



Ice Detection Methods and Measurements

Matthew Wadham-Gagnon

Nigel Swytink-Binnema, Cédric Arbez,

Dominic Bolduc, Charles Godrea

WinterWind 2016

Winterwind 2013, Östersund – 1420m



Mont Blanc (Gaspésie) – 1060m





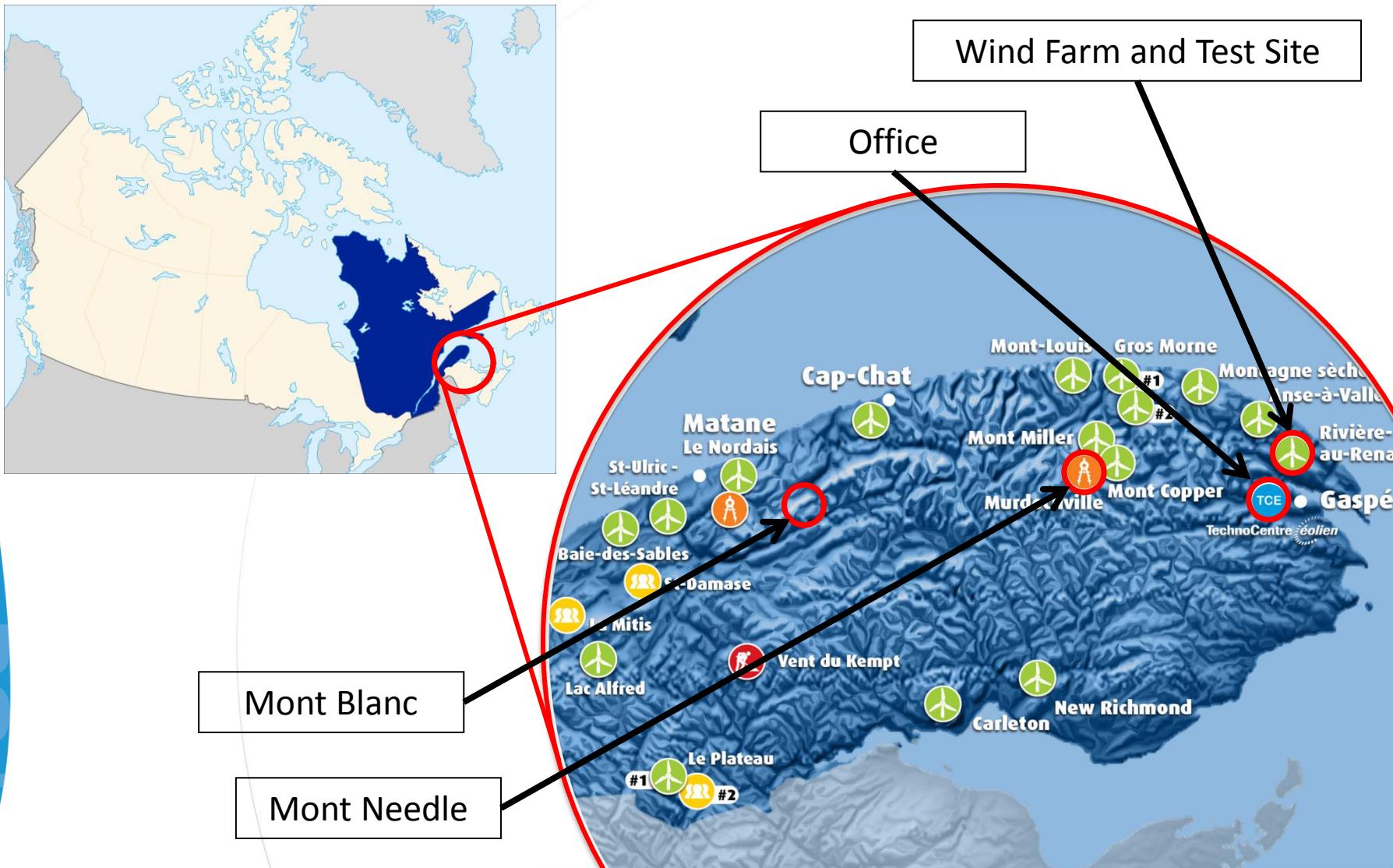
TechnoCentre éolien
Wind Energy TechnoCentre



Mont Needle (Murdochville) – 714m



TechnoCentre éolien (TCE)

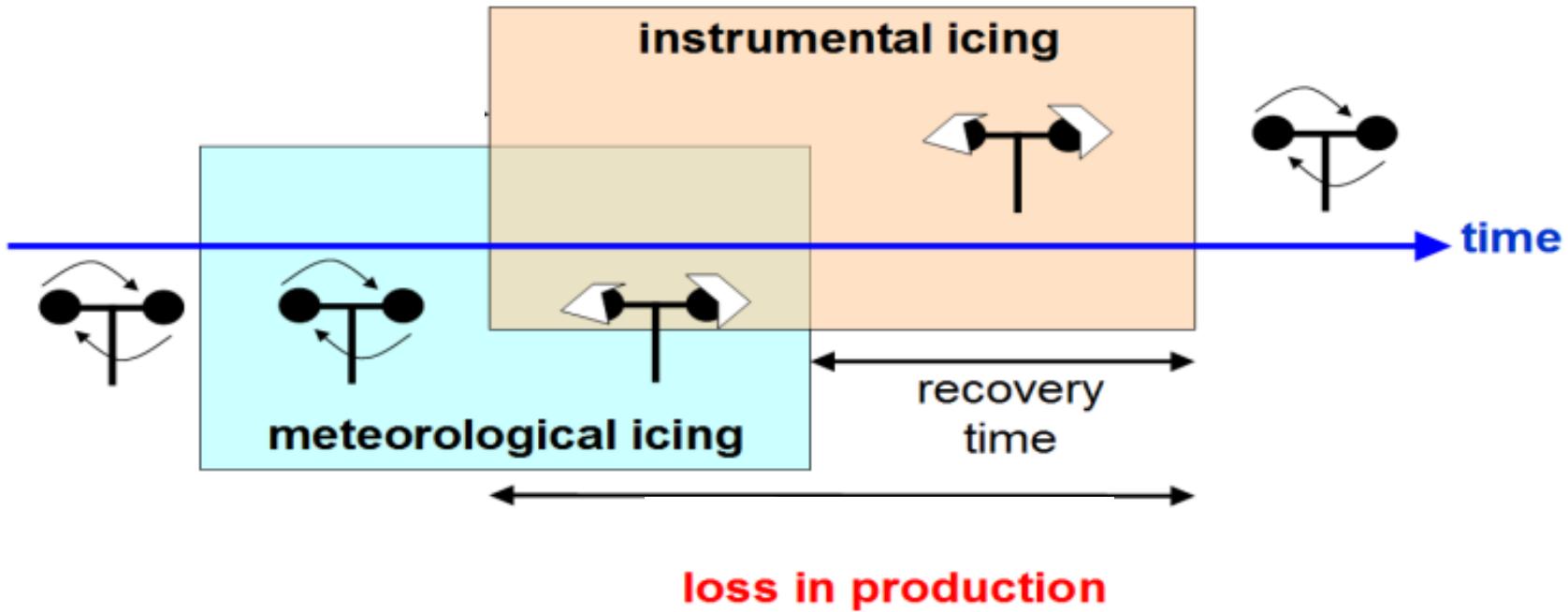


Met Mast

Name	MMV1
Height (AGL)	126 m
Base Altitude (ASL)	343 m
Tower type	Tripod permanent guyed wire CSA S37-01
Location	Rivière-au-Renard (QC)



