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The combination of visibility and temperature, strong surrogate for icing occurrence?

Jarkko Hirvonen
Finnish Meteorological Institute
Winterwind2012
Feb 6 – 7 2012 Skellefteå

Background

- **Visibility (VIS) and temperature (T) measured since Oct 2005 in Puijo tower**
- **Direct observations of icing only partially for icing seasons:**
  - 2009-2010, 2010-2011, 2011-2012
  - Webcam, LID-3300IP, Rosemount 0871LH1 FZ Sensor
- **How reliable is it to use visibility and temperature to deduce icing occurence?**
  - Comparison between direct icing observation and VIS/T-measurements
  - Aim: longer period of “icing” measurements for icing climatology

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Case selection and criteria for icing

- **Only in-cloud cases are considered so far**
  - Icing by mist (BR) or patchy cloudiness likely excluded
  - Icing by freezing (FZ) precipitation likely excluded
- **in-cloud cases selected independently according to nearby lower level cloud base height (CBZ) detector (ceilometer), in-cloud if CBZ < 200 m.**
- **Surrogate icing: if VIS is poor (< 200 m) and freezing T (< 0°C)**
- **Real icing: if one of the direct instruments hints for icing**
- **Manual inspection of cases**
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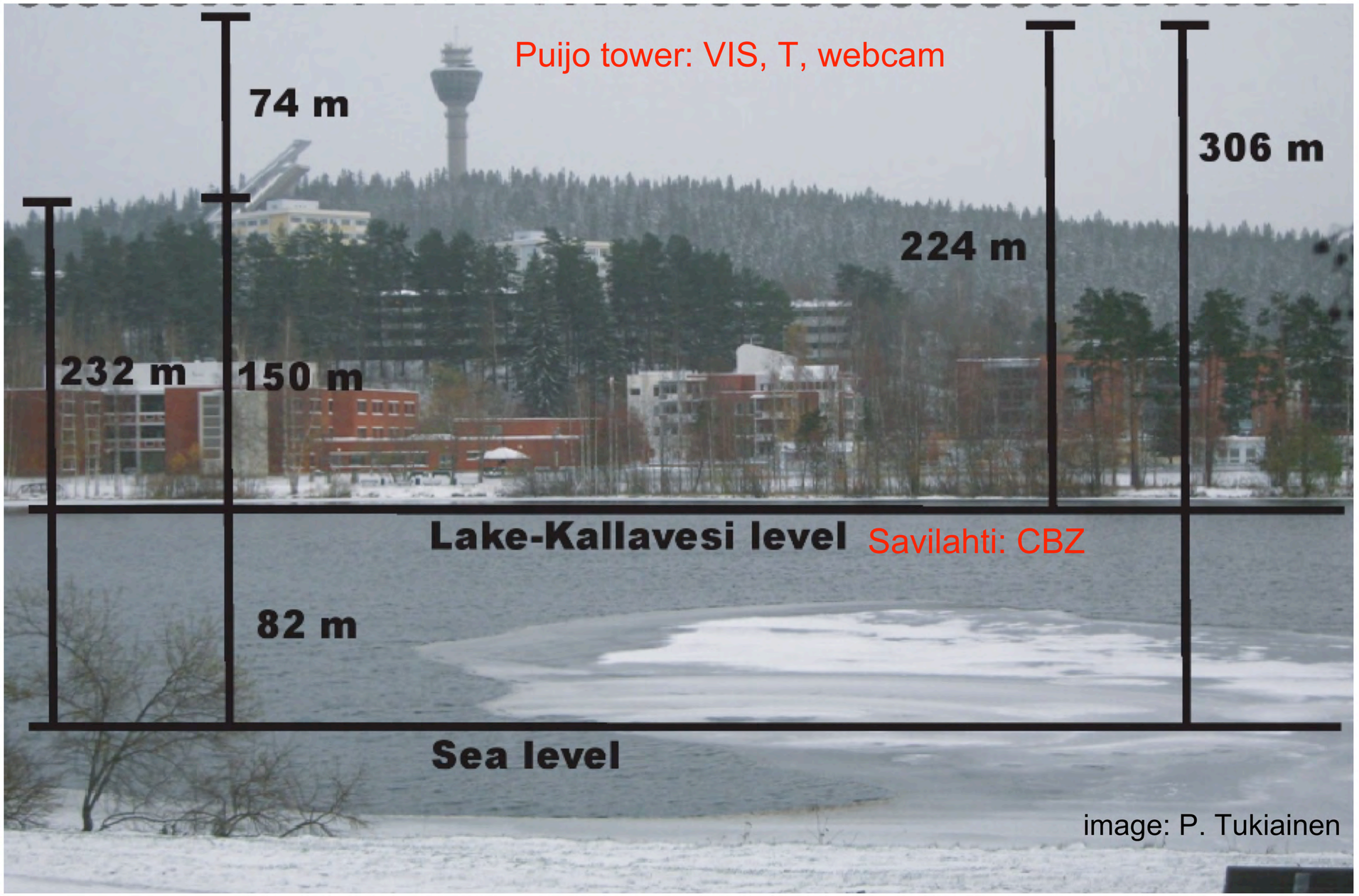
Instrument elevations



