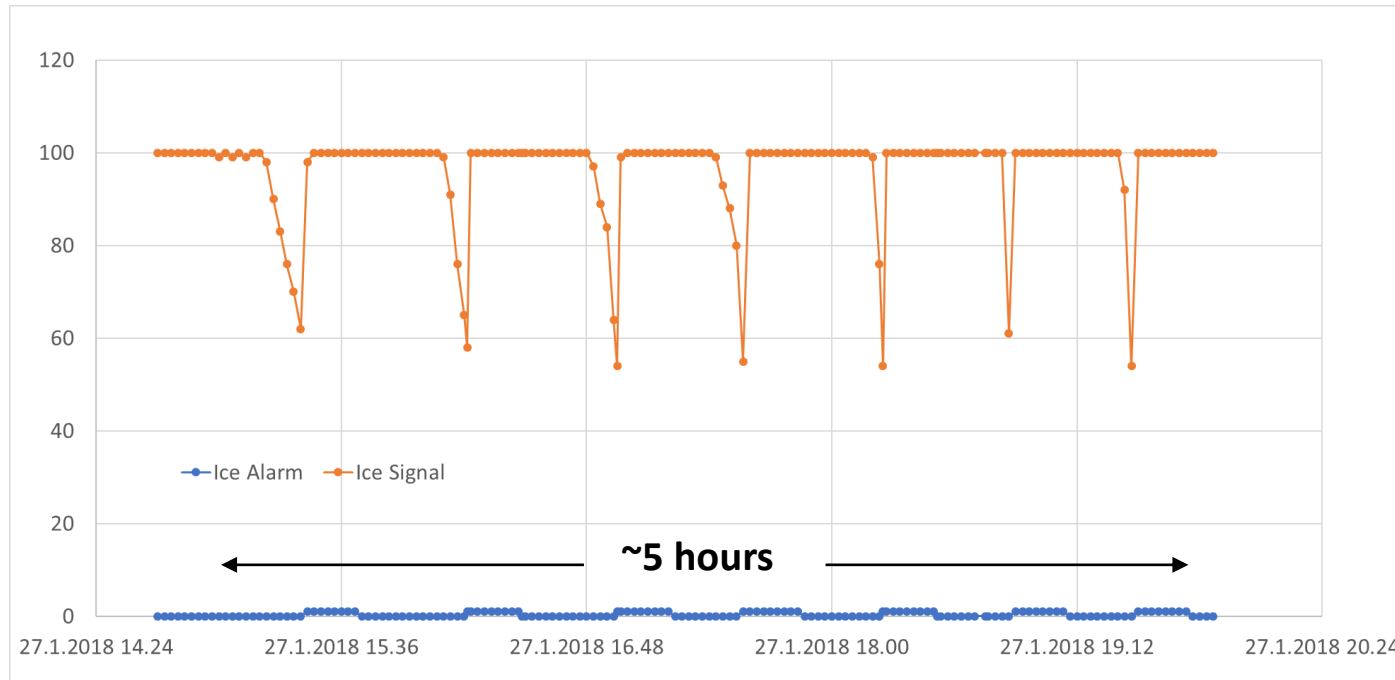
Ice warning
systems for
wind farms

Basic operating principle of LID-3300IP

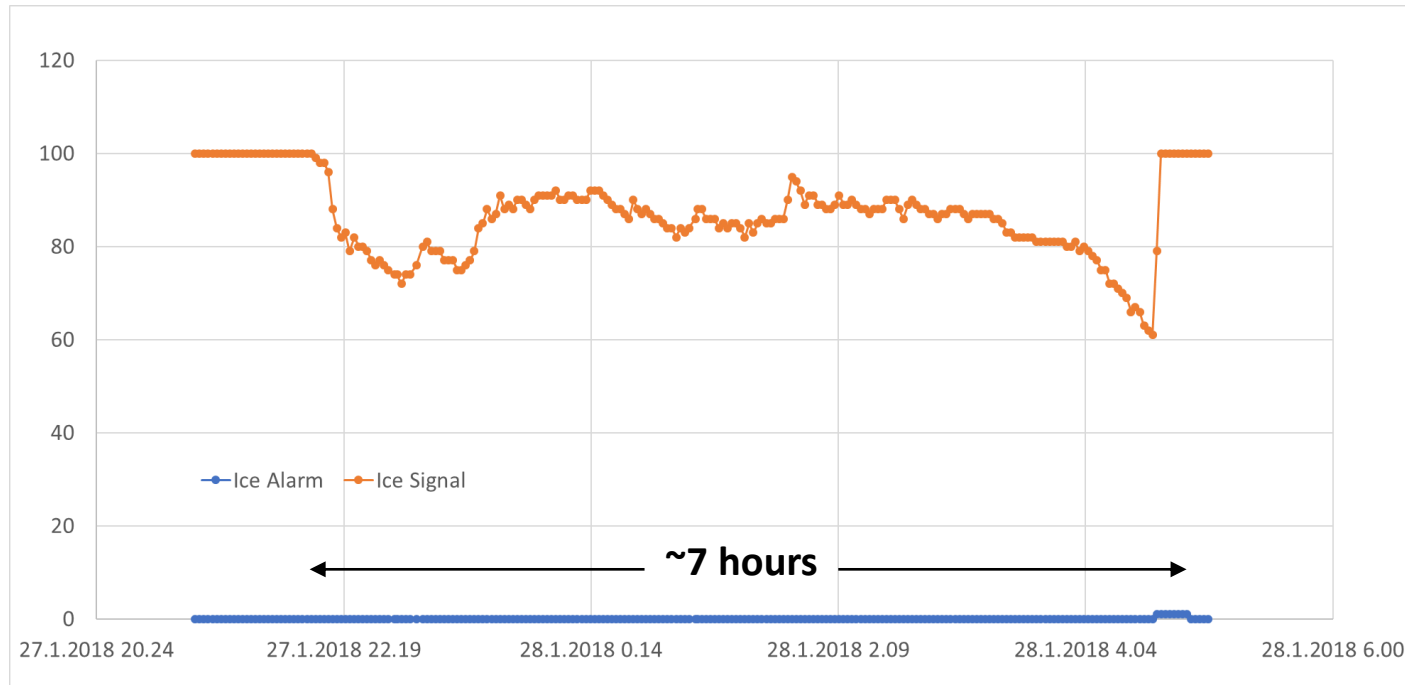


- Ice signal value decreases in icing conditions
- Ice alarm activates on a defined signal level
- Sensor heats up and cools down
- Ice alarm deactivates

