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Theoretical Study of the Ionospheric Mid-latitude Summer Nighttime Anomaly (MSNA) using SAMI2

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The physical mechanisms for the formation of the Mid-latitude Summer Nighttime Anomaly (MSNA) are investigated and simulated by performing the SAMI2 (Sami2 is Another Model of the Ionosphere) model in this study. Results show that the SAMI2 model can successfully reproduce the ionospheric MSNA structure. The time series of the altitude-latitudinal maps reveal that the longer time of the photoionization rate can provide more ion ionization in the summer ionosphere. Furthermore, the equatorward (northward) neutral wind can drive the electron density up to a higher altitude along the magnetic field lines and sustain the electron density for a longer life time in the summer hemisphere. The ion velocity, the motion of the plasma, is also an important factor to form the MSNA structure. The altitude-latitudinal map of the field aligned ion velocity show that the highly downward ion velocities in the winter hemisphere decrease the electron density and the high electron density is preserved for a long time by the upward ion velocities in the summer hemisphere. In order to understand how the neutral wind and the ion velocity relate to the MSNA structure in the ionosphere nighttime, the NO neutral wind and the NO ExB drift condition are applied to drive the SMAI2 model. Results show that the meridional neutral winds can produce the asymmetric ion velocity between the both hemispheres and cause the appearance of the MSNA structure in the summer hemisphere, which tell us that the neutral wind may be the important role of the formation of the MSNA feature.

Keywords: Mid-latitude Summer Nighttime Anomaly, Weddell Sea Anomaly, SAMI2