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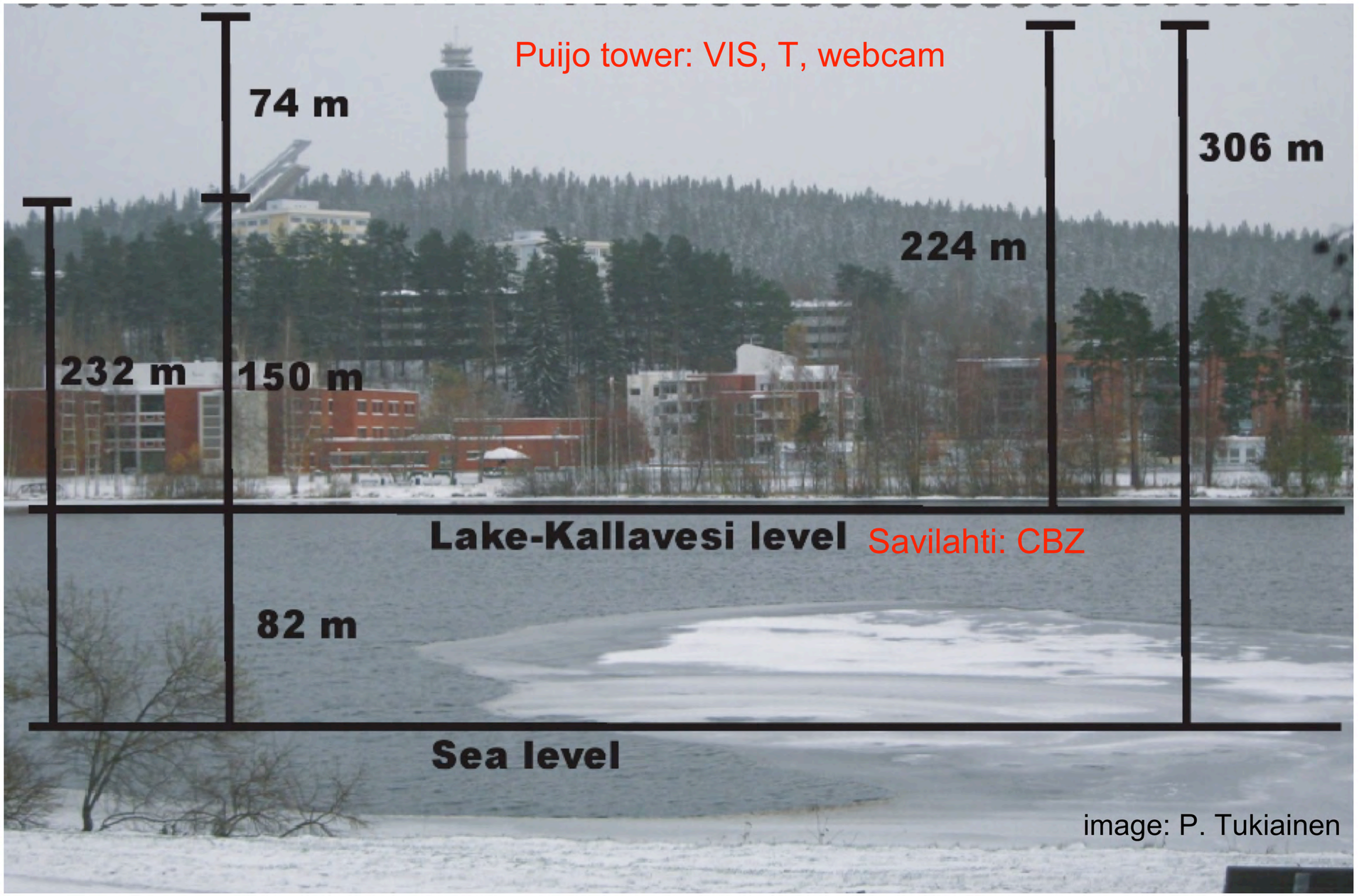
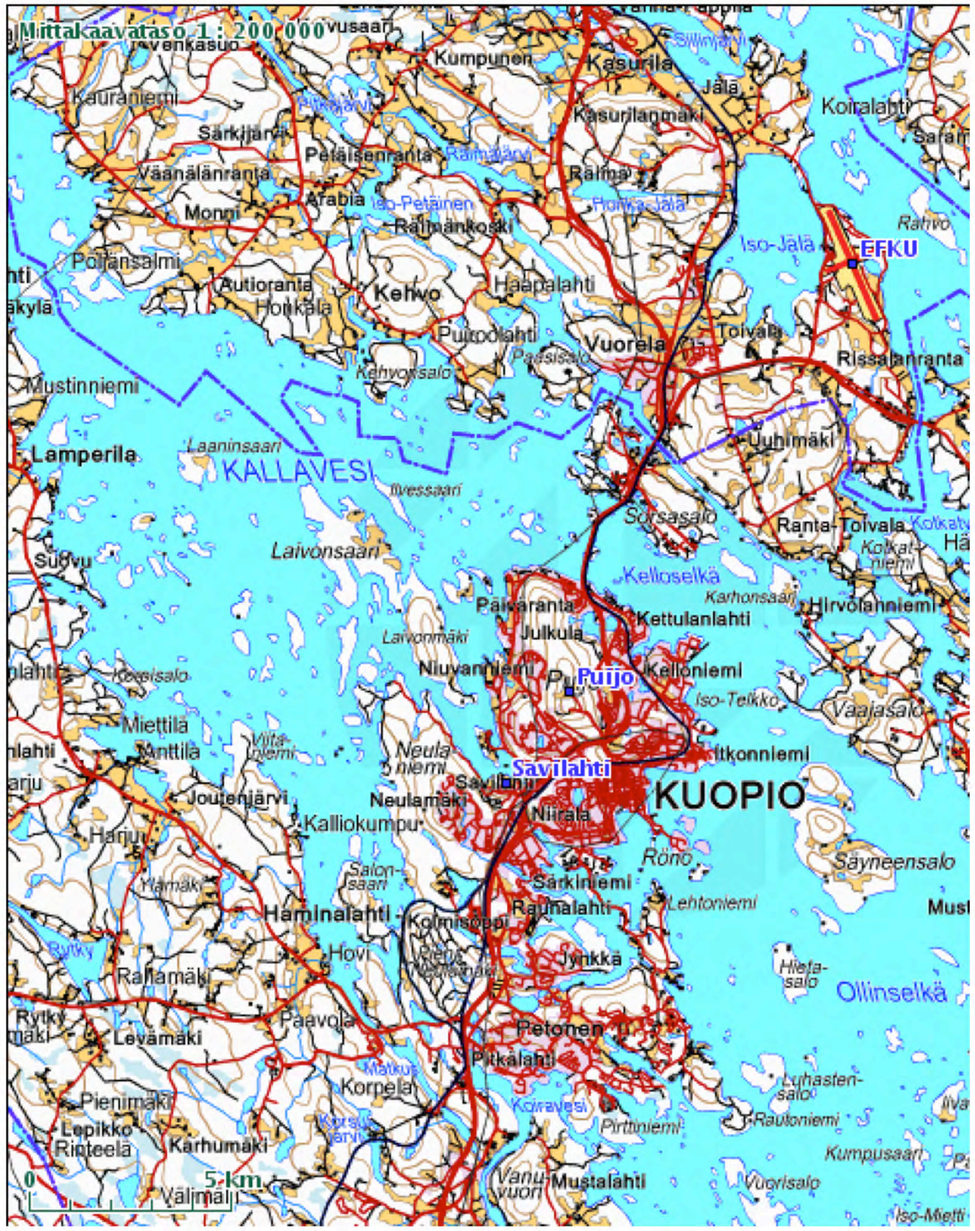
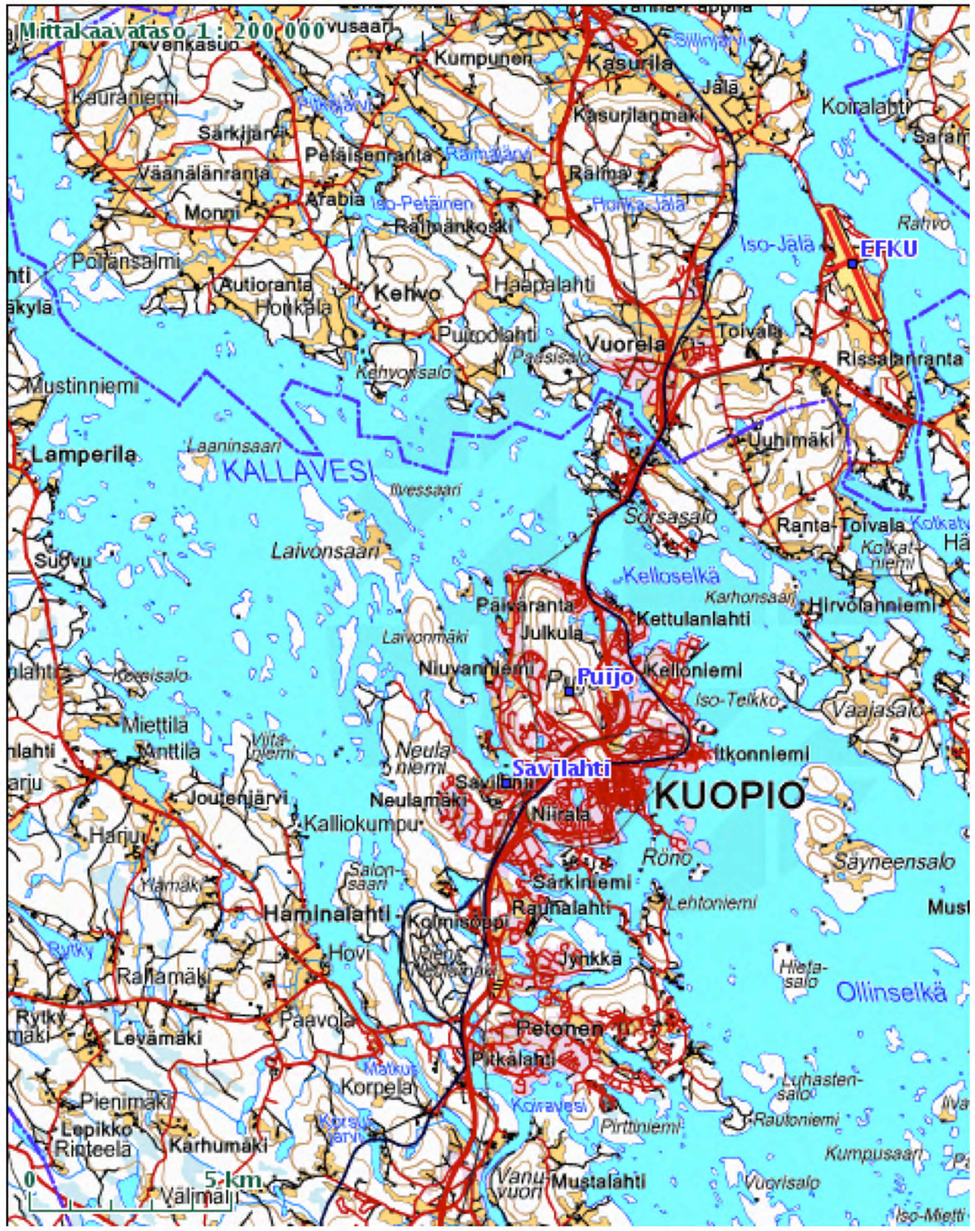




