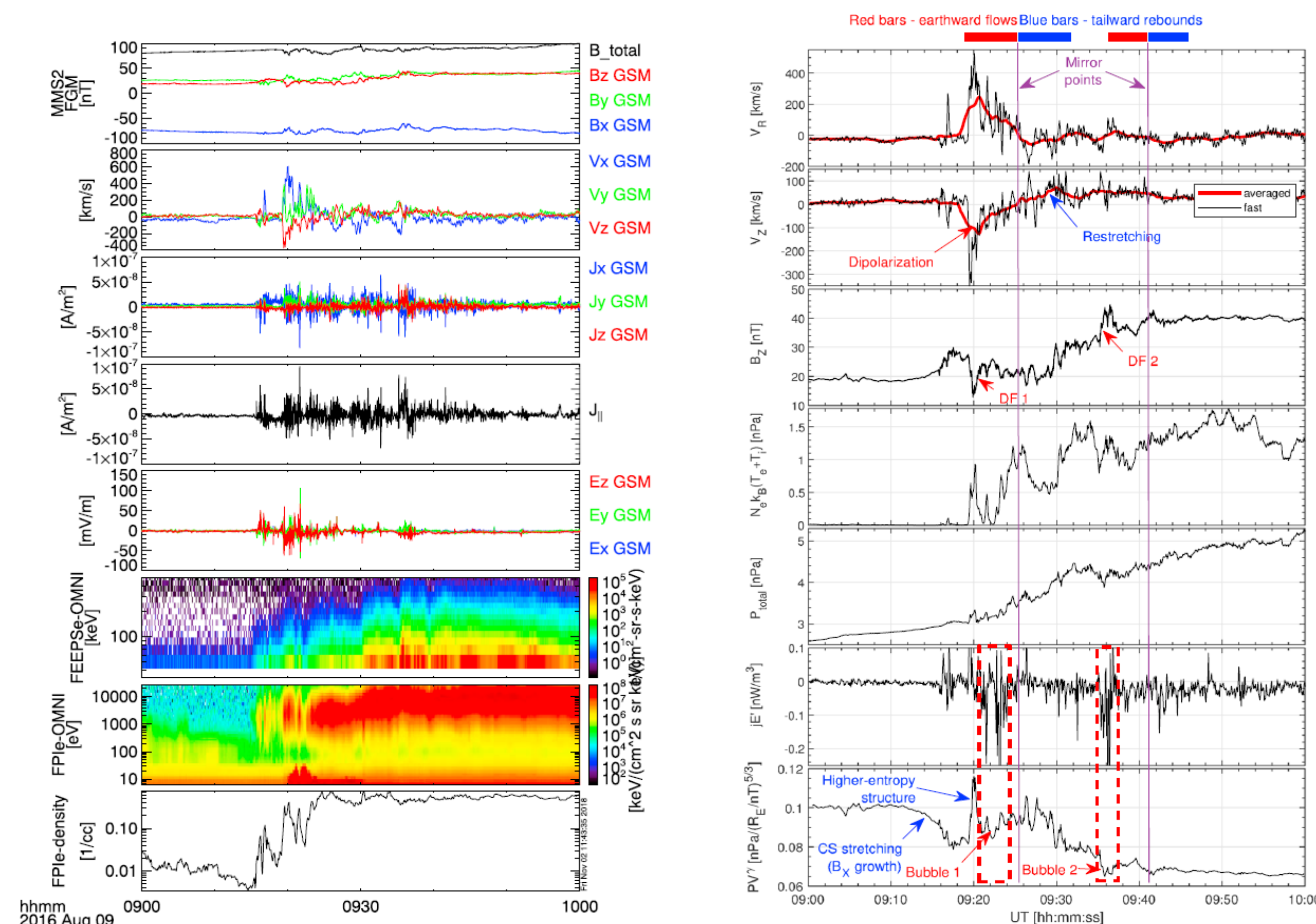


SM13D-3325 - CONTINENT-WIDE R1/R2 CURRENT SYSTEM AND OHMIC LOSSES BY BROAD DIPOLARIZATION-INJECTION FRONTS

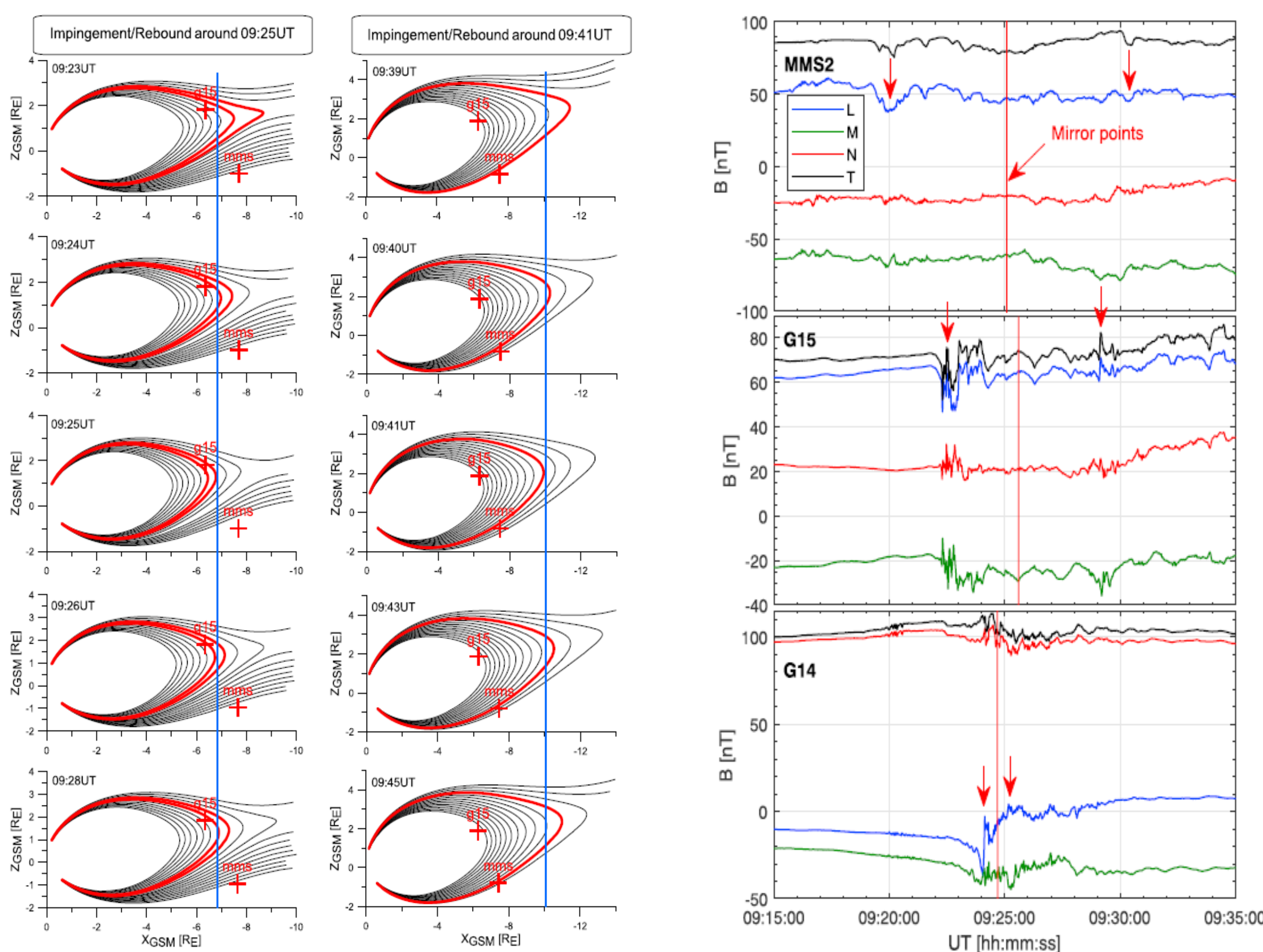
E.V. Panov¹, W. Baumjohann¹, R. Nakamura¹, J.M. Weygand², B.L. Giles³, C.T. Russell², G. Reeves⁴, and M.V. Kubyshkina⁵, V.G. Merkin⁶

¹Space Research Institute, Austrian Academy of Sciences, Graz, Austria, ²Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA, USA, ³NASA Goddard Space Flight Center, Greenbelt, MD, USA, ⁴Los Alamos National Laboratory, Los Alamos, NM, USA, ⁵Institute of Physics, St. Petersburg State University, St. Petersburg, Russia, ⁶The Johns Hopkins University Applied Physics Laboratory

