4.012 Year-round in situ measurements of Arctic low-level clouds: Microphysical properties and relationship with aerosols.

Presenting Author:
Makoto Koike, Department of Earth and Planetary Science, University of Tokyo, Tokyo, Japan, koike.u.tokyo@gmail.com

Co-Authors:
M. Shiobara, National Institute of Polar Research, Tokyo, Japan
J. Ukita, Niigata University, Niigata, Japan
J. Ström, Department of Environmental Science and Analytical Chemistry, Stockholm University, Stockholm, Sweden.
P. Tunved, Department of Environmental Science and Analytical Chemistry, Stockholm University, Stockholm, Sweden
V. Vitale, Institute of Atmospheric Sciences and Climate (ISAC) / Italian National Research Council (CNR), Bologna, Italy
A. Lupi, Institute of Atmospheric Sciences and Climate (ISAC) / Italian National Research Council (CNR), Bologna, Italy
O. Hermansen, Norwegian Institute for Air Research (NILU), Norway
C. Ritter, Alfred Wegener Institute (AWI), Potsdam, Germany
D. Baumgardner, Universidad Nacional Autonoma de Mexico, Mexico
K. Yamada, National Institute of Polar Research, Tokyo, Japan.
C. A. Pedersen, Norwegian Polar Institute, Tromsø, Norway

Abstract:

Continuous in situ measurements of Arctic low-level clouds/fogs have been made at the Mt. Zeppelin Observatory (78°56'N, 11°53'E, 474 m above mean sea level), in Ny-Ålesund, Spitsbergen, since October 2013. The monthly median value of the cloud particle number concentration (N_c) showed a seasonal variation, reaching a maximum in May - July (60 – 70 cm^{-3}) and gradually decreasing in the following months. The median N_c values were 2 – 10 cm^{-3} between October and March. At temperatures of higher than 0°C, hourly N_c values correlated with the aerosol number concentrations with dry diameters of greater than 100 nm (N_{100}), a proxy of cloud condensation nuclei (CCN) concentrations measured at both observatories at Mt. Zeppelin and the mountain foot (Gruvebadet Observatory). When clouds were detected below 0°C, some of the data followed the summertime N_c to N_{100} relationship, while other data showed systematically lower N_c values. Lidar-derived depolarization ratios suggested that the former (CCN-controlled) and latter (CCN-uncontrolled) data generally corresponded to clouds consist of super-cooled water droplets and those contain ice particles, respectively. A fraction of the CCN-uncontrolled data increased with decreasing temperatures, yielding values of more than 0.3 at temperatures below –4°C and values of unity below –19°C. Because monthly averages of atmospheric temperature are between 5 and –16°C at Zeppelin, the CCN-controlled data persistently appeared throughout the year, indicating that CCN concentrations play an important role in controlling the cloud microphysics that affect the radiative properties of clouds and their various indirect effects.