R005-06
Zoom meeting C ：11/1 AM2 (10:45-12:30)
10:45〜11:00

Effects of CIR- and CME-driven magnetic storm on ion upflows in the low-altitude polar ionosphere

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Molecular ions ($O_2{}^+$/NO^+/$N_2{}^+$) in the ring current of the terrestrial magnetosphere have been observed during the magnetic storms [e.g., Klecker et al., 1986; Seki et al., 2019]. These ions originate from the low-altitude ionosphere. In the ionosphere, upward ion transports (upflows) supply sources of the ions outflowing to the magnetosphere. Since the molecular ions usually exist in the low-altitude ($<$300 km) ionosphere and can be affected by neutral winds, the generation mechanisms and properties of ion upflows to transport molecular ions are different from those of O^+ [e.g., Ogawa et al., 2010; Yamazaki et al., 2017]. In particular, their dependence on solar activities is one of the important properties to understand formation mechanisms of the ion upflows. In a previous study by Ogawa et al. [2019], the characteristics of O^+ ion upflows in the polar ionosphere were investigated during CIR- and CME-driven magnetic storms by using EISCAT radars. They reported that the upflows during CIR- and CME-driven storms have different dependence on magnetic local time. For the CIR-driven storms, upward ion flux around noon was pronounced, while it was enhanced around midnight during the CME-driven storms. Their study focused on the ion upflows in the altitude range between 400 and 500 km, where O^+ is the dominant species, and responses of the ion upflows to the different type of magnetic storms in the low-altitude ionosphere, where molecular ions exist, are far from understood. The purpose of this study is thus to understand effects of CIR- and CME-driven magnetic storms on ion upflows in the low-altitude ionosphere based on long-term observations of the EISCAT radars.

We used data from the EISCAT UHF radar at Tromso and Svalbard radar at Longyearbyen from January 1, 1996 to January 1, 2016, and investigated statistical properties of ion upflows and ionospheric conditions during CIR- and CME-driven magnetic storms. We used 5-minute time resolution data when the radar was looking along the local magnetic field line. The ionospheric parameters such as electron density, ion velocity, and ion and electron temperatures were averaged over 250-350 km altitudes. We screened data to exclude unrealistic values with the following criteria: Absolute value of ion velocity was less than 1500 m/s, ion and electron temperatures were less than 10000 K, and electron density was more than 10^{10} m^{-3} and less than 10^{13} m^{-3}. To understand the similarity and difference between low- and high- altitude upflows, we compared data at different altitude ranges using results from the previous study [Ogawa et al., 2019]. The results show that the upward velocity in the nightside at Tromso increased with increasing altitude in the main phase of both CIR- and CME-driven magnetic storms. On the other hand, the upward flux in the nightside at Longyearbyen was not enhanced at any altitude after CIR-driven storms, whereas it increased from the low-altitude region after CME-driven storms. It was also confirmed that any effect of the magnetic storms that was remarkable at the higher altitudes reported in the previous study [Ogawa et al., 2019] was not seen in the dayside low-altitude ionosphere at Longyearbyen. In the presentation, we will also discuss dependence of the low-altitude upflows on ion/electron temperature and density.

References:
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