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Editorial

Low-Latitude Mesosphere, Thermosphere, and Ionosphere

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The objective of this proposed special issue was to provide a forum for papers related to the recent advances in the field of equatorial and low-latitude regions of mesosphere, thermosphere, and ionosphere from observational (ground-based and space-borne), theoretical, and simulation studies. A total of 11 papers are presented, out of which 10 are invited and 1 contributed (F. Ouattara et al.). 2 papers are reviews, one dealing with a network of Fabry-Perot interferometers for large-scale measurements of the neutral winds and temperature in the Earth's thermosphere (J. J. Makela et al.) and the second dealing with the equatorial F2 layer stratification (M. V. Klimenko et al.).

The upper atmosphere in the equatorial and low-latitude regions is fairly different from that at other latitudes due to the fact that in these regions the geomagnetic field is nearly parallel to the Earth's surface. This needs many more multiinstrument and multisite investigations as much of this region is occupied by developing or underdeveloped countries. The MLT (mesosphere and lower thermosphere) region studies are still in initial stages. Better and improved specifications of the ionosphere and thermosphere system are necessary for the new areas like space weather and space climate. Papers presented in this special issue related to the recent advances in the field of equatorial, mid- and low-latitude regions from ground-based (magnetometers, ionosondes, multisite Fabry-Perot interferometer network, GPS receivers, low-latitude ionospheric sensor network (LISN), VHF backscatter, and incoherent scatter radars) and space-borne satellite (ISIS-1, ISIS-2, Intercosmos-19, UARS, TIMED, CHAMP, DEMETER, COSMIC3/FORMASAT), observational, theoretical, and simulation (CCM SOCOL, SUPIM, SAMI2, GSM TIP). Below we briefly described all papers presented in this special issue.

In mesospheric studies, we had 2 papers (I. Mingalev and V. Mingalev) and (T. Egorova et al.).

I. Mingalev and V. Mingalev investigated solar activity dependence on the large-scale global circulation of the mesosphere and lower thermosphere using the nonhydrostatic model of the global neutral wind system of the Earth's atmosphere, developed in Polar Geophysical Institute. Their simulation results indicate that solar activity ought to influence considerably on the formation of global neutral wind system in the MLT region. The influence is conditioned by the vertical transport of air from the lower thermosphere to the mesosphere and stratosphere. This transport may be rather different under distinct solar activity conditions.

T. Egorova et al. applied chemistry-climate model (CCM) SOCOL to simulate the distribution of the temperature and gas species in the upper stratosphere and mesosphere. Using the combination of the level of noise due to nonlinear dynamics and connected with it transport of the species, the authors defined the area in the middle atmosphere where the nowcast and short-term forecast can be performed using CCM SOCOL model with the highest level of success. As an input for the simulation, they employ daily spectral solar UV irradiance measured by SUSIM instrument onboard UARS satellite in January 1992.

In thermospheric studies, we had only 1 review paper (J. J. Makela et al.).

J. J. Makela et al. presented results from a new network of Fabry-Perot interferometers (FPIs) (North American Thermosphere Ionosphere Observation Network (NATION)) that allowed to make coordinated measurements of the neutral winds and temperature in the Earth's thermosphere using measurements of the 630-nm redline emission. At present only 4 midlatitude sites are operational, but the network could be extended to other locations including low latitudes for large-scale coverage. The observing strategy of the network will take into account local observing conditions, and common volume measurements from multiple sites will be made in order to estimate local vector wind quantities. The resulting estimates of temperatures and horizontal neutral winds will be used to address many scientific questions described in this paper.

In ionospheric studies, we had 8 papers (1 review paper (M. V. Klimenko et al.) and 7 papers (6 invited (C. S. Carrano et al., Y. Otsuka, E. Yizengaw, R. R. Ilma et al., C. Valladares and M. Hei, and S. Pulinets)) and 1 contributed (F. Ouattara et al.)).

M. V. Klimenko et al. in their review paper presented the history of the equatorial F2 layer stratification researches, describes the current progress of these investigations, and identify them as the most important problems in the field of equatorial and low-latitude ionospheric physics. A considerable amount of research has been devoted to the formation of these additional layers or topside ionization ledge in the F region of the equatorial ionosphere; originally the occurrence of such layers was named stratification of equatorial F2 layer. This additional layer was later renamed as the F3 layer. The F3 layer is formed by zonal component of electric field with assistance of meridional component of thermospheric wind and field-aligned plasma diffusion.

C. S. Carrano et al. presented a new technique called iterative parameter estimation (IPE) for inferring ionospheric turbulence parameters from a time series of scintillating intensity measurements resulting from propagation through the low latitude ionosphere. This method is valid when the scintillation index saturates due to multiple-scatter effects. The authors found that the strength of plasma turbulence parameters tends to be largest near the crests of the equatorial anomaly and at early postsunset local times. They suggested that IPE analysis may provide useful estimates of zonal irregularity drift measurements at scintillation monitoring sites which are equipped with only a single GPS receiver. They have included latitudinal and local time variation of ionospheric turbulence parameters during the conjugate point equatorial experiment (COPEX) in Brazil. They have characterized the turbulent ionospheric medium that produced these scintillations and reported on the variation of turbulent intensity, phase spectral index, and irregularity zonal drift as a function of latitude and local time for the evening of 1-2 November 2002.

S. Pulinets presented the general conception of low-latitude ionospheric processes initiated by strong earthquake preparation process using the results of the recent author's publications, including also rethinking the earlier results. Physical mechanisms causing the ionospheric variations are discussed for the recent major earthquakes. Segregation of low-latitude regions for special consideration is due to the fact that EIA has an important role in seismoionospheric coupling. The equality of effects observed over land or sea implies a possible mechanism that these anomalies are initiated by gaseous emanations from the Earth's crest, and radon plays the major role.

Y. Otsuka analyzed E-region field-aligned irregularities (FAIs) observed with a VHF radar in Indonesia and classified the E-region FAI into two groups: descending FAI, which can be seen most clearly in June solstice season after sunrise and after sunset and low-altitude FAI that was observed at constant altitude around 88–94 km mainly during nighttime. In addition, the author determined the velocity direction of the observed FAIs above and below E-region FAI echoes.

E. Yizengaw for the first time presented simultaneous observations of the tidally modulated global wind structure in the E-region and the ionospheric density distribution. The results of his analysis showed that the longitudinally structured zonal wind component could be responsible for the formation of wave number four pattern of the equatorial ionization anomaly. Also he suggested that the meridional wind may not make a significant contribution to the modification of the E-region dynamo.

R. R. Ilma et al. reported on a correlation between equatorial ionospheric electric field pulse and the time derivative of the magnetic field during the superstorm of November 2004. They showed that it is impossible to create the observed field by inductive effect and suggested that the effect was caused by a modulation of the location of the ring current relative to the earth due to the electric field.

C. Valladares and M. Hei measured the characteristics of medium-scale traveling ionospheric disturbances (TIDs) (the TID traveling velocity, its propagation direction, and the scale-size of the disturbances) at low latitudes. Authors concluded that small and/or regional arrays of GPS receivers can be used at low latitudes to study the role that gravity waves may have on seeding plasma bubbles.

F. Ouattara et al. examined the foF2 effect of the changing levels of solar extreme ultraviolet radiation with sunspot number during three solar cycles. The study shows high correlation between foF2 and sunspot number (Rz). The ionospheric data in Africa have been less. This study gives a valuable statistics of the foF2 at low latitudes in Africa.

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