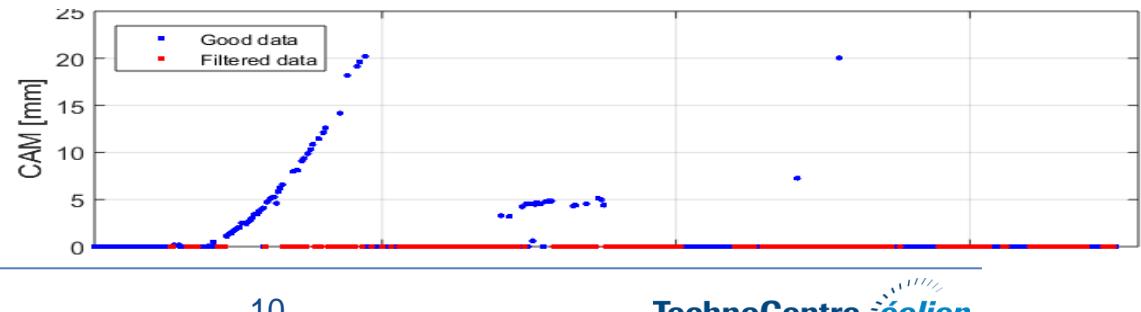
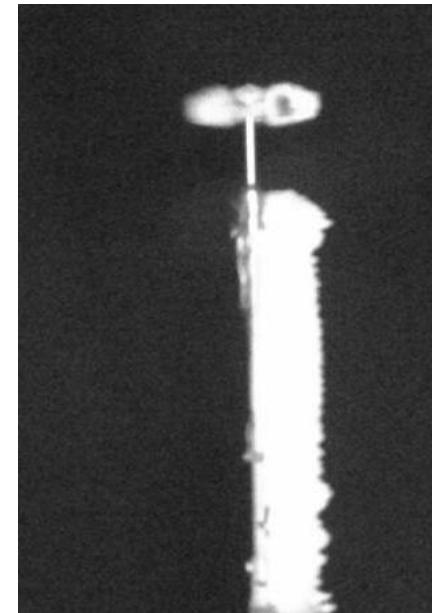
Ice periods



(Image: IEA Task 19 2011)

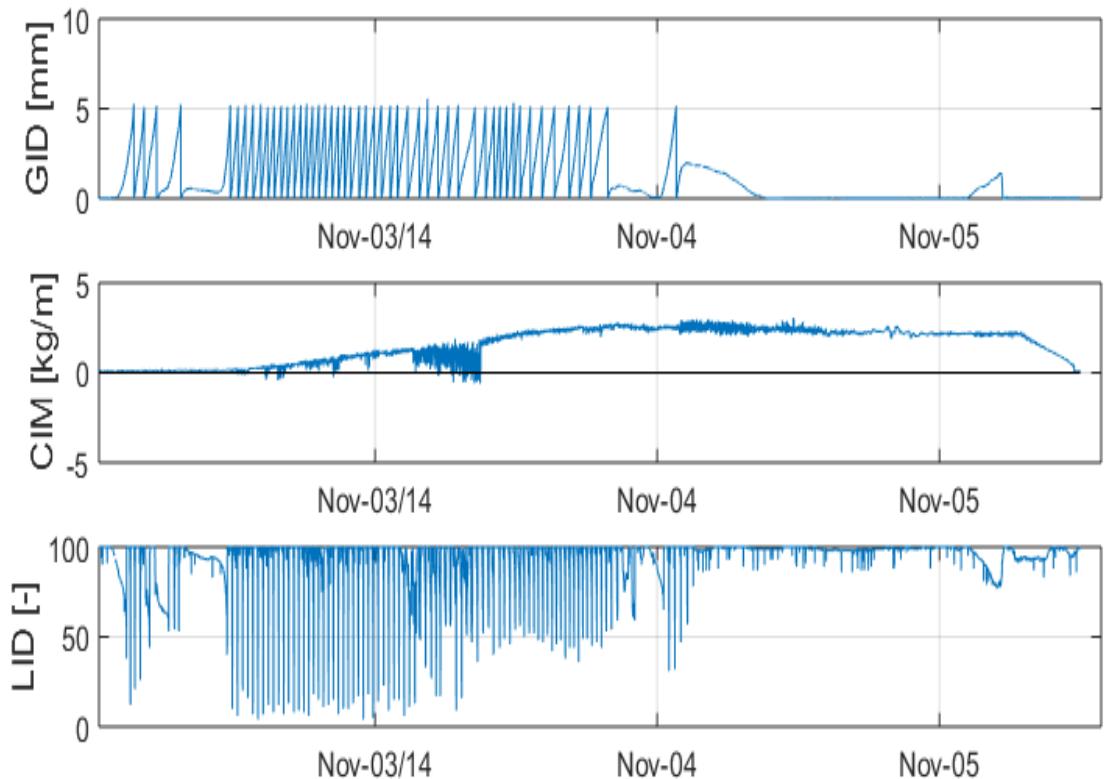
Ice detection methods

Method	CAM	CIM	GID	LID	LWCT	CBHT	RHT	WDD	WSD
Sensor	Camera	Combitech Ice Monitor	Goodrich 0872F1	Labkotek LID-3300IP	LWC & T	CBH, T	RH, T	WV	HUA, UCA



