

Estimates of the net-current by lightning discharge in global electric circuit

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Global electrical circuit (GEC) has been thought as the current system including the solid Earth, atmosphere, ionosphere, and magnetosphere in the research field of atmospheric electricity. In the recent GEC model, the activity of thunderstorm is considered as the main source of the current system in atmosphere. Transient Luminous events (TLEs), which are discovered in the recent, are regarded as the evidence of connection between lower-atmosphere and ionosphere.

The goal of our study is to show the transport system of charge in global electric circuit (GEC) and to develop the new GEC model which take into account the electrical connection between the lower atmosphere and ionosphere. It is necessary for the development of new model to consider the current of lightning discharge and Transient Luminous Event (TLE). In this presentation, we derive the global distribution of huge lightning discharge to estimate the net-current in GEC.

We made use of the ELF electromagnetic wave measurement network with 4 sites in the world constructed and maintained by Tohoku University. We calculated the positions and electrical properties (charge moment change and polarity) for 295,653 events observed in the period from January 1, 2004 to December 31, 2004.

This result enable us to discuss the net current caused by lightning discharge with a charge moment of larger than about 700 C km. It is found that the current by lightning discharge have regional variations, namely, upward currents are dominant in continents while downward currents maritime area. Upward and downward currents are estimated to be 0.98A and 1.24A on the globe, respectively. This value is about 0.1 percent of the total global lightning discharge current estimated by previous studies. This fact implies that most of the currents are carried by the activities of smaller events.

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