



FINNISH METEOROLOGICAL INSTITUTE



UNIVERSITY OF HELSINKI



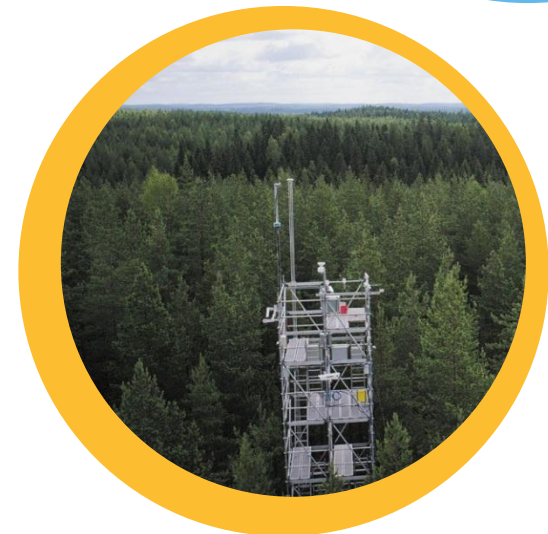
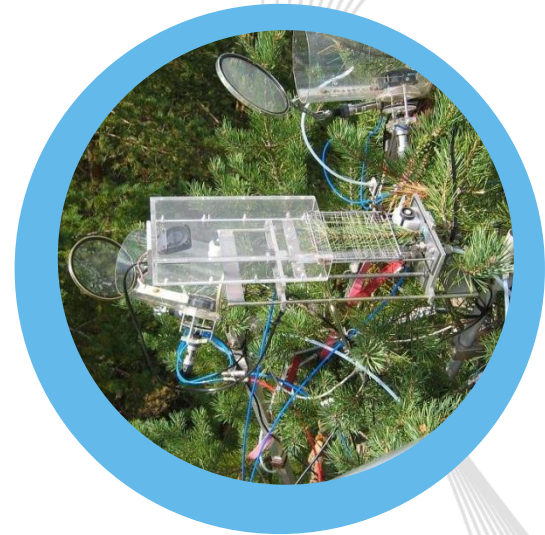
BAECC SNEX: Extensive snowfall campaign in Finland during 2014

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BAECC: Biogenic Aerosols - Effects on Clouds and Climate

- **Objective:** To verify the effects of secondary aerosol formation on cloud properties with combination of *in-situ* observations and active remote sensing instruments and place these observations with in larger context through modeling efforts
- **Duration:** 1 February – 12 September 2014
- **Collaboration:** Atmospheric Radiation Measurement Climate Research Facility (ARM, U.S. Department of Energy), University of Helsinki, Finnish Meteorological Institute, University of Eastern Finland and other international collaborators





BAECC: Biogenic Aerosols - Effects on Clouds and Climate





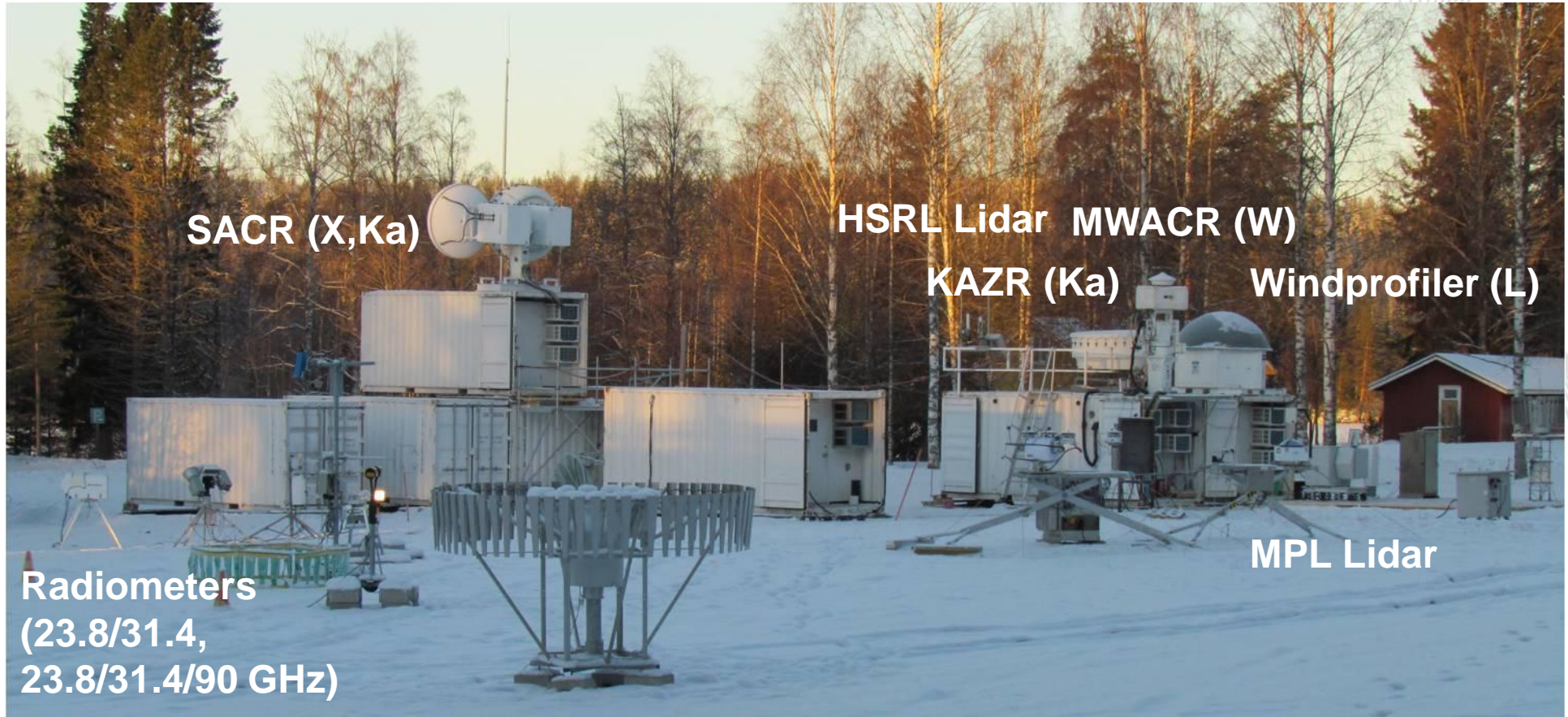
Snowfall Experiment (BAECC SNEX)

