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Editorial

Mesosphere and Lower Thermosphere

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The mesosphere and low thermosphere (MLT) region is defined as the region of the atmosphere between approximately 60 and 110 km in height. It is dominated by the effects of atmospheric waves and oscillations with different scales, including ENSO, AO, SAO, QBO, planetary waves, tides, and gravity waves. Radar and lidar, using both ground-based and satellite-based optical instruments, are important observational tools in this region [1,2]. Furthermore, the method of the resonant scattering of radio waves on artificial periodic inhomogeneities (APIs) of the ionospheric plasma is used to conduct temperature measurements in the MLT region [3].

Based on TIMED/SABER data, Gu et al. investigated the semiannual oscillation (SAO), annual oscillation (AO), and quasi-biennial oscillation (QBO) of the atomic oxygen volume mixing ratio at 96 km from 40° S to 40° N [4]. They found that the SAO amplitudes presented two peaks at about 25° S and 25° N, displaying clear hemispheric symmetry. The AO amplitude increased with latitude and showed distinct minima around the equator, as well as a clear hemispheric asymmetry. Wu et al. conducted research on the diurnal and seasonal variation of gravity wave (GW) activity in the MLT region and found that GW activity exhibited 12 h and 24 h periodicity [5].

Irregularities and disturbances in this region are of particular interest. Based on ionosonde data, Tang et al. found an unusual enhancement of the sporadic E (Es) layer during a geomagnetic storm event [6]. The response of the Es layer to the geomagnetic storm was also studied by Resende et al. [7]. Simulation results revealed that a thundercloud charge of 30–100 °C could cause a disturbance in the electron density in the lower ionosphere [8].

In addition to the irregularities, the variation in the normal D-region ionosphere was numerically studied by Zhu et al. [9]. The simulation results show that molecular ions, such as NO^+, $NO^+(H_2O)n$, $H^+(H_2O)n$, $CO_3{}^-$, and $O_3{}^-$, are the main components of ions in the D-region, and the diurnal change in electron density at low latitudes is more pronounced than at high latitudes.

In addition to the ion layers, the neutral metal layers and their correlation with the Es layers are also extensively investigated. Andrioli et al. investigated the occurrence of Es layers and the influences of wind shear in the formation of C-structures in the mesospheric metal layers and found a low correlation between Es occurrence and C-structures [10].

Conflicts of Interest: The authors declare no conflict of interest.

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References

1. Bakhmetieva, N.V.; Grigoriev, G.I. Study of the Mesosphere and Lower Thermosphere by the Method of Creating Artificial Periodic Irregularities of the Ionospheric Plasma. *Atmosphere* **2022**, *13*, 1346. [CrossRef]
2. Klimov, P.; Sharakin, S.; Belov, A.; Kozelov, B.; Murashov, A.; Saraev, R.; Trofimov, D.; Roldugin, A.; Lubchich, V. System of Imaging Photometers for Upper Atmospheric Phenomena Study in the Arctic Region. *Atmosphere* **2022**, *13*, 1572. [CrossRef]
3. Bakhmetieva, N.V.; Grigoriev, G.I.; Zhemyakov, I.N.; Kalinina, E.E. Artificial Periodic Irregularities and Temperature of the Lower Thermosphere. *Atmosphere* **2023**, *14*, 846. [CrossRef]
4. Gu, S.; Zhao, H.; Wei, Y.; Wang, D.; Dou, X. Atomic Oxygen SAO, AO and QBO in the Mesosphere and Lower Thermosphere Based on Measurements from SABER on TIMED during 2002–2019. *Atmosphere* **2022**, *13*, 517. [CrossRef]
5. Wu, Y.; Tang, Q.; Chen, Z.; Liu, Y.; Zhou, C. Diurnal and Seasonal Variation of High-Frequency Gravity Waves at Mohe and Wuhan. *Atmosphere* **2022**, *13*, 1069. [CrossRef]
6. Tang, Q.; Sun, H.; Du, Z.; Zhao, J.; Liu, Y.; Zhao, Z.; Feng, X. Unusual Enhancement of Midlatitude Sporadic-E Layers in Response to a Minor Geomagnetic Storm. *Atmosphere* **2022**, *13*, 816. [CrossRef]
7. Resende, L.C.A.; Zhu, Y.; Arras, C.; Denardini, C.M.; Chen, S.S.; Moro, J.; Barros, D.; Chagas, R.A.J.; Da Silva, L.A.; Andrioli, V.F.; et al. Analysis of the Sporadic-E Layer Behavior in Different American Stations during the Days around the September 2017 Geomagnetic Storm. *Atmosphere* **2022**, *13*, 1714. [CrossRef]
8. Yang, X.; Liu, Y.; Lin, Y.; Zhou, C.; Zhao, Z. Simulation of Electron Density Disturbance in the Lower Ionosphere Caused by Thundercloud Electrostatic Fields. *Atmosphere* **2023**, *14*, 444. [CrossRef]
9. Zhu, M.; Xu, T.; Sun, S.; Zhou, C.; Hu, Y.; Ge, S.; Li, N.; Deng, Z.; Zhang, Y.; Liu, X. Physical Model of D-Region Ionosphere and Preliminary Comparison with IRI and Data of MF Radar at Kunming. *Atmosphere* **2023**, *14*, 235. [CrossRef]
10. Andrioli, V.F.; Xu, J.; Batista, P.P.; Resende, L.C.A.; Pimenta, A.A.; Martins, M.P.; Savio, S.; Targon, C.G.; Yang, G.; Jiao, J.; et al. C-Structures in Mesospheric Na and K Layers and Their Relations with Dynamical and Convective Instabilities. *Atmosphere* **2022**, *13*, 1867. [CrossRef]