Auroral Streamers as Ionospheric Footprints of Bursty Bulk Flows

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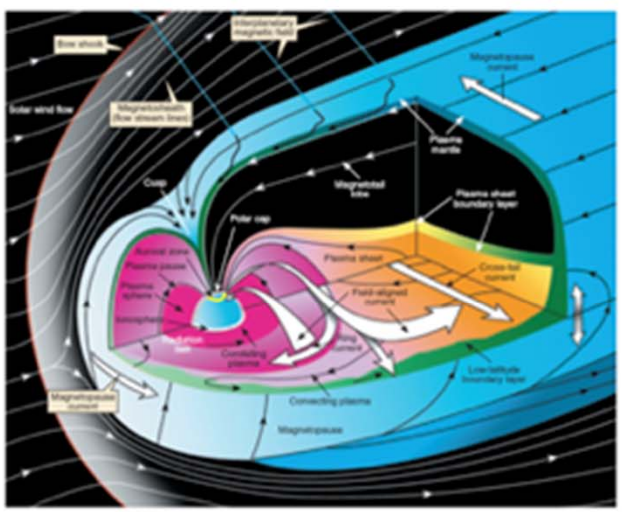
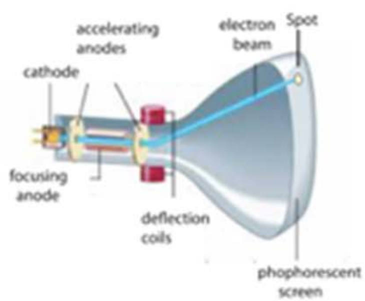
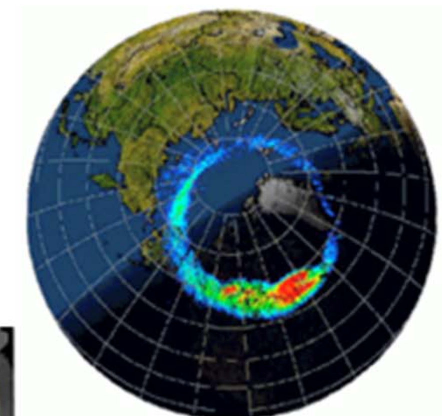
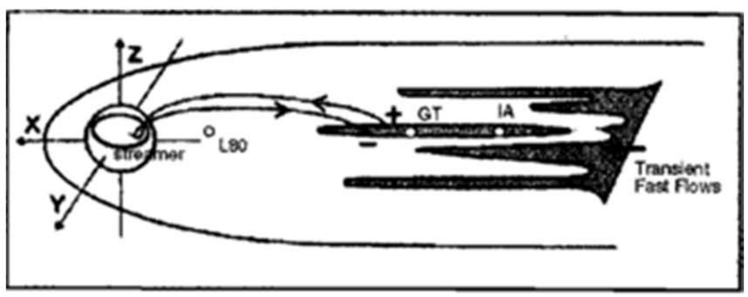
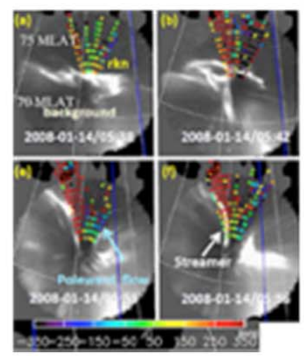