- **Objectives:**
 - Snowfall microphysics and connection to multi-frequency and dual-pol radar observations
 - Characterization of performance of the surface based snowfall measurement instruments
- **Duration:** February 1 – April 30, 2014
- IOP is carried out in coordination with GPM GV program





Remote Sensing Instruments



In addition: Doppler lidar with 100 m distance on building roof and FMI Ikaalinen Dual-Pol Weather Radar (C-band) with 64 km distance



Surface Observation Instruments

Sounding every
6 hours





Double Fence International Reference

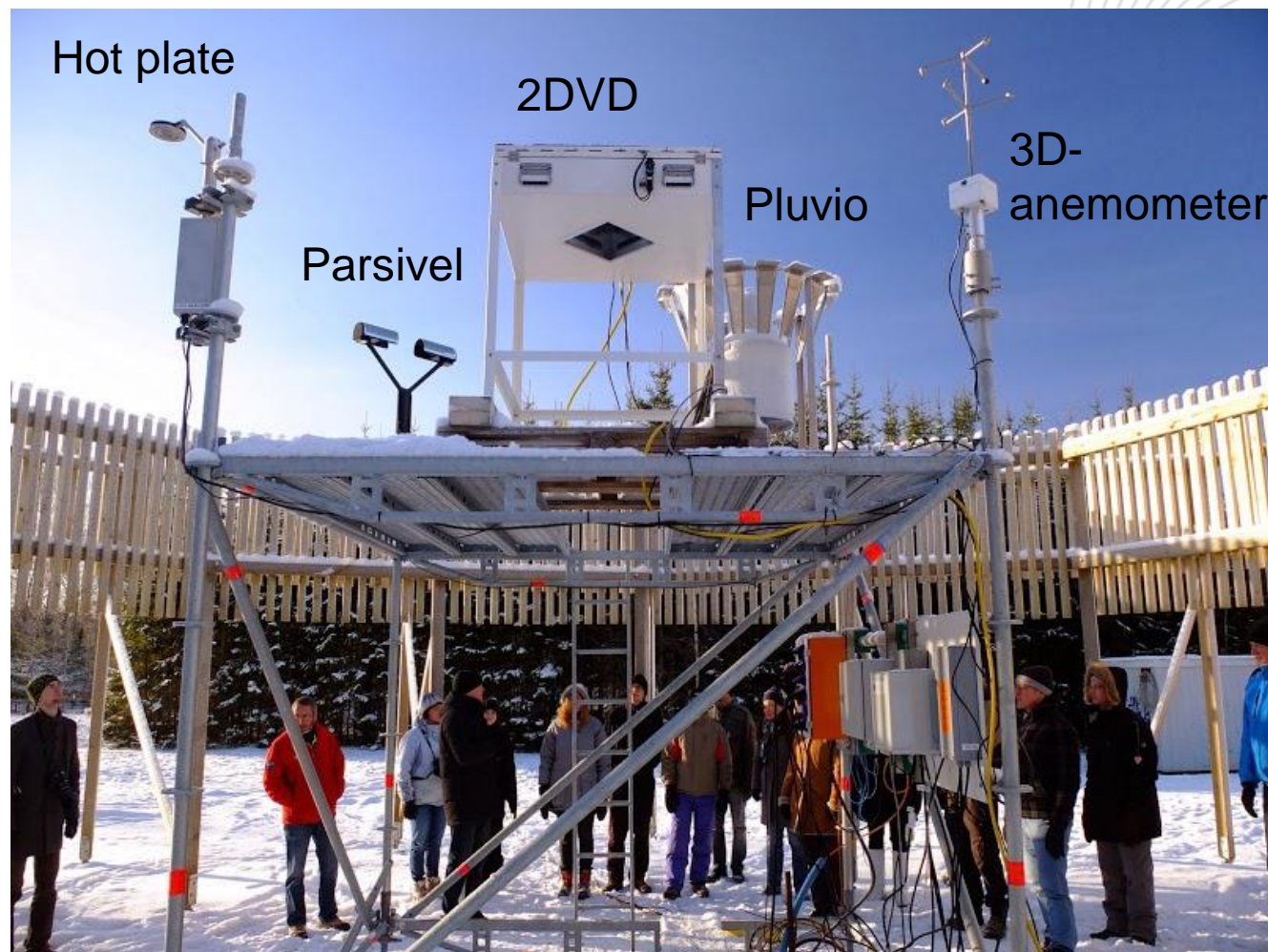


Following WMO and improved GCPEX design (according to recommendations by Peter Rodriguez, Environment Canada)

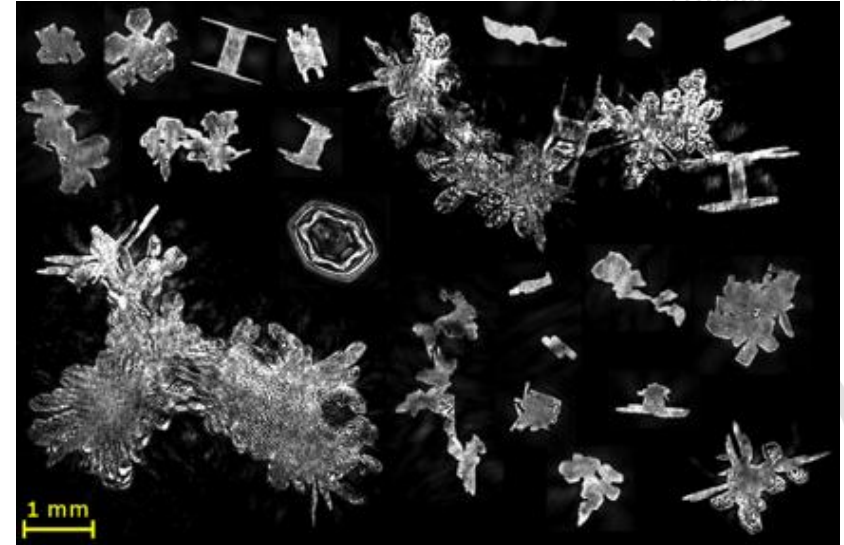
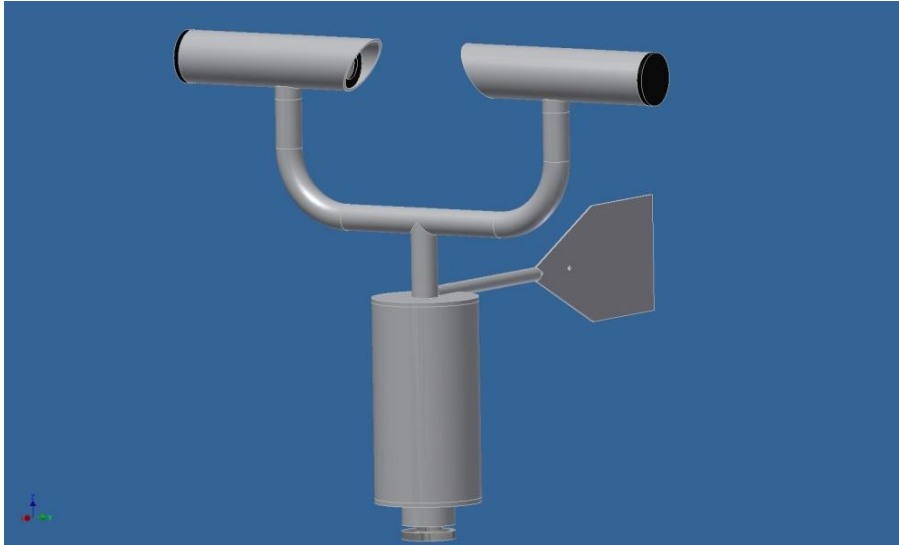


