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Mechanism of solar flare based on energy storage in the magnetic field of the current sheet

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Understanding the solar flare mechanism, which makes it possible to establish a flare situation in the solar corona when using numerical MHD simulations and find a place for the accumulation of magnetic energy for a solar flare, can improve the forecast quality of solar flares, which have a significant impact on the Earth's space environment. The appearance of a flare in the corona at altitudes of 15 000 to 30 000 km is explained by the accumulation of energy in the magnetic field of the current sheet, which is created in the vicinity of X-type singular. Based on the mechanism of energy release in the current sheet, using the results of numerical simulation and observations, the electrodynamic model of a solar flare is proposed, explaining its main observable manifestations. The hard X-ray emission is caused by the electrons bremsstrahlung in the chromosphere, which are accelerated in field-aligned currents generated by the Hall electric field. To study the flare situation, numerical MHD simulation was performed in corona above the real active region. At setting the conditions of simulation, no assumptions were done about the flare mechanism. The simulation shows the appearance of a current sheet whose position coincides with the position of the observed source of thermal X-ray emission. For more accurate simulation in real scale of time, the parallelizing of calculations is currently underway on a supercomputer specially assembled for solving this task based on the Tesla M2050 multiprocessor GPU graphics card.

Long-term changes in the intensity of mesoscale variations in hydroxyl rotational temperature near the mesopause as indicators of dynamic processes in the underlying atmosphere

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We used digital difference filters for the analysis of the spectral observations of the rotational temperature of vibrationally excited hydroxyl at altitudes 85-90 km at the Zvenigorod scientific station of IAP RAS (56° N, 37° E) in 2004-2016 and at the Geophysical observatory of ISTP SB RAS (52° N, 103° E, Tory) in 2012-2017. Seasonal and interannual changes in the mean temperature and intensity of variations with periods 0.4-5.4 h are studied. These changes may be associated with the propagation of internal gravity waves (IGWs) in the mesopause region. To filter out mesoscale variations, differences between the sequential values of the OH temperature, averaged over the intervals by duration from 10 min to 2 h, were obtained. It was revealed, that the average monthly variances of mesoscale variations in the OH rotational temperature obtained at the Tory station are larger than in Zvenigorod. Average seasonal changes of relative mesoscale variances

demonstrate two maxima in winter and in summer, with the summer maximum shifted closer to spring months for the Tory station. The reasons for the differences could be different orography and jet streams in the lower and middle atmosphere, also different spectra of IGW horizontal wavelengths due to different geometry of observations at the Tory and Zvenigorod stations.

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Solar flare effects on the thermosphere and ionosphere

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Solar flares are sudden increased brightness from the Sun's active regions. This sudden brightness is mainly in X-ray and extreme ultra-violet wavelengths. Solar flares typically last for less than an hour, and take several minutes to arrive at the Earth. During solar flares, solar irradiance increases rapidly in X-rays and extreme ultra-violet. Solar irradiance in these short wavelengths ionizes the thermosphere and creates ionosphere. Therefore, solar flares impact the thermosphere and ionosphere. In this paper, we use model simulations and data to illustrate and understand solar flare effects in the thermosphere and ionosphere system; how flare characteristics affect flare responses in the thermosphere and ionosphere; the EUV late phases of solar flares and how the EUV late phases impact the thermosphere and ionosphere; and large-scale traveling atmospheric disturbances during concurrent solar flare and geomagnetic storm events.

Preliminary observational investigation of equatorial plasma bubbles over Africa using an all-sky airglow imager and the study of its occurrence frequency

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The first all-sky imager in Africa was installed in Abuja, Nigeria (Geographic: 8.99°N, 7.38°E; Geomagnetic: 1.60°S), close to magnetic equator, in June 2015 during VarSITI campaign. The camera, has a 180° fish eye view covering almost the entire airspace of Nigeria. This report covered June 2015 to 31 December 2018. We investigated the occurrence frequency of equatorial plasma bubbles and their dependences on local time, season, and geomagnetic activity. Rate of Change of Total Electron Content ROTI obtained from GNSS observation were also engaged as proxy of plasma bubbles within the coverage of the all-sky imager. Plasma bubble