Earthward Flows and Tailward Rebounds

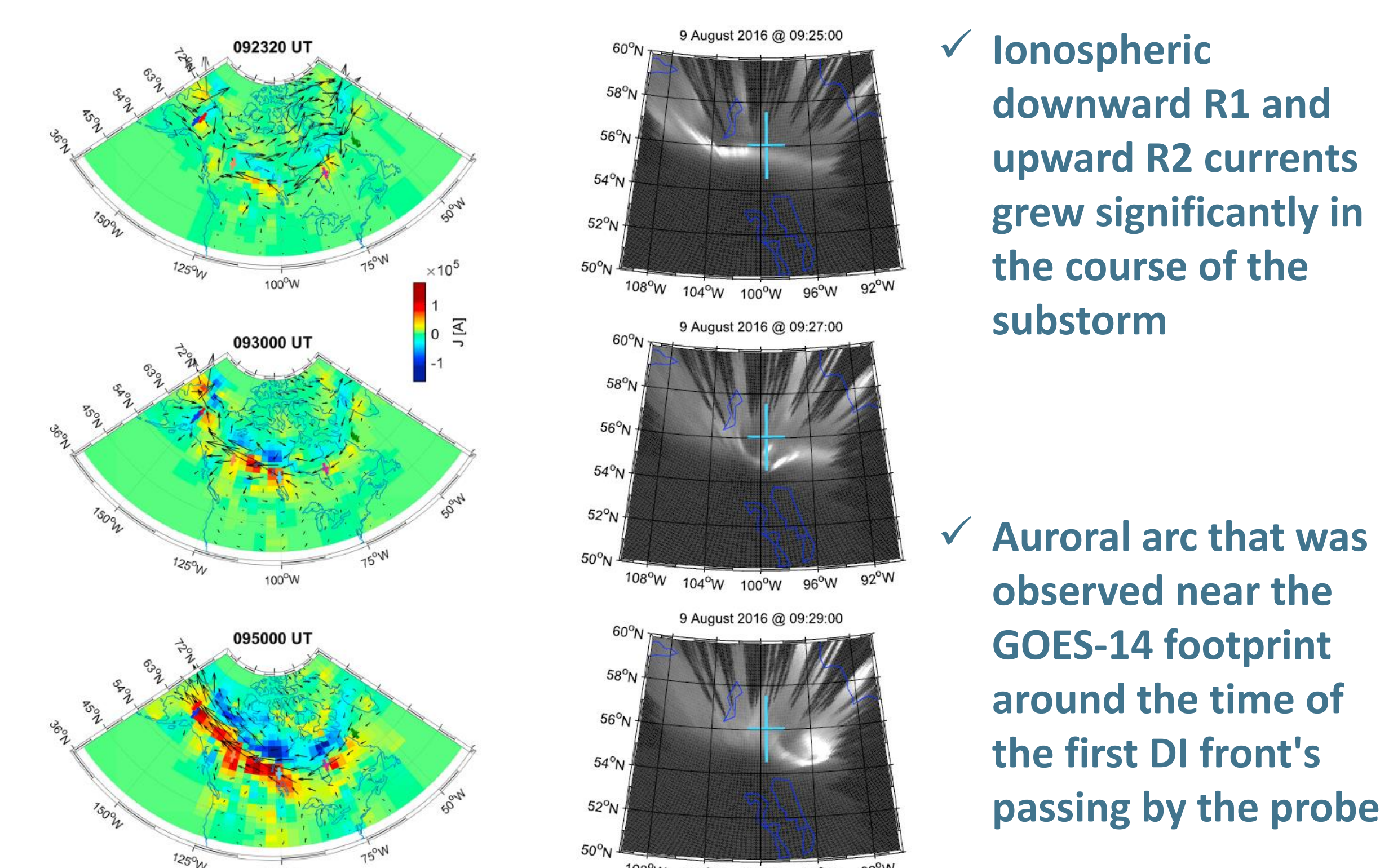


- ✓ Both dipolarization-injection fronts rebounded from the Earth's dipolar field lines
- ✓ The fronts exhibited signatures of bubbles (flux tubes with lower entropy) and were associated with negative $\mathbf{j} \cdot \mathbf{E}'$ (generator)



- ✓ The rebounds were seen in the field line reconstruction using the AM03 model
- ✓ MMS and GOES-15 and -14 probes observed remnants of the dipolarization-injection fronts during rebounds