Inside of the fence

Wind measurements at instrument sampling volume heights were carried out by 3D-anemometers inside and outside of the fence



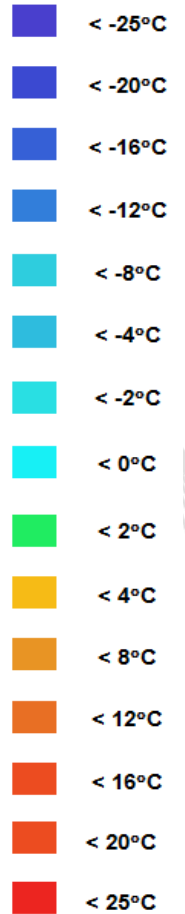
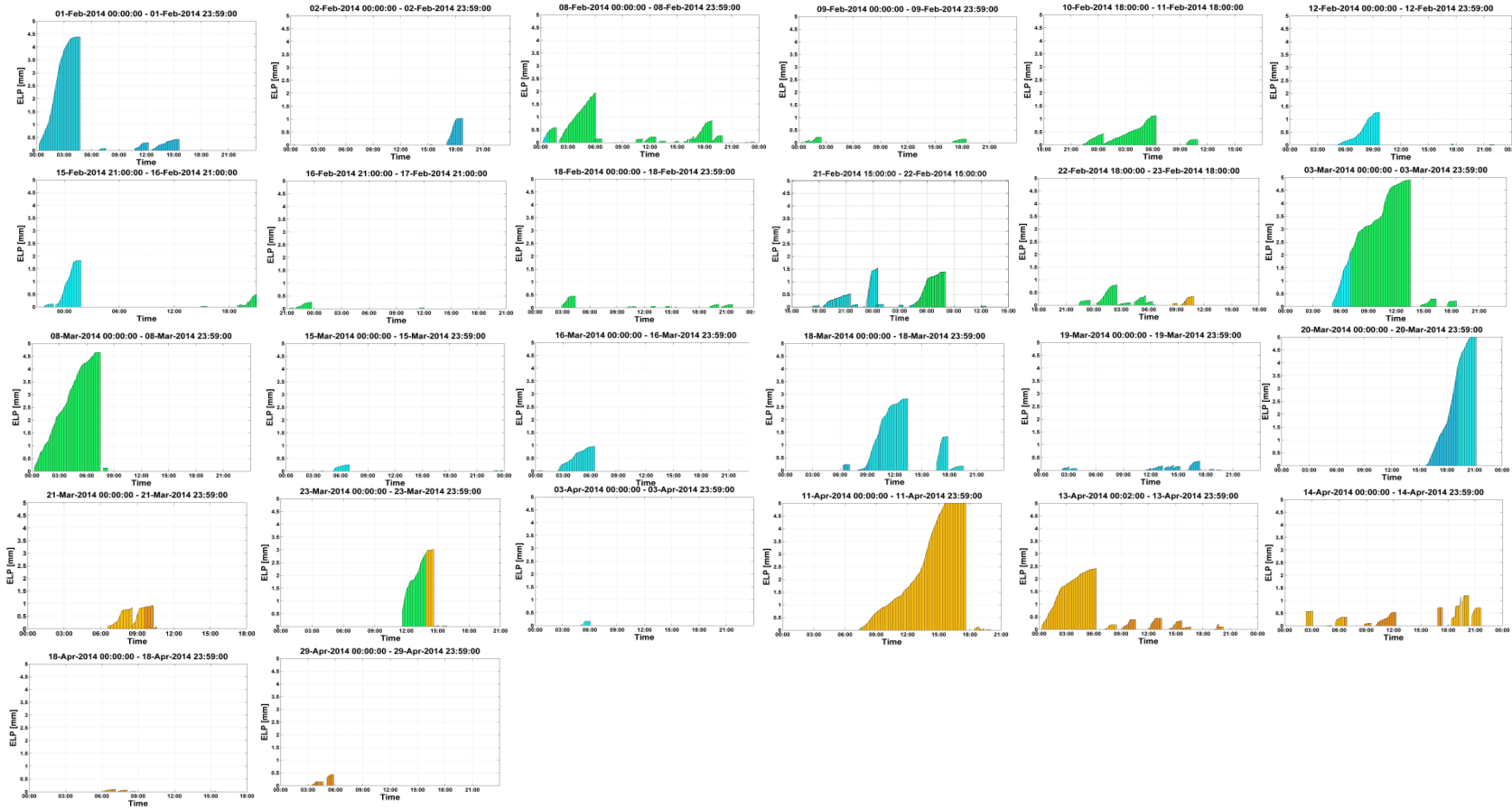
Testing New Instruments



- University of Oulu tested a holographic in-line imaging system during the campaign in Hyytiälä
- Camera yields very high resolution images (about 20 micrometers) of ice particles