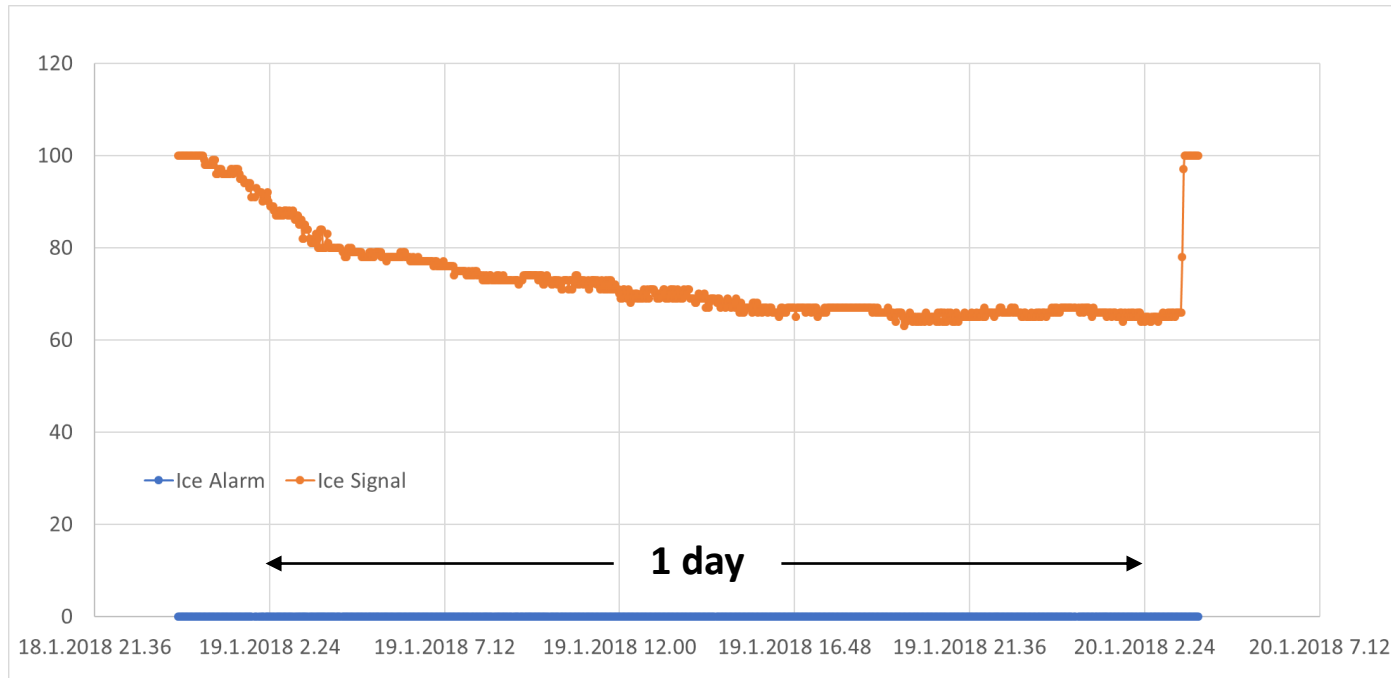
Real life - Case #1



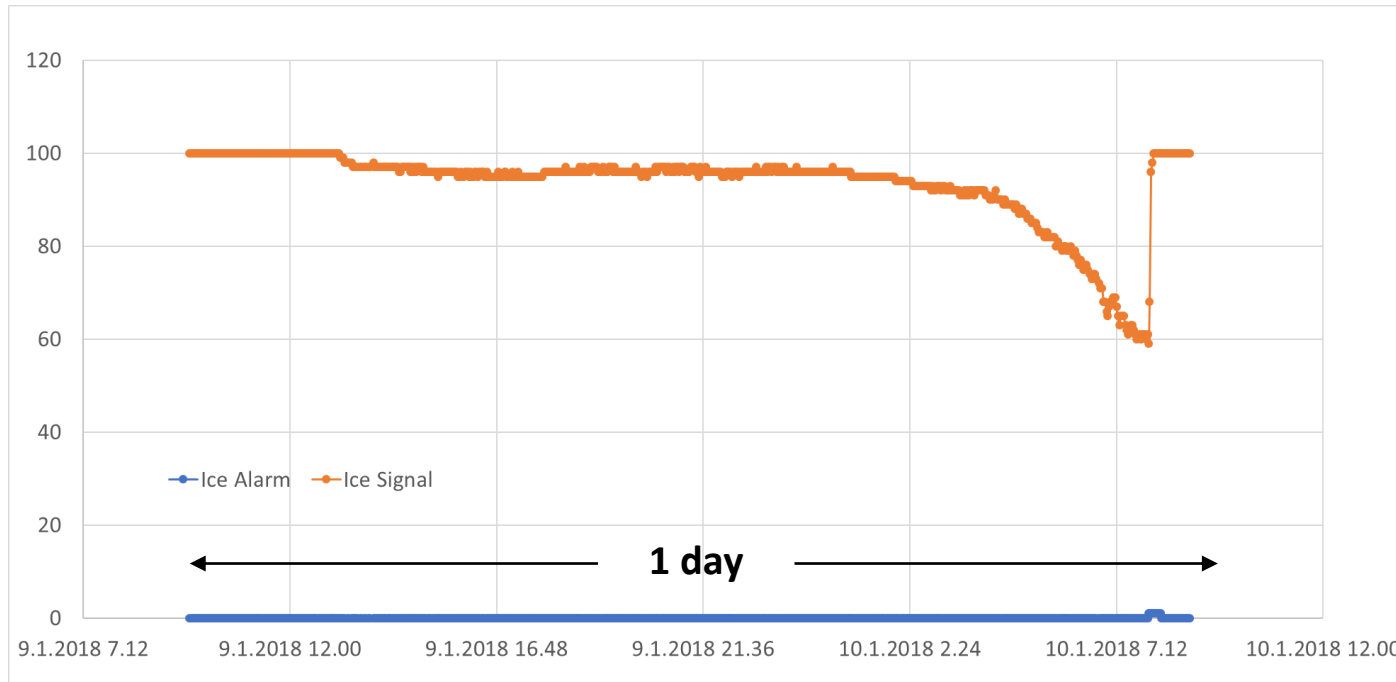
Real life - Case #2



