

Measurements of cloud droplet size and concentration related to icing

Mika Komppula,

Ari Leskinen, Antti Ruuskanen and Sami Romakkaniemi

(mika.komppula@fmi.fi)

Finnish Meteorological Institute
Atmospheric Research Centre of Eastern Finland
(Kuopio)

Additional working group:

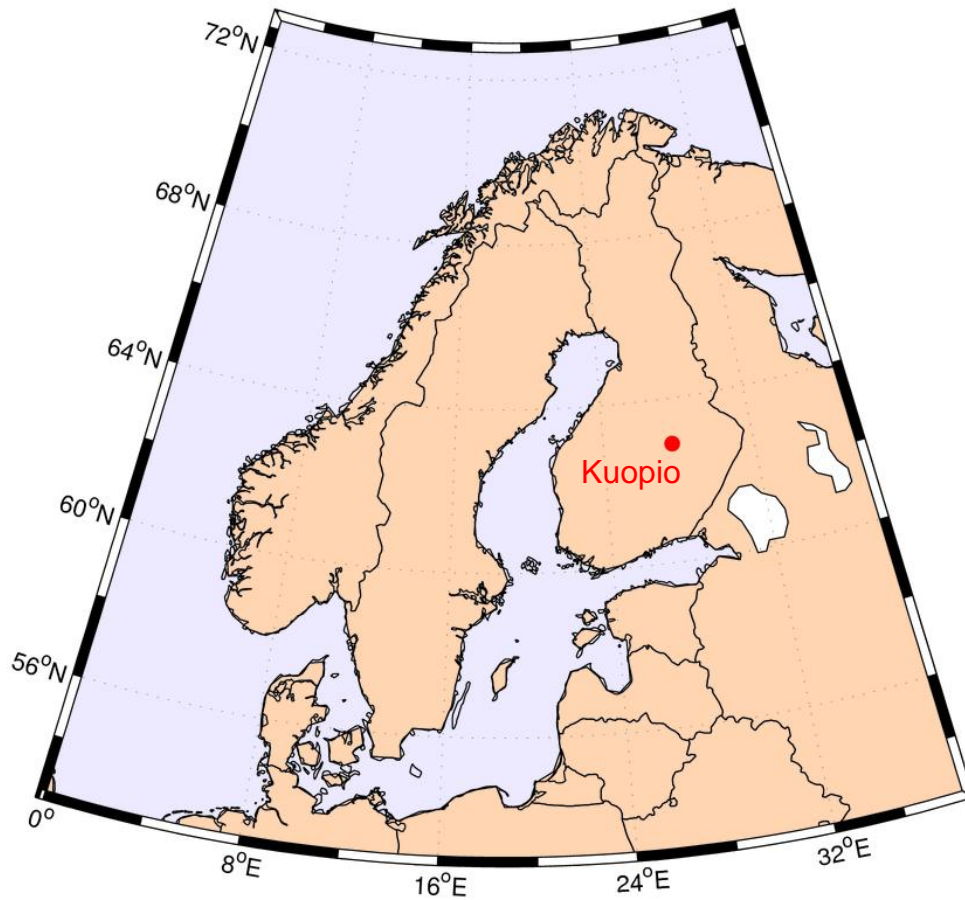
Anne Hirsikko, Karoliina Hämäläinen and Simo Tukiainen

Two sites in Kuopio, Finland

Puijo tower



3.2.2018



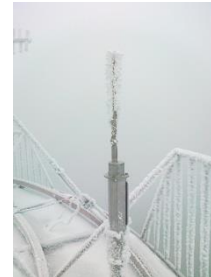
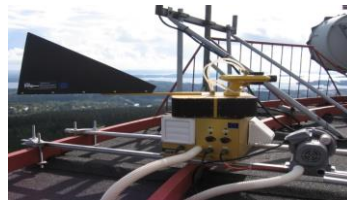
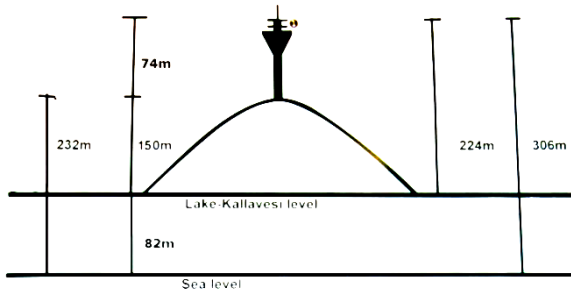
Vehmasmäki mast