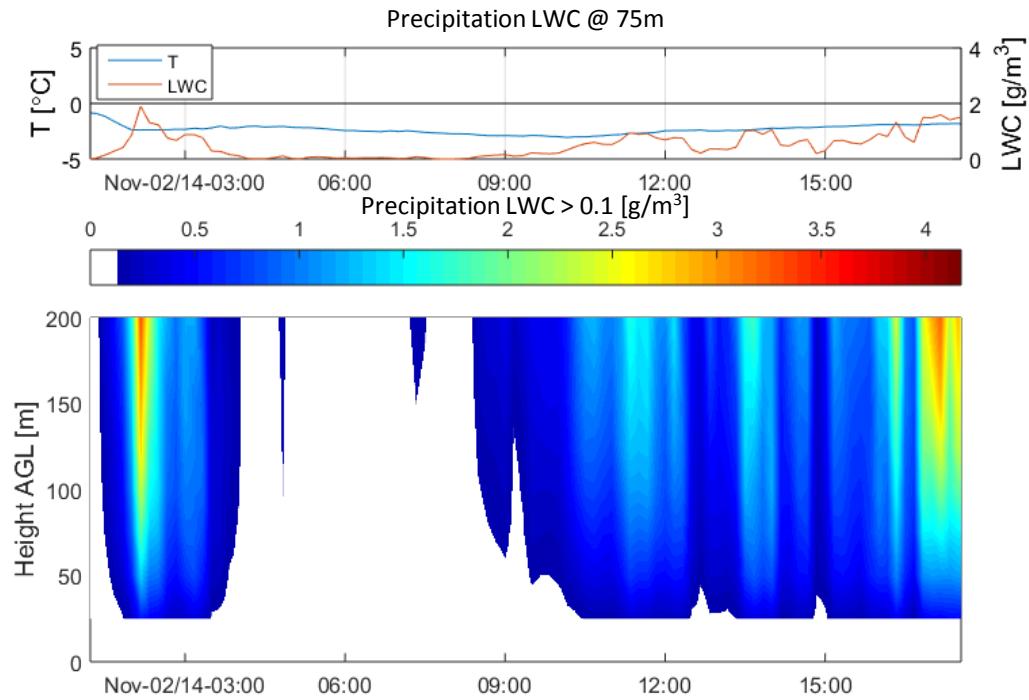
Ice detection methods

Method	CAM	CIM	GID	LID	LWCT	CBHT	RHT	WDD	WSD
Sensor	Camera	Combitech Ice Monitor	Goodrich 0872F1	Labkotek LID-3300IP	LWC & T	CBH, T	RH, T	WV	HUA, UCA



Ice detection methods

Method	CAM	CIM	GID	LID	LWCT	CBHT	RHT	WDD	WSD
Sensor	Camera	Combitech Ice Monitor	Goodrich 0872F1	Labkotek LID-3300IP	LWC & T	CBH, T	RH, T	WV	HUA, UCA



Ice detection methods

Method	CAM	CIM	GID	LID	LWCT	CBHT	RHT	WDD	WSD
Sensor	Camera	Combitech Ice Monitor	Goodrich 0872F1	Labkotek LID-3300IP	LWC & T	CBH, T	RH, T	WV	HUA, UCA