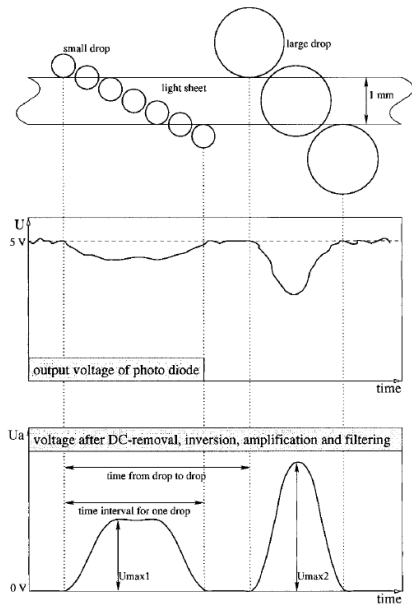
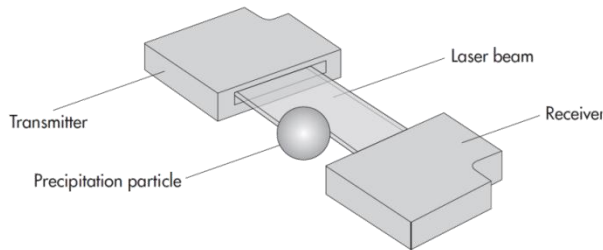
BAECC SNEX 2014 Events according to Wet-Bulb Temperature



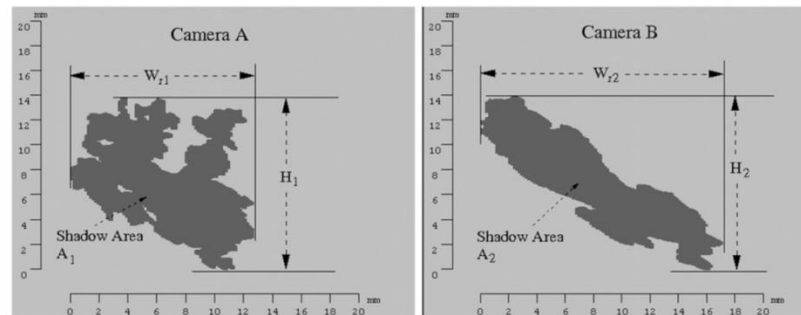
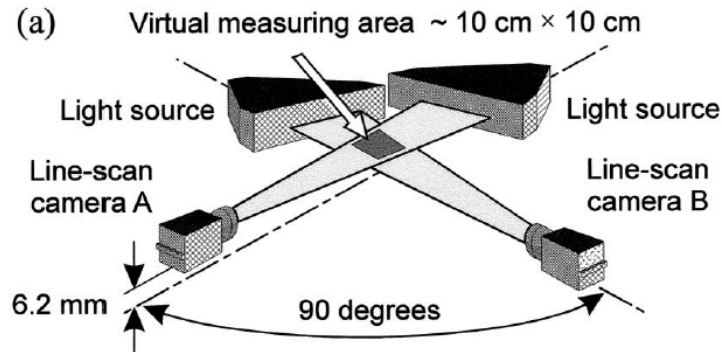


In situ Instrument Comparison

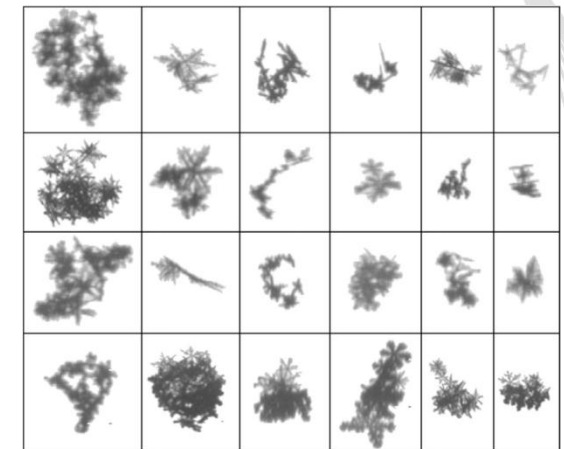
OTT Parsivel



2D -video disdrometer

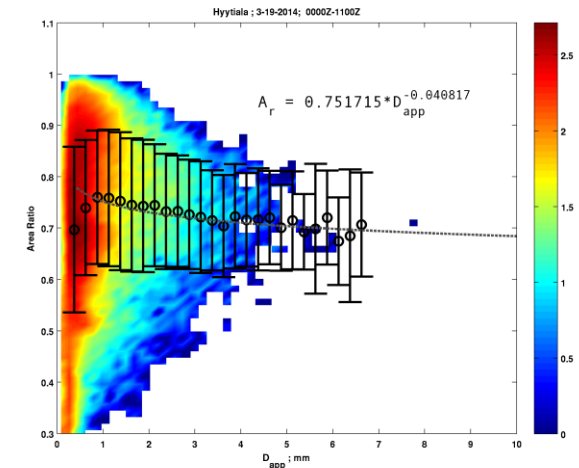
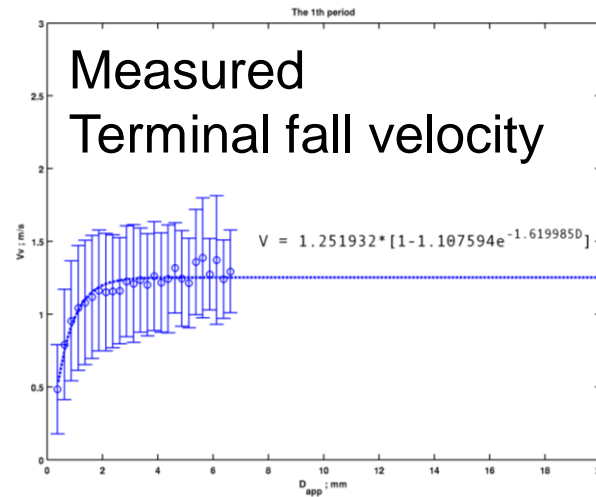
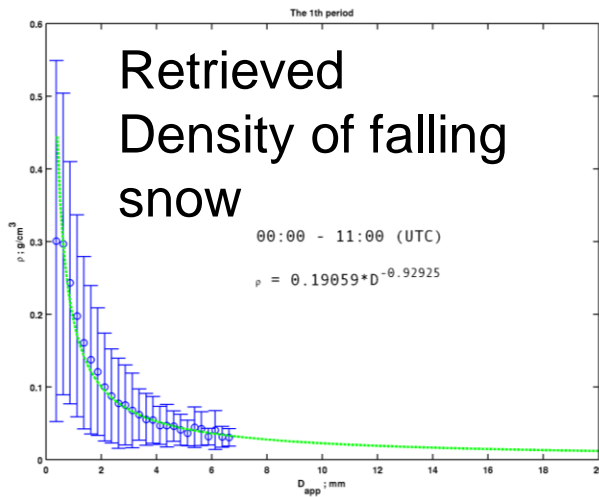


