BNL-73883-2005-AB

PARAMETERIZATION OF THE AUTOCONVERSION PROCESS: KESSLER-TYPE, SUNDQVIST-TYPE, AND UNIFICATION

Y. Liu, P. H. Daum, and R. L. McGraw
Atmospheric Sciences Division
Brookhaven National Laboratory
Upton, NY 11973-5000

February 2005

For presentation at the
2005 ARM Science Team Meeting
Daytona Beach, FL
March 14-18, 2005

ABSTRACT

A key process that must be parameterized in atmospheric models of various scales (from large eddy simulation models to cloud-resolving models to global climate models) is the autoconversion process whereby large cloud droplets collect small ones and become embryonic raindrops. Accurate parameterization of this process is especially important for studies of the second indirect aerosol effect. In terms of the representation of the threshold behavior of the autoconversion process, existing parameterizations can be classified into either Kessler-type or Sundqvist-type. Kessler-type parameterizations have been developed to explicitly account for cloud droplet number concentration, relative dispersion, and liquid water content, whereas Sundqvist-type parameterizations consider only the liquid water content.

In this work, we first put Sundqvist-type parameterizations on the same footing as Kessler-type parameterization by generalizing Sundqvist-type parameterizations to explicitly account for droplet number concentration, relative dispersion, as well as liquid water content. We then show that the more commonly used Kessler-type parameterizations are in fact a special case of the corresponding Sundqvist-type parameterizations, unifying the two types of parameterizations. A new parameterization is further derived theoretically, and is compared to Kessler-type and Sundqvist-type parameterizations.

Research by BNL investigators was performed under the auspices of the U.S. Department of Energy under Contract No. DE-AC02-98CH10886.