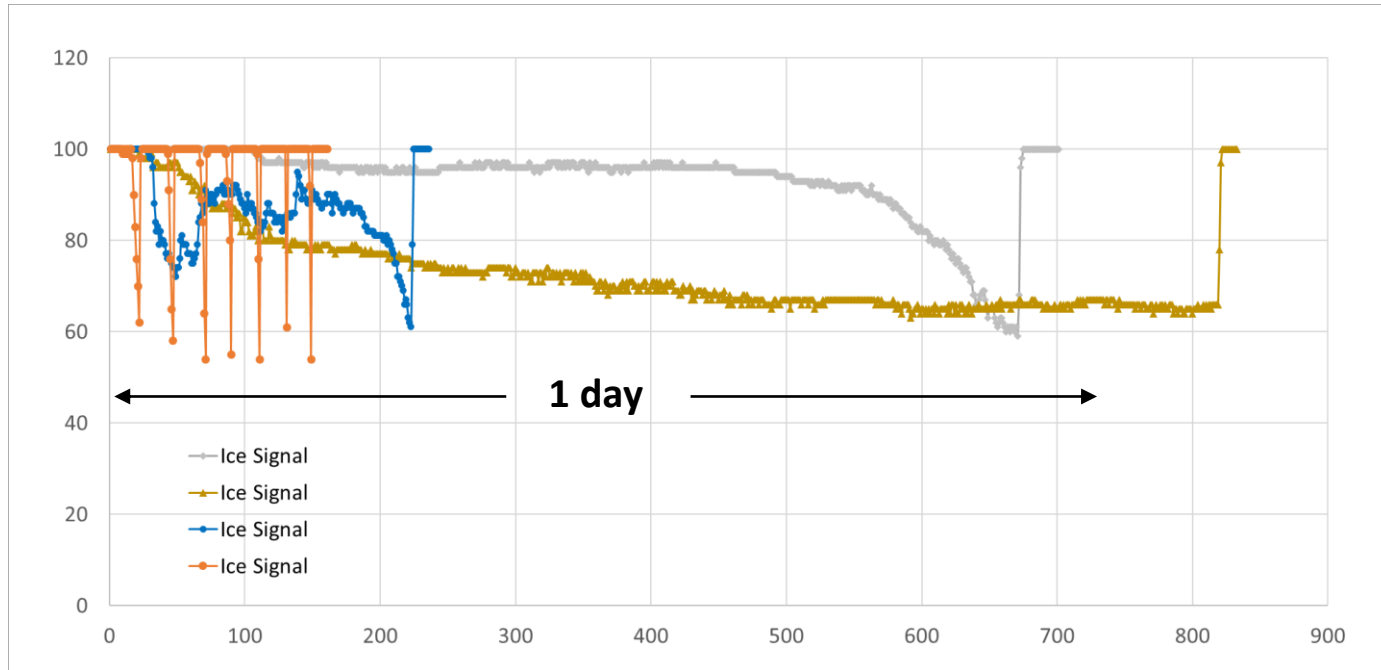
Real life - Case #3



Real life - Case #4



Summary of real life cases



Goals of the study

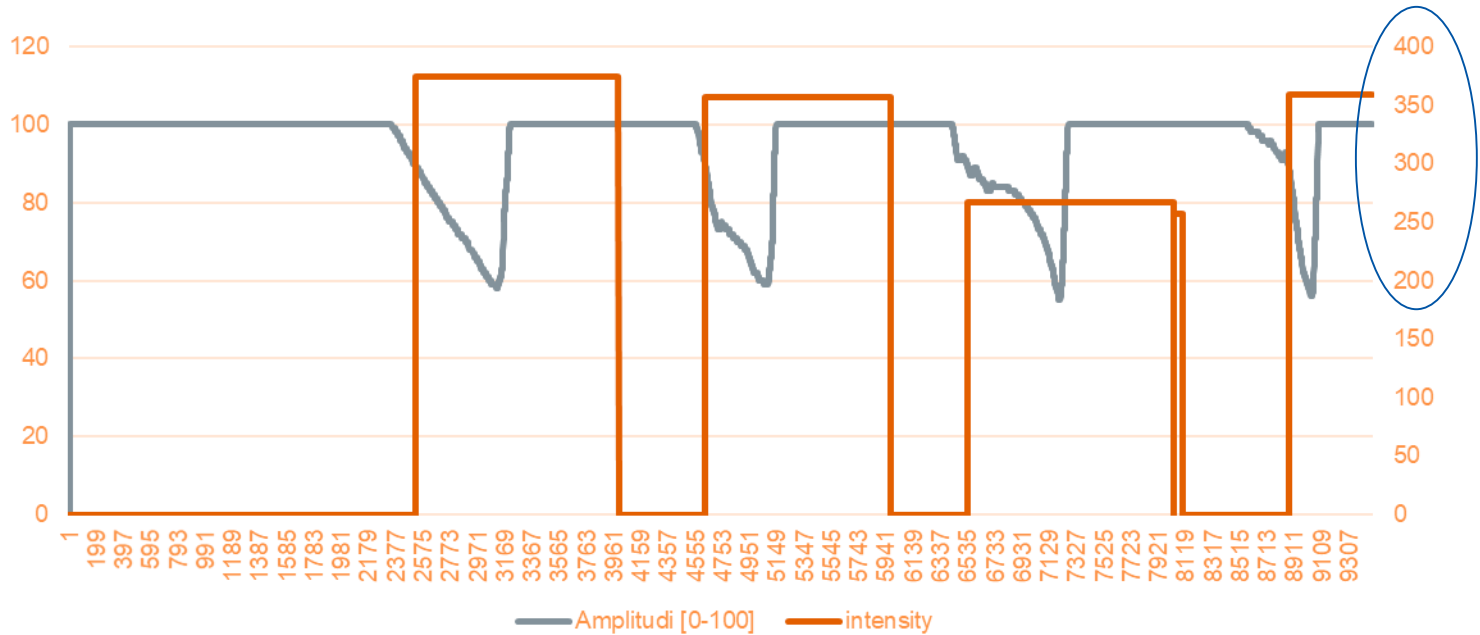
