



Observation of Magnetotail Structure in Comparison to the Substorm Current Wedge

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Introduction

- Using the data provided by the TWINS ENA Imager, a global temperature map of the magnetotail is generated.
- Using the generated temperature map of the magnetotail, we examine the mesoscale structures observed in these maps for 13 substorm events by performing a superposed epoch analysis on the temperature maps based on a zero-epoch derived from the in-situ measurements.
- Spherical Elementary Current Systems (SECS) [Weygand et al. 2011], was used for ionospheric observations of the SCW.
- GOES 13, was used for the in-situ observation and definition of time zero for the SEA.
- Time zero is defined as the time of particle flux increase in the GOES 13 data.

SEA of In Situ Observations

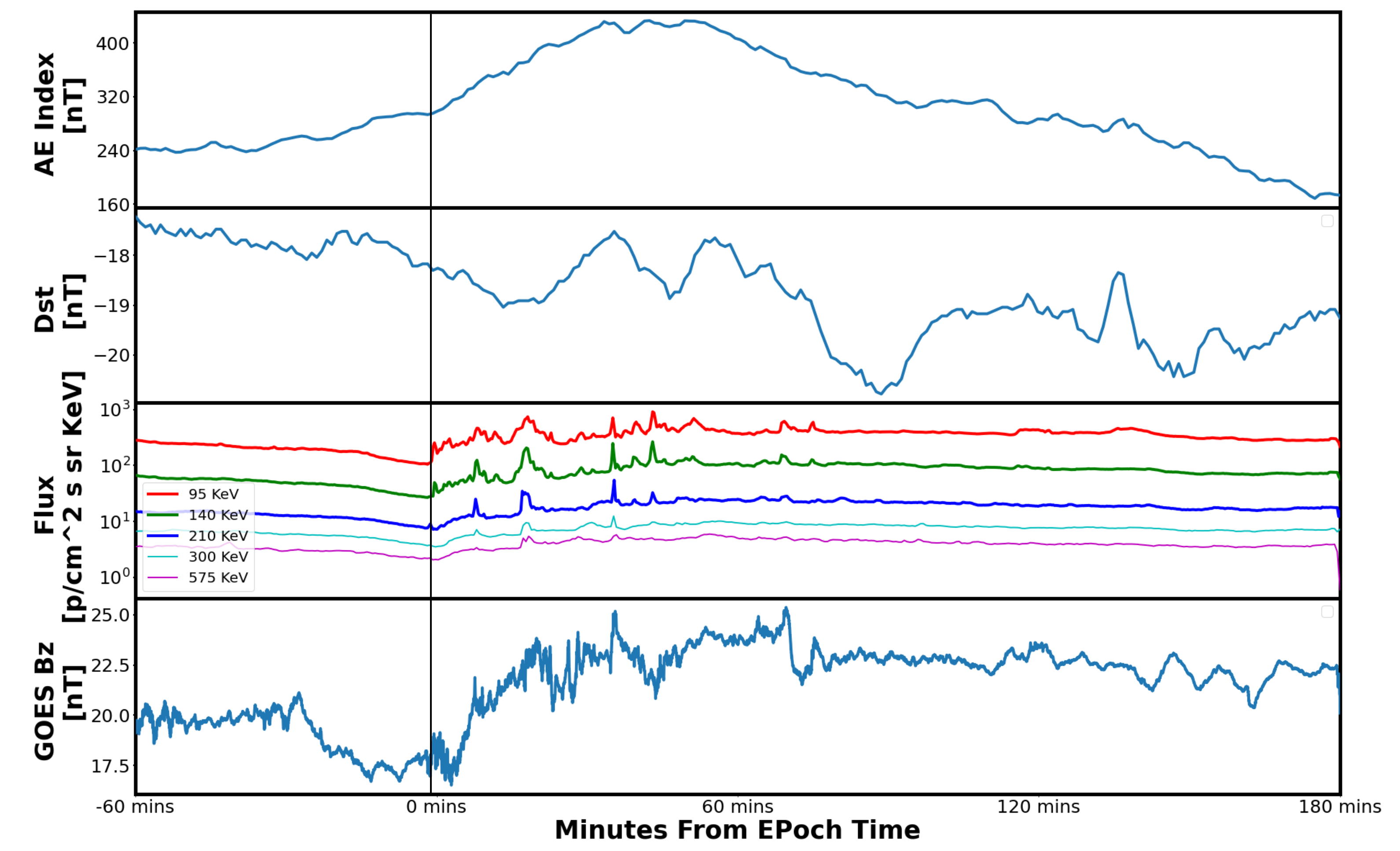


Fig. 1: SEA of GOES 13 data along with DST and AE index for 13 substorm events. Fairly quiet DST values can be seen. Zero Epoch at time of injection. Dipolarization of the magnetic field can be seen almost simultaneously with particle injection. Upward trend of the AE index shortly prior to the injection can also be seen.

