



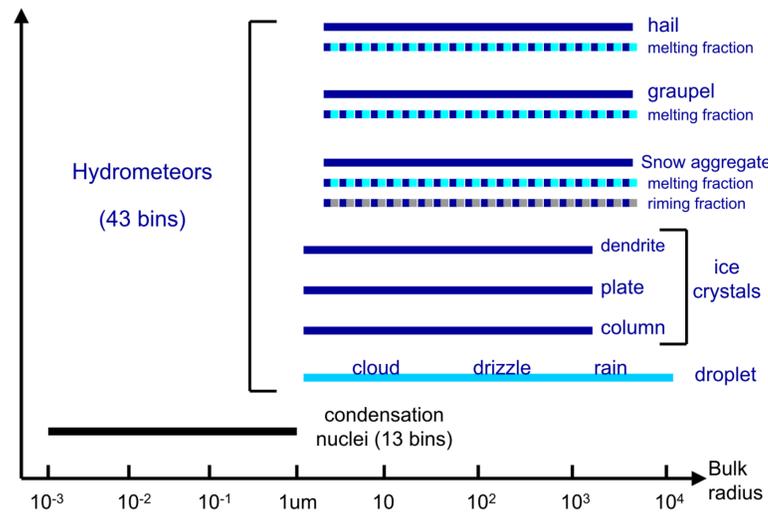
# WRF-SBM simulations of melting-layer structure in mixed-phase precipitation events observed during LPVEx

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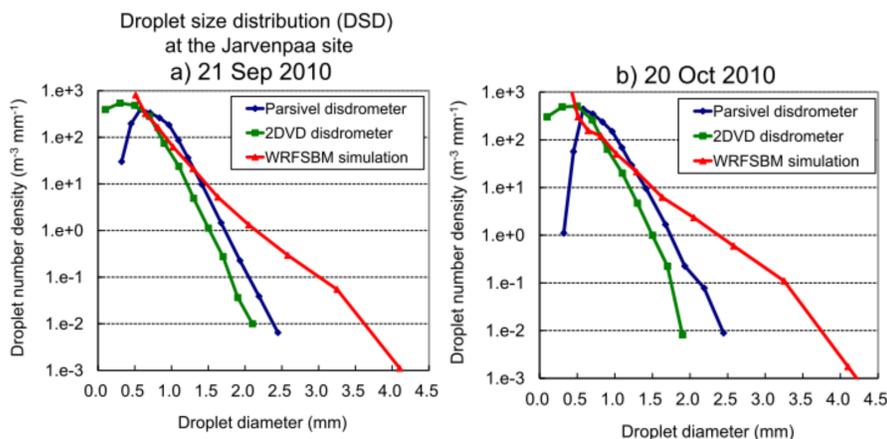


Two mixed-phase precipitation events were observed on 21 September and 20 October 2010 over the southern part of Finland during the Light Precipitation Validation Experiment (LPVEx). These events have been simulated using the Weather Research and Forecasting model coupled with spectral bin microphysics (WRF-SBM). We have focused on the structures of observed and simulated radar signatures containing melting layers to attempt evaluating melting process in the WRF-SBM model.

The simulation results have been compared to the C-band 3D radar measurements for the purpose of evaluating the overall profiles of cloud and precipitation. The structures of the melting bands have been evaluated against the vertically pointing K-band radar measurements.

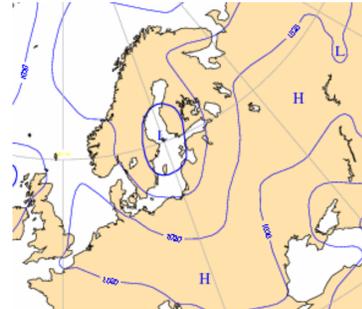


The spectral bin microphysics (SBM) based on the Hebrew University Cloud Model (HUCM) (Khain et al., 2011) was implemented into the Weather Research and Forecasting model (WRF) ver. 3.4. Explicit simulation of melting layer is allowed by the new gradual melting scheme (Phillips et al., 2007).