2

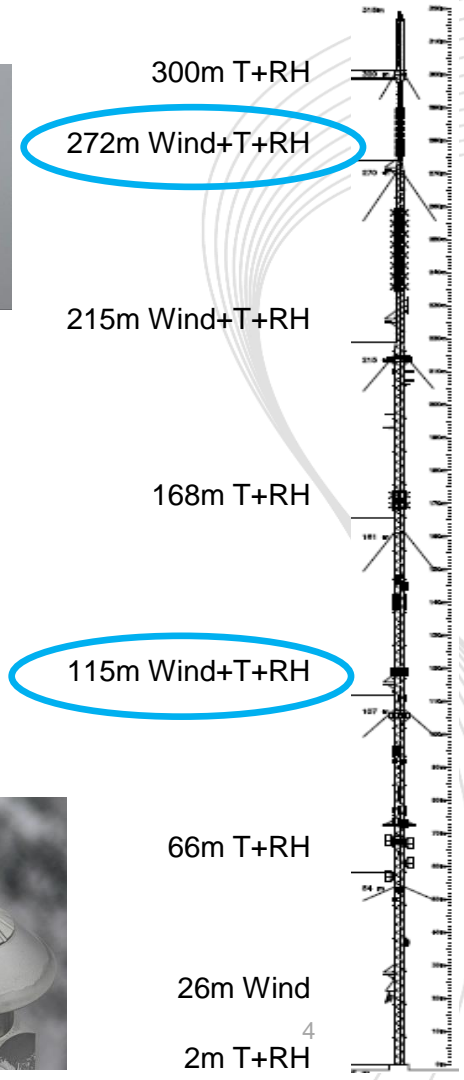
Puijo tower

- 224 m above the local lake level
- Inside a cloud for about 15% of the time
- **Icing sensors** at the moment: Goodrich 0872F1, Labkotec LID-3300IP (4 pcs) & Saab Combitech
- **Ceilometer** Vaisala CT25K
- Weather parameters (WS, WD, T, p, RH, vis, rain)
- **Cloud droplet size distribution** (3-50 μm) and many aerosol instruments

