Geophysical Research Abstracts
Vol. 17, EGU2015-5039, 2015
EGU General Assembly 2015

Observations of small ice in mixed phase clouds using an airborne SID2 Small Ice Detector

Paul Barrett (1,2), Alan Blyth (2,3), Phil Brown (1), and Joseph Ulanowski (4)

(1) The Met Office, Observational Based Research, Fitzroy Road, Exeter, EX1 3PB, United Kingdom (paul.barrett@metoffice.gov.uk), (2) University of Leeds School of Earth and Environment, Institute for Climate and Atmospheric Science, Leeds, LS2 9JT, United Kingdom (blyth@env.leeds.ac.uk), (3) National Centre for Atmospheric Science, University of Leeds, Leeds, LS2 9JT, United Kingdom (blyth@env.leeds.ac.uk), (4) Centre for Atmospheric and Instrumentation Research, University of Hertfordshire, Hatfield, United Kingdom (Z.Ulanowski@herts.ac.uk)

Here we present observations of small ice crystals in mixed phase cloud systems using an aircraft mounted SID2 (Small Ice Detector 2) probe. It is likely that these small ice particles have formed through an immersion freezing process from the underlying liquid cloud population. The exact nature of the immersion freezing mechanisms at work in the real atmosphere is uncertain and may include contributions from singular and stochastic processes as well as hybrid processes such as Contact Nucleation Inside Out. Observations of the number and position in the cloud structure of the first ice in mixed phase clouds are essential if we are to understand the microphysical mechanisms responsible for the conversion of liquid cloud drops into ice particles.

The SID2 probe is able to observe particles smaller than 10 microns and so is useful when assessing the properties of ice that has formed from liquid cloud particles. Using the scattering patterns produced by SID2 it is possible to distinguish between liquid drops and non-spherical particles. A liquid cloud drop will produce a scattering pattern containing concentric rings whereas a non-spherical particle will not. The SID2 probe has a relatively large sample volume, and while this is good in the low concentrations found in typical cirrus clouds it presents difficulties in liquid clouds where concentrations can be orders of magnitude greater. Coincidence events, where two or more spherical particles are co-located within the extended sample volume, do not produce the typical scattering pattern associated with a liquid particle and are therefore more difficult to distinguish from ice. There are, however, some characteristic features of the scattering pattern from a coincidence event.

Here we present an algorithm to identify coincidence events from analysis of individual scattering patterns. Results are presented that show that it is possible to obtain an estimate of the concentration of small ice in clouds which have relatively low concentrations of liquid cloud drops (<100/cc). Observations are presented of the occurrence of small ice in a mixed phase altocumulus cloud relative to cloud top. The significance of these observations in relation to the potential freezing mechanism is discussed.