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Modelling some mesospheric effects of lightning discharges

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We consider an electrical engineering model of processes acting below, in and above thunderstorms and in electrified shower clouds, driving upward currents which close through the global atmospheric electric circuit. They are simulated using the commercially available software package, PSpice A/D. We conclude that the conduction and convection currents associated with the batteries within thunderclouds and electrified shower clouds contribute equally, $\sim$500 A each, to maintaining the ionospheric potential at $\sim$250 kV. Further we study the contribution of cloud-to-ground lightning discharges and sprites to the global atmospheric electric circuit, assuming the ionosphere to be an equipotential surface. We model a moderate cloud-to-ground (CG) lightning flash from the bottom of a thunderstorm and estimate the changes of the ionospheric potential due to both + and – CG discharges. We also estimate the time scales for the recovery of the ionospheric potential. Next, knowing the global average rate of lightning discharges, we find that the net upward current to the ionosphere due to lightning is only $\sim$20 A.