Vaisala CL31



Thies Vane Compact



Thies First Class

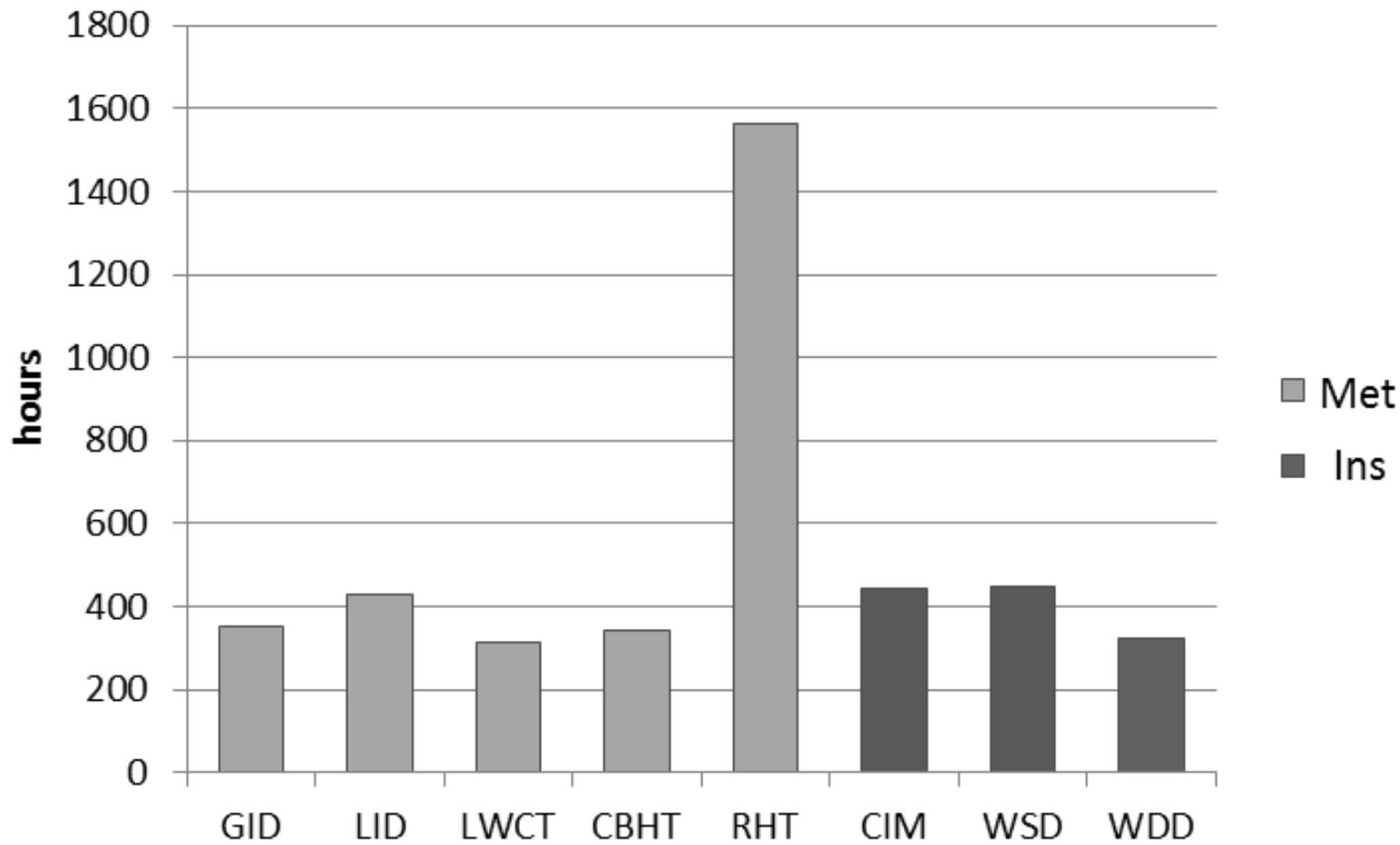


Vaisala HMP60

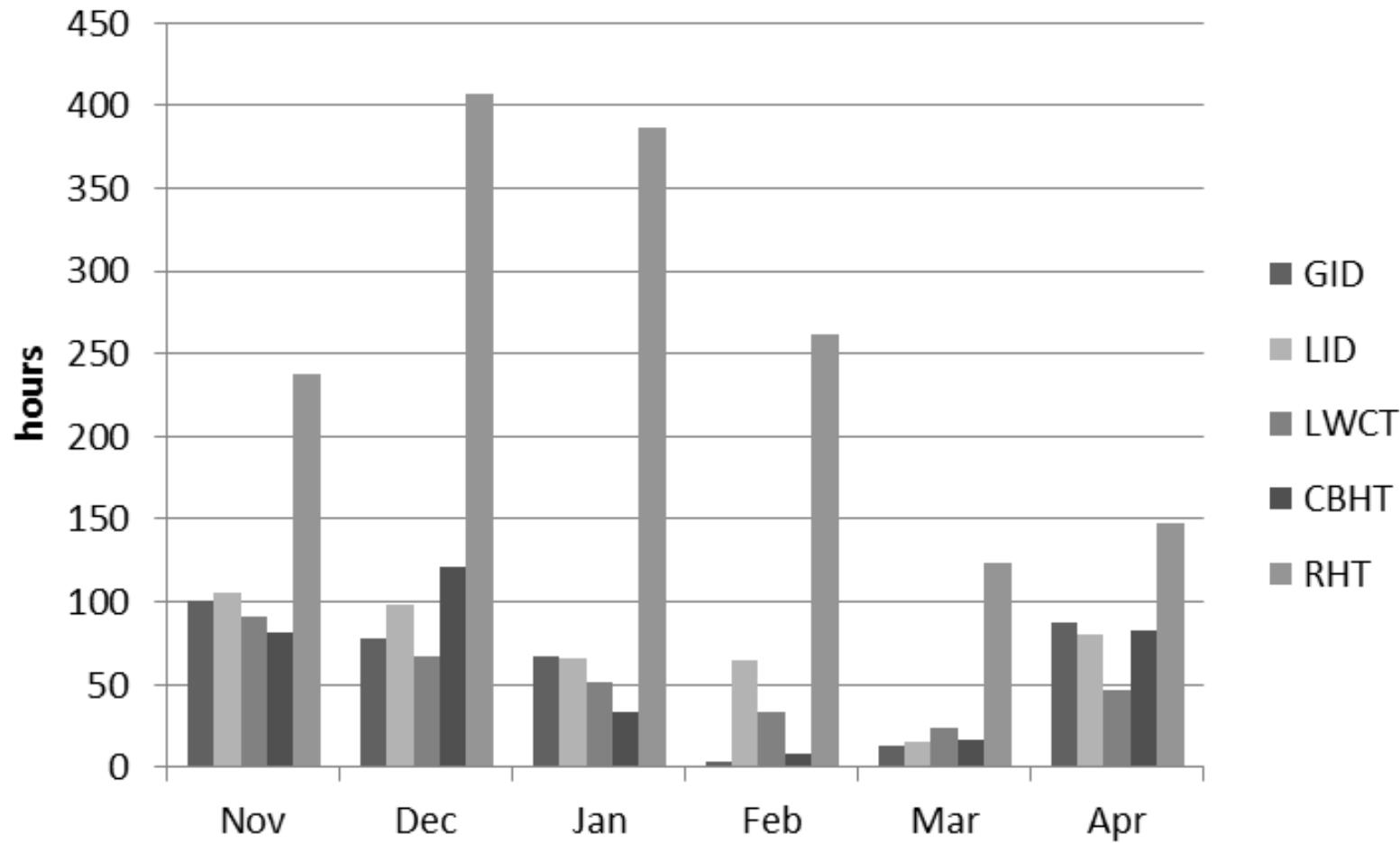


NRG RT240

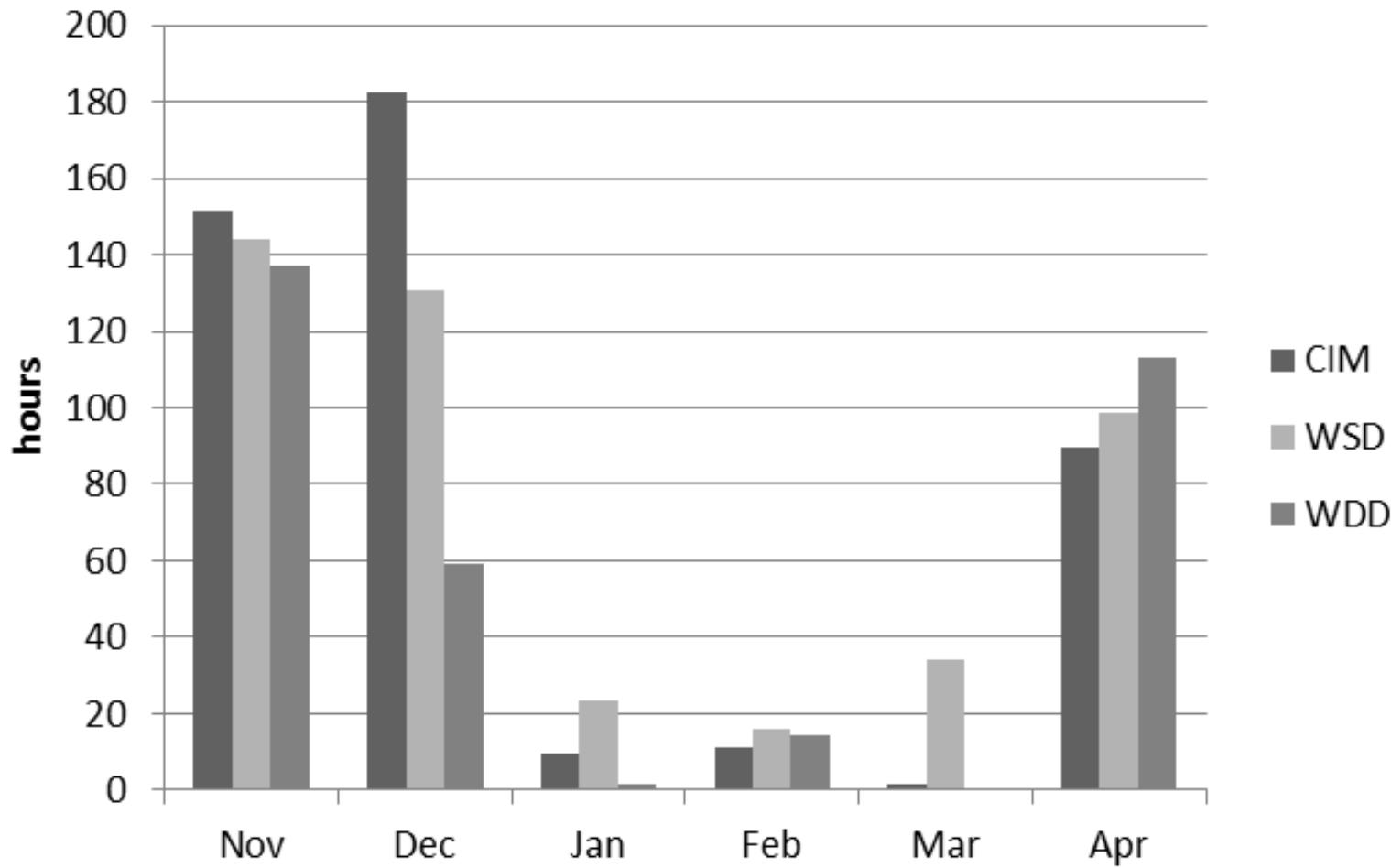
Annual Statistics: winter 2014-2015