Local map

- **Distance between Savilahti ceilometer and Puijo tower 2,2 km.**



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Icing instruments on the roof of Puijo tower

- **FD12P: VIS and T**
- **webcam**

- **LID-3300IP, right**
- **Rosemount 0871LH1, left**

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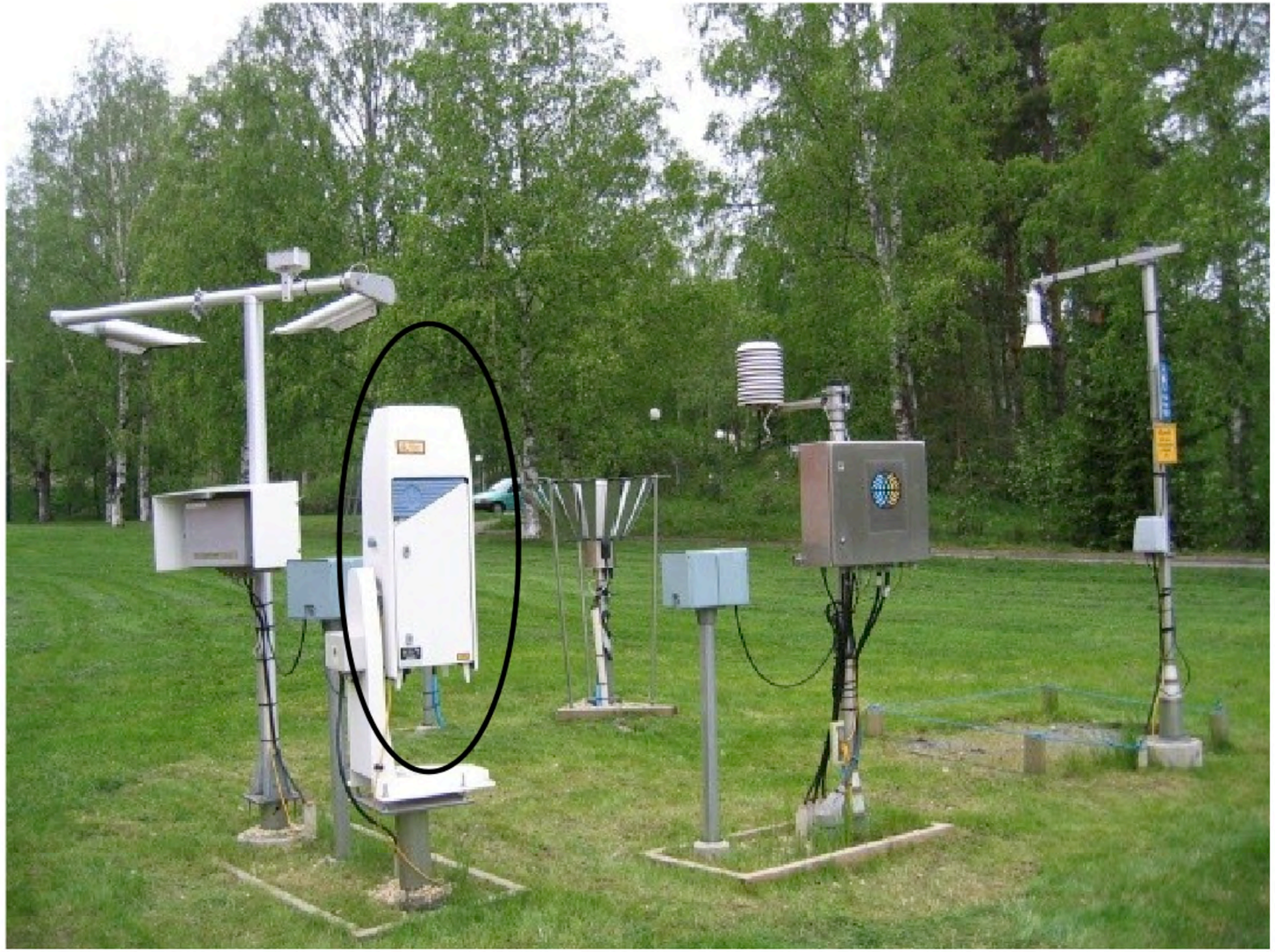
Ceilometer on Lake Kallavesi level Savilahti weather station



- **Savilahti weather station**

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Left: Rosemount Aerospace 0871LH1

Right: Labkotec LID 3300IP

Icesensors on the roof of Puijo tower seen through the webcam

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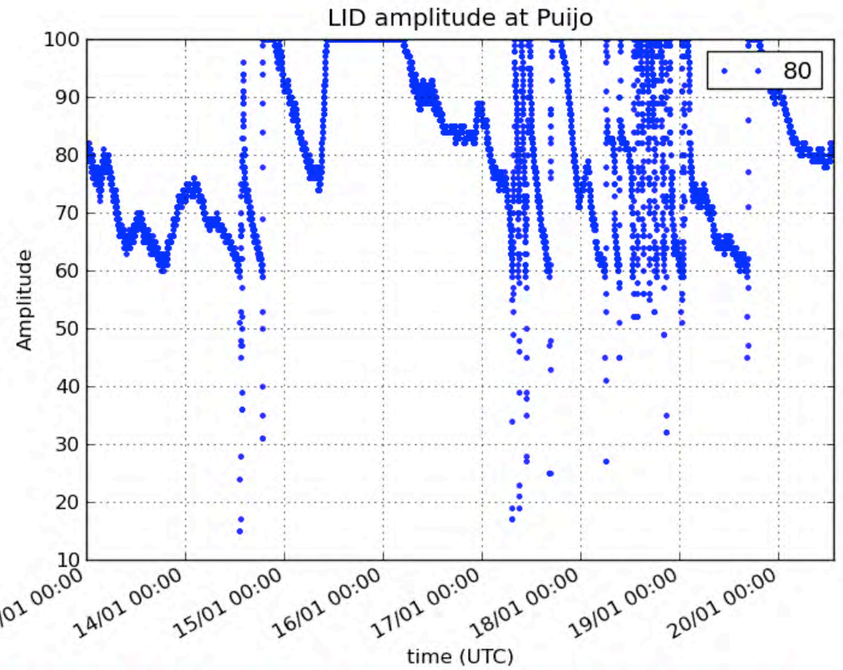
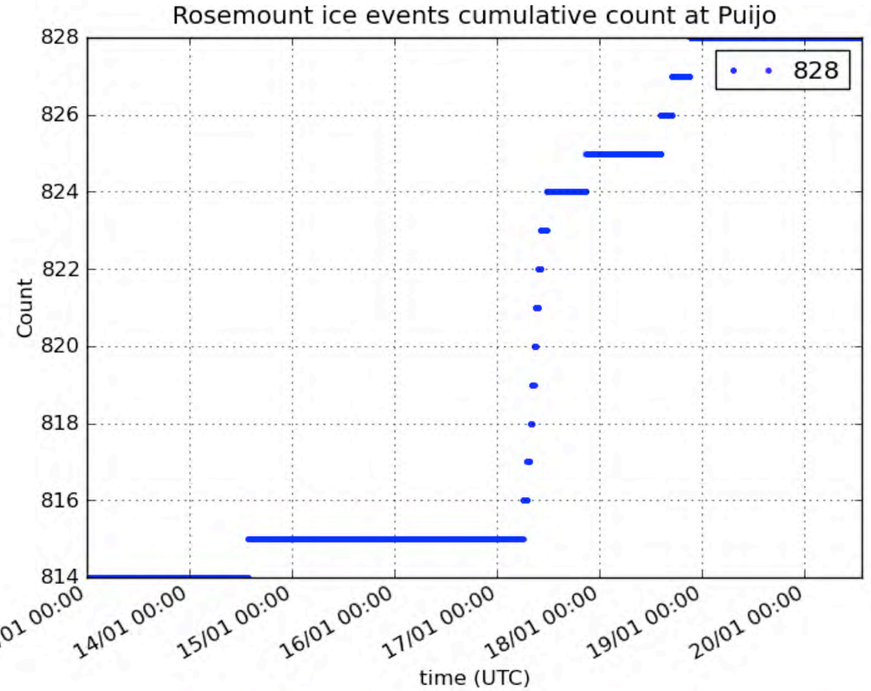
Sensor signals during icing (FZDZ case)



