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Mid-Latitude Daytime F_2-Layer Disturbance Mechanism under Extremely Low Solar and Geomagnetic Activity in 2008–2009

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European near-noontime ionosonde observations were considered during the period of deep solar minimum in 2008–2009 to analyze f_oF_2 perturbations not related to solar and geomagnetic activity. Quiet time F_2-layer disturbances (Q-disturbances) present a special class of N_mF_2 perturbations occurring under magnetically quiet conditions. Their morphology and the formation mechanism differ from F_2-layer storm effects related to enhanced geomagnetic activity. Such day-to-day N_mF_2 variations may be considered in the framework of F_2-layer variability A large part of F_2-layer variability is linked to geomagnetic activity; the rest is attributed to 'meteorological' sources at lower levels in the atmosphere Sudden stratospheric warming (SSWs) events in January 2008 and 2009 were analyzed.

An original method was used to retrieve aeronomic parameters from observed electron concentration in the ionospheric F-region. Atomic oxygen was shown to be the main aeronomic parameter responsible both for the observed day-to-day and long-term (during SSWs) f_oF_2 variations. Atomic oxygen rather than neutral temperature mainly controls the decrease of thermospheric neutral gas density in the course of the SSW events. Day-to-day variations of thermospheric circulation and an intensification of eddy diffusion during SSWs are suggested to be the processes changing the atomic oxygen abundance in the upper atmosphere for the periods in question.

Recent Global-Scale Observations of the Limb and Disk (GOLD) observations of O/N_2 column density confirm the depletion of the atomic oxygen abundance not related to geomagnetic activity during SSWs.

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