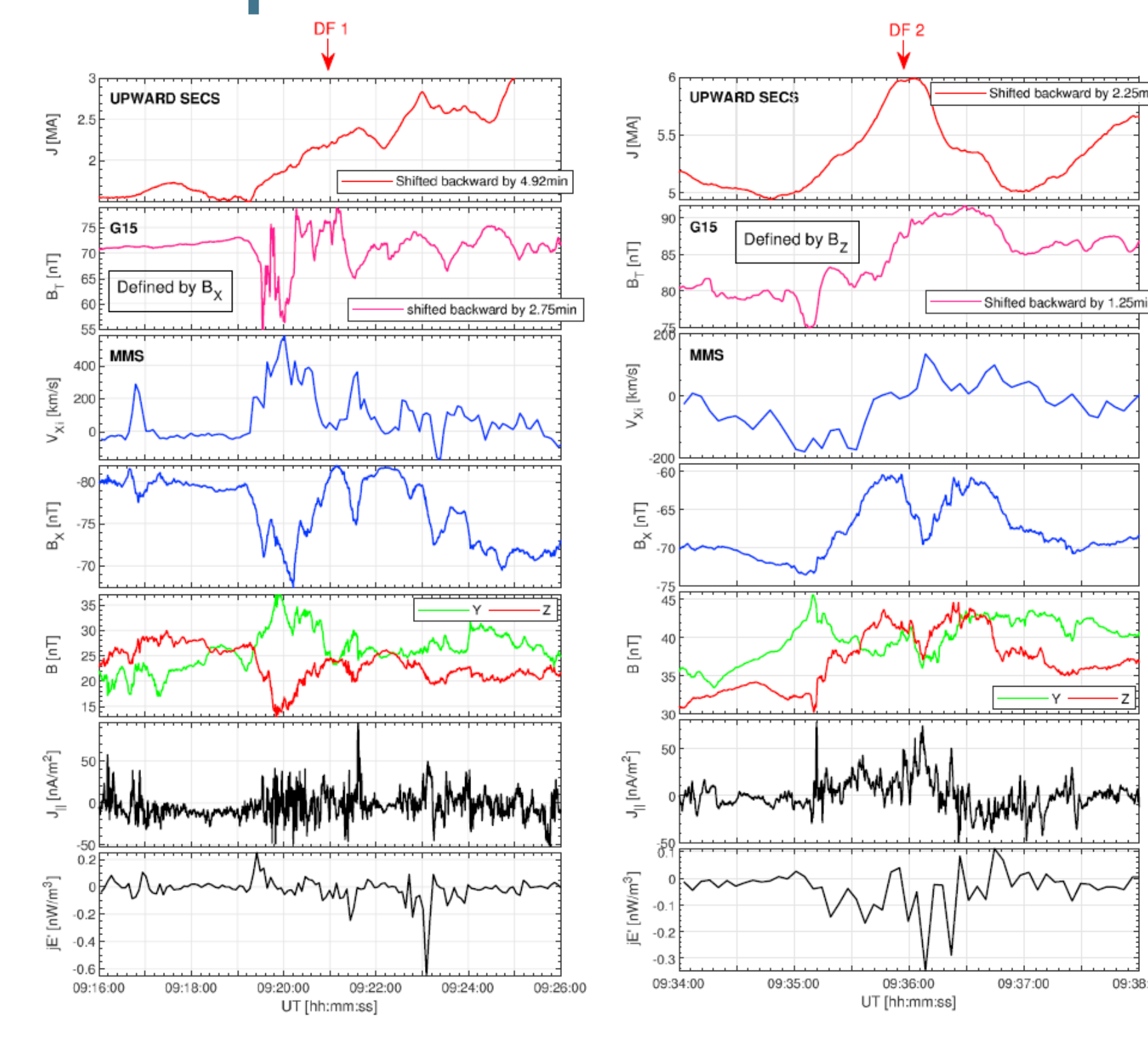
Ionospheric Substorm Current System



- ✓ Ionospheric downward R1 and upward R2 currents grew significantly in the course of the substorm
- ✓ Auroral arc that was observed near the GOES-14 footprint around the time of the first DI front's passing by the probe

