南極昭和基地大型大気レーダーで得られた中間圏エコーと下部電離圏における電子密度モデルとの比較研究

Comparison study between coherent radar echo and empirically-modeled electron density in the mesosphere based on the PANSY radar

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Polar Mesosphere Winter Echo (PMWE) is known as back scatter echo from 55 to 85 km in the mesosphere, and it has been observed by MST and IS radar in polar region during non-summer period. Since density of free electrons as scatterer is low in the dark mesosphere during winter, it is suggested that PMWE requires strong ionization of neutral atmosphere associated with Energetic Particles Precipitations (EPPs) during Solar Proton Events [*Kirkwood et al.*, 2002] or during geomagnetically disturbed periods [*Nishiyama et al.*, 2015]. However, studies on relationship between occurrence of PMWE and background electron density has been limited yet [*Lübken et al.*, 2006], partly because the PMWE occurrence rate is known to be quite low (2.9%) [*Zeller* et al., 2006].
The PANSY (Program of the Antarctic Syowa MST/IS) radar, which is the largest MST radar in Antarctica, observed many PMWE events since it has started mesosphere observations in June 2012. We established an application method of the PANSY radar as riometer, which makes it possible to estimate Cosmic Noise Absorptions (CNA) as proxy of relative variations on background electron density. In addition, electron density profiles from 60 to 150 km altitude are calculated by Ionospheric Model for the Auroral Zone (IMAZ) [*McKinnell and Friedrich*, 2007] and CNA estimated by the PANSY radar.
In this presentation, we would like to focus on strong PMWE during two big geomagnetic storm events, St. Patrick's Day and the Summer Solstice 2015 Event, in oreder to compare observed PMWE characteristics to model background electron density. On March 19 and 22, recovery phase of St. Patrick's Day Storm, sudden PMWE intensification was detected near 60 km by the PANSY radar. At the same time, strong Cosmic Noise Absorptions (CNA) of ~ 0.8 dB and 1.0 dB were measured, respectively. However, calculated elctron density profiles did not necessarily demonstrate high elecetron density at the altitude where the PMWE intensifications were observed. On June 22, the Summer Solstice 2015 Event, strong nighttime PMWE near 80 km was detected around 16 UT, which is equal to 19 LT at Syowa station. Since PMWE observations are primarily confined to daytime because of relatively abundant free electrons in the illuminated mesosphere, this strong and long-lived nighttime PMWE implies that EPPs related to the storm caused the sporadic ionization sufficient for PMWE even in dark mesosphere. The modeled electron density profile agreed with the occurrence of the PMWE, showing density enehancement of 10^9 - 10^{10} cm^{-3} from 60 to 80 km altitude. The difference between the above two events is thought to be caused by overestimations of CNA in St. Patrick's Day Storm, which leads to underestimation of modeled electron density. We are going to validate CNA estimated by the PANSY radar and discuss about discrepansy between modeled elecron density and PMWE in detail.

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