LID-3300IP: Icing if signal value drops from 100 significantly
Heating starts at signal value 50



Rosemount 0871LH1: Ice event (cumulative): one 130 Hz
Decrease from 40 kHz

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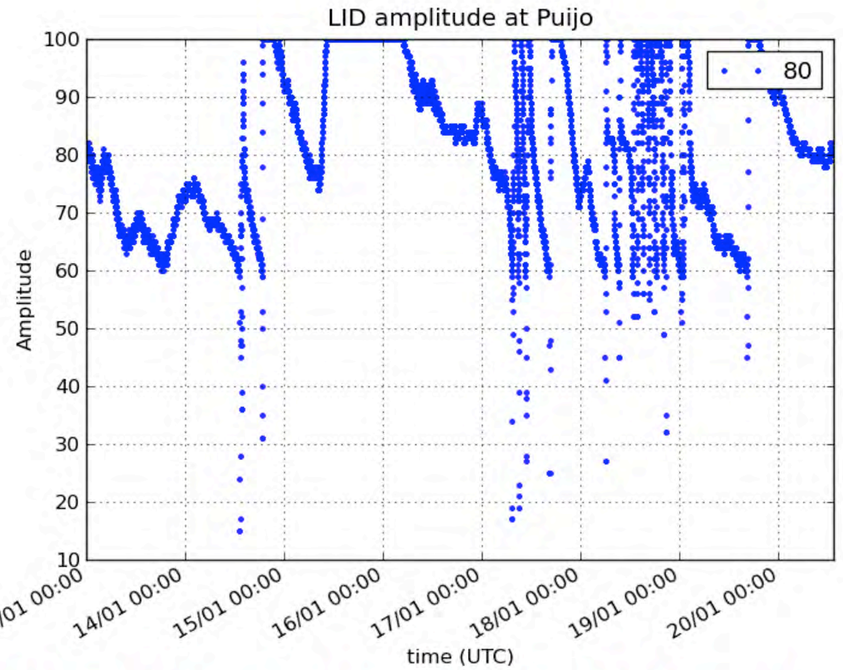

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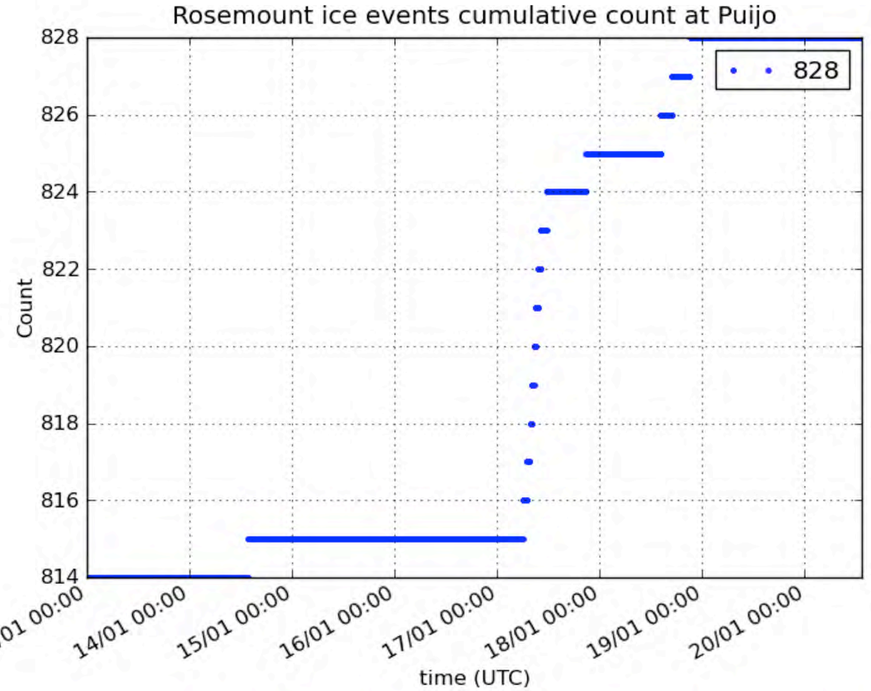

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Webcam, 10 hours icing Jan 16 2012 14:00 UTC

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Webcam, 10 hours icing Jan 17 2012 02:00 UTC

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Webcam, 3 days of sublimation between Jan 28 2012 06:45 UTC

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Webcam, 3 days of sublimation between Jan 29 2012 06:45 UTC

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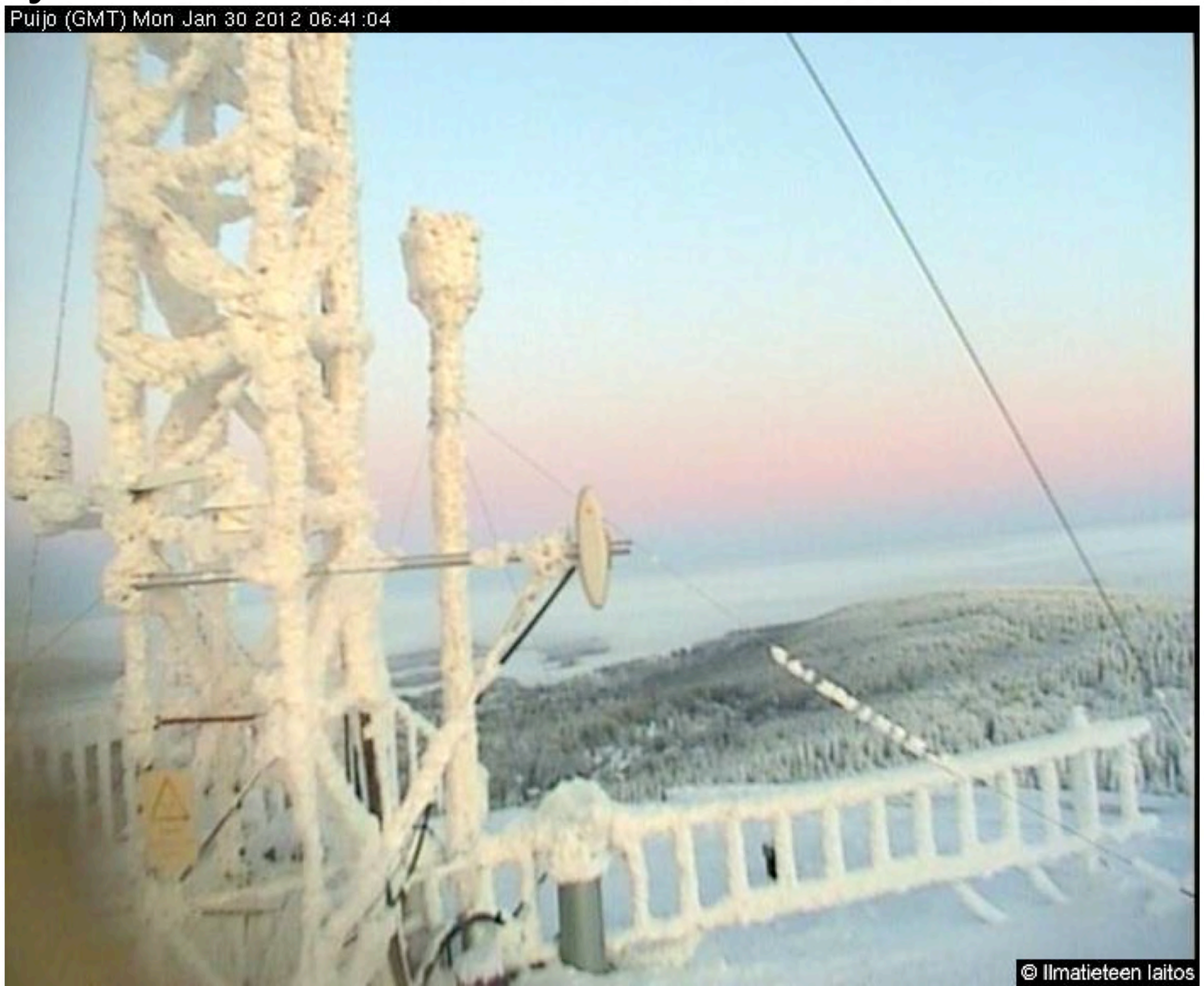
Webcam, 3 days of sublimation between Jan 30 2012 06:45 UTC



