

The Global Atmospheric Electric Circuit: an Overview

Michael J. Rycroft^{1,2} and Anna Odzimek³

¹ CAESAR Consultancy, 35 Millington Road, Cambridge CB3 9HW, U.K.

² Centre for Space, Atmospheric and Oceanic Science, University of Bath, U.K.

³ Department of Physics and Astronomy, University of Leicester, U.K.

We give an overview of our present understanding of the global circuit formed by the atmosphere, the ionosphere and the solid and ocean surface of the Earth. The circuit is driven by currents (~ 1 kA) above both thunderclouds and electrified shower clouds up to the ionosphere, which is presumed to be an equipotential surface (~ 250 kV). This large scale circuit is completed by currents (~ 2 pA/m²) flowing down through the fair weather atmosphere to the Earth's surface and up into the atmosphere below the electrically active clouds. Using a realistic profile of the atmospheric electric conductivity, we have generated a model of this circuit using the PSpice software package. Model sprites exhibiting discharge processes have also been constructed, first for positive cloud-to-ground lightning discharges (+CGs) without a continuing current, and then for +CGs with a significant continuing current. These models have then been used to estimate the effect of sprites on the global electric circuit. Only a very small effect is expected; it will be very challenging to detect this experimentally, even in regions remote from thunderstorms.