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Ionospheric Seasonal Variation in Martian Equatorial Region Ionospheric Seasonal Variation in Martian Equatorial Region

Mingyuan Wang^{1*}, Takao Kobayashi¹, Jinsong Ping¹

Mingyuan Wang^{1*}, Takao Kobayashi¹, Jinsong Ping¹

¹Shanghai Astronomical Observatory, CAS

¹Shanghai Astronomical Observatory, CAS

Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS) is a multi-frequency, synthetic-aperture, orbital sounding radar onboard Mars Express which was launched into an elliptical orbit with an inclination of 86.35 deg on 25 Nov 2003. By analyzing the surface echoes of MARSIS, Safaeinili proposed a method to calibrate the ionospheric effect and estimate the total electron content (TEC), peak electron density and neutral atmosphere scale height near the ionospheric peak properly. Using this method to collect TEC of Martian ionosphere over one Martian year from MARSIS, we have found TEC of ionosphere in Martian Equatorial Region is seasonal changed, and the changing trend is correlated with the seasonal cycle of carbon dioxide. As we know, in the lower ionosphere, photoelectron ionization is significant and makes a contribution of 20~30% to the total ionization rate [Nier and McElroy, 1977]. Even though CO₂ is the major atmospheric constituent of Mars at low altitudes and CO₂⁺ ions are the primary ions produced below 100 km, O₂⁺ ions are dominant at low altitudes (<260 km) because most of the CO₂⁺ ions are broken down into O₂⁺ ions through a subsequent ion-neutral reaction (CO₂⁺ + O → O₂⁺ + CO). In a word, CO₂ is vaporized from polar cap, then photo-ionized to be CO₂⁺, O₂⁺ etc. These charged particles are main ions of Martian ionosphere, and interact with solar wind directly. As solar wind flows past Mars, significant amounts of ions are taken away. It means that oxygen dissociated from CO₂ escape from Martian atmosphere. Based on MARSIS TEC data, the amplitude of TEC changing is about 10² per m² which affects the oxygen escape speed.

キーワード: Mars, TEC, Carbon Dioxide

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