

Role of global electric circuit in solar-climate connection

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Global electric circuit model was proposed long time ago, in 1930s, in which thunderstorm plays a role of generator, and the ground and the ionosphere work as a spherical capacitor. We need to reconstruct this simple model, taking into account 3 aspects: 1) global-scale nonuniformities both of ionospheric conductivity and of the distribution of the generators, 2) connections between the troposphere and D-region, considering the effects of TLEs, such as sprites and blue jets, 3) establishing the observational methodology for global electric field, excluding the effect of cloud existing just above the observation sites. Recently, the relationship between the global circuit and solar-climate connection was pointed out. Here we introduce an example, which indicates the roles of thunderstorm or its resultant electric circuit in solar-climate connection. Global relationship between thunderstorm/cloud activities and solar parameters are examined based on lightning measurement by Global ELF observation Network (GEON) operated by Hokkaido University and Outgoing Longwave Radiation (OLR) intensity. It was found that the number of lightning strokes in Asia Maritime Continent (AMC) varies with about month periodicity in the period from February to June 2004 and shows positive correlation ($R \sim 0.8$) with OLR in the Western Pacific Warm Pool (WPWP). On the other hand, OLRs in the central Africa and some other tropical areas show negative correlation with the number of lightning strokes in the AMC in that period. It is also found that the galactic cosmic rays or UV intensity associated with solar activity indicates good correlation with tropical OLR or lightning activity in AMC. One explanation to connect such global variations in thunderstorm / cloud amount with solar parameters would be the electrical circuit involving lower and upper atmospheres. If the ionospheric electric field modulates the potential gradient in the lower atmosphere, it could cause the re-distribution of ionized atmospheric particles, which may, in turn, change the generation / reduction speed of cloud particles.

Keywords: global electric circuit, solar-climate connection, TLEs, thunderstorm activity, Asia Maritime Continent