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Solar cycle variations of the tweek reflection height

Hiroyo Ohya[1*], Kazuo Shiokawa[2], Yoshizumi Miyoshi[2]

[1]Graduate School of Eng., Chiba Univ., [2]STE Laboratory, Nagoya University

The purpose of this study is to reveal solar-cycle variations of the tweek reflection height. Tweek atmospherics are reflected at a height where the equivalent electron densities are 20 - 30 cm^{-3}. Descent (rise) of the reflection height corresponds to increase (decrease) in electron density in the ionospheric D- and lower E-regions. It is known that electron density in the sub-ionosphere depends on solar activities, although nighttime lower ionosphere has not been sufficiently investigated yet. An advantage of using tweeks is to be able to monitor variations of electron density less than 10^2 cm^{-3} along long propagation paths (several thousands of kilometers). From cut-off frequency of the first order mode on dynamic spectrum, we can estimate the reflection height. We use tweek data obtained at Kagoshima (31.5N, 130.7E), Japan, on magnetically quiet days in 1976-2010; solar cycles 21,22, 23, and the rising phase of solar cycle 24. The average and standard deviation of the reflection height were 95.9 km and +/-3.1 km, respectively. The years when the tweek reflection height was lower than 93.0 km were 1976 (solar minimum), 1979 (solar maximum), 1985 (solar minimum), 1995-1997 (solar minimum), and 2002 (solar maximum). On the other hand, the years when the tweek reflection height was higher than 99.0 km were 1977-1978 (rising phase), 1987-1991 (rising phase to solar maximum), and 2006-2009 (solar minimum). The significant peaks of the periodgram were seen to be 13.3, 3.2, and 1.3 years. We have considered possible causes of this long-term variation of the reflection height: geocorona emission, galactic cosmic ray (GCR), particle precipitation from the inner radiation belt, and the neutral atmosphere. In the presentation, we discuss possible causes of this long-term variation of the reflection height.