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Mechanisms of Nighttime Enhancements in the Electron Concentration in the F2 Layer of the Midlatitude Ionosphere

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Various types of the nighttime enhancements in the electron concentration in the F2-layer maximum (NmF2) of the midlatitude ionosphere differing by mechanisms of their formation are known. In the majority of the papers the nighttime enhancements in NmF2 in the midlatitude ionosphere are related to an increase in the velocity of the downward plasma flux from the protonosphere and by the rise of the height (hmF2) of the layer maximum caused by the equatorward thermospheric wind to heights where the recombination rate is small. The probability of the formation of nighttime enhancements in NmF2 is very high. It should be noted that the nighttime variations in NmF2 can also be caused by large-scale traveling ionospheric disturbances (LS TIDs). The probability of the observation of the LS TIDs is very high as well. That is why the goal of this paper is to reveal signs in the behavior of the nighttime F2 layer, making it possible to identify the events of enhancements in NmF2 and LS TIDs according to the ionospheric vertical sounding data.
The data obtained are interpreted on the basis of the occurrence of a self-supporting avalanche-like process, representing the mechanism of formation of electron concentration nighttime enhancements, which is based on the equatorward thermospheric wind, and therefore a raise of the F2-layer to heights characterized by substantially lower recombination rates, and on the increase in the downward plasma flux from the protonosphere.
Comparison of the behavior of the F2-layer parameters caused by the mechanism considered, with their behavior during LS TIDs passages showed their similarity. During a passage of LS TIDs, the NmF2 peak value is formed later than the hmF2 peak value, as in the first mechanism. Phase relations between the variations of the electron density at the neighboring heights, showing the phase delay of variations at lower altitudes relative to the higher altitudes, also reveal the similarity in the F2-layer reactions to two considered mechanisms of nighttime enhancements. Possible methods of identification of mechanisms are discussed.
The difference between the reaction of the F2-layer parameters to the enhancements caused by the rise of the layer and plasma flux from the protonosphere and the summer midlatitude anomaly in the ionosphere is shown. The difference is that there is no pronounced peak in the behavior of hmF2 preceding the peak in NmF2 in the latter event.