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Naturally Enhanced Ion-Acoustic Lines Seen in Background Data of the EISCAT Svalbard Radar: Its Interpretation and an Application

Yasunobu Ogawa[1], Ryouichi Fujii[2], Satonori Nozawa[2], Stephan C. Buchert[3]

[1] IRF, Uppsala, [2] STEL, Nagoya Univ, [3] STEL., Nagoya University

Naturally enhanced ion-acoustic lines (NEIALs) are often received with incoherent scatter (IS) radars, and the NEIALs occur around high electron temperature (more than 6000 K) and field-aligned ion upflow regions. In general, the NEIALs are seen in signal data around the topside ionosphere between 400 and 1000 km altitudes where plasma parameters can be measured with the IS radars. Here we report NEIALs in the signal data, and moreover in background data observed with the EISCAT Svalbard radar (ESR) on July 28, 2000.

According to the pulse scheme of the ESR, echoes from higher altitudes (between 1200 and 1900 km) are used as the background (noise-level) data. The NEIALs in the background data hence imply the occurrence of NEIALs above 1000 km altitude. The peaks of the enhanced ion-acoustic lines around 500 km altitude clearly continue to occur up to 1500 km altitude.

We have derived the Doppler velocity of NEIALs and the spectral width between two peaks of the enhanced ion-acoustic lines at altitudes between 500 and 1500 km. The Doppler velocity becomes faster with increasing altitude and reaches 2000 m/s around 1500 km altitude. This suggests that the field-aligned ion upflow continues to at least 1500 km altitude, and the upward velocity exceeds the thermal velocity which is approximately 1200 m/s for oxygen ions. The spectral width around 500 km altitude becomes wider with increasing altitude, but it becomes narrower with increasing altitude above 1200 km altitude. The decrease of spectral width suggests that electron temperature decreases with increasing altitude. These results support that the ambipolar diffusion term in the momentum equation of ions will become large and the force may cause the strongly upward velocities of ions (more than the thermal velocity) above 1200 km altitude.