PIP/PVI



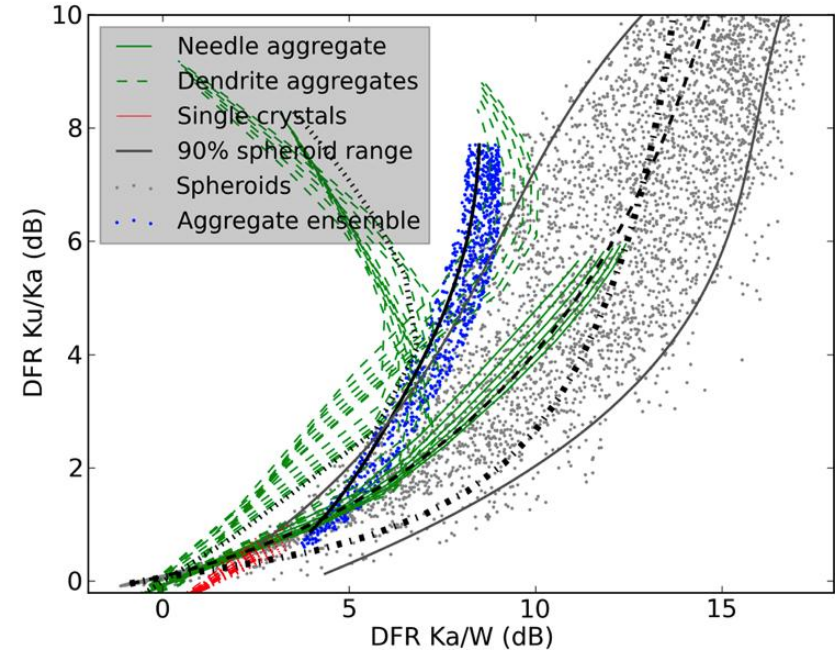
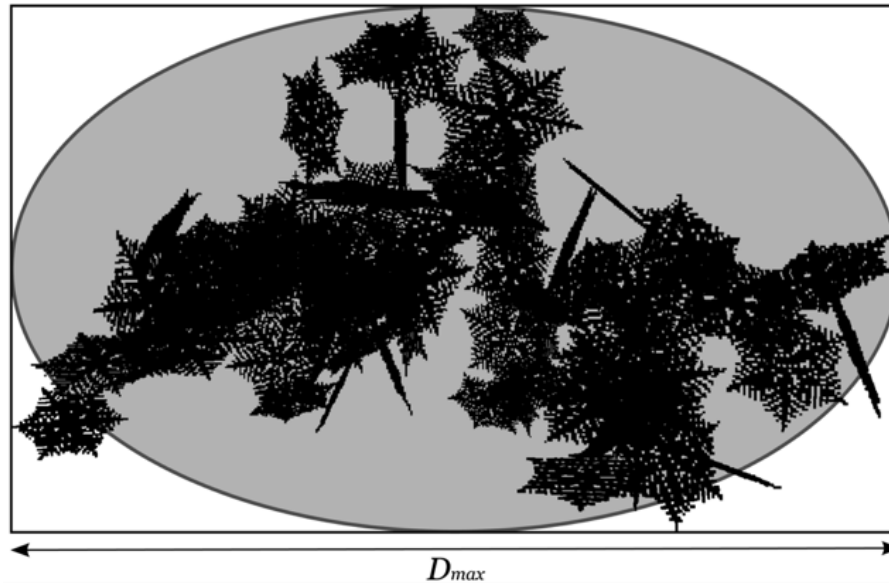


Precipitation microphysics



- Preliminary analysis of the 2DVD data was carried out by following Huang et al. (2014)
 - yielding mass (density)-dimensional relations

Spheroid vs. complex particles

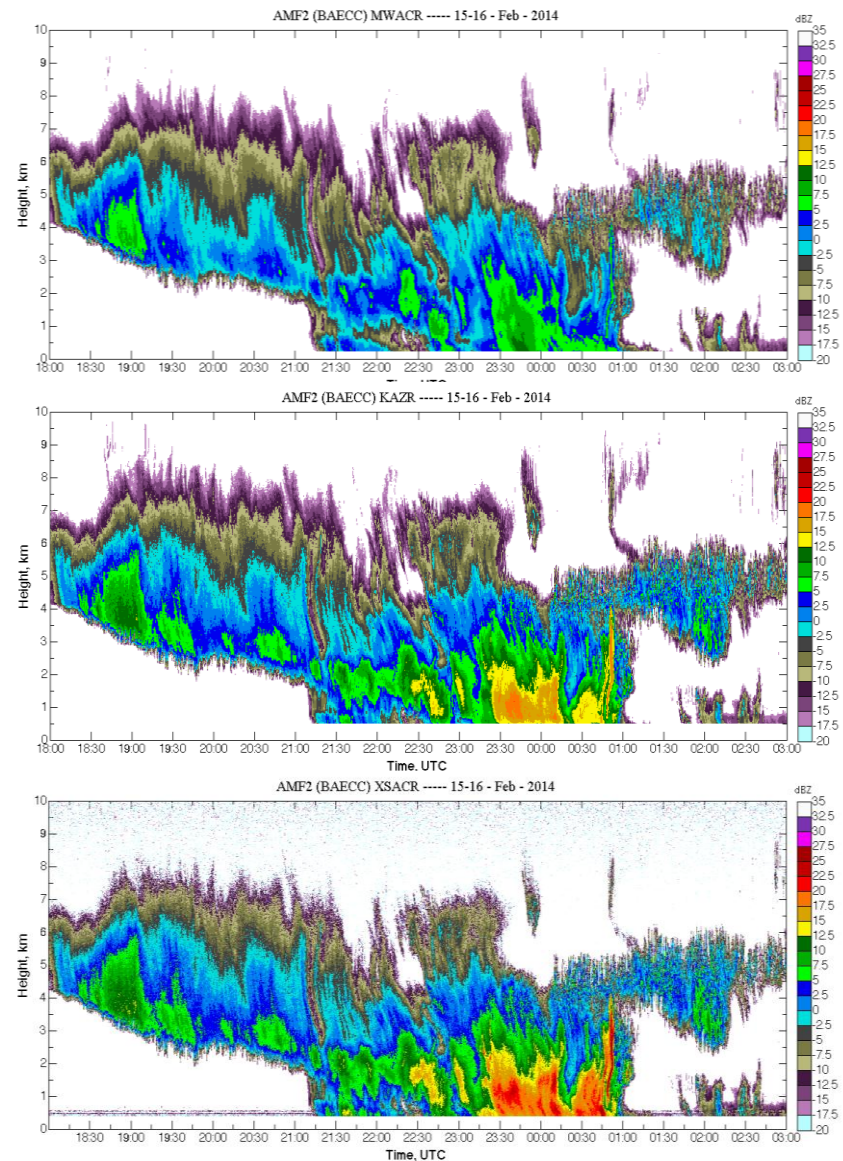


- One of the research topics was to investigate under which conditions 'spheroid' model fail
- Leinonen *et al.* (2012) have shown by using triple frequency observations that neither complex or spheroid particle models explain the complete measurement space