- To create a method to evaluate icing intensity from LID-3300IP data
- To categorize icing events according to icing intensity

Validation of the icing intensity method

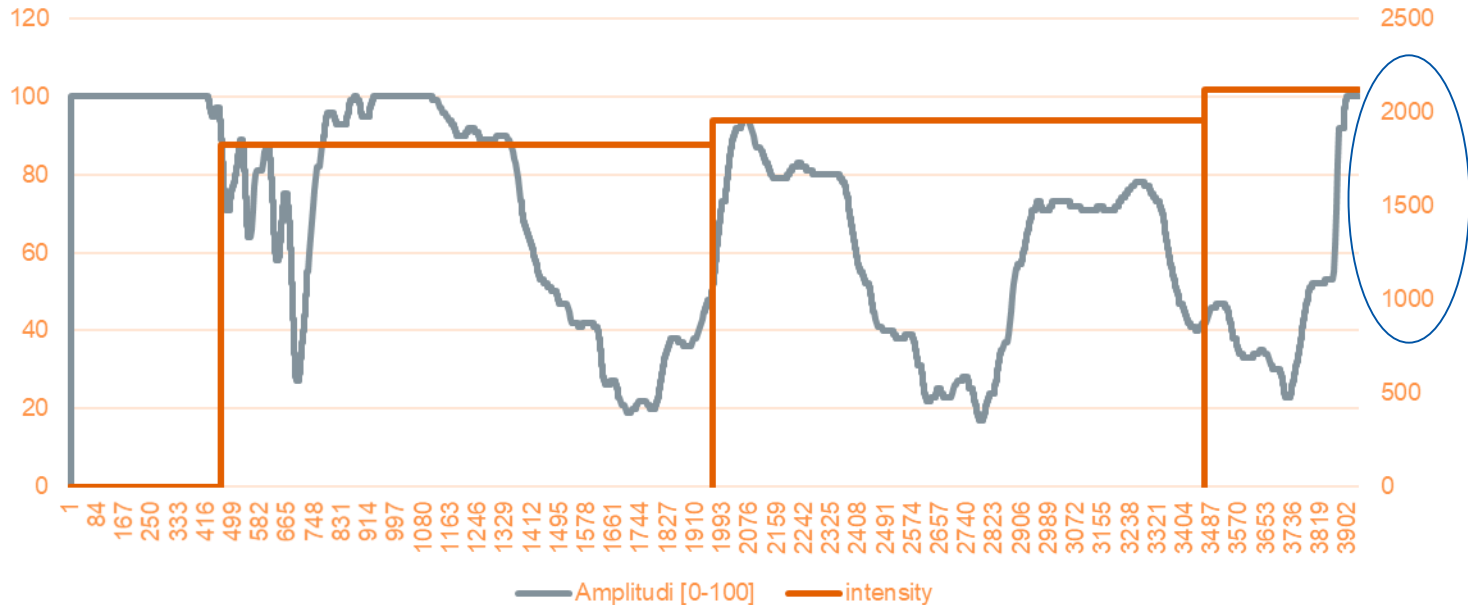
Definition of icing events for icing wind tunnel tests