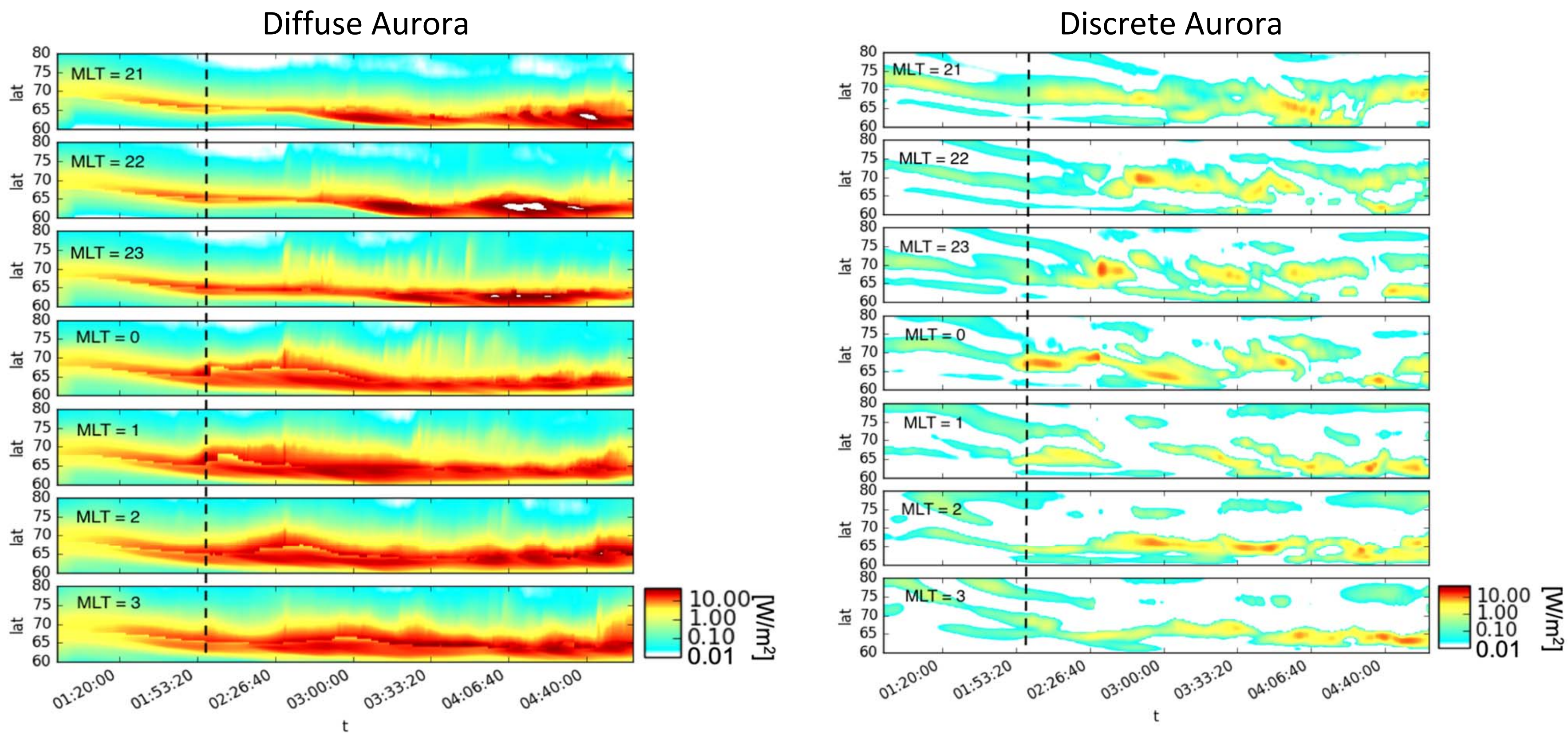






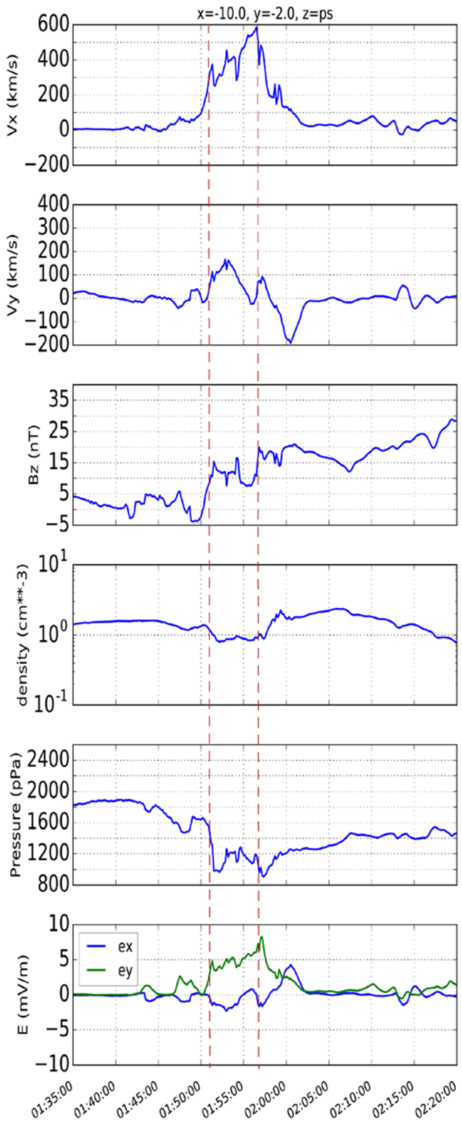


OpenGGCM-CTIM Keogram, Substorm Onset at 0200 UT

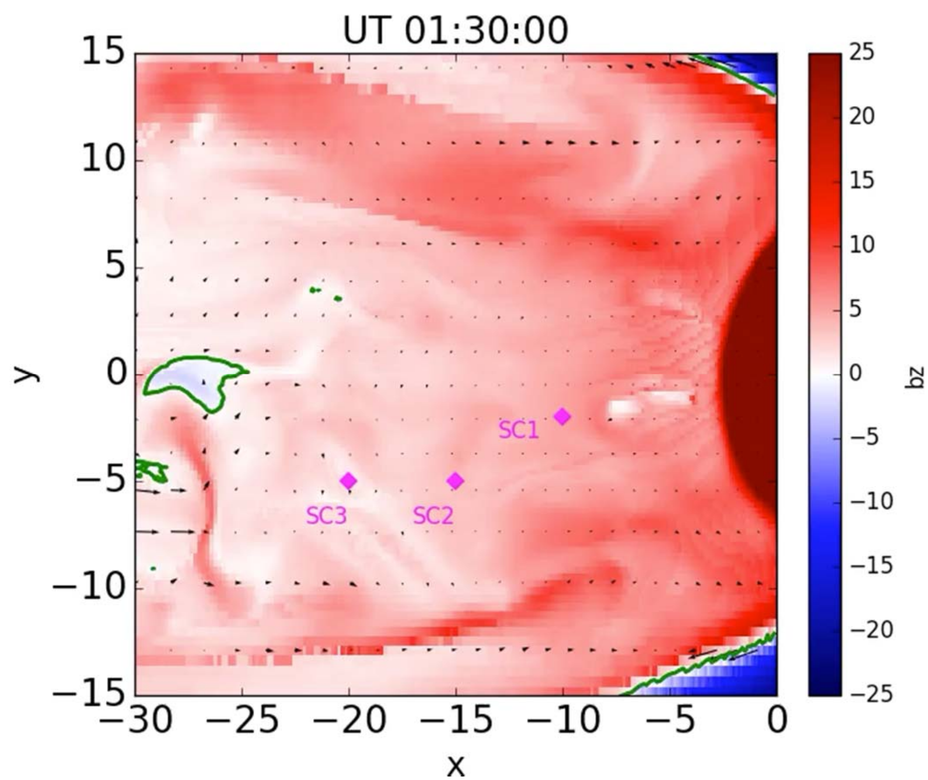


