Studying atmospheric and ionospheric variabilities in the mesopause and ionospheric F2-region during winter sudden stratospheric warmings of various types

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We present the results of studying the activity of atmospheric waves at the heights of the mesopause (80-100 km) and ionospheric F2-region during the periods of winter sudden stratospheric warmings (SSW) of various types. The analysis is based on the experimental data on the rotational temperature of the hydroxyl molecule (OH band (6-2) 834.0 nm) obtained from spectrometric measurements at the Geophysical Observatory of the ISTP SB RAS (51.8˚ N, 103.1˚ E, Tory), and on the peak electron density NmF2, from the Irkutsk ionosonde DPS-4 (52.3˚ N, 104.3˚ E) data. The rotational temperature of the hydroxyl molecule corresponds to the temperature of the atmosphere at the mesopause heights. In this study, we used the method for estimating the atmospheric and ionospheric variabilities described in (Medvedeva and Ratovsky, 2015), which allows one to analyze the manifestation of wave activity in a wide range of altitudes of the upper atmosphere. As a characteristic of atmospheric variability, we used standard deviations of the mesopause temperature in the annual and nightly variations, by which one can analyze the manifestation of the various timescale wave process activity in the upper atmosphere (Perminov et al., 2014, Medvedeva and Ratovsky, 2015). As a characteristic of ionospheric variability, we used the variability of the F2 peak electron density (NmF2). The values of atmospheric and ionospheric variability obtained using this technique during the SSWs, are compared with seasonally average values. We revealed significant differences in the manifestation of wave activity at the heights of the mesopause and ionospheric F2-region during the SSWs of various types. Thus, the major SSW in February 2018 led to an increase in the day-to-day atmospheric and ionospheric variability, which can be caused by the intensification of planetary wave activity in the upper atmosphere. The largest effects of the major January 2019 SSW in the upper atmosphere were observed in the behavior of diurnal atmospheric variability due to the effects of tides and internal gravity waves.

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