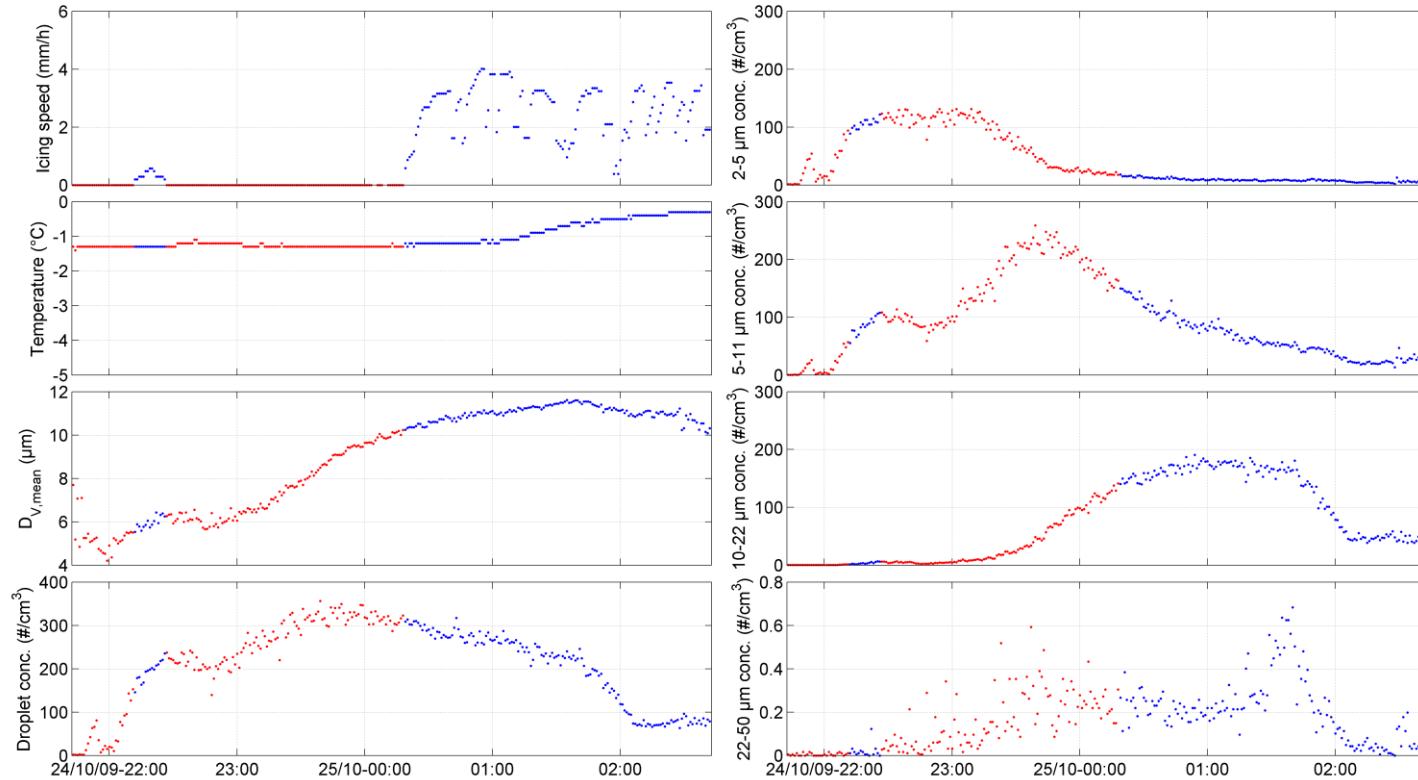


Vehmasmäki

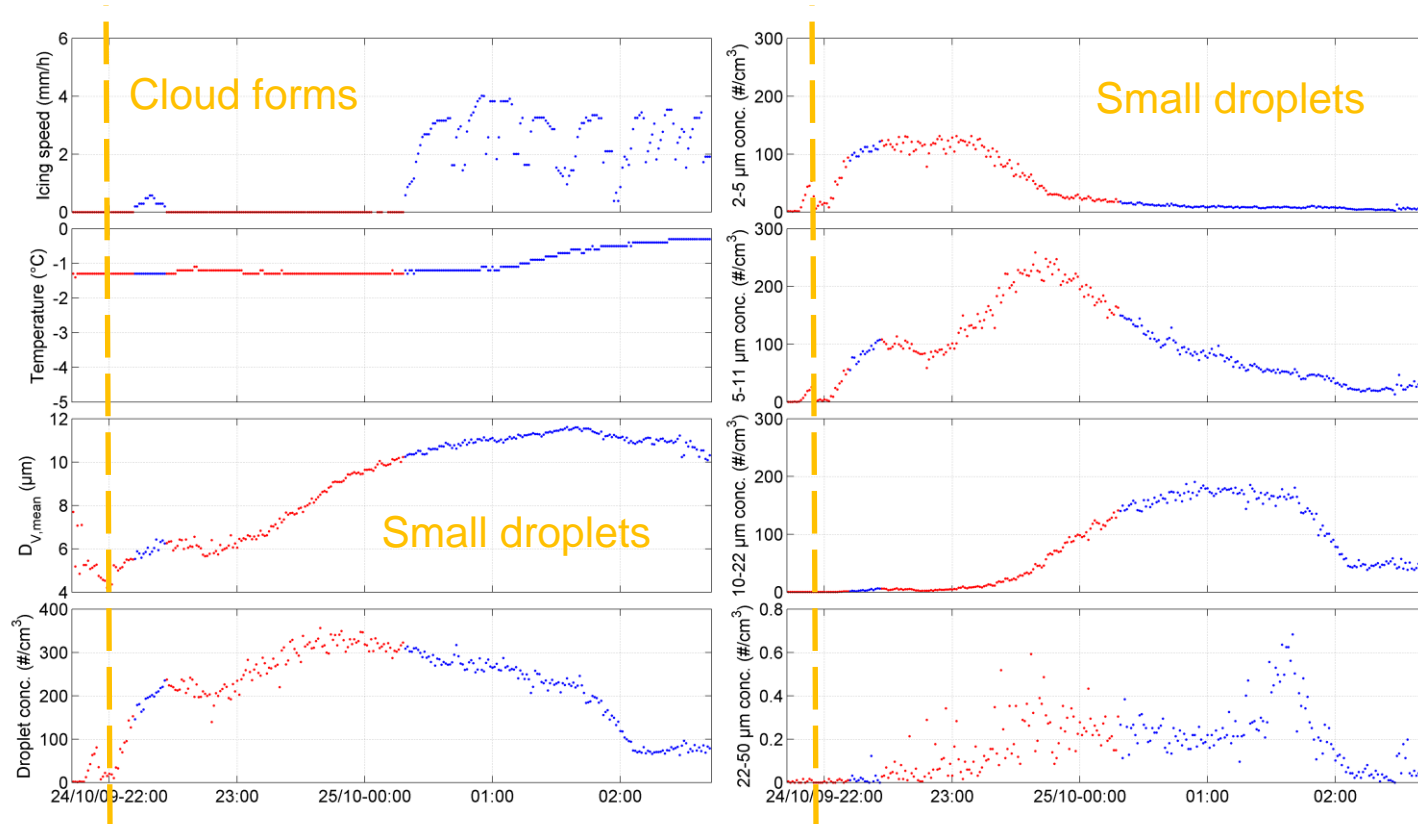
- 20 km from Kuopio city, 318 m mast
- **Icing sensors** (115 & 272 m)
 - 2x Goodrich 0872F1 & 2x Labkotec LID-3300IP
- **Ceilometer** Vaisala CL51
- Weather parameters at multiple heights
- Campaign based: PollyXT Raman lidar (7 channels), Halo Doppler lidar & Doppler cloud radar (Metek Mira)



