Diurnal, seasonal and solar-cycle variations in the short-term variability of total electron content at mid latitudes

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The ionosphere at mid latitudes is the region subject to both solar plus magnetospheric forcing, and the effect from underlying shells of the neutral atmosphere. This study presents the analysis of the short-period variability of ionospheric total electron content (TEC) at several mid latitude points during 2002-2019. The period involves almost two solar cycles that enables to estimate not only diurnal and seasonal changes in the variability but also the fluctuations within a solar activity cycle. The absolute values of TEC were obtained from the measurements of GPS/GLONASS dual-frequency receivers and calculated by the technique described in [1]. As an index for estimating the level of the short-period TEC variability we calculated a relative standard TEC deviation from an average value in the specified time interval (2 hours). TEC variations with periods of less than 2 hours are mostly associated with internal gravity waves activity.

We show that TEC variability experiences clear diurnal, seasonal and solar cycle variations. During a day there are two distinct peaks in the variability level near the solar terminators' time. Moreover, the level of variability around the morning terminator is higher than during the evening one and significantly exceeds the variability in the daytime (Fig. 1, left). There is a pronounced seasonal variation in the level of variability (Fig. 1, right): the largest values are observed in winter and the smallest ones in summer with the summer-winter difference exceeding 3 times. Such seasonal behavior is regularly observed from year to year. During a solar activity cycle the maximum values of variability in winter reduces more than 50% toward the solar activity descending stage. Surprisingly, the variability level in summer months does not change with solar activity (Fig. 1, right). The sources for winter enhancement of the short-term variability may be connected with the circumpolar vortex forming in the stratosphere during winter months [2].

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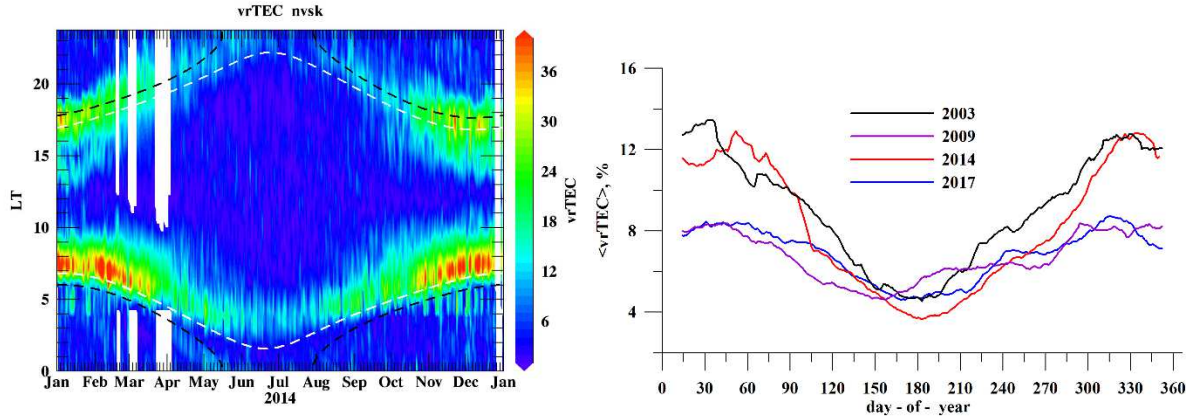

Figure 1. Right - local time vs day of the year distribution of the short-term TEC variability in 2014 at station NVSK (53ºN, 83ºE); left - seasonal changes in the variability at different solar activity levels.

References

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[2] A. Yasyukevich, I. Medvedeva, V. Sivtseva, M. Chernigovskaya, P. Ammosov, G. Gavrilyeva "Strong Interrelation between the Short-Term Variability in the Ionosphere, Upper Mesosphere, and Winter Polar Stratosphere," *Remote Sens.*, **12**, 1588, 2020, doi:10.3390/rs12101588.