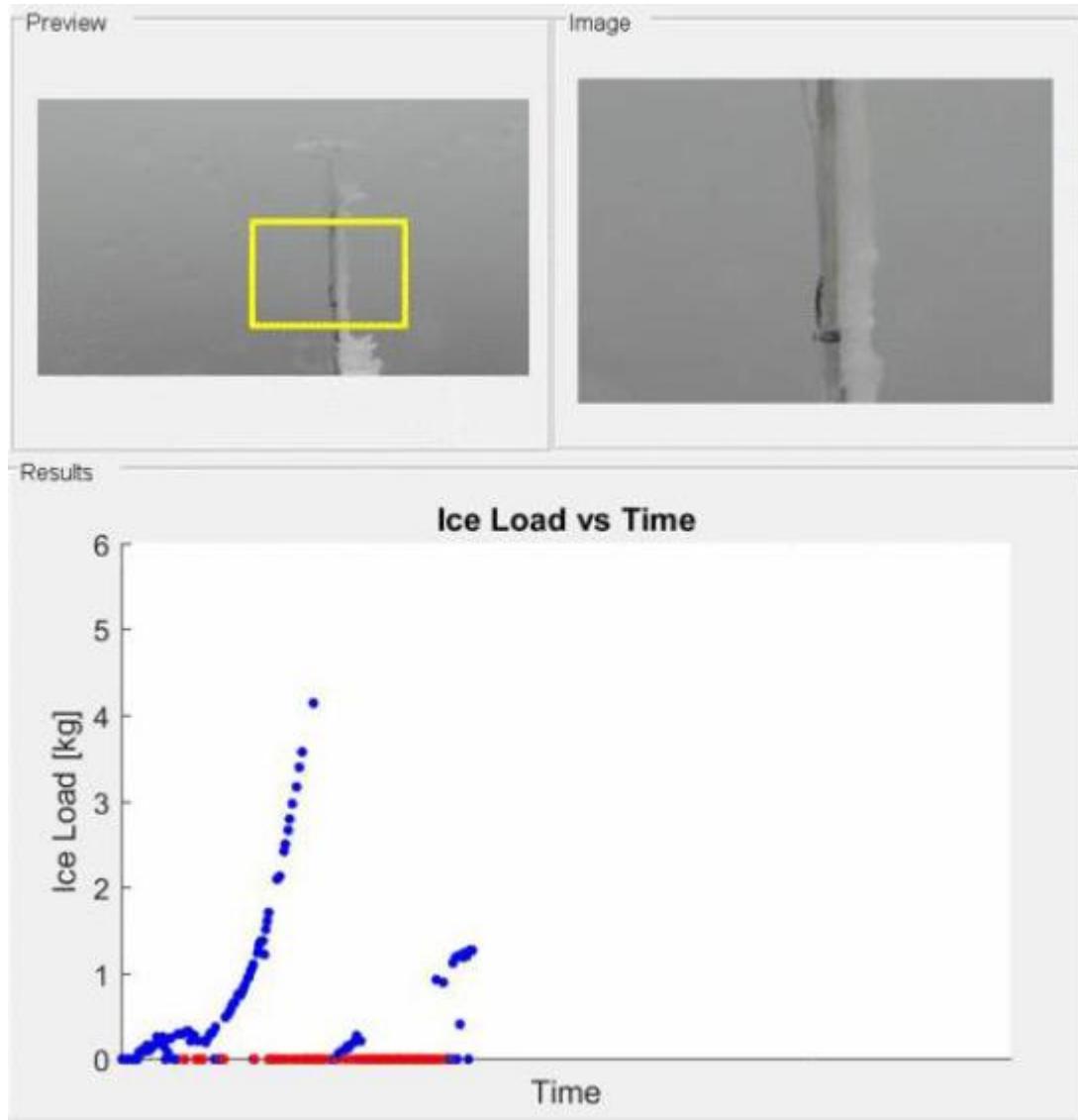
Monthly Statistics – Meteorological Icing



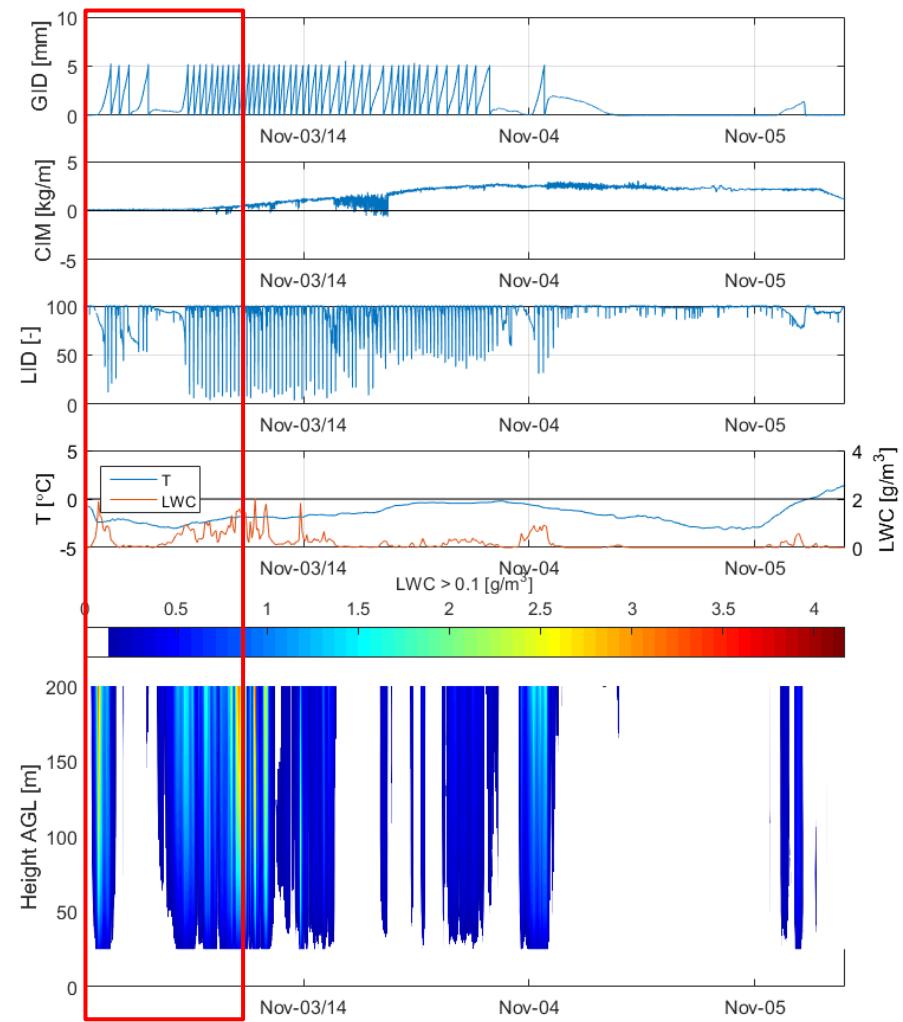
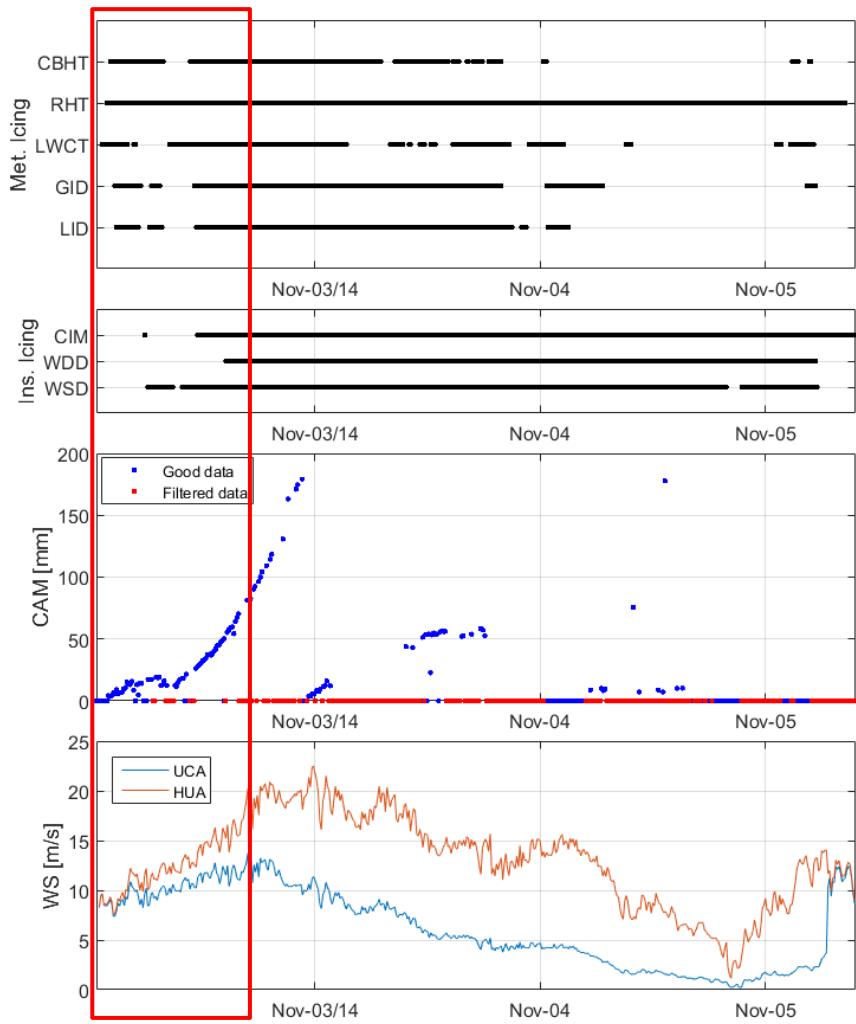
Monthly Statistics – Instrumental Icing