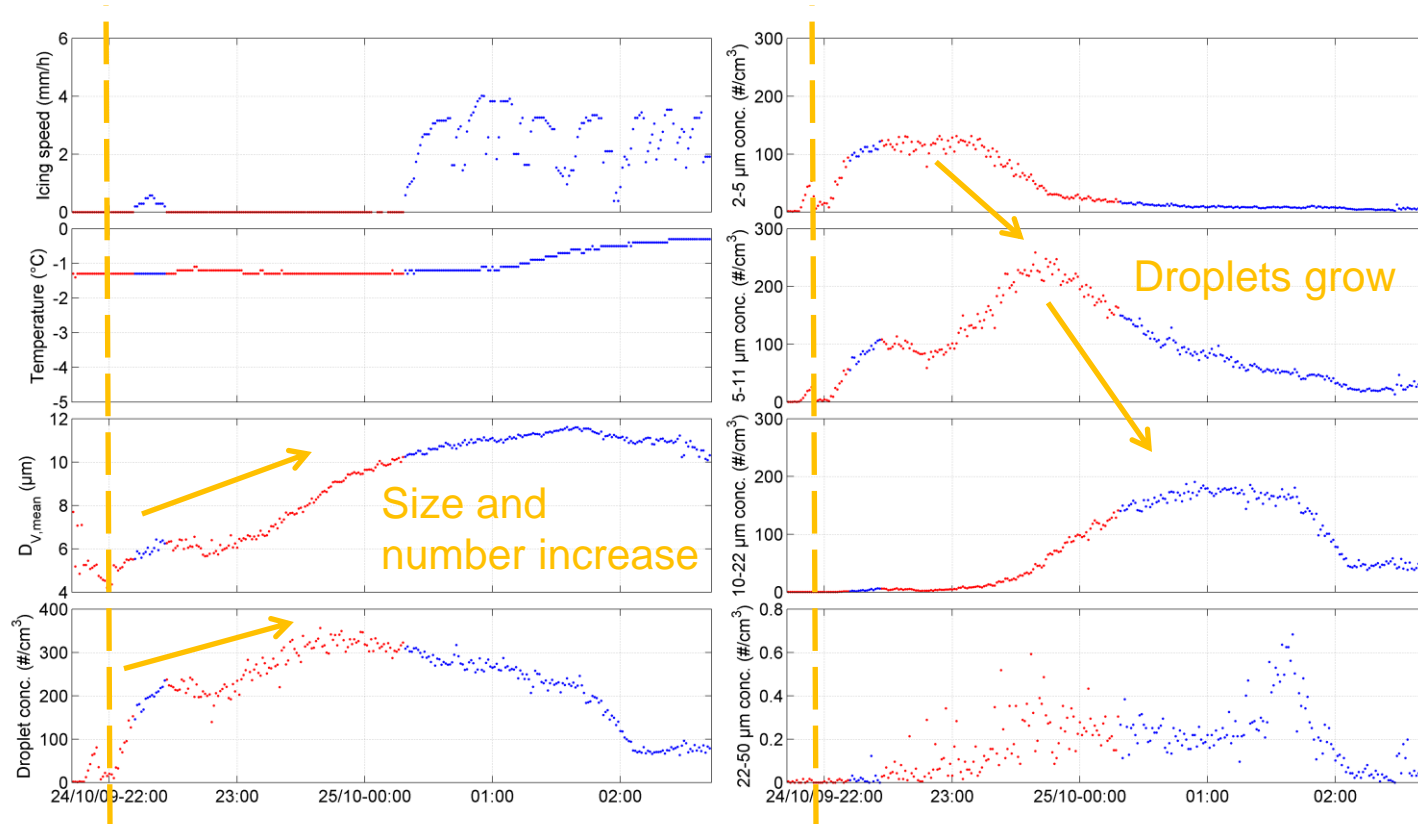
Cloud droplet size and concentration during an icing case (1)



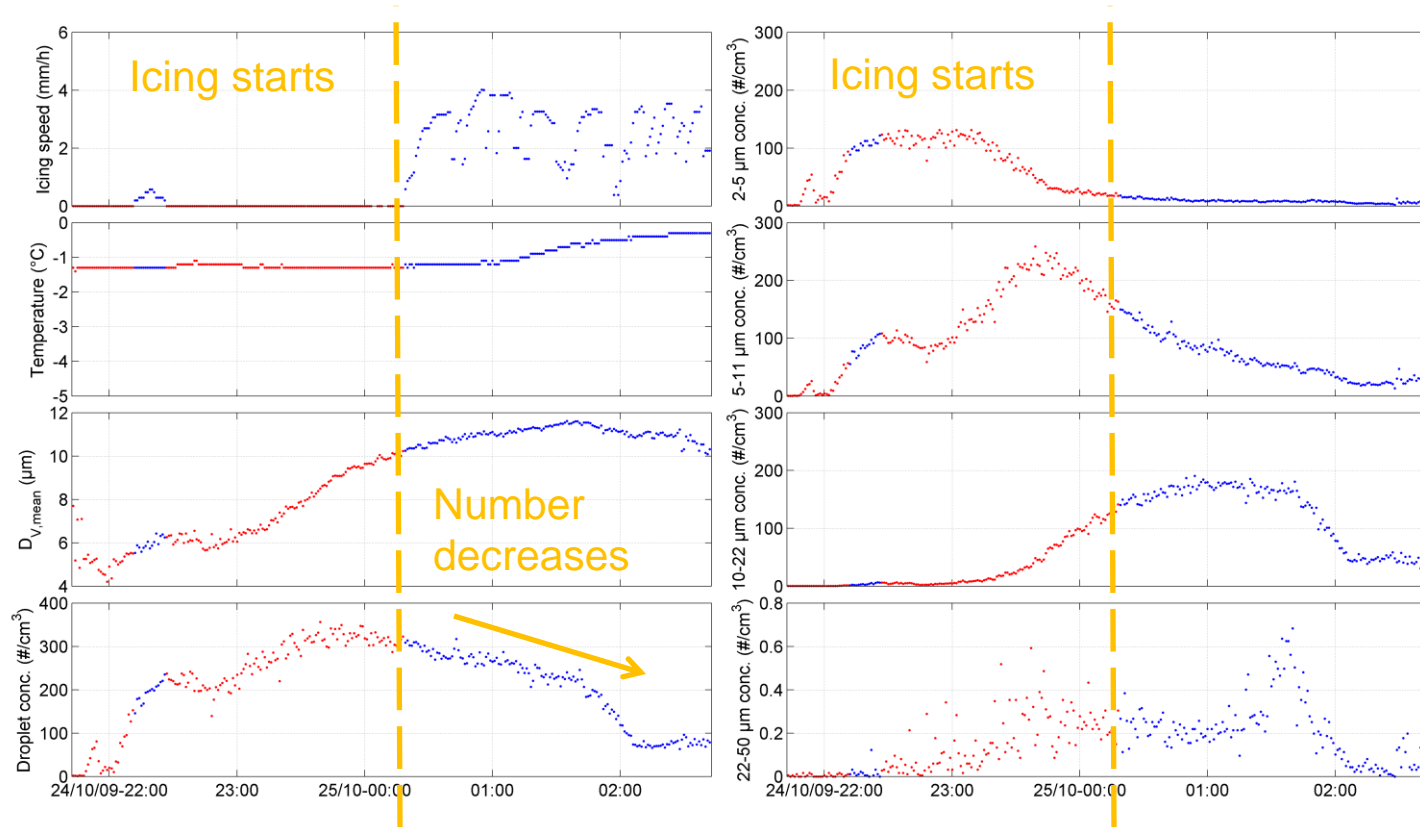
Cloud droplet size and concentration during an icing case (1)