Bursty Bulk Flows (BBF) in OpenGGCM

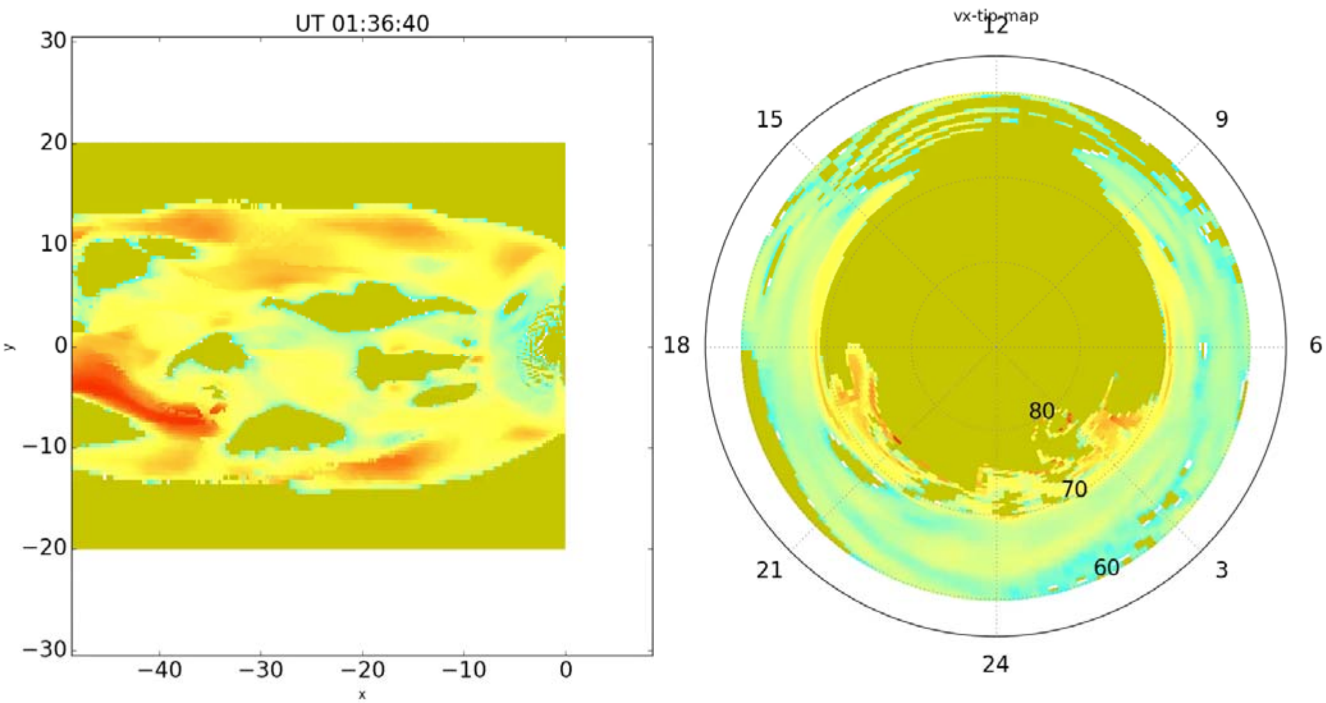
The time series of flow (SC1 satellite).
The dashed red line indicates the TIME of BBFs.



Magnetic field B_z in nT with flow vectors in central plasmasheet. The green lines are contours of B_z = 0. Magenta square are virtual satellites.