SEA of SECS

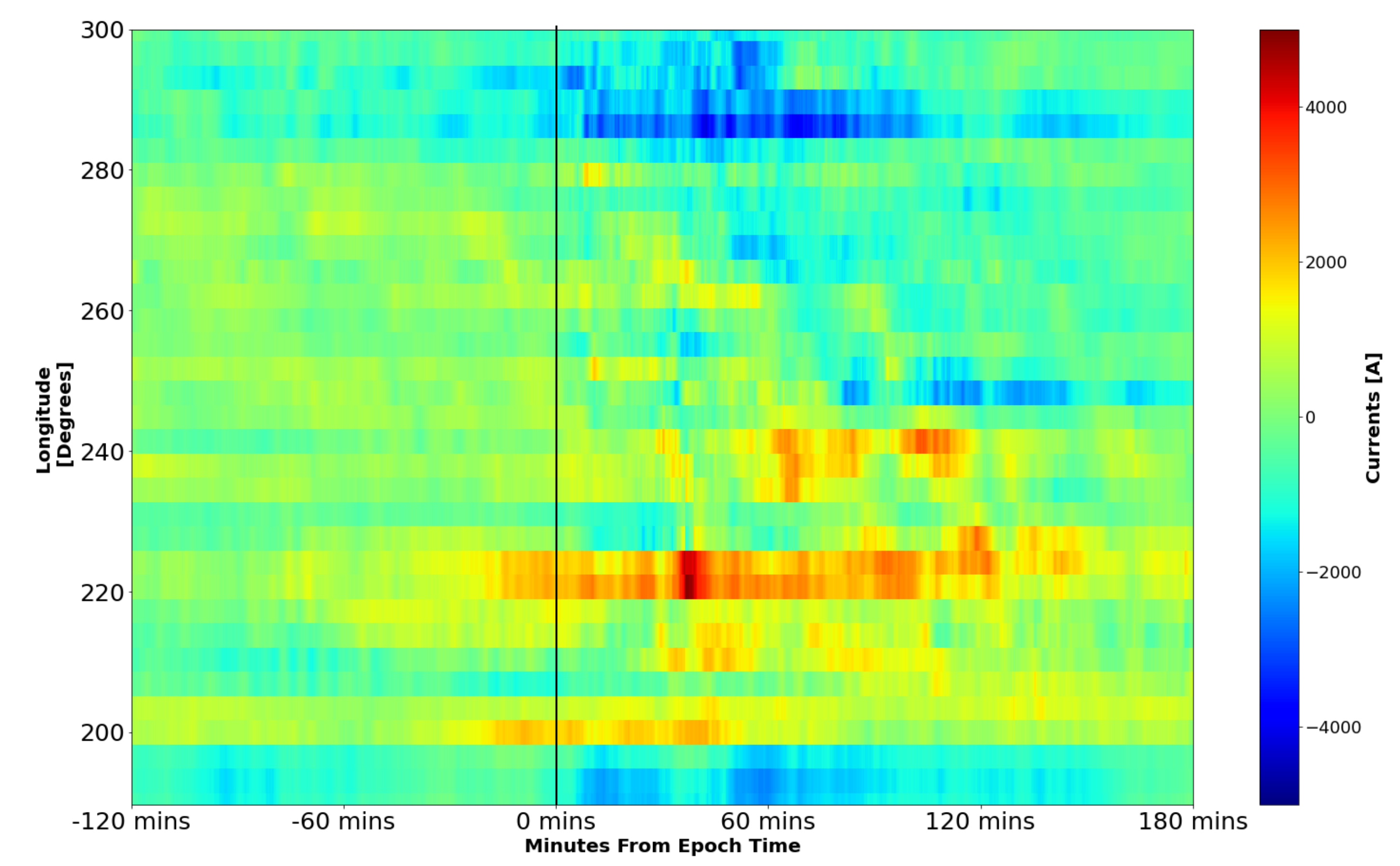
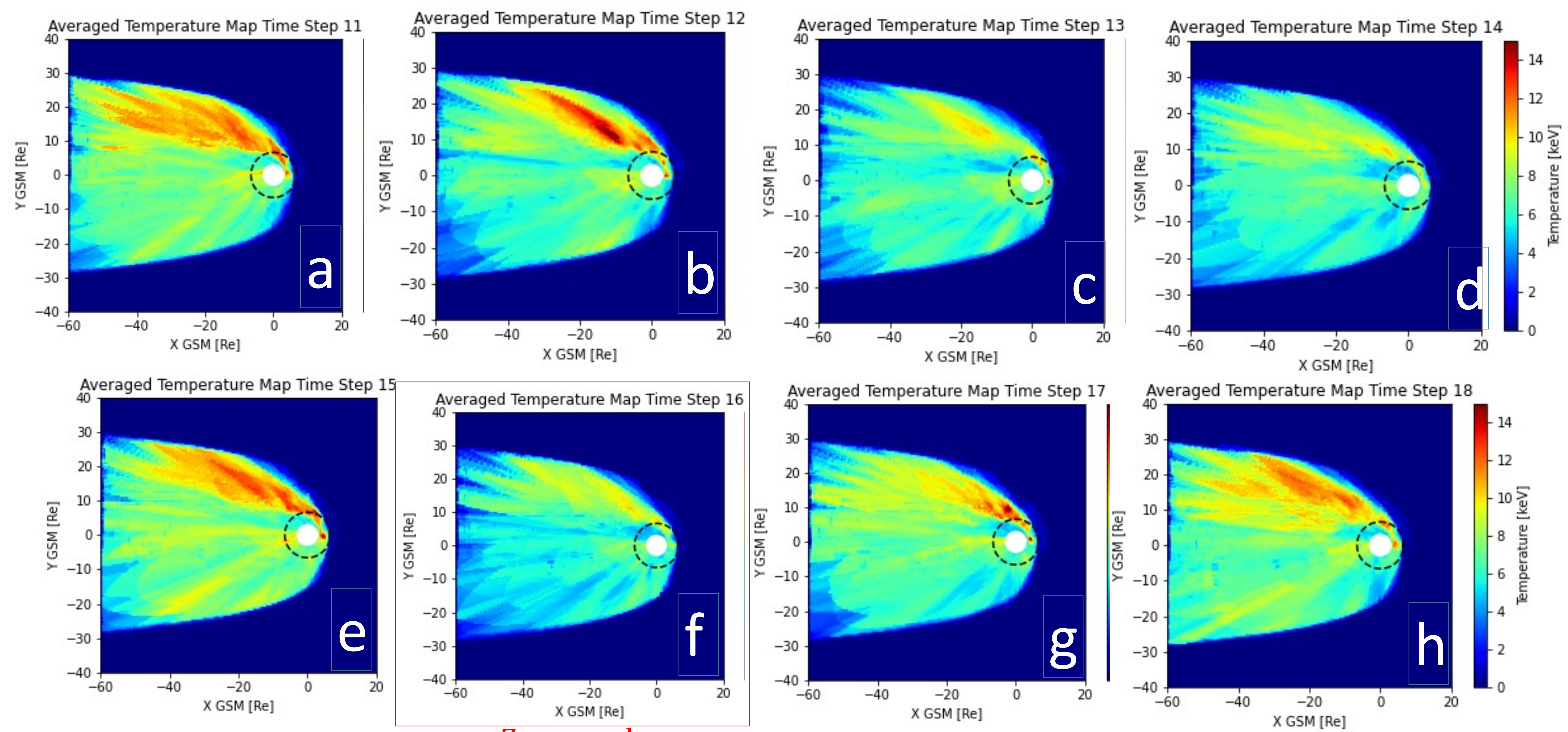