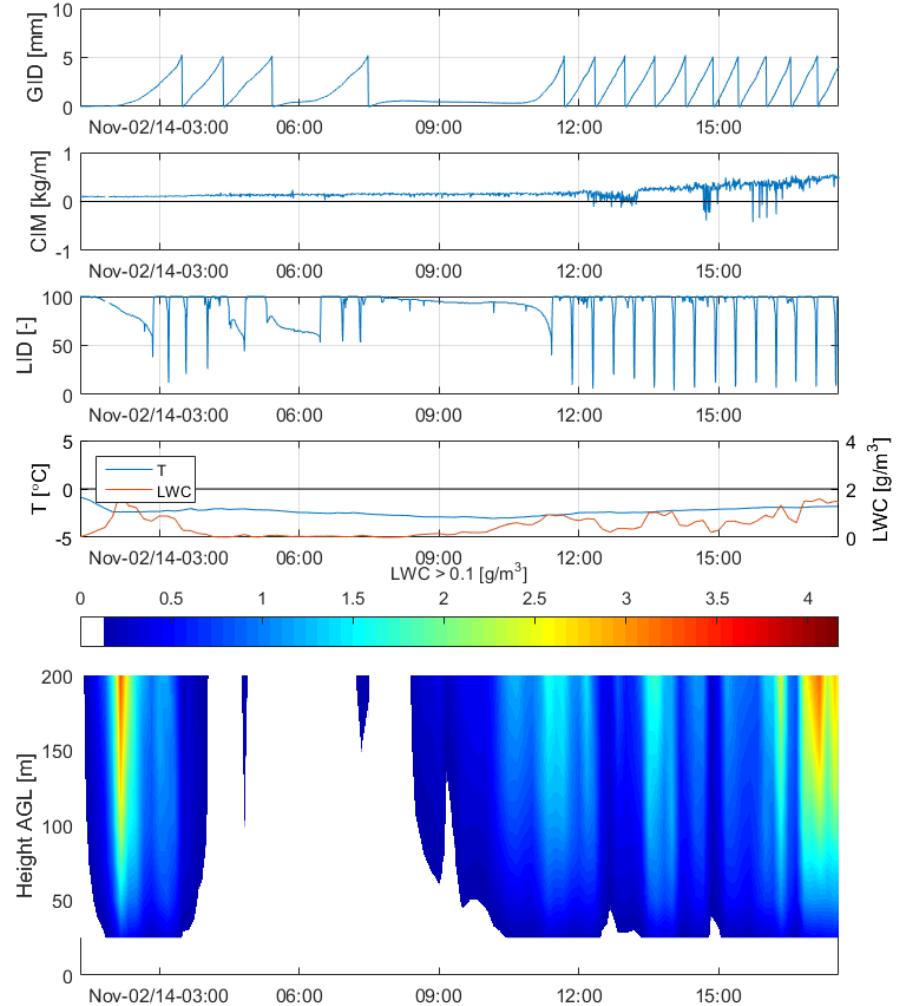
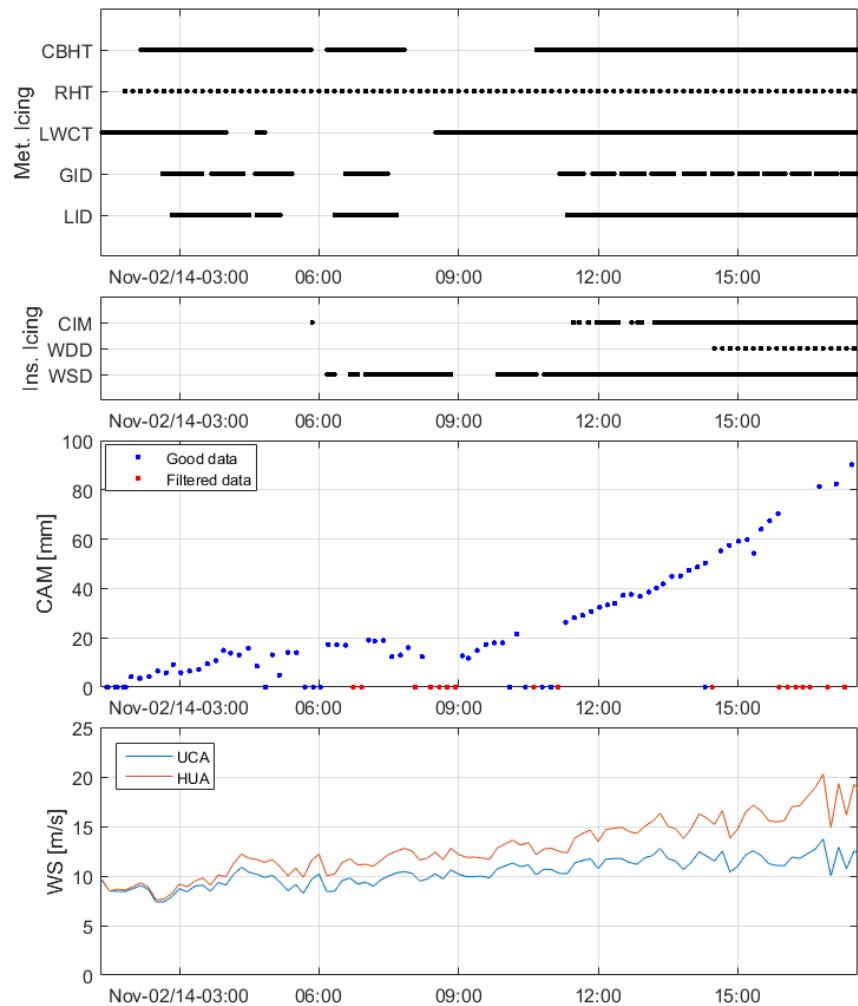
Icing Event 1 – Camera