Plasma Sheet-Ionosphere Current Circuit

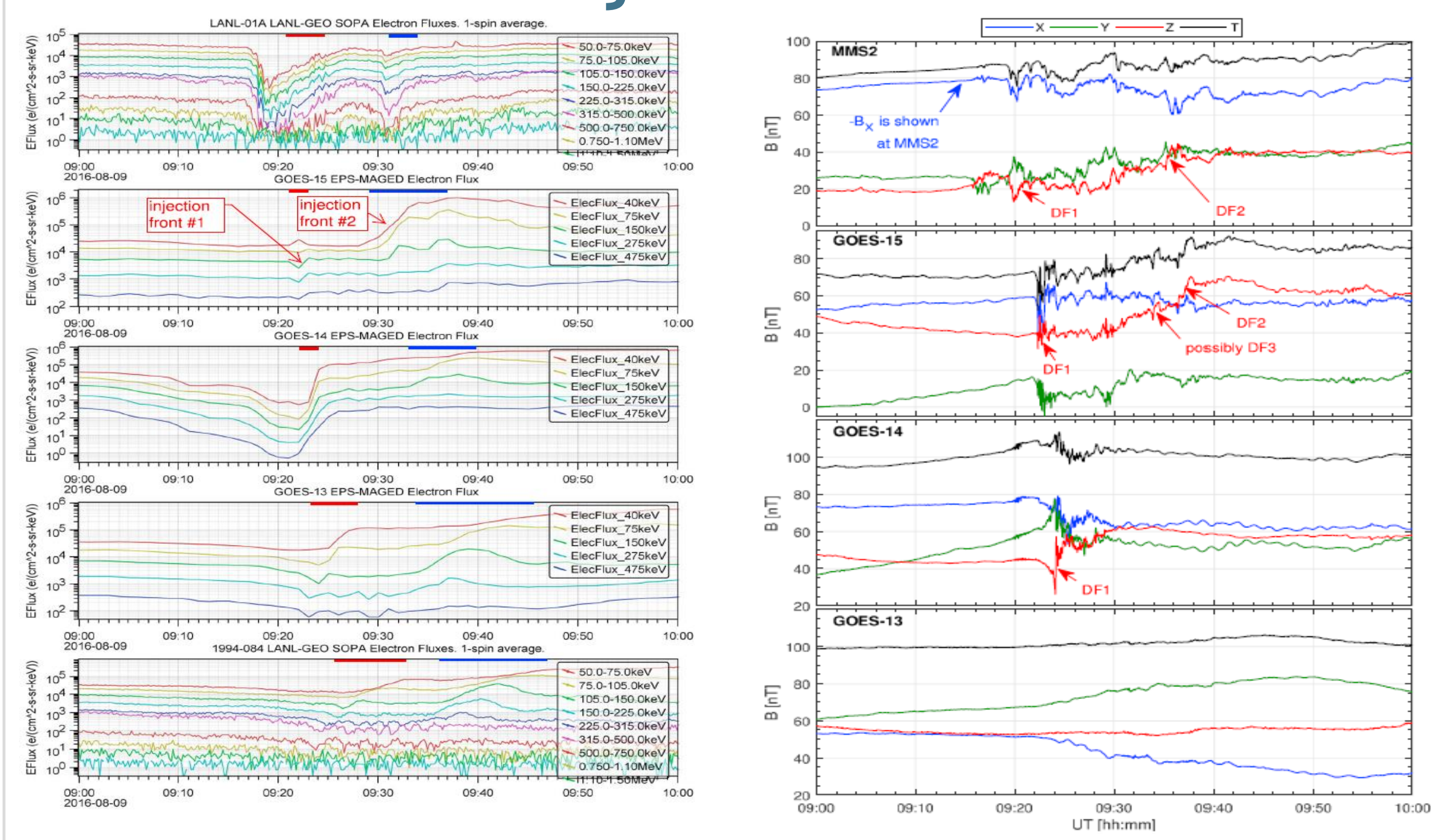
- ✓ The R1/R2 currents were initiated by the first DI front.
- ✓ The R1/R2 currents were contributed by the second DI front causing a significant local current disturbance.
- ✓ At the fronts, negative $\mathbf{j} \cdot \mathbf{E}'$ indicated negative energy dissipation - consistent with the Joule heating in the ionosphere.



Key Points:

- Two broad (6.5 and $4 R_E$ in Y_{GSM}) dipolarization-injection fronts impinged and rebounded from Earth's dipolar field lines near GEO during the same substorm
- Downward R1 and upward R2 currents grew to azimuthally cover the whole North American continent in the course of the substorm
- Regions of negative $\mathbf{j} \cdot \mathbf{E}'$ (generator) peaked toward the end of the impingements and were conjugate to R2 auroral current (load)

Two Injections at GEO



- ✓ Two broad (6.5 and $4 R_E$ in Y_{GSM}) dipolarization-injection fronts were observed by GOES and LANL in the course of a significant substorm