Cloud droplet size and concentration during an icing case (1)

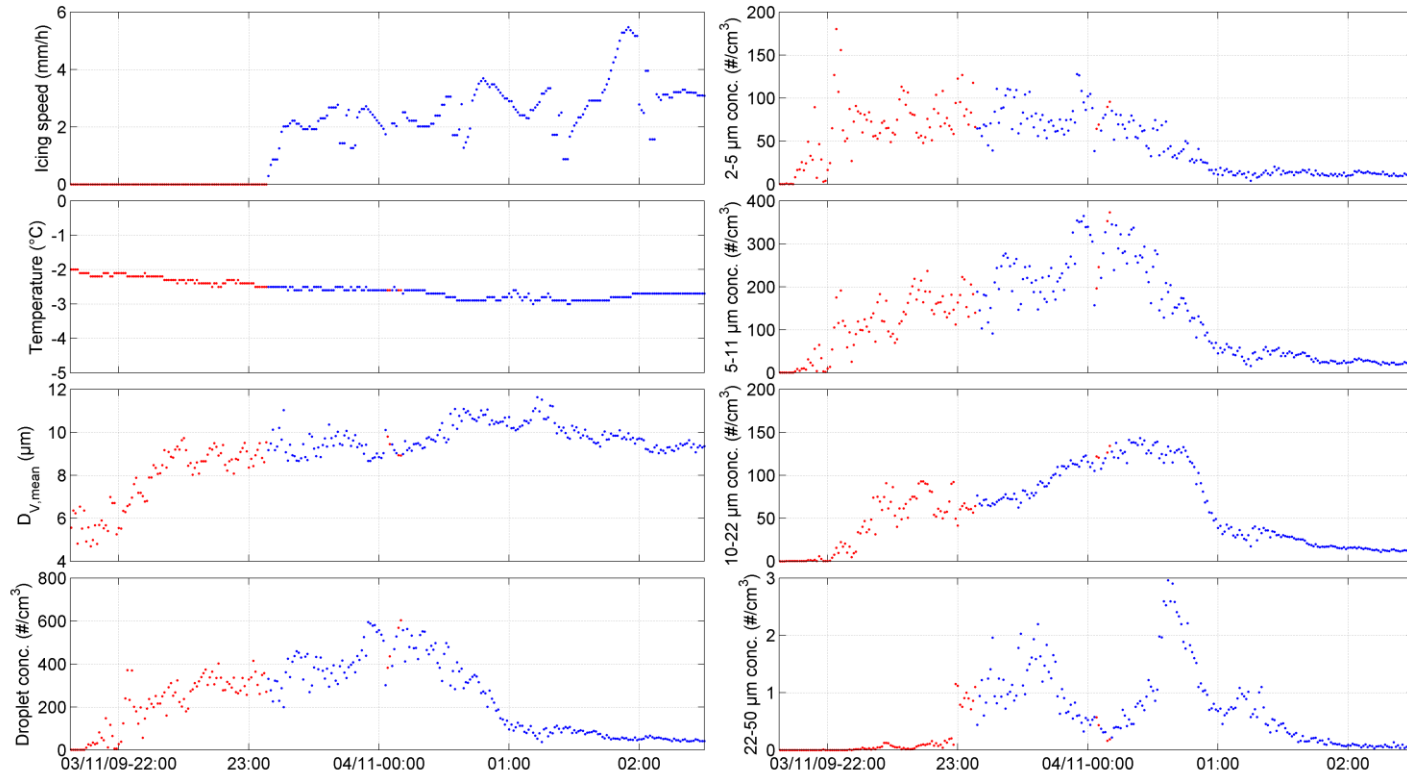


Cloud droplet size and concentration during an icing case (1)