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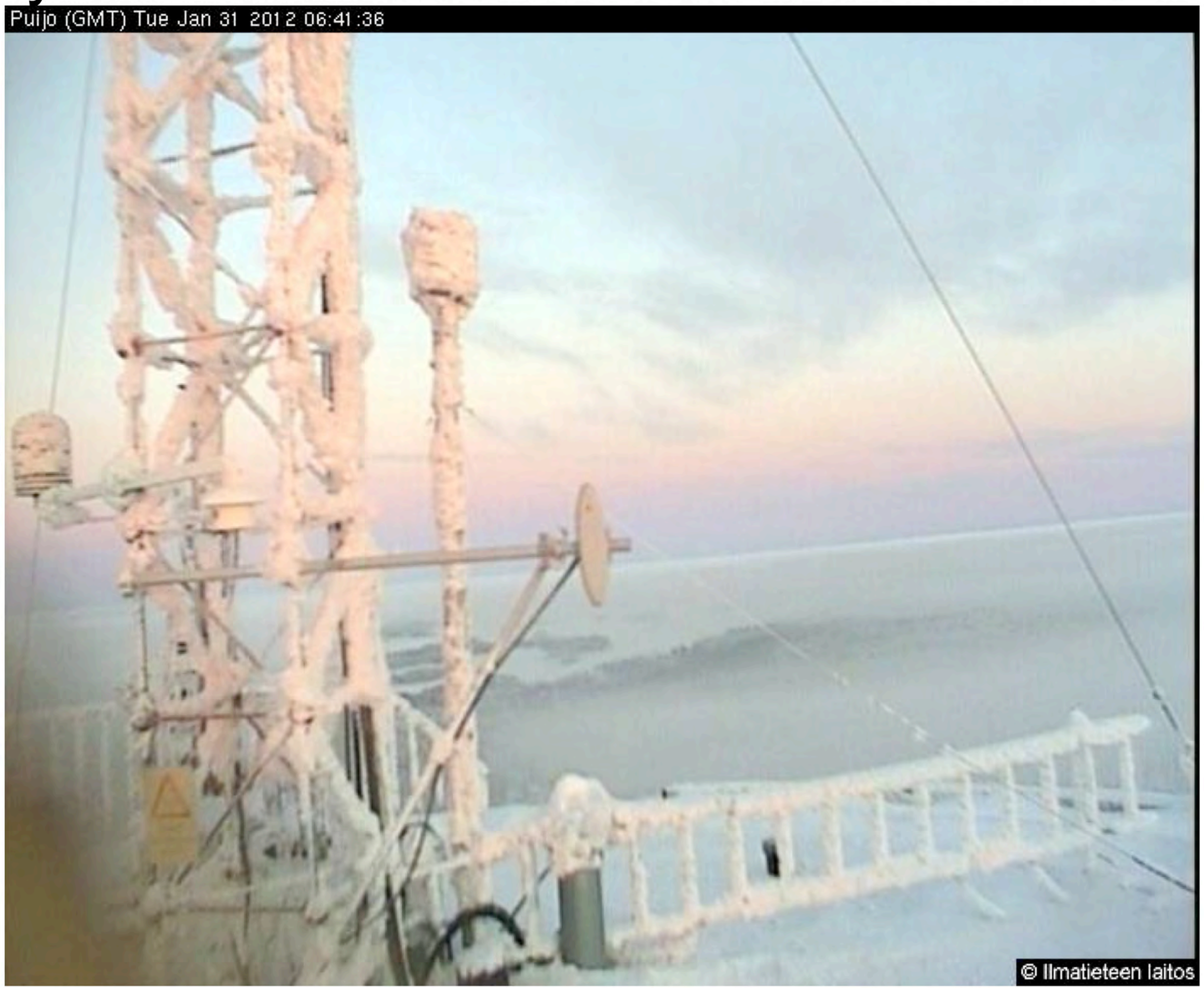
Webcam, 3 days of sublimation between Jan 31 2012 06:45 UTC



