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Multi-timescale statistical analysis of ionospheric trough with long-term EISCAT dataset

Tetsuro Ishida[1*], Yasunobu Ogawa[2], Akira Kadokura[2]

[1]The Graduate University for Advanced Studies, [2]National Institute of Polar Research

The statistical analysis to northern ionospheric auroral/subauroral trough has been conducted for the purpose of clarifying the controlling mechanism of the trough's basic structure.

Ionospheric trough, known as an electron density depletion region in ionosphere, is considered as one of the important phenomena driving the coupling system between ionosphere and magnetosphere via magnetic-field-lines. Therefore the trough research is not only restricted to ionospheric physics but also could contribute to magnetospheric physics, especially magnetosphere-ionosphere coupling system. Moreover, it is indicated that sharply decreasing of electron density over the tough wall region could influence the HF radio wave propagation and GPS navigation system. Thus the trough research is expected to make contribution to radio communication science.

It is commonly accepted that the dissociative recombination caused by ionospheric heating generates the trough's basic structure. However, it is very difficult to reveal the causal relationship between several heating mechanisms and trough's characteristics because various physical and/or chemical processes could drive depletion of ionospheric density. In this study, therefore, we have used EISCAT database which covers 29-years (1983~2011) ionospheric data and conducted long-term statistical analysis of the ionospheric trough. In particular, we focus on investigations of the characteristics of the trough's spatial structure by using multi-timescale statistical analysis. We have obtained the following results so far.

(1) Nighttime trough is steadily structured in all seasons, while structure of daytime trough has seasonal dependence because ionization rate is controlled by solar zenith angle.

(2) The longitudinal structure of trough shifts equatorward and toward pre-midnight with increasing Kp index.

(3) While the background electron density becomes higher in F-region, the depth of trough becomes deeper with increasing F10.7 index.

In this paper, we present the analysis method and the obtained results, and discuss how the characteristics are generated.

Keywords: EISCAT, Ionosphere, Trough