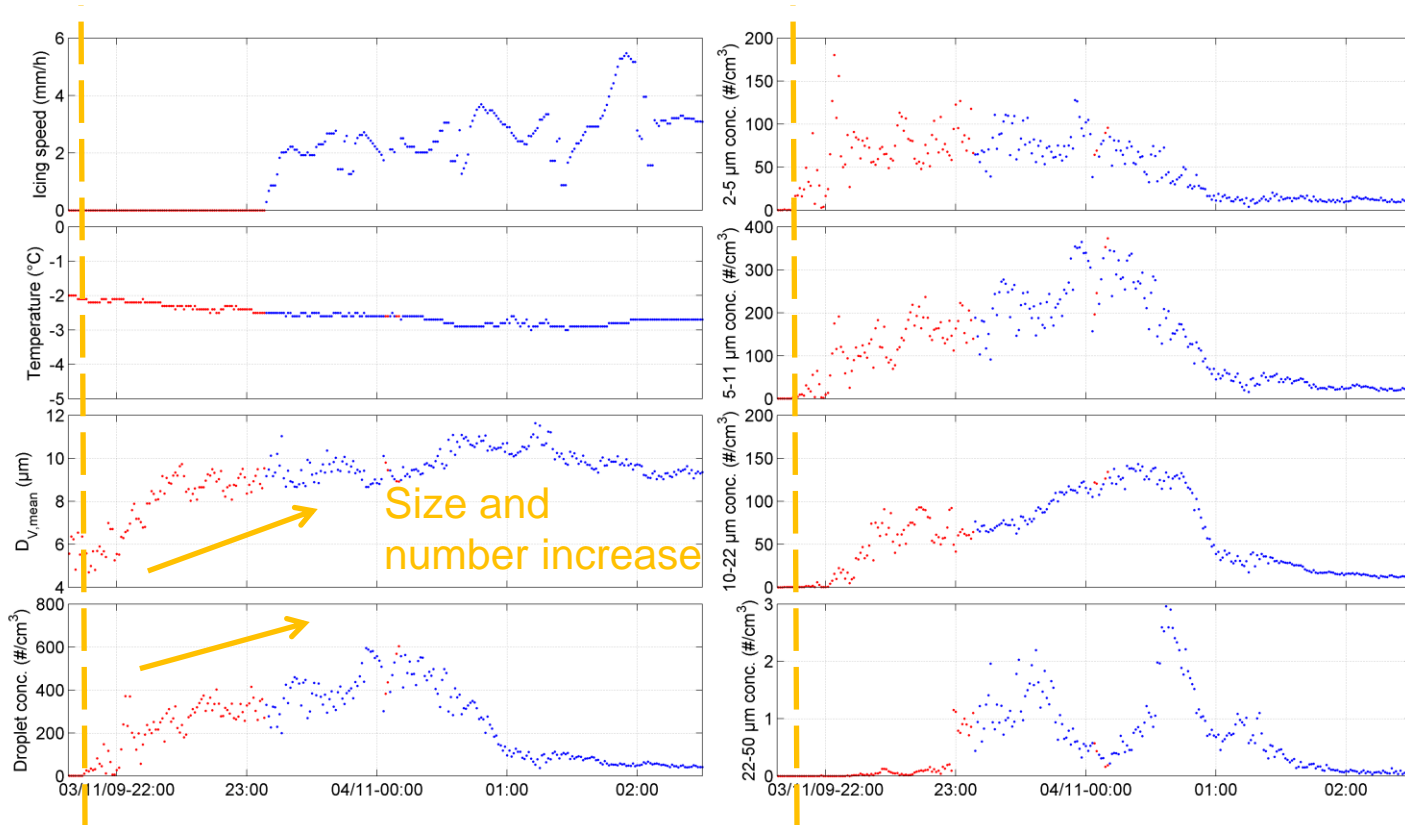


red color = non-icing, blue color = icing

Cloud droplet size and concentration during an icing case (2)