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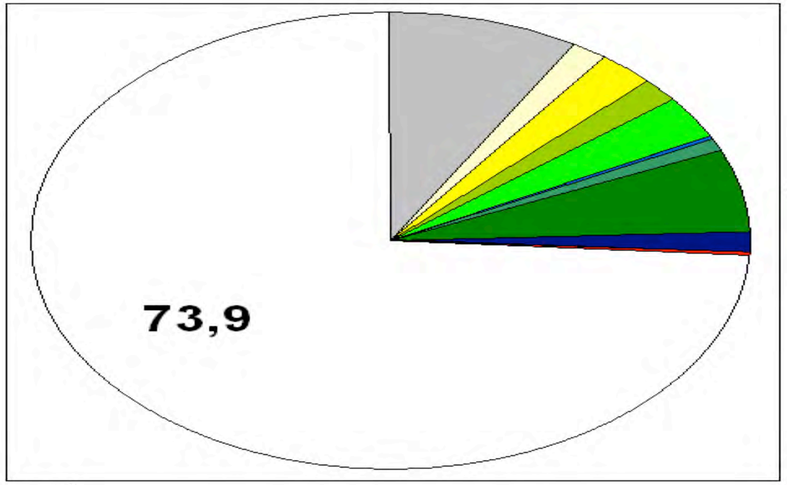
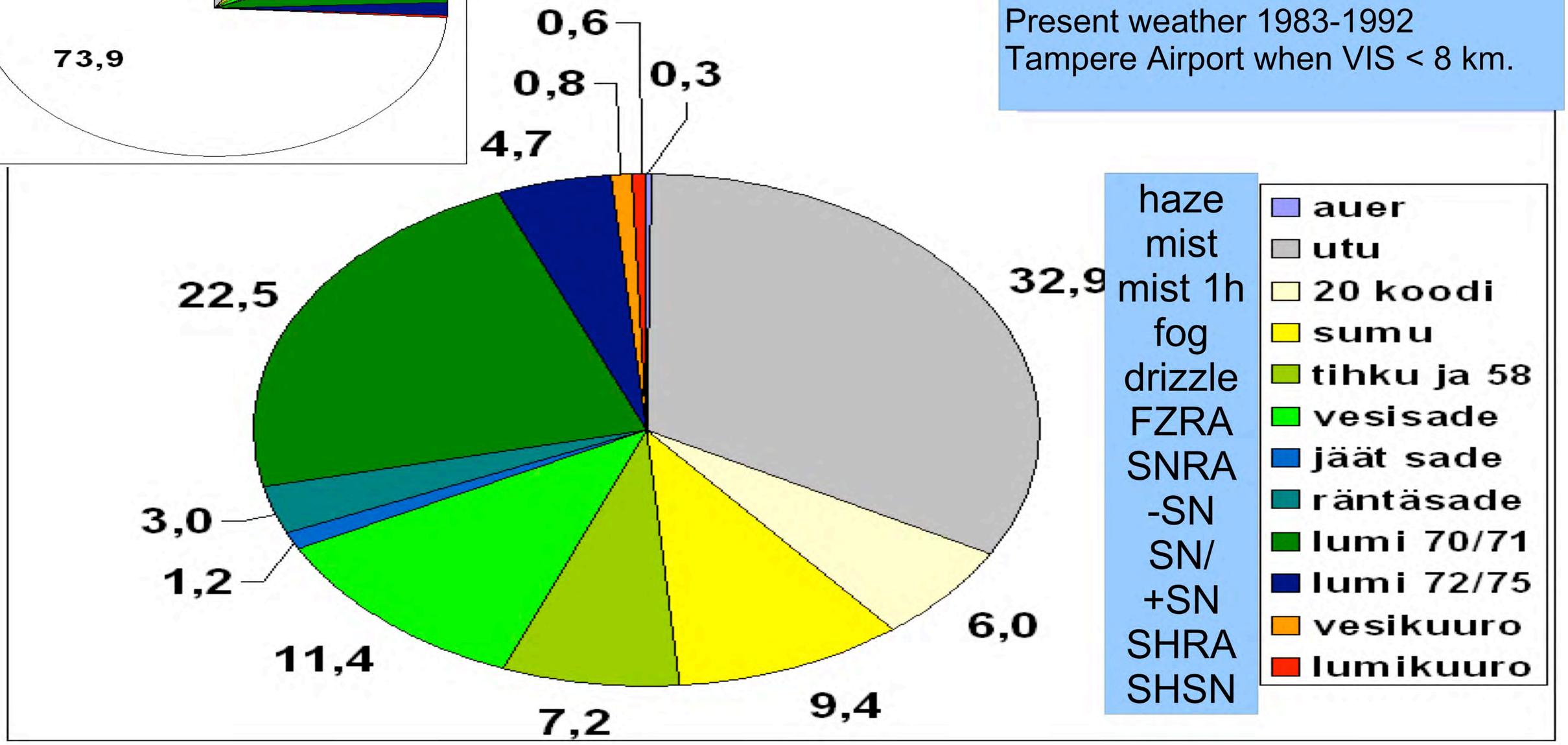
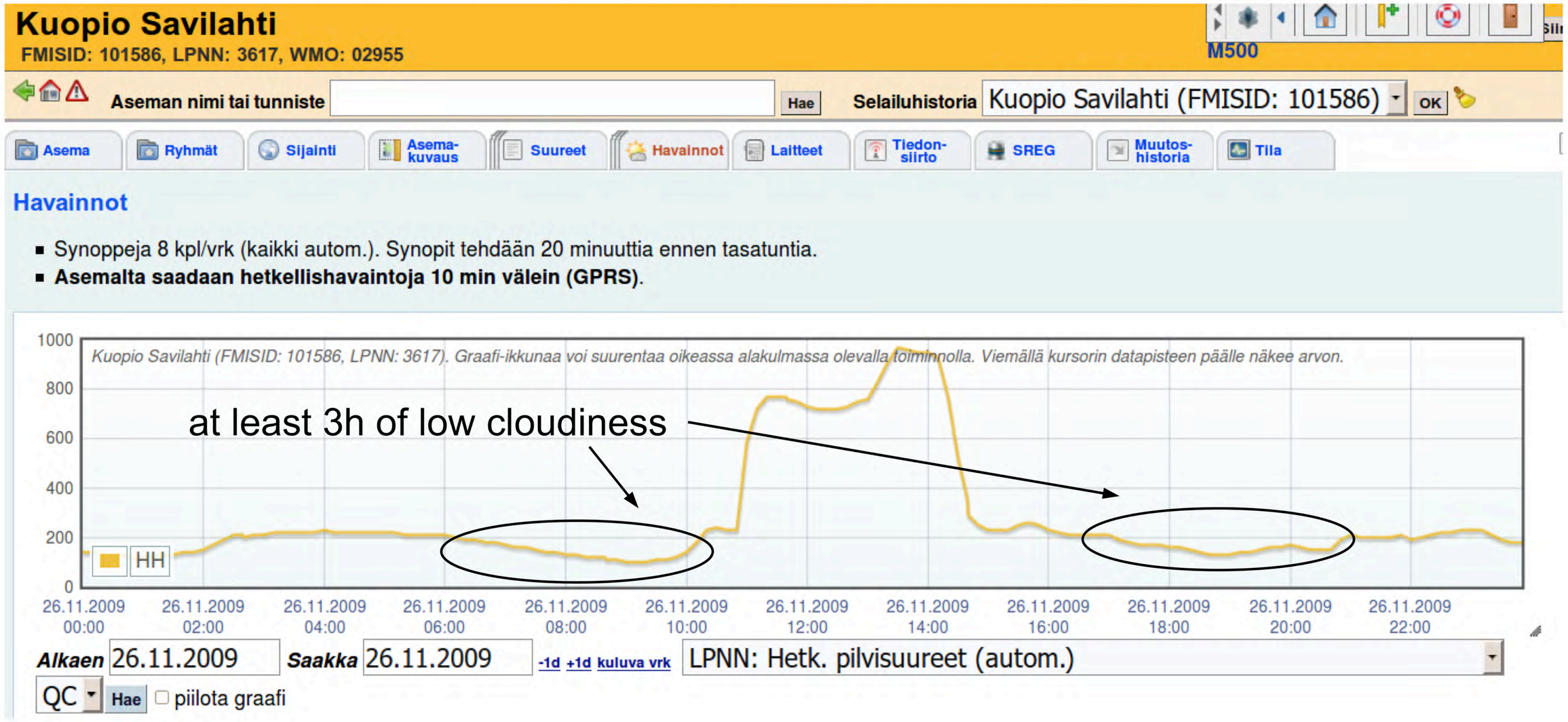
Glaze ice formed by freezing drizzle on tower structures 23 Nov 2011



Present weather 1983-1992
Tampere Airport when VIS < 8 km.



