R005-15
B 会場 ：9/25 AM1 （9:00-10:30）
9:00～9:15

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Properties of ionospheric low-altitude ion upflows during CIR- and CME- driven magnetic storms based on the EISCAT observations

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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 properties of ion upflows in the low-altitude polar ionosphere during CIR- and CME- driven magnetic storms based on the long-term EISCAT observations.

We used data from the EISCAT ultra high frequency (UHF) radar at Tromso (Invariant Latitude: 66.12' N) and Svalbard 42m antenna radar (ESR) at Svalbard (Invariant Latitude: 75.10' N) during CIR- and CME-driven magnetic storms from 1996 to 2015. We used 5-minute time resolution data when the radar was looking along the magnetic field line. The ionospheric parameters such as electron density, ion velocity, and ion and electron temperatures were averaged between 250 and 350 km and we screened data to exclude unrealistic values. The results show that ion upflows in the low-altitude ionosphere were mainly detected in the dayside and nightside at Tromso during both CIR- and CME- driven magnetic storms. On the other hand, the upward flux at Svalbard was not enhanced in nightside but remarkable in dawnside after CIR-driven storms, whereas it increased from the low-altitude region in the nightside only after CME-driven large storms. The ion upflows were detected in the duskside at Tromso only during CME-driven large storms. We also estimated the generation mechanisms of upflows by comparing ion and electron temperatures between pre-storm time and after storm onset. The frictional heating mainly caused upflows during CME-driven storms at both locations and possibly in the dawnside during CIR-driven storms at Svalbard, whereas the precipitation mainly caused upflows during CIR-driven storms at both locations and possibly in the nightside during CME-driven small storms at Tromso.

References:

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