## Sep 21, 2010

ECMWF mean sea level pressure 12UTC

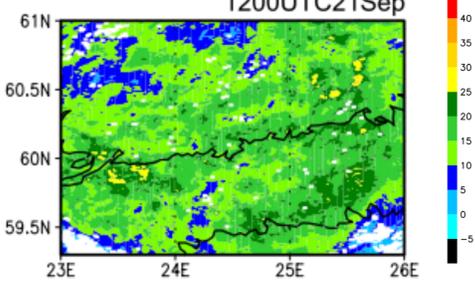


Wide spread warm sector stratiform rain covered the full operations area making for some ideal sampling conditions. Nearly four full hours of research flights were carried out in continuous stratiform rainfall. The freezing level today was quite high at 2000-2400 m.

## Against C-band radar 3D scanning

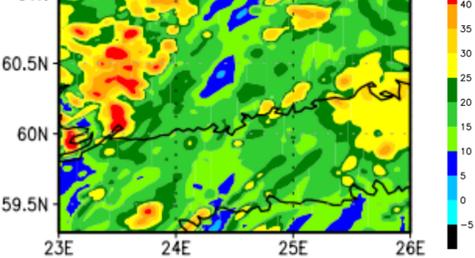
Radar measurements

Max Z (dB) snapshot at 12Z  
1200UTC21Sep



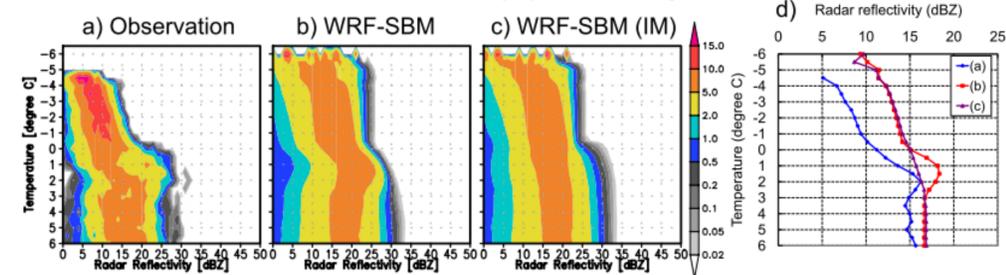
WRF-SBM

Max Z (dB) snapshot at 12Z

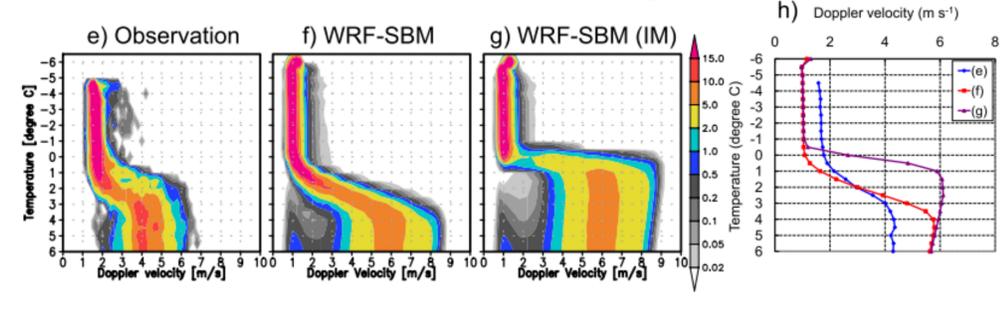


## Against vertically pointing micro rain radar (24.15GHz(K-band), FM-CW Doppler)

K-band dBZe CFTD (%) and average on 21 Sep

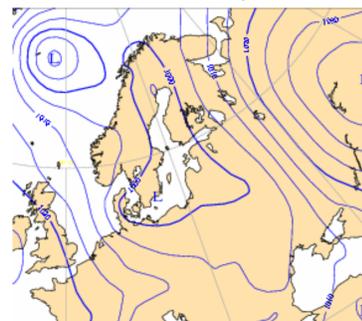


K-band DV CFTD (%) and average on 21 Sep



## Oct 20, 2010

ECMWF mean sea level pressure 12UTC

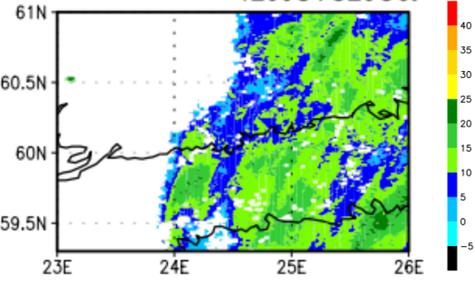