Cloud base height (CBZ) during an (icing) in-cloud case



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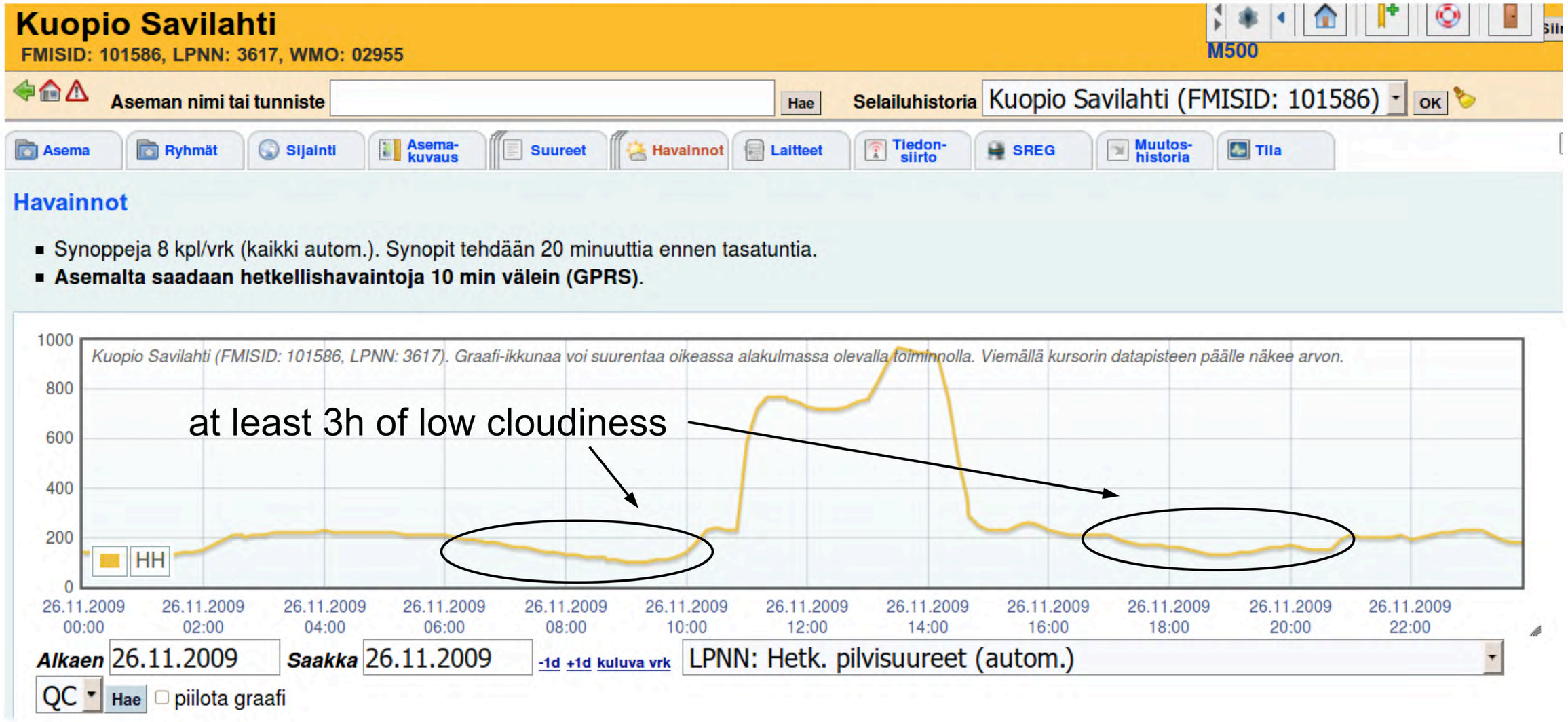

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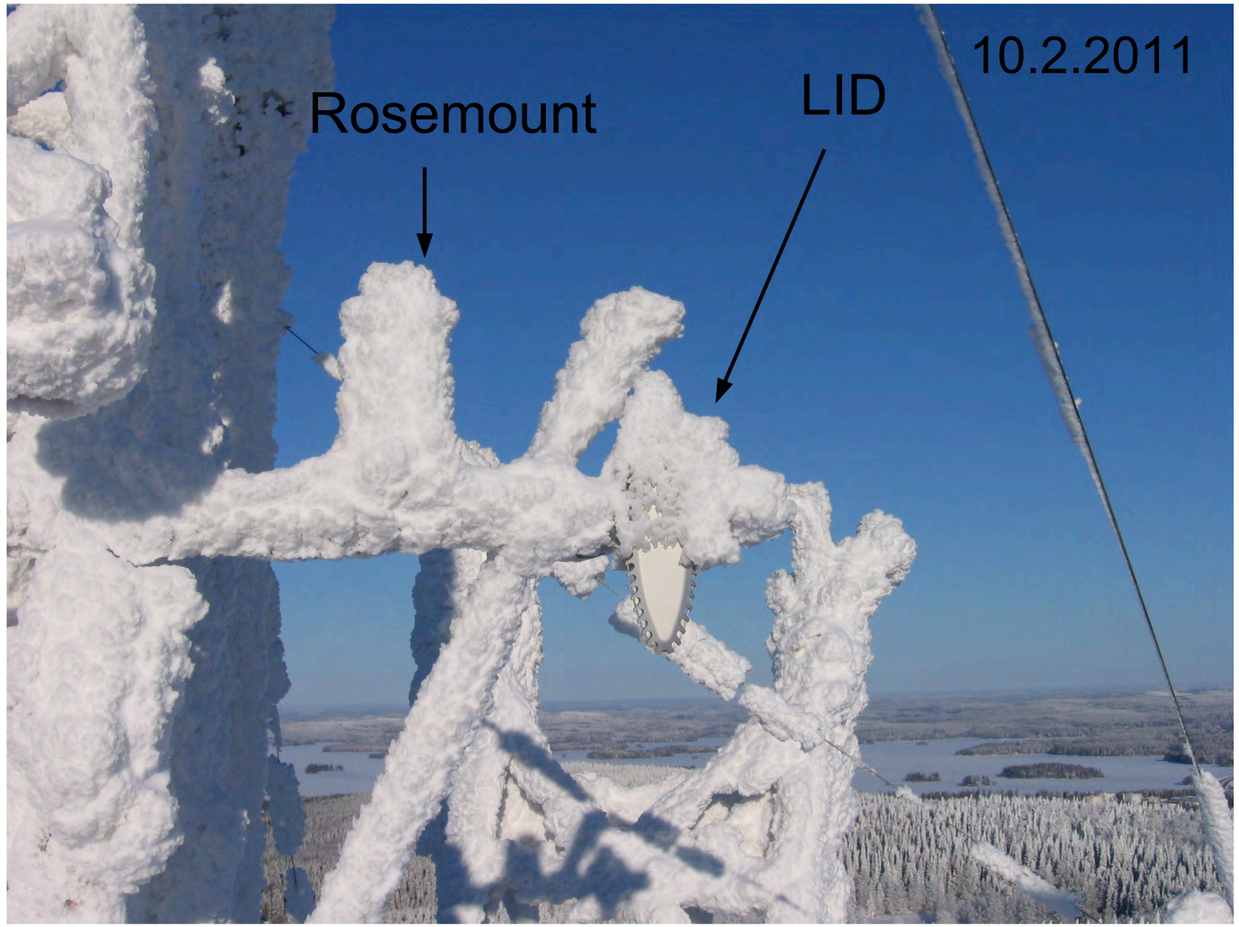
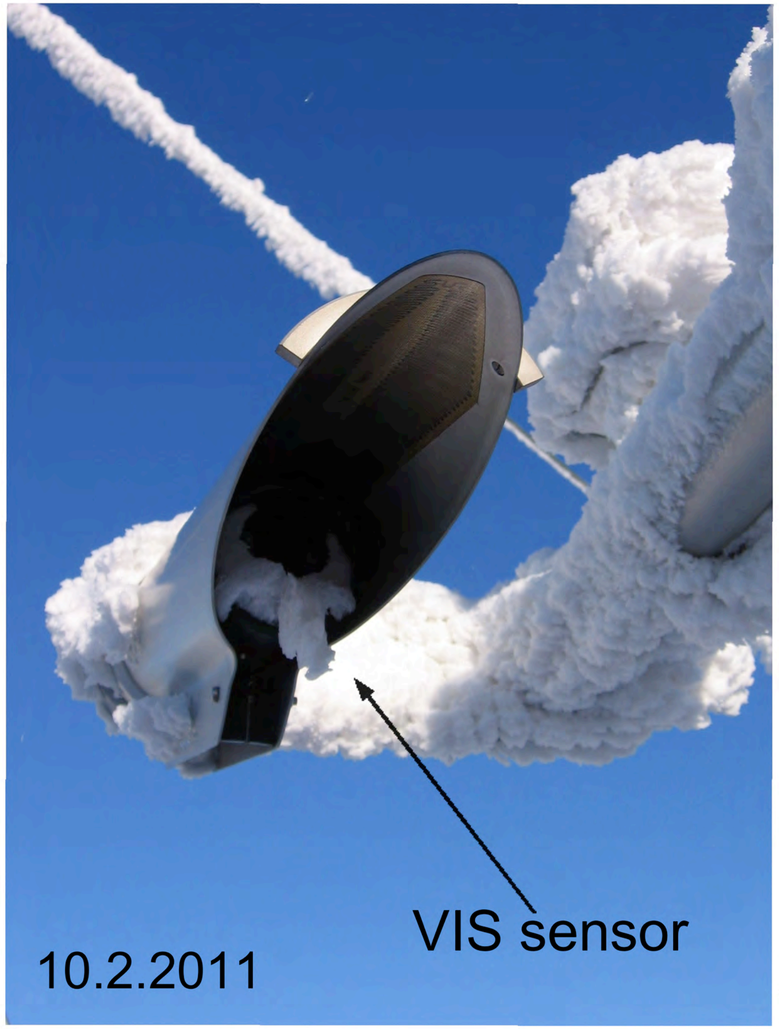
General problem with icing detectors in weather station usage

