Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PEM06-25 会場:304 時間:5 月 22 日 10:25-10:45

Annual/Semiannual Variation in the Thermosphere and Ionosphere
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Thermosphere neutral density derived from long-term satellite drag data exhibits an annual/semiannual variation, with maxima near the equinoxes, a primary minimum during northern hemisphere summer, and a secondary minimum during southern hemisphere summer. This annual/semiannual variation is also evident in thermosphere composition (O/N2) measured by the Global Ultraviolet Imager (GUVI) instrument on the TIMED satellite. Recently, we obtained climatology of the daytime peak density and height of the ionospheric F2-region GPS radio occultation measurements by the Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC) for the years 2007?2010. The COSMIC data shows that low-latitude NmF2 was dominated by annual/semiannual variations, where NmF2 had maxima near the equinoxes, a primary minimum near the June solstice, and a secondary minimum near the December solstice, and that these annual/semiannual variations extended to mid-latitudes. These thermosphere and ionosphere measurements were compared to simulations by the NCAR Thermosphere-Ionosphere-Electrodynamics General Circulation Model (TIE-GCM). Model reproduction of the annual/semiannual variations in both the thermosphere and ionosphere was significantly improved by imposing seasonal variation of eddy diffusion at the lower boundary. Eddy diffusion represents turbulent mixing processes, which are mainly caused by gravity wave breaking in the mesopause region. These gravity waves are generated in the troposphere, propagate upward, and break in this region. Since changes in turbulent mixing processes affect both the thermosphere and ionosphere by altering the proportion of atomic and molecular gases, the consistent results support the proposition that lower atmospheric forcing can change composition in the thermosphere, and this composition change is a major driver of the annual/semiannual variation in both the neutral and ionized components of the coupled system.

キーワード: thermosphere/ionosphere, neutral density/neutral composition, F2 peak electron density, annual/semiannual variation, eddy diffusion, gravity wave breaking
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