Widespread light and moderate precipitation in Helsinki and points east. Extensive microphysics measurements were collected above, below, and in the melting level at 1000 m.

## Against C-band radar 3D scanning

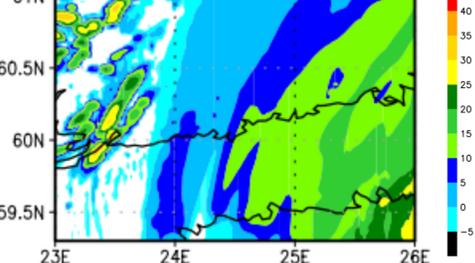
Radar measurements

Max Z (dB) snapshot at 12Z  
1200UTC20Oct



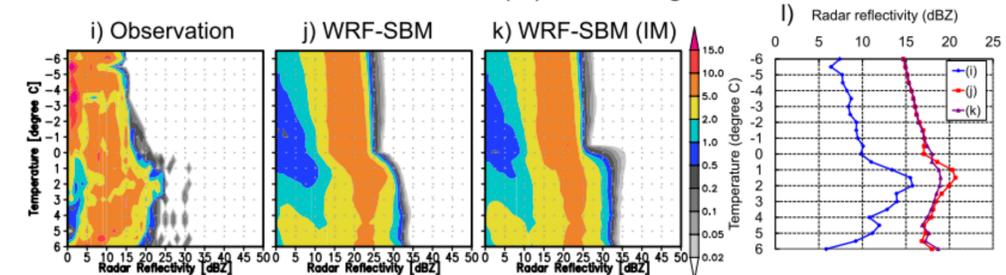
WRF-SBM

Max Z (dB) snapshot at 12Z

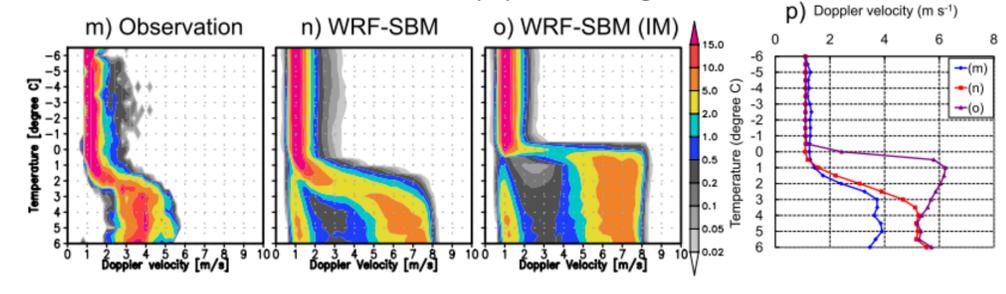


## Against vertically pointing micro rain radar (24.15GHz(K-band), FM-CW Doppler)

K-band dBZe CFTD (%) and average on 20 Oct



K-band DV CFTD (%) and average on 20 Oct



## Summary

- Bright bands were observed and similarly simulated in the layers with temperature roughly from 0 to +3 °C.
- Gradual melting model is necessary to reproduce the characteristics. Outdated instantaneous melting model did not work well.
- Radar reflectivity simulated by WRF-SBM is generally overestimated, because of a droplet-size bias toward large diameters.