Deciphering the Radar Reflectivity Profile in Liquid Stratiform Clouds

Edward Luke
Brookhaven National Laboratory, USA
Kollias, Pavlos (McGill University, Montreal, Quebec, Canada)

E-mail: eluke@bnl.gov

In the absence of non-Rayleigh scattering, the radar reflectivity factor Z represents the sixth moment of the particle size distribution and is thus strongly influenced by the presence of larger-sized particles. This dependency complicates the use of Z for retrieving lower moments of the particle size distribution (e.g., number concentration, water content). In the absence of drizzle droplets, the profile of Z is controlled by condensation in the lower and middle parts of the cloud layer, and typically increases with height at a rate determined by changes in the number concentration and mean particle size. In the upper part of the cloud layer, evaporation via cloud-top mixing becomes an additional factor and results in a decrease of Z. In the presence of drizzle, autoconversion and accretion also affect the profile of Z, driving a gradual downward shift in the location of maximum Z to cloud base as drizzle intensity increases. Here, we take a new and comprehensive look at the vertical structure of the radar reflectivity profile in marine stratiform clouds in the context of cloud/drizzle balance as revealed by higher order moments of the cloud radar Doppler spectrum, using data drawn from the CAP-MBL field campaign conducted in the Azores during 2009 and 2010 by the U.S. Department of Energy ARM Program. The dominant regimes of the Z profile are determined and their association to liquid water path, inversion strength and drizzle particle size at the cloud base is investigated.