

LONG-TERM VARIATIONS OF THE TWEAK REFLECTION HEIGHT DURING THE SOLAR CYCLE 21

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It is known that electron density in the lower ionosphere varies depending on solar activities and that the ratio of electron density at solar maximum to that at solar minimum is about 1.5 according to the ionosphere F-region measurements by ionosondes. However, electron density variations below 100-km heights are not well known. In this study, we investigate variations of reflection height (equivalent to the electron density below 100 km) of tweak atmospherics during the solar cycle 21 (1976-1986).

Tweak atmospherics are VLF/ELF electromagnetic waves (1.5-10 kHz) that originate from lightning discharges and propagate in an Earth-ionosphere waveguide over several thousands of kilometers. The frequency of the tweaks falls from 10 kHz to 2 kHz during 50 ms. Tweaks are usually received only at night, when attenuation by the ionosphere is negligible. On average, about 100 tweaks are received per minute at night. The equivalent electron densities at the reflection heights of tweaks are 20-28 cm^{-3} . The reflection heights (the waveguide heights) are calculated from the cut-off frequency for the first-order mode of tweaks. We regard that the descent (rise) of the reflection heights correspond to the increase (decrease) in the electron densities.

In this study, we use tweaks to monitor the density variations in the lower ionosphere at altitudes between 70 km and 100 km, where conventional ionosondes cannot measure the ionospheric height. Tweaks are useful for monitoring the lower electron density variations in the D-region ionosphere.

We estimate the reflection heights of tweaks from their dynamic spectra by fitting a theoretical curve represented from a homogeneous spherical Earth-ionosphere waveguide model with an automatic parameter-analysis procedure that we developed. We used observational VLF data that have routinely received at Kagoshima, Japan, since April 1976. As a result, the reflection height at the solar maximum tends to be lower than one at the solar minimum. In the session, we will report the variations of tweak reflection heights over the solar cycle 21.

tweak, reflection height, sunspot number

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