

Variations of the Es layer over Novosibirsk in 23 and 24 solar cycles

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At the ionospheric station in Novosibirsk (54.84° N., 83.23° E), continuous observations by vertical sounding have been conducted since the late 60s of the XX century. Since 1995, a digital ionosonde "PARUS" has been installed, thanks to which a digital archive of data has been accumulated. To study the morphological features of the behavior of the ionosphere over Novosibirsk, the critical frequency and the effective height of the Es layer (foEs and h'Es, respectively) were chosen as parameters characterizing the state of the lower ionosphere. The accumulated material made it possible to analyse the probabilities of observation (PEs) of this layer in each month, depending on the time of day and the height of appearance for the period from 1996 to 2021, which covers 23 and 24 eleven-year solar cycles. There was no direct dependence on the level of solar activity, which was represented by Wolf numbers (the number of spots on the Sun). The 23rd cycle of solar activity began in May 1996 and ended in January 2009. It lasted 12.6 years. The maximum was recorded in March 2000 and the secondary maximum in November 2001, the minimum in December 2008. The 24th cycle was slightly weaker, it began in December 2008 and ended in December 2019, the maximum was in April 2014, it lasted 11 years. PEs shows a clear dependence on the season and the hour of the day. In January-February 2002, the Es layer was practically not observed (PEs=15%), when, as in other years, this value reached 40-45%. In July and August, the appearance of the Es layer is almost 100%. The conditions of anomalous variations of the sporadic layer over Novosibirsk are discussed. The formation of the Es layer during the preparation and implementation of earthquakes in the area of 200-300 km from the ionospheric station is discussed.