A Climatological Simulation Study of the Southern High-latitude F Region Ionosphere in Winter

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A three-dimensional, time-dependent model for the polar ionosphere has been developed. The daily variation is simulated for the global polar ionospheric F-region electron density(NmF2), taking into account the interaction between the solar radiation, the aurora precipitation and the ionospheric convection processes in the polar regions. Good agreement is achieved between the simulation and the observation of NmF2 at ZhongShan (69.4˚S,76.4˚E), Casey(66.3˚S,110.5˚E) and Scott Base(77.9˚S, 166.8˚E) stations, Antarctica, respectively. It is fount that the southern polar F region ionosphere is mainly controlled by the ionospheric convection in winter time. The daily trend of NmF2 is mainly determined by the interaction between solar EUV ionization and the plasma convection at high latitudes. Auroral precipitation affects the NmF2 diurnal variation, but plays a minor role. The UT variation of the southern polar F region ionosphere has their manifestations at different stations. The peak of NmF2 observed in the daily variation at Zhongshan Station results from the unique location of the station. While Zhongshan station is moving toward the magnetic noon, the high density plasma existing at lower latitudes is transported into higher latitudes by the convection flow, forming the tongue of ionization (TOI) structure. Zhongshan station locates right under this TOI structure which has been fully structured at about 0900 UT, a time in terms of which the simulation shows well agreement with observations. Casey and Scott Base locate at higher geomagnetic latitudes than Zhongshan. The higher plasma densities transported into the polar cap from lower latitudes, as well as the convection patterns in the polar cap contribute to the NmF2 variations at these two stations.