Geophysical Research Abstracts
Vol. 19, EGU2017-2001, 2017
EGU General Assembly 2017

The role of precipitation in controlling the transition from stratocumulus to cumulus clouds in a northern hemisphere cold-air outbreak

Steven Abel (1), Ian Boutle (1), Kirk Waite (1), Stuart Fox (1), Philip Brown (1), Richard Cotton (1), Gary Lloyd (2), Tom Choularton (2), and Keith Bower (2)

(1) Met Office, Exeter, United Kingdom (ian.boutle@metoffice.gov.uk), (2) School of Earth, Atmospheric and Environmental Sciences, University of Manchester, United Kingdom

Aircraft observations in a cold-air outbreak to the north of the United Kingdom are used to examine the boundary layer and cloud properties in an overcast mixed-phase stratocumulus cloud layer and across the transition to more broken open cellular convection. The stratocumulus cloud is primarily composed of liquid drops with small concentrations of ice particles and there is a switch to more glaciated conditions in the shallow cumulus clouds downwind. The rapid change in cloud morphology is accompanied by enhanced precipitation with secondary ice processes becoming active and greater thermodynamic gradients in the sub-cloud layer. The measurements also show a removal of boundary layer accumulation mode aerosols via precipitation processes across the transition that are similar to those observed in the subtropics in pockets of open cells. Simulations using a convection permitting (1.5 km grid-spacing) regional version of the Met Office Unified Model were able to reproduce many of the salient features of the cloud field although the liquid water path in the stratiform region was too low. Sensitivity studies showed that ice was too active at removing supercooled liquid water from the cloud layer and that improvements could be made by limiting the overlap between the liquid water and ice phases. Precipitation induced decoupling of the boundary layer appears to be the key process responsible for initiating the transition from closed to open cellular convection. Finally, we comment on the implications of this work for the Southern-Ocean warm-bias found in many GCMs.