Fig. 2: Keogram of Currents averaged over latitudes. Instances of current enhancements can be seen in the keogram, starting shortly before Zero Epoch, especially with the upward FAC (Red). Enhancement of the downward FAC (blue) occurs almost simultaneously with the injection from figure 1. The separation between the upward and downward FAC is approximately 4 hours in MLT, but moved closer over time.

SEA of ENA Temperature Maps



Zero epoch

Fig. 3: SEA of temperature maps of the magnetotail for the time intervals of interest. Image F (red box) above is the zero-epoch map based on the definition from the GOES 13 data. The black dashed circles is geosynchronous orbit. The white circle has a radius of about 3 Re and blocks out region where the temperature map calculations are not valid. Consistent regions of enhanced proton temperature can be observed. These regions are biased heavily towards the dusk side of the magnetotail. Azimuthal drift of the fast flows towards the dayside of the magnetosphere can be seen.

Conclusions

- Temperature maps of the magnetotail was generated using ENA data from the TWINS mission.
- SEA was performed to observe the dynamics of the tail during 13 substorm events.
- Time zero was defined as the moment of injection from the point of view of GOES 13.
- Dipolarization of the magnetic field can be seen simultaneously with the particle injection.
- Fast flows can be observed in the temperature maps, but rarely penetrating into geosynchronous orbit.
- Azimuthal drift of the particles towards the dayside can be seen.
- Formation of SCW can be observed in the ionosphere, with a separation between the upward and downward FAC that reduced overtime

References

- A. M. Keese, R. M. Katus, M. Floyd, and E. E. Scime (2020), Database of storm-time equatorial ion temperatures in Earth's magnetosphere calculated from energetic neutral atom data. *Journal of Geophysical Research: Space Physics*
- Scime, E., and S. Hokin (1992), Design and calibration of a fast-time resolution charge-exchange analyzer, *Rev. Sci. Instrum.*, **63**, 4527.

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