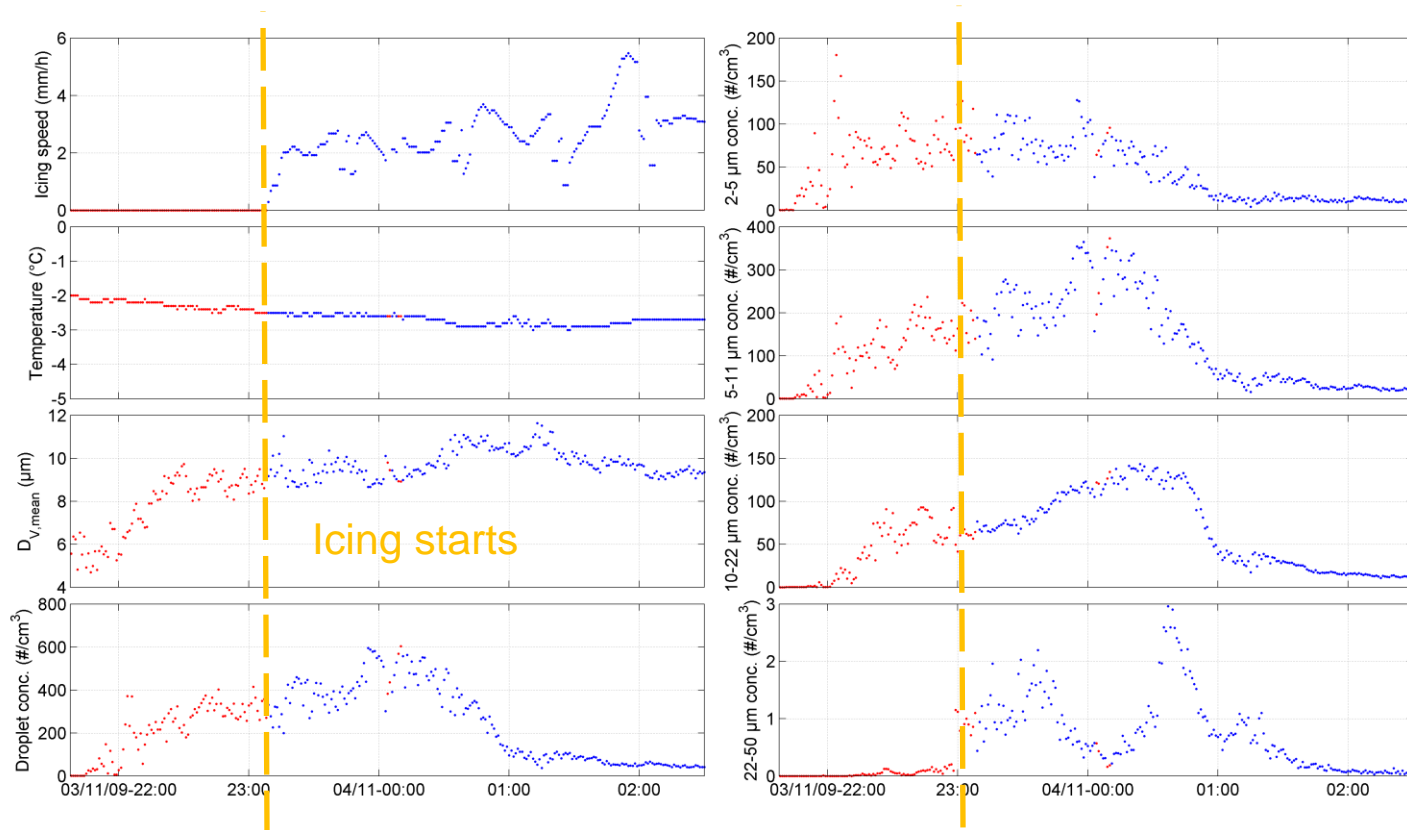


Cloud droplet size and concentration during an icing case (2)



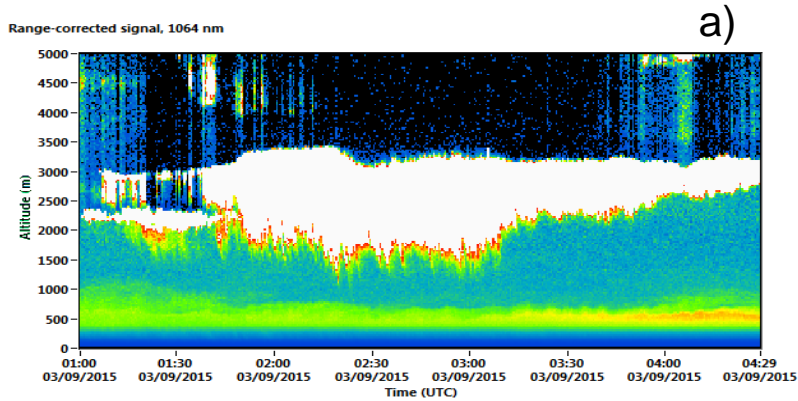
red color = non-icing, blue color = icing

Cloud droplet size and concentration during an icing case (2)

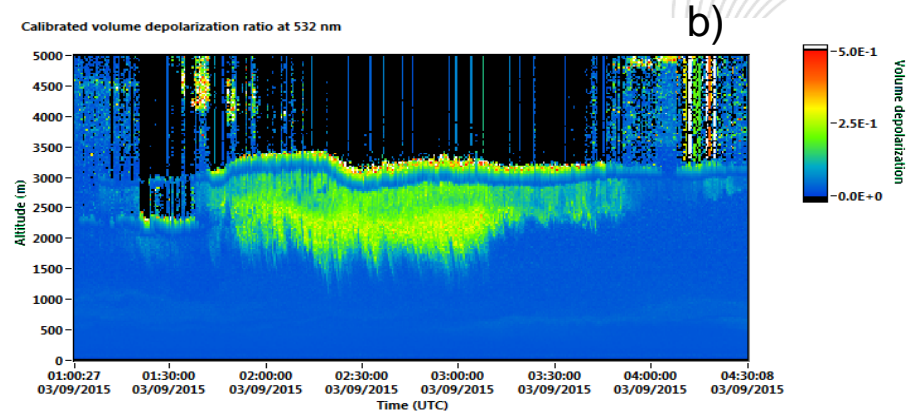


red color = non-icing, blue color = icing

A remote sensing icing case



a)

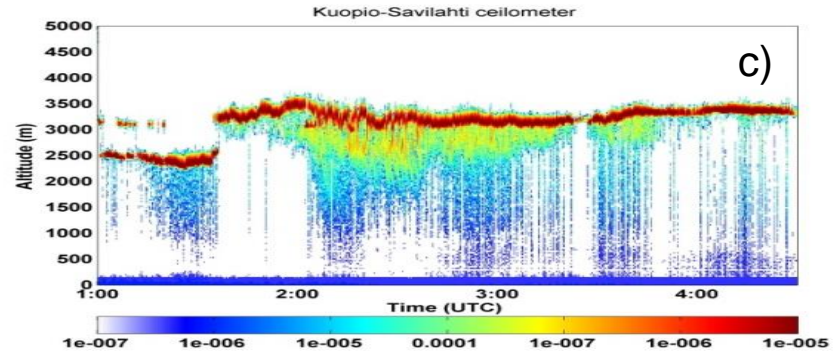


b)

a) Lidar backscatter (cloud = white)

