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Origin of Ice in Supercooled layer clouds influenced by lower level convection: In-situ and remote sensing measurements from a case study

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Abstract
The UK BAe146 atmospheric research aircraft flew in the vicinity of the Chilbolton Observatory in Southern England as part of the NERC APPRAISE-Clouds project. In-situ cloud microphysics were measured onboard the BAe146 whilst cloud properties were simultaneously measured using Radar and Lidar from Chilbolton. A flight took place on the 18th February 2009 when a stationary front was located over the UK (orientated roughly north-south) roughly 20 km west of Chilbolton. The stationary front appeared to initiate convection which was capped at around 4 km altitude by a layer of warm and dry air associated with the high pressure system which also affected the UK at the same time. A vertically thin (approximately 400 m) but horizontally extensive supercooled layer cooled was found just below the warm/dry layer. This cloud contained significant amounts of primary ice despite the warm temperatures in this cloud. This ice appears important in initiating secondary ice formation in the convective liquid water regions (via the Hallett-Mossop process) and also appears to affect surface precipitation.
Detailed measurements were made of the atmospheric aerosol size distribution and composition both on the ground beneath the convection and on board the aircraft. A discussion of the likely source and characteristics of the ice nuclei will be presented. A direct comparison between the properties of the cloud and aerosol made by radar and insitu measurements on the aircraft will be presented.

A detailed aerosol and microphysical model incorporating the formation of cloud droplets on aerosol, ice nucleation and secondary ice processes will be used to discuss the mechanisms of precipitation formation in the cloud system and the role of primary ice nucleation, secondary ice particles, the Bergeron process and riming on the water budget, cloud microphysics and hence radiative properties of the cloud system.

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