

Simultaneous observations of polar mesosphere winter echoes (PMWE) and Cosmic Noise Absorption (CNA) by the PANSY radar

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In the lower thermosphere at the altitude of around 100 km, both neutral turbulence and ionization of atmosphere due to solar radiations cause irregularities of refractive index, and as a result back scatter echoes from that altitude are frequently observed by radars on the ground. In the mesosphere, Polar Mesosphere Summer Echo (PMSE) is reported to be a strong echo associated with ice particles, which are produced around the coldest mesopause region in the polar summer, by a number of past radar observations [Cho and Röttger, 1997; Rapp and Luebken, 2004]. It should be also noted that occurrence rate of PMSE is very high (80-90%) [Bremer et al., 2003]. On the other hand, Polar Mesosphere Winter Echo (PMWE) is also 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 winter [e.g., Ecklund and Balsley, 1981; Czechowsky et al., 1989; Luebken et al., 2006; Strelnikova and Rapp, 2013]. Due to the lack of free electrons and ice particles in the dark and warm mesosphere during winter, it is suggested that PMWE requires strong ionization of neutral atmosphere associated with precipitations of Solar Energetic Particles (SEPs) during geomagnetically disturbed periods [Kirkwood et al., 2002; Zeller et al., 2006]. However, the detailed generation process of PMWE has not been identified yet, partly because the reported PMWE occurrence rate was quite low (2.9%) [Zeller et al., 2006].

We present occurrence characteristics of PMWE from June 2012 to October 2013 and its relation to Solar Energetic Particles. When PMWE was detected by the PANSY (Program of the Antarctic Syowa MST/IS) radar, highly energetic particle precipitations, either protons or electrons, were frequently observed by NOAA satellite particle measurements above Syowa Station. During the SPE that occurred in May 23, 2013 PMWE and a significant Cosmic Noise Absorption (CNA) of about 1 dB were simultaneously detected by the PANSY radar. MF radar also showed Isolated Lower Mesosphere Echo (ILME) at the same time [Morris et al., 2011], suggesting enhancement of electron density in ionospheric D-regions. Moreover, occurrence of PMWE was likely related to the flux of precipitating electrons in the medium energy range (30-300 keV) during recovery phase of geomagnetic storms. We would like to show correlations between PMWE and CNA using dataset for mesospheric observation mode.

Keywords: Polar Mesosphere Winter Echo, Energetic Particle Precipitation, Ionospheric D-region, Turbulence, Cosmic Noise Absorption, the PANSY radar