Icing Event 1: 2–5 Nov 2014

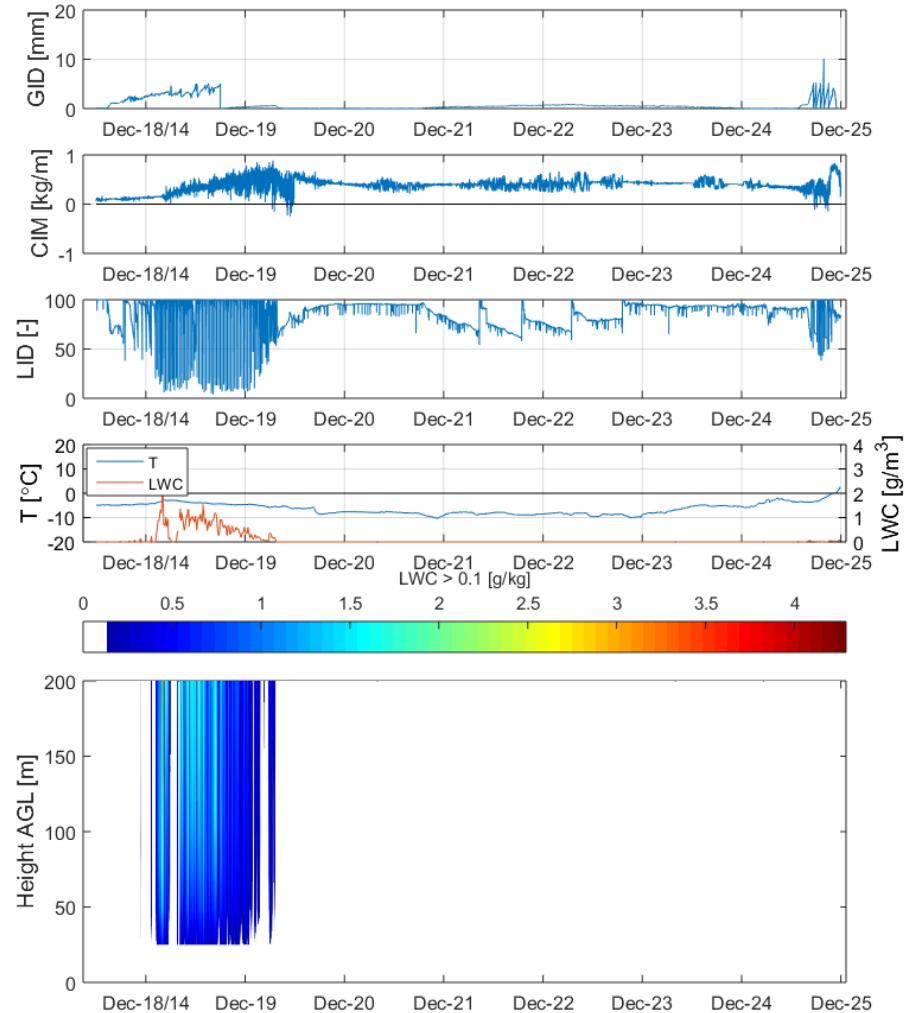
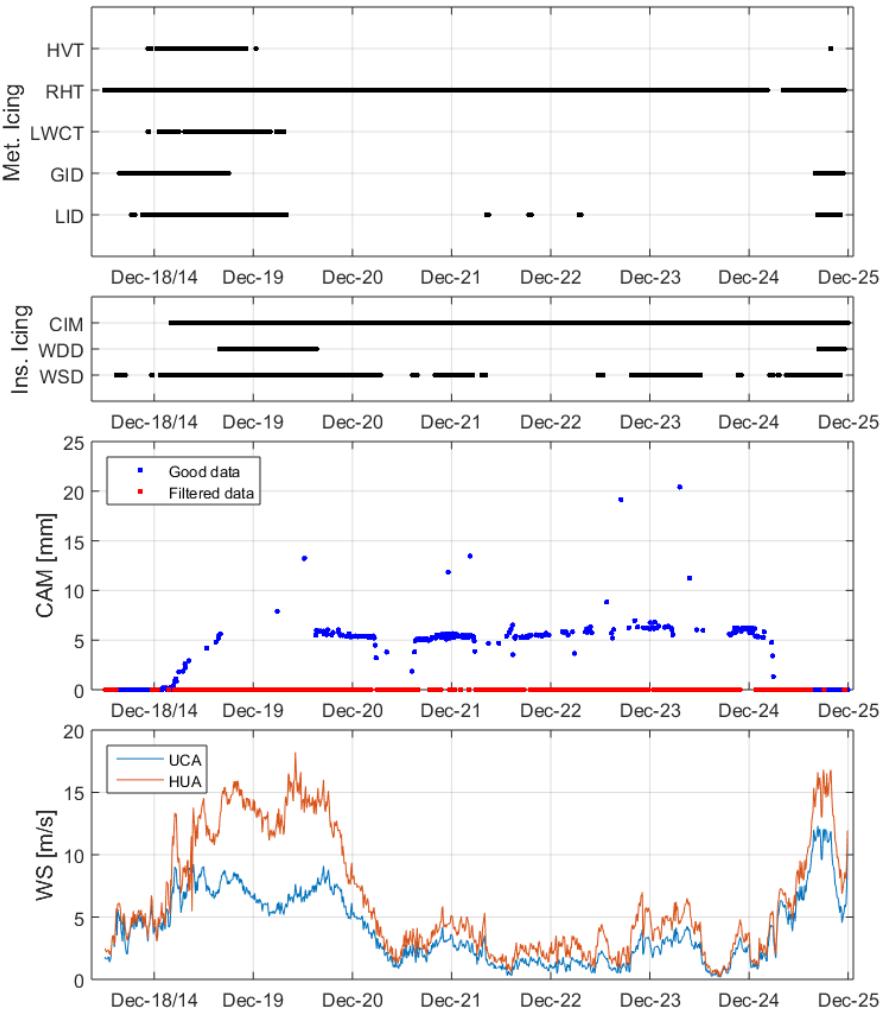


