GPS受信機網データを用いた成層圏突然昇温の中規模伝搬性電離圏擾乱への影響の研究

Study of Effects of Stratospheric Sudden Warming on Medium-Scale Traveling Ionospheric Disturbances Using Total Electron Content Data Obtained from World-Wide GPS Receiver Networks

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Medium-Scale Traveling Ionospheric Disturbances (MSTIDs) are wavy structures of the ionospheric plasma density with horizontal scale-size of hundreds of kilometers. In order to investigate effects of Stratosphere sudden warming (SSW) on MSTIDs, we have analyzed total electron content (TEC) data obtained from GPS receivers at different four longitudinal sectors (east Asia, Europe, and western and eastern America) before and after SSW that occurred on January 2009 and 2013. To obtain perturbation component of TEC, which could be caused by MSTID, we have subtracted 1-hour running average from the original TEC time series for each pair of satellites and receivers, and converted the slant to vertical TEC. We have defined MSTID activity as dI/I, where dI is the standard deviation of the perturbation component within 1 hour, and I is 1-hour average absolute vertical TEC. In this study, we applied the same method to the GPS-TEC data at mid-latitudes before and after major Stratospheric Sudden Warming (SSW) events that occurred on January 2009 and 2013. We have found that MSTID activity during daytime is high before SSW events and low after SSW events. On the other hand, the nighttime MSTID activity does not show such a difference between before and after SSW events. These results suggest difference of mechanisms generating MSTIDs between daytime and nighttime. The daytime MSTIDs could be caused by gravity waves propagating upward from below into the thermosphere. Recent simulations suggest that these gravity waves are secondary waves generated from dissipation of the primary waves in the MLT region. Miyoshi et al. (JGR, 2015) have reported that the generation of secondary gravity waves is more active when the strato-mesospheric jet is strong, and that the generation of secondary waves is inactive when the strato-mesospheric jet is attenuated or becomes westward. Consequently, low MSTID activity after January 24 could be caused by weaker generation of secondary gravity wave during weaker or westward strato-mesospheric jet. On the other hand, gravity waves propagating from below does not contribute to generation of MSTIDs during nighttime.

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