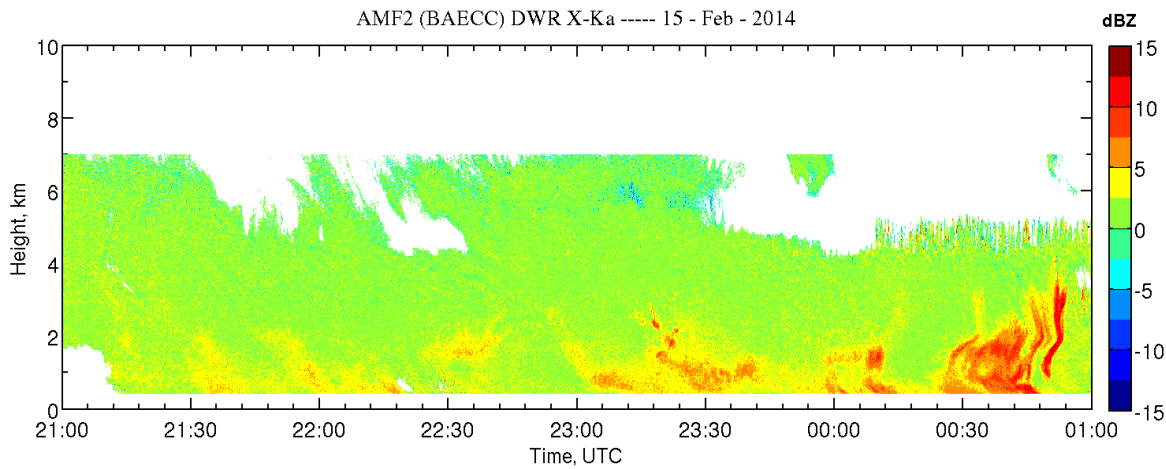
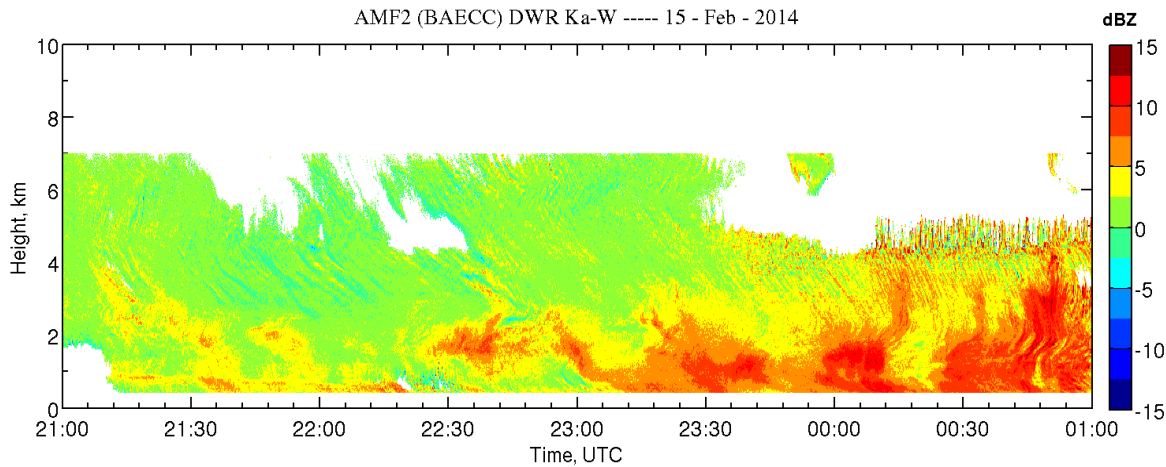
Triple-frequency observations

- Event on Feb 15-16, 2014
- Interpretation of observations are supported by surface based precipitation measurements

