



The air Earth conduction current and stratiform cloud edge charging

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The air Earth conduction current density, J_c , flows through the fair weather regions of the atmosphere as a result of the atmospheric global electric circuit. In the presence of layer cloud, it has been assumed that the current density flows through the cloud if the cloud is of sufficient horizontal extent, such as a uniform horizon to horizon stratiform cloud. If the current flows through the cloud, electrostatics considerations resulting from the cloud-air conductivity transitions require there to be regions of unipolar charge at the upper and lower boundaries of the cloud. For symmetric upper and lower cloud edges, the charge will also be symmetric. Droplets and aerosol particles in these areas are likely to become charged, and it is known that cloud microphysical processes are sensitive to charge. Because of the radiative importance of clouds and the possibility of widespread small effects of charge on cloud processes, in-situ measurements to evaluate the existence of charge in layer clouds are desirable.

A two step approach has been applied to investigate the prevalence of stratiform cloud edge charging in the atmosphere. First, the question of whether J_c flows through layer cloud has been considered by analysing surface measurements of J_c from three UK sites under different cloud conditions. Second, a balloon borne charge sensor has been specially developed to obtain high vertical resolution in-situ measurements of charge inside stratiform cloud. The sensor has frequently detected regions of charge near cloud edges, where net charges of several hundred pC m⁻³ are common.