Event name	Wind speed [m/s]	Temperature [°C]	LWC [g/m ³]	Ice growth rate [g/h]
Mild1	4	-1	0.2	7
Mild2	7	-3	0.4	25
Severe	10	-5	0.4	98
Extreme	20	-15	0.4	225

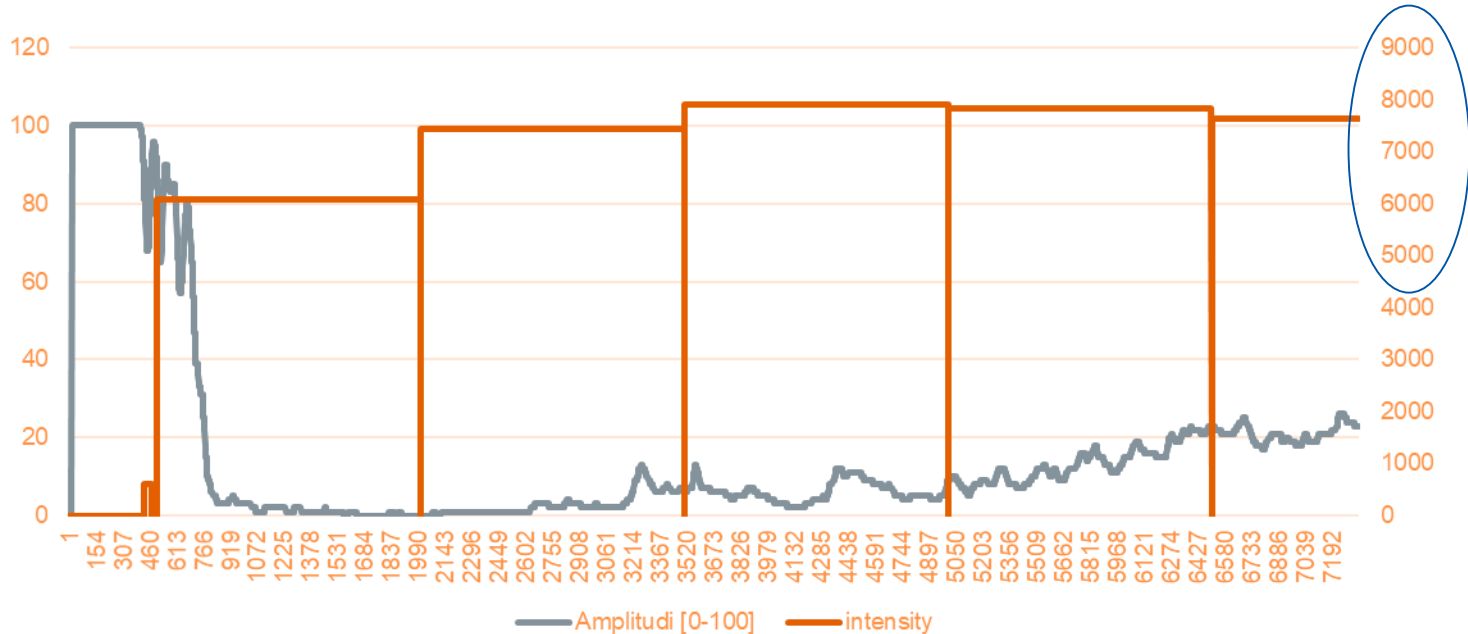
Case Mild1 (-1°C, 4 m/s)



Case Severe (-5°C, 10 m/s)



Case Extreme (-15°C, 20 m/s)



Conclusions

With the developed method, it was possible to

- calculate an icing intensity signal value from LID-3300IP Ice Detector measurement data
- separate and categorize icing events based on icing intensity value
- estimate the ice growth rate during an icing event

Event name	Ice growth rate [g/h]	Intensity signal values
Mild1	7	<500
Mild2	25	500 - 750
Severe	98	1000-2000
Extreme	225	> 5000

