Localized intensification of snowfall by air traffic

Susanna Lautaportti
University of Helsinki, Finland

Rojas, Laura (University of Helsinki, Finland)
Atlaskina, Ksenia (University of Helsinki, Finland)
Moisseev, Dmitri (University of Helsinki, Finland)
O'Connor, Ewan (Finnish Meteorological Institute, Finland)

E-mail: susanna.lautaportti@helsinki.fi

In the Helsinki region it is not uncommon to observe localized intensification of snowfall. It manifest itself as increased snowfall intensity on spatial scales of several kilometres and temporal scales of 30 to 90 min. The snowfall intensifications are often seen in weather radar images where radar reflectivity (Z) values show local narrow band-like features, i.e. trails, or in RHI observations they appears as 'streamers'. The most probable cause of the snowfall intensification is air traffic approaching or departing the Helsinki-Vantaa airport. A typical situation where this phenomenon is observed is a combination of a shallow precipitation that originates from a super-cooled liquid stratocumulus (Sc) layer. There is another super-cooled liquid cloud layer above the Sc. Our observations show that in cases where this features occur airplanes flying through upper cloud initiate the glaciation. Ice crystals falling from the glaciating cloud seed the stratocumulus cloud and initiate the 'seeder-feeder' process.

For this study we have used the Kumpula dual-polarization C-band weather radar observations from 2009 until 2013 and identified a total of 63 aircraft trail cases. From RHIs we were able to identify 17 cases where the streamers reached the ground level. We analyzed the conditions which led to the localized snowfall intensification by using data from weather radar, lidar, satellite and Particle Video Imager.

We calculated a snowfall rate by using Ze values. In all cases snowfall rate was larger inside than outside the streamer: snowfall rate could be even 15 times higher inside the streamer. The average ZDR values were smaller inside than outside the streamer: typically the ZDR value was close to zero inside the streamers. When temperature is below 0 °C these small ZDR values are associated with aggregation process: the smaller the ZDR and lagrer the Z are, the larger agrregates are present in the radar measurement volume.

According to our results we can conclude that air traffic enhances the aggregation process when snowfall existst below the aircraft-produced ice particles. This type of snowfall enhacement by air traffic may lead to large aggregates and intense local snowfall.