b) Lidar depolarization (shape), water layer (blue line) at the top of the cloud

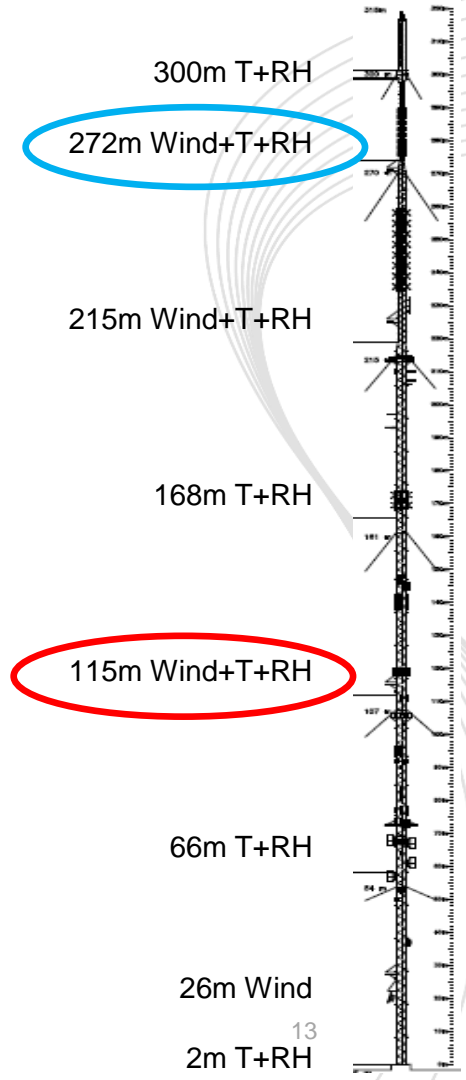
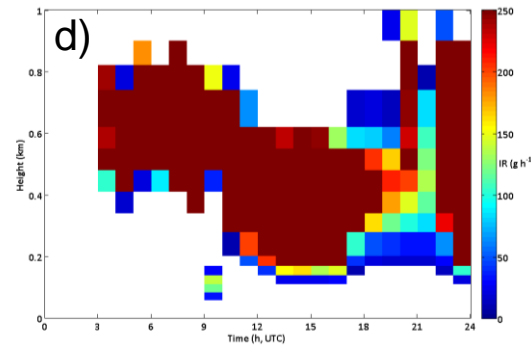
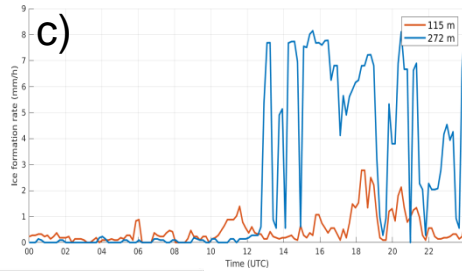
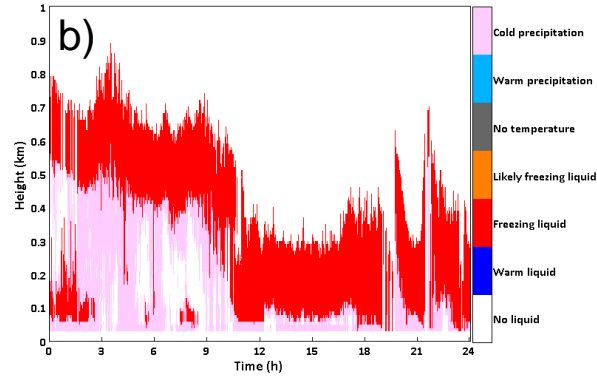
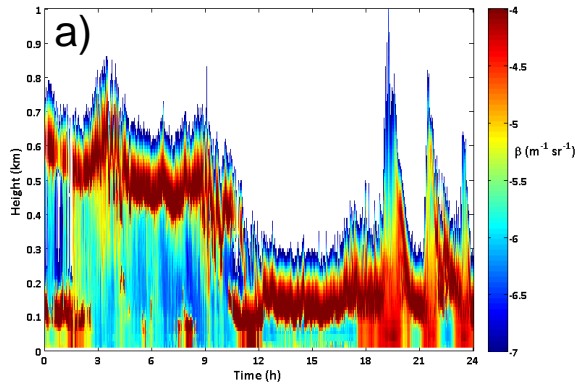
c) Ceilometer raw data, water layer (red) seen as high "backscatter")



c)

Temp at 3 km is about -15°C

Comparison of icing data from mast in-situ, ceilometer and icing model



A) Ceilometer data
 B) Icing classification (preliminary)
 C) Ice formation rate (in-situ)
 D) Modelled icing rate

Comparison of icing data from mast in-situ, ceilometer and icing model

- 1.1.-16.2.2017
- Total number of data points: 1974 (30 min aver.)
- **Icing observed 41-42 %** of the time with in-situ sensors
- **Simultaneous observations 85-94 %**, but also additional ones seen

Height	115 m	272 m
Number of icing observations		
In-situ icing sensor	810	835
Ceilometer	1079	1125
Icing model	1565	1505

Height	115 m	272 m
Simultaneous icing observations		
Ceilometer & in-situ	85 %	94 %
Model & in-situ	89 %	92 %

Icing product from ceilometer data and icing model

- Icing classification from ceilometer including the data quality info (top figures) and icing model forecast (bottom figures)
- Data presented real-time in a website

