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Long-term variations in characteristics of upper neutral atmosphere and ionosphere from spectrometric and radio sounding measurements

Irina Medvedeva[1] , Konstantin Ratovsky[1]

[1] Institute of Solar-Terrestrial Physics, Siberian Branch of the Russian Academy of Sciences

ivmed@iszf.irk.ru

We present the results of studying year-to-year variations in the characteristics of the upper neutral atmosphere and the ionosphere. The analysis is based on the experimental data from the instrumental complex of the Institute of Solar-Terrestrial Physics SB RAS. As atmospheric and ionospheric characteristics we used the mesopause temperature (Tm) and peak electron density (NmF2); the analyzed period is 2008-2020. The mesopause temperature was obtained from spectrometric measurements of the OH emission ((6-2), 834 nm, Tory (51.8°N, 103.1°E)). The peak electron density was derived from the Irkutsk DPS-4 Digisonde measurements (52.3°N, 104.3°E). We analyzed the annual mean Tm and yearly average values of NmF2, as well as yearly average values of day-to-day and intradiurnal variability in Tm and NmF2. The analysis involved data on solar and geomagnetic activity, as well as on variations in the Southern Oscillation Index (SOI). To interpret the year-to-year variations, we use multiple regressions of the ionospheric and atmospheric characteristics on the F10.7- and Ap-indices of solar and geomagnetic activity, respectively. For the atmospheric characteristics, we also used regressions on the SOI-index as a characteristic of the lower atmosphere activity. It was revealed, that the yearly average values of NmF2 are dominantly controlled by changes in the solar flux. The year-to-year variations in the NmF2 variability are mainly driven by changes in both solar and geomagnetic activity. The year-to-year variations in the mesopause temperature weakly correlate with changes in the indices of solar and geomagnetic activity. The yearly average values of Tm variability correlate with changes in the SOI-index: the day-to-day variability demonstrates a positive correlation with the SOI-index, while the intradiurnal variability shows a negative correlation with the SOI-index. A significant relationship between the year-to-year variations in the NmF2 variability and Tm variability was not revealed.

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