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Polar cloud observatory at Ny-Ålesund in GRENE Arctic Climate Change Research Project

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Cloud is one of the main processes in the climate system and especially a large feed back agent for Arctic warming amplification (Yoshimori et al., 2014). From this reason, observation of polar cloud has been emphasized and 95 GHz cloud profiling radar in high precision was established at Ny-Ålesund, Svalbard in 2013 as one of the basic infrastructure in the GRENE (Green Network of Excellence Program) Arctic Climate Change Research Project. The radar, "FALCON-A", is a FM-CW (frequency modulated continuous wave) Doppler radar, developed for Arctic use by Chiba University (PI: T. Takano) in 2012, following its prototype, "FALCON-1" which was developed in 2006 (Takano et al., 2010).
The specifications of the radar are, central frequency: 94.84 GHz; antenna power: 1 W; observation height: up to 15 km; range resolution: 48 m; beam width: 0.2 degree (15 m at 5 km); Doppler width: 3.2 m/s; time interval: 10 sec, and capable of archiving high sensitivity and high spatial and time resolution. An FM-CW type radar realizes similar sensitivity with much smaller parabolic antennas separated 1.4 m from each other used for transmitting and receiving the wave.
Polarized Micro-Pulse Lidar (PMPL, Sigma Space MPL-4B-IDS), which is capable to measure the backscatter and depolarization ratio, has also been deployed to Ny-Ålesund in March 2012, and now operated to perform collocated measurements with FALCON-A. Simultaneous measurement data from collocated PMPL and FALCON-A are available for synergetic analyses of cloud microphysics. Cloud mycrophysics, such as effective radius of ice particles and ice water content, are obtained from the analysis based on algorithm, which is modified for ground-based measurements from Okamoto's retrieval algorithm for satellite based cloud profiling radar and lidar (CloudSat and CALIPSO; Okamoto et al., 2010).
Results of two years will be shown in the presentation. Calibration is a point to derive radar reflectivity (dBZ) from original intensity data. Degradation of transmission power was monitored and sensitivity of receiving system was derived with estimating antenna gain by using radio wave absorber and considering antenna geometry of two antenna system. In order to estimate final results, altitude dependent detection limit curve was also calculated. Original intensity data in real time and calibrated radar reflectivity data are archived on "Arctic Data archive System (ADS)".
Other collocated observations were made with fog monitor (particle size distribution), MPS (particle image) for continuous measurements at Zeppelin Mountain, 450 m height a. s. l., and tethered balloon for intense observing period. From these measurements together with aerosol and meteorological monitoring made by collaborating institutes (Stockholm University, University of Florence, AWI, NILU, NCAR and NPI) microphysics of low level cloud and aerosol-cloud interactions are discussed.
Ground based remote sensors provide a powerful validation for satellite cloud observations. Radar reflectivity (dBZ) by FALCON-A was compared with that by CPR on CloudSAT during several overpasses around Ny-Ålesund, and though some difference due to the different vertical resolution was seen, overall agreement was confirmed. We are planning to establish Ny-Ålesund observatory as the super site for validation for EarthCARE (JAXA-ESA) mission.