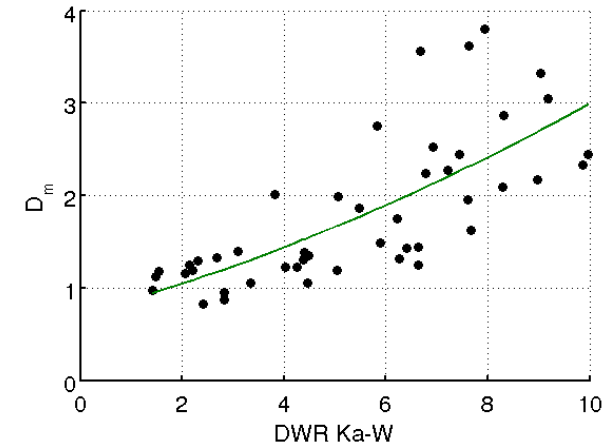




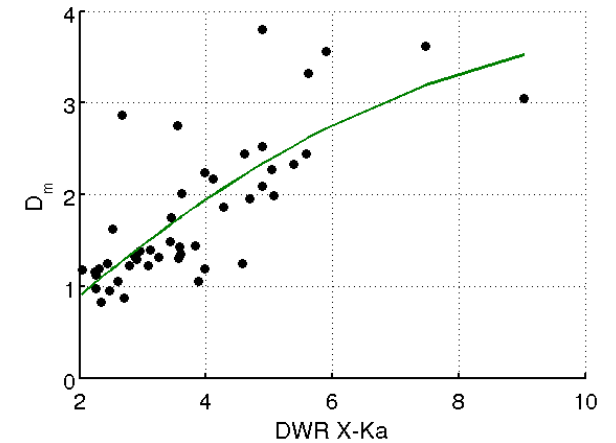
DFR plots for 15-16 February 2014



AMF2 (BAECC) DWR Ka-W ----- 15-16 - Feb - 2014

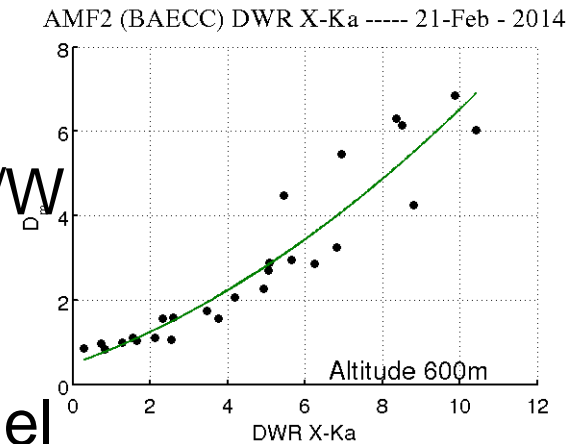
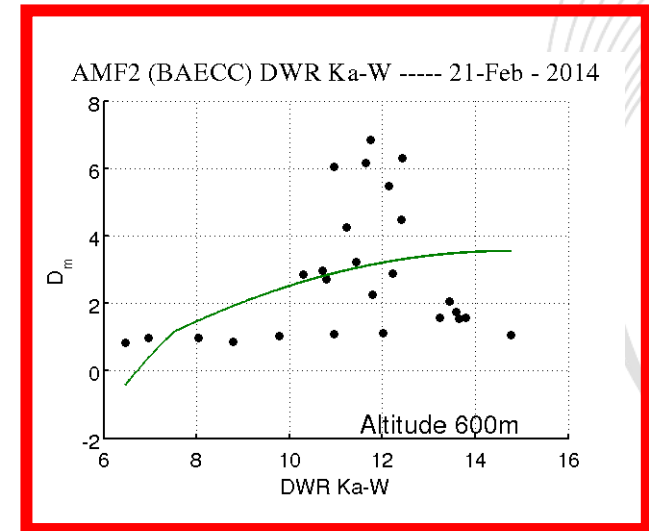
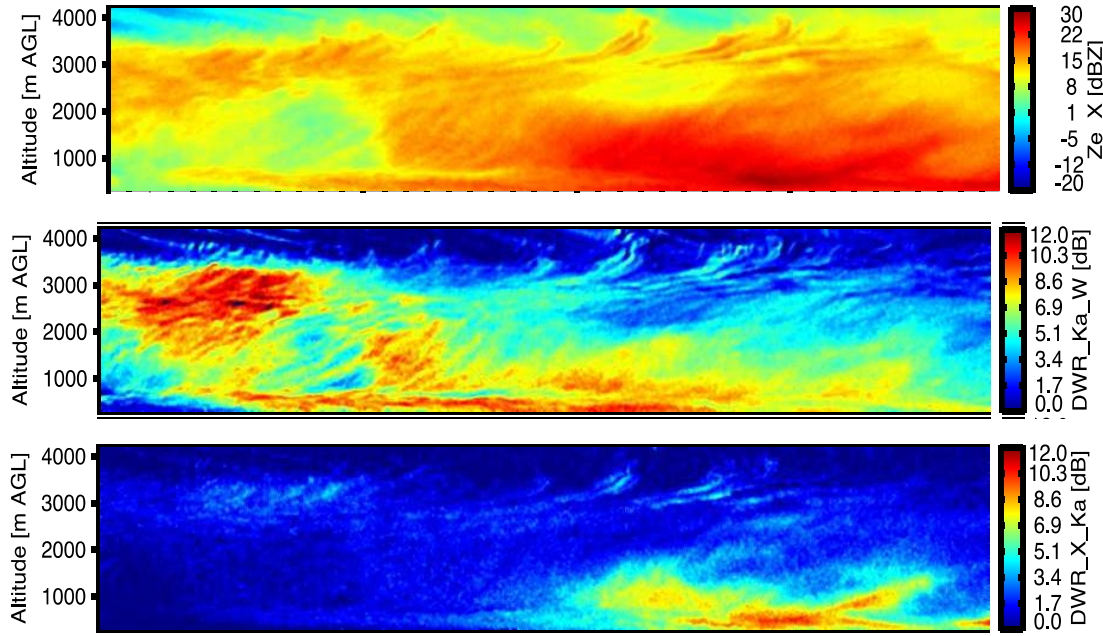