Icing Event 1: Zoom

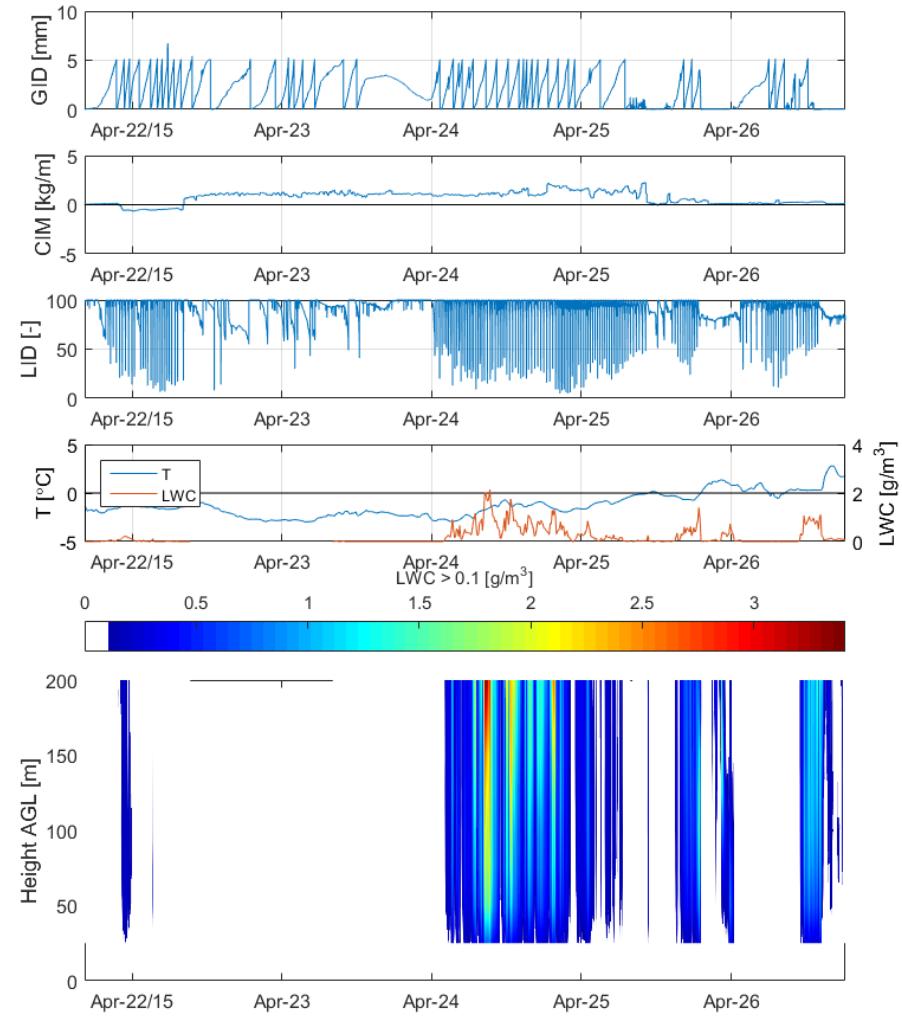
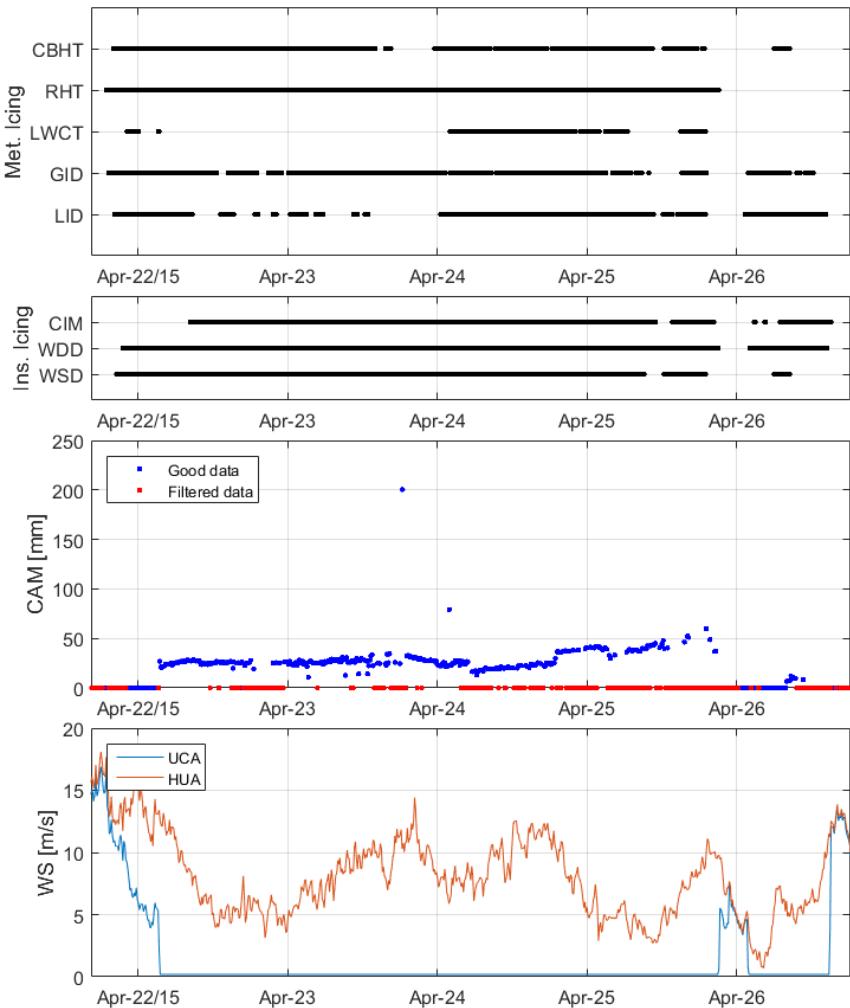


Icing Event 2

Event #2: 17-Dec-2014 to 25-Dec-2014



Icing Event 3: 21–27 Apr 2015



Conclusion

Method	Pros	Cons
CAM	Most information	Camera icing needs to be managed, visibility affects algorithm, most accurate perpendicular to wind dir.
CIM	Direct measurement of ice load	Noise and negative values
GID & LID	Good measurement of meteorological icing Adjustable parameters and thresholds (will see effects of changes this winter)	May overestimate meteorological icing Sensitive to non-icing precipitation?
LWCT	Very promising, can provide more information by modifying transfer fctn	Does not detect in-cloud icing
CBHT	Directly measures presence of cloud	Does not measure precipitation
RHT	Inexpensive instrument	Over 75% false positives
WDD & WSD	Good indication of instrumental icing	Loss of data at low wind speeds

What's Next?

- Towards validation of microphysics schemes in numerical weather prediction models for icing applications
 - Magnus Baltscheffsky, WeatherTech (Next)
- On-site measurement from cold Climate - possibilities and applications towards validation of CFD model
 - Marie Cecilie Pedersen, Vattenfall (after Magnus)
- Control Optimisation of Iced Turbines
 - Dominic Bolduc, TechnoCentre éolien (Session 4, Arena)
- Rotor Blade Icing Bench Test
 - TechnoCentre éolien (2015-2017)

Matthew Wadham-Gagnon

Project Manager

mgagnon@eolian.qc.ca

70, rue Bolduc, Gaspé (Qc)

G4X 1G2, Canada

Tél. : +1 418 368 6162

Nos principaux partenaires / Our principal partners



Développement
économique Canada
pour les régions du Québec

Canada Economic
Development
for Quebec Regions

Canada

Québec

Thank you