- **every once in a while sensors do get ice all over if right meteorological conditions for icing prevail long enough**





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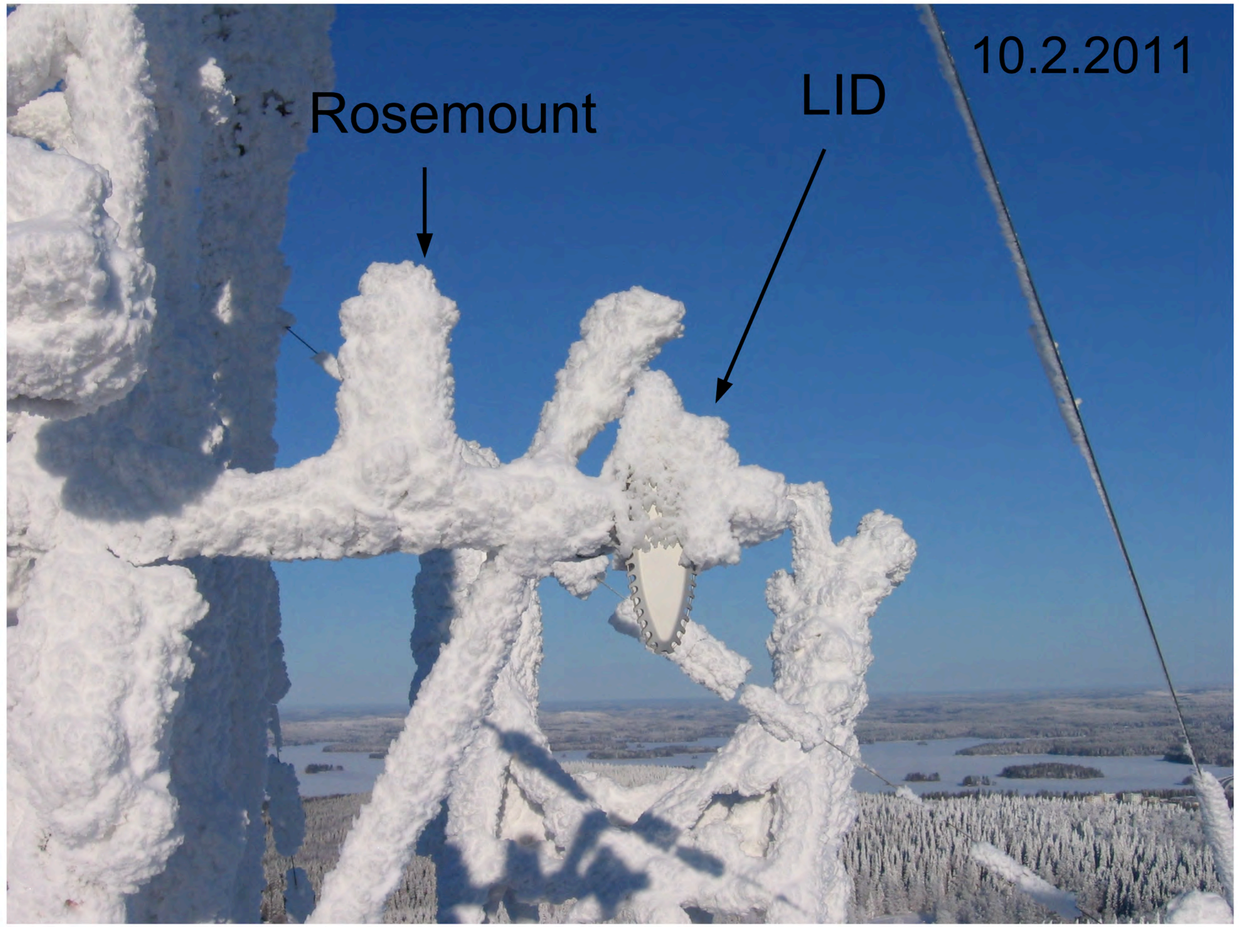

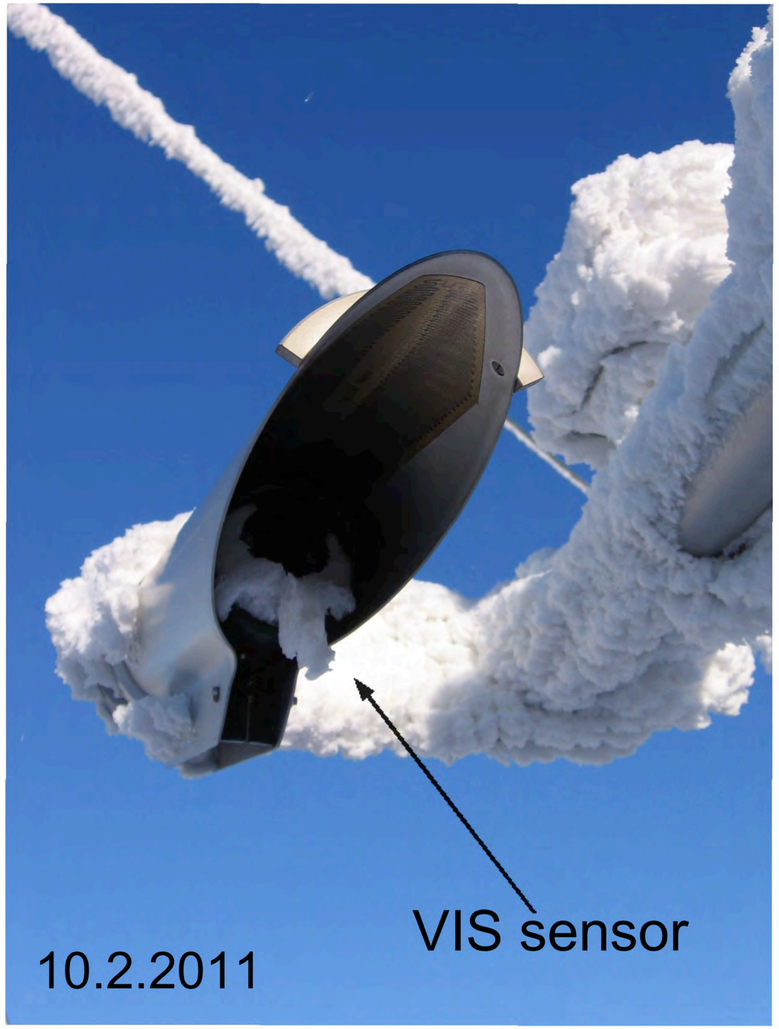

Results: comparison table for 13 (from 132 available) cases from 2009, (2010, 2011 TODO)

		Direct icing observation	
		yes	no
VIS/T-rule	yes	9	1
	no	0	3

Conclusions

- **Low cold (T<0°C) clouds practically always contain some liquid water**
- **VIS and T rule strong indicator for in-cloud icing as visibility is poor in-cloud**
  - Exception might occur when T just slightly below zero (T=0...-1°C)
  - Then the ice detectors might stay quiet as latent heat release in phase transition (water->solid) is able to keep sensor surface above zero.3
- **Other icing phenomena excluded in this study**
  - Mist, pathy cloudiness , freezing precipitation, snow mixed rain
  - VIS/T-rule probably not work as well in these situations
  - Cases with ice detectors indicating without clear reason needs further studying
- **Number of cases analyzed here is very small due to manual manipulation**
  - further studies required with automated analysis
- **Heavy and/or long-lasting mid and late icing season cases harder to study as ice detectors more likely ice up**

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Thank you!

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