AMF2 (BAECC) DWR X-Ka ----- 15-16 - Feb - 2014

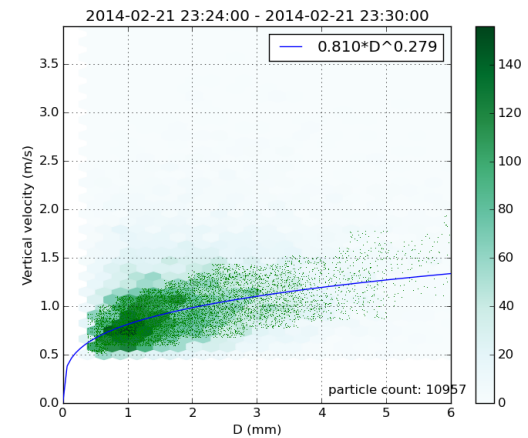
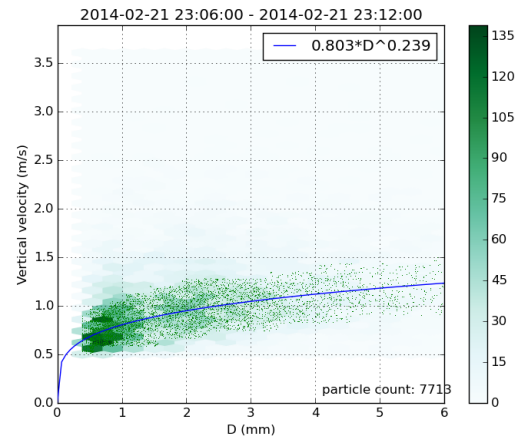
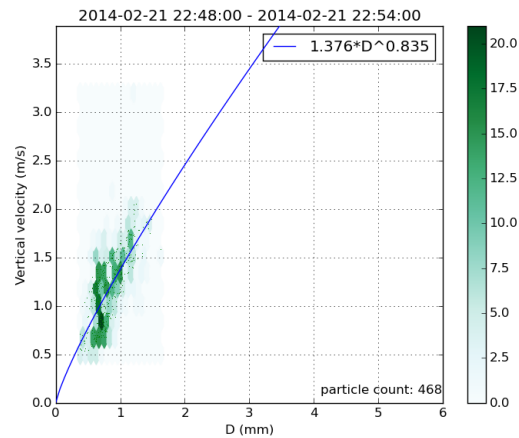
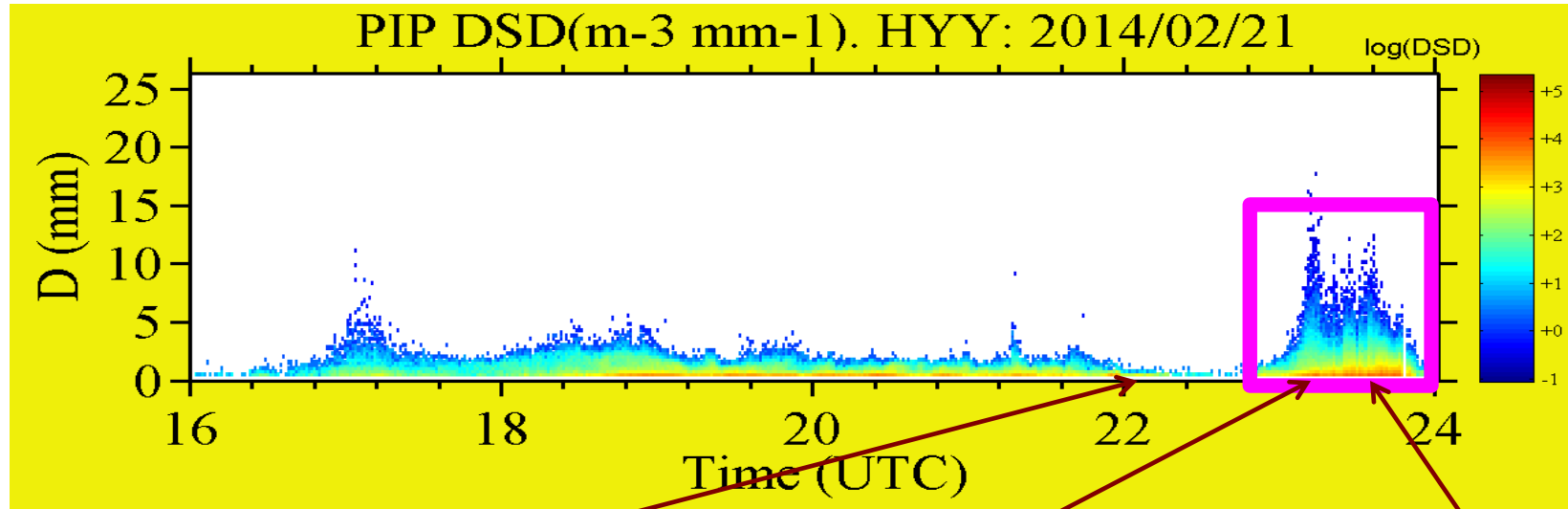




Event on February 21, 2014 22.50-23.30



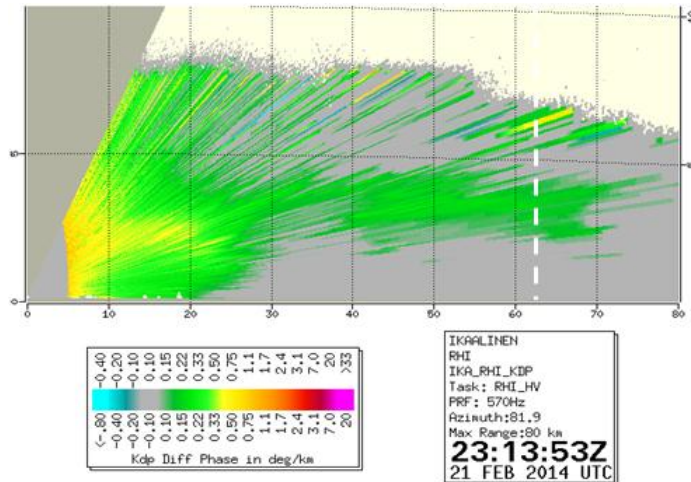
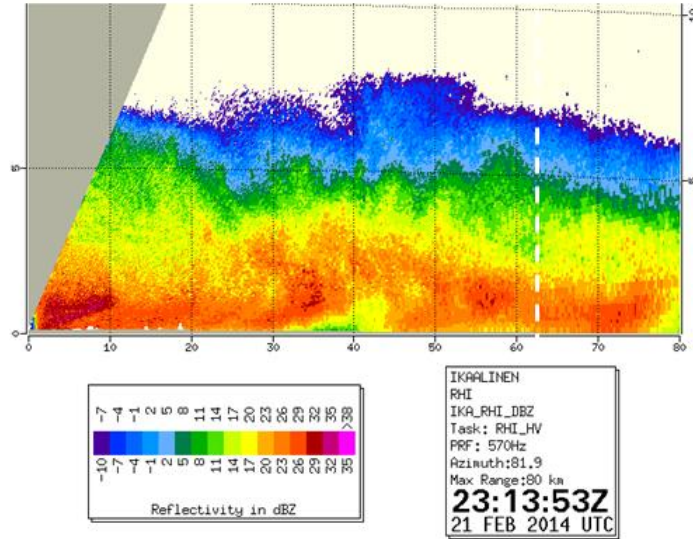
- On Feb 21, correlation between DFR Ka/W and D_m disappears.
- This is due to failure of the spheroid model with effective medium approximation



Surface observations indicate transition from rimed particles to aggregates. The DFR-Dm correlation fails in the aggregation part.



Dual-polarization FMI- radar measurements



- At the time when DFR W / $K_a - D_m$ correlation failed FMI radar recorded a K_{dp} (specific differential propagation phase) band above Hyytiälä

- K_{dp} band indicates onset of aggregation (Moisseev *et al.*, 2014, submitted)

- K_{dp} / Z_{dr} bands could show a skill in diagnosing areas where “spheroidal” model fails => could be used for GPM GV





Summery

- Excellent multi-frequency radar and surface based observations of snowfall were collected
- ARM data is freely available by registration
- Comparison between surface observation instruments is under study, novel technics to retrieve mass-dimensional relations
- Failure of the spheroidal model with effective medium approximation is linked to intense aggregation
- Dual-polarization radar observation can be used to diagnose such conditions