地磁気日変化に見られる電離圏・下部熱圏における長期変動特性

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Characteristics of long-term variation in the ionosphere and lower thermosphere as seen in the Sq variation

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In order to investigate characteristics of the long-term variation in the ionosphere and lower thermosphere, we analyzed the amplitude of geomagnetic solar quiet (Sq) field daily variation using 1-h geomagnetic field data obtained from 69 geomagnetic stations within the period of 1947 - 2013. In the present data analysis, we took advantage of the Inter-university Upper atmosphere Global Observation NETwork (IUGONET) products (metadata database and analysis software) for finding and handling the long-term observation data obtained at many observatories. The Sq amplitude observed at these geomagnetic stations showed a clear solar activity dependence and tended to be enhanced during each solar maximum phase. The Sq amplitude was the smallest around the minimum of solar cycle 23/24 in 2008 - 2009. This significant depression implies that the solar extreme ultraviolet (EUV) radiation responsible for ionization of the upper atmosphere decreased during this solar cycle minimum. In order to examine a global distribution of the long-term trend in the Sq amplitude, we derived the residual Sq amplitude from the deviation from the fitting curve between the solar F10.7 index and Sq amplitude. As a result, a majority of the trends in the residual Sq amplitude showed negative values over a wide region. This tendency was relatively strong in Europe, India, the eastern part of Canada, and New Zealand. Moreover, we estimate the neutral wind in the lower thermosphere from the Sq amplitude and height-integrated ionospheric conductivity in order to know the physical mechanism of the long-term trend in the residual Sq amplitude. As a result, the estimated thermospheric zonal and meridional winds showed a seasonal variation with a period of one year or less, but the solar activity dependence was unclear. This result suggests that the solar cycle dependence of the Sq amplitude may be mainly attributed to the variation of the ionospheric conductivity.