全球雷活動の周期的変動と地球気候変動および太陽活動との関係

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Global lightning variability and the relation to climate change and solar activities

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Lightning activity is one of the good proxies representing the intensity of the vertical deep convection in the troposphere. Since ˜80% of lightning discharges occur in the tropical and subtropical zones, monitoring of lightning activities enables us to assess the activities of the deep convection at the tropical and subtropical atmosphere. For this purpose, observation systems of electromagnetic waves in the ELF range excited by lightning discharges and DC electric field maintained by lightning discharge currents are installed at Syowa station in Antarctica. According to ELF data analyses, it is found that global lightning activities dynamically change with a periodicity of ˜5, ˜10 and ˜30 days. ˜5-day and ˜10-day variations of lightning activities are possibly related to the passage of the low- and high-pressure air masses over the continental regions. On the other hand, ˜30-day variation of lightning activities is considered to be related with the variations of the solar activities. We also found ˜30-day periodicity in the tropical and subtropical cloud amount variability and found the antiphase relation between the cloud amount variations and lightning activities. Recently, it is reported that lightning activities and the upper tropospheric water vapor variability in the tropics are well correlated. Such water vapor, which is a potent greenhouse gas, was transported from the lower altitude to the upper troposphere through the deep convections related with the active lightning activities. It is reported that the ˜11-year variations of global cloud amount and cosmic ray flux are closely correlated and that the amplitude of the variations peaked at the solar minimum period. To the contrary, recent studies on the global lightning activities revealed that there is ˜11-year periodicity in the amplitude variations of ELF electromagnetic waves excited by lightning discharges and that the amplitude of the variations peaked at the solar maximum period. Thus, it is deduced that the antiphase relation between the ˜11-year cloud variability and ˜11-year variations of the global lightning activities are also exist. In order to nowcast and forecast the short/long period variations related with the global climate change and effects of the solar activities on the Earth’s climate, continuous monitoring of global lightning activities are very useful. Future collaboration between the measurements by the large atmospheric radars newly installed at Syowa station and ELF and DC electric field measurements will contribute more quantitative understanding of the deep convection in the tropical and subtropical zones, global climate change and possible Sun-Earth connection.