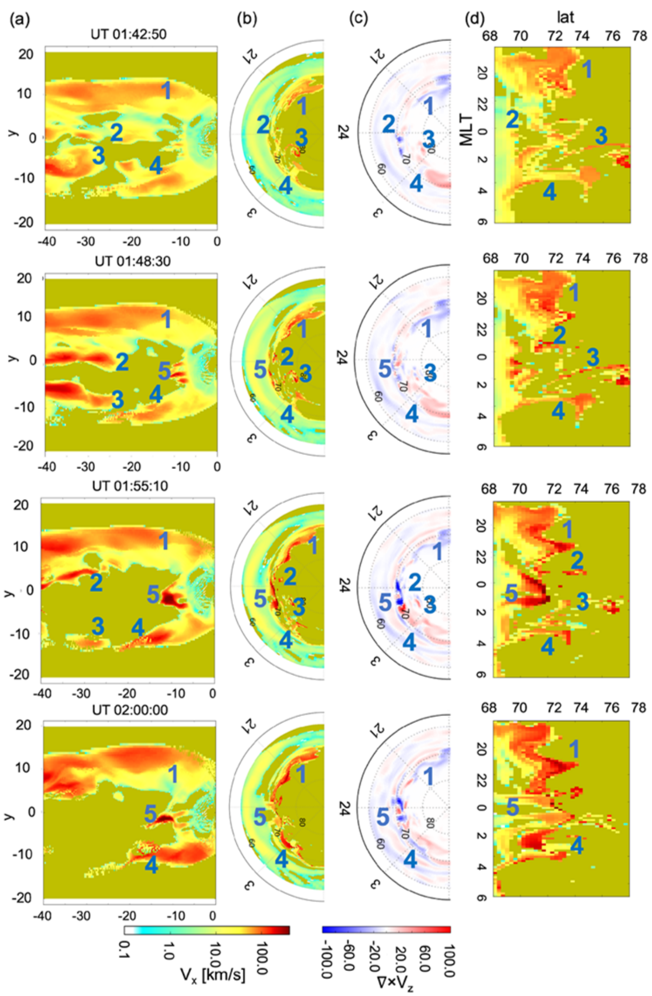


Mapping Flows from the Plasma Sheet to the Ionosphere

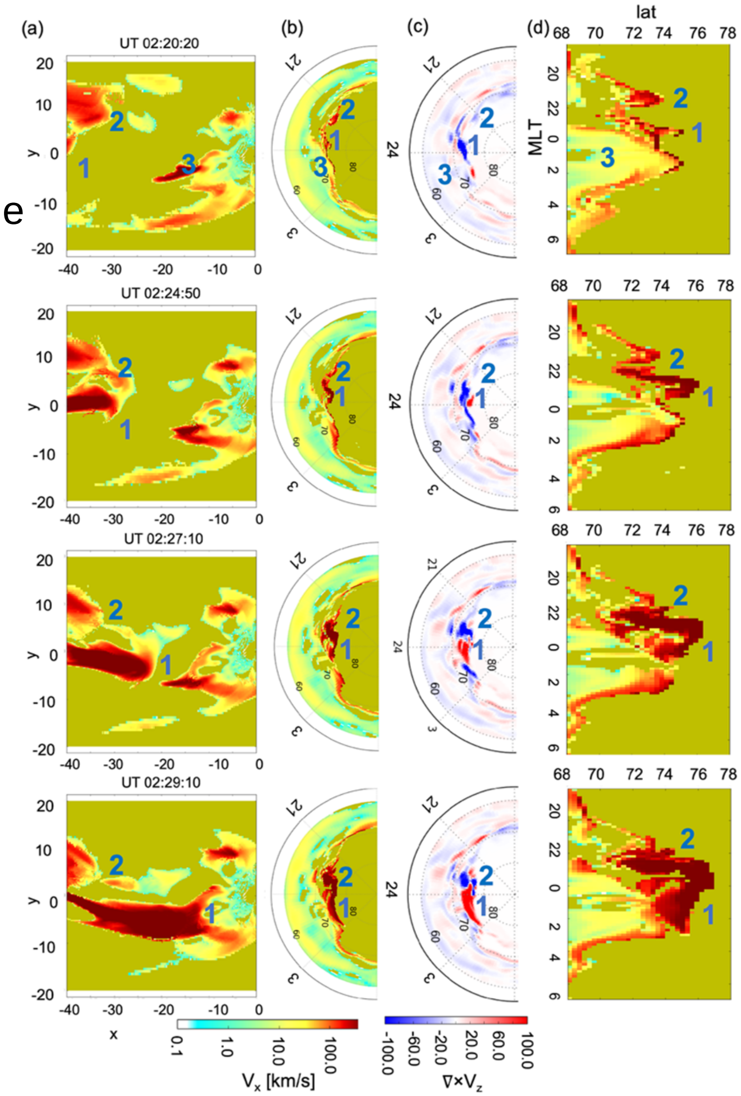


Earthward moving flows in the plasmasheet (left), their projection on the ionosphere polar plot.

Before Substorm Onset



Substorm Expansion



(a) Earthward moving flows in the plasmasheet
(b) Their projection on the ionosphere polar plot
(c) Vorticity mapping
(d) Earthward velocity in MLT and lat

The blue numbers identifies flows and their correspondence in the ionosphere.

Summary and Conclusions

1) There is little activity in the tail and the ionosphere before auroral onset. Thus, there are not many streamers in the ionosphere prior to the substorm onset.
2) The shape of the streamers depends on the location of flow channels in the tail:
    a. Flow channels closer to the Earth (x <= -10 R_E) and closer to midnight (y ~ 0) tend to map to more north-south (NS) oriented structures.
    b. BBFs that are located further down in the tail tend to map to structures that are predominantly oriented in the east-west (EW) direction in the ionosphere.
    c. Flow structures in the flanks also follow a more east-west orientation in the ionosphere. They also are longer and narrower in longitude and latitude, respectively.
3) BBFs do not propagate earthward as straight channels, but rather interact with each other and have theirf lows deflected. BBFs can also split and merge.
4) The fast flows before substorm onset are not as strong as the ones during expansion and SMC. This suggests that such flows or streamers are not necessary for substorm onset.