

Polar Cap Boundary Reaction to Geomagnetic Storms

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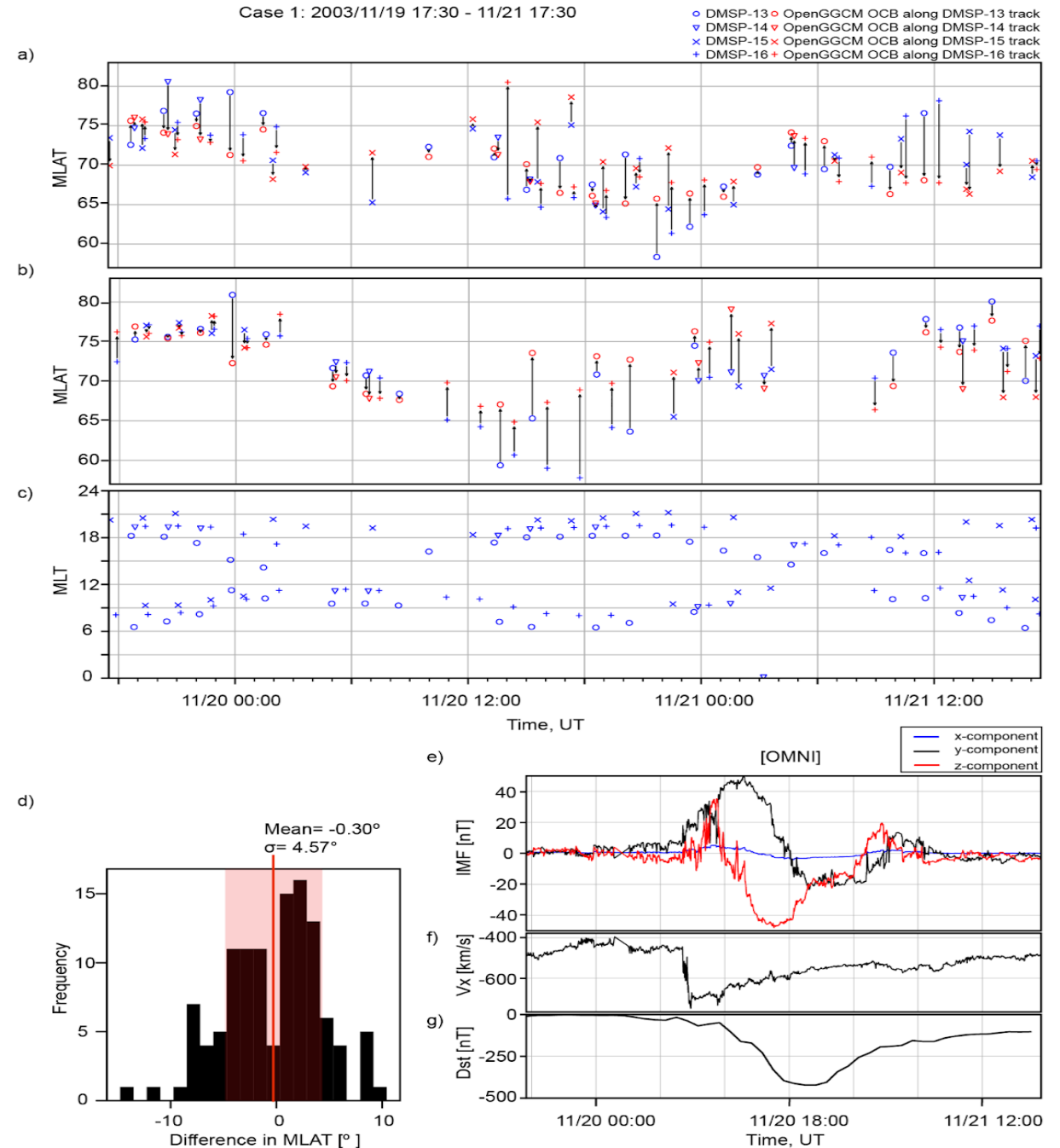
Goals

- Show how the polar cap, or Open-Closed Boundary (OCB), expands and contracts in response to IMF.
- Show that there exists a correlation between the Magnetic Local Time (MLT) of maximal OCB expansion and the IMF clock angle.

Events

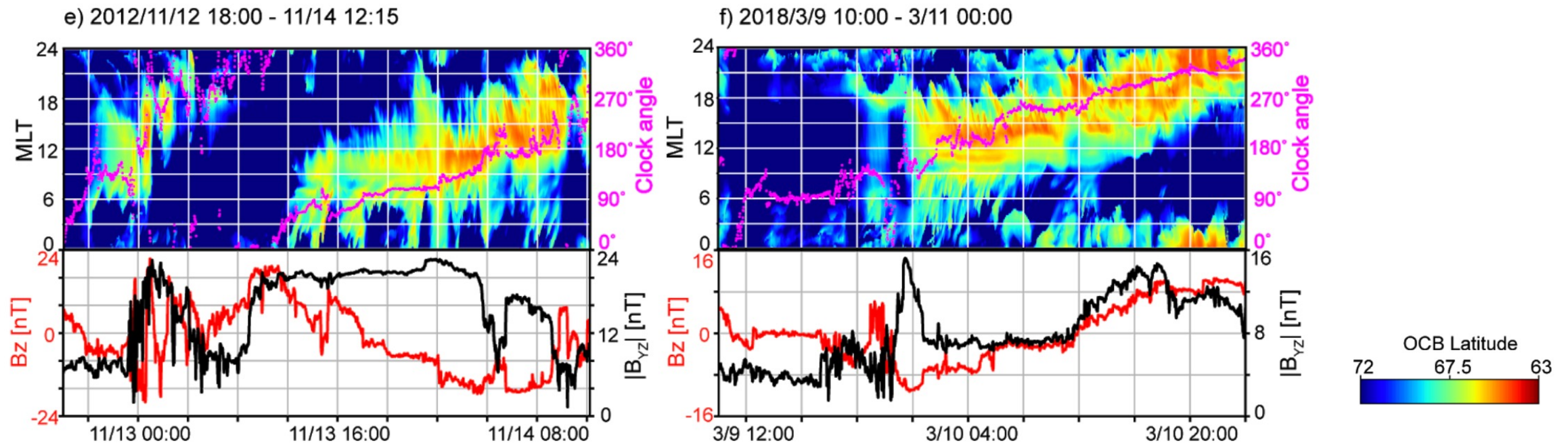
- 5 events of varying geomagnetic activity
- Total of 297 DMSP OCB crossings.
- From these crossings it is difficult to find correlations and to draw conclusion.
- The DMSP orbits are biased and have few crossings near noon and none near midnight
- OpenGGCM simulations reproduce the events reasonably well.
- There is large scatter of the OCB magnetic latitude both within the data and the simulated crossings, but fairly little bias.

Start time (UT)	End time (UT)	Driver type	Min. Dst [nT]	mean $\Delta\theta$	st.dev. $\Delta\theta$
2003/11/19 17:30	2003/11/21 17:30	CME	-422	-0.30	4.57
2012/09/30 07:00	2012/10/01 13:00	CME	-108	0.88	3.57
2012/10/31 08:00	2012/11/02 04:00	CME	-65	1.11	3.23
2012/11/12 18:00	2012/11/14 12:15	CME	-122	2.31	3.24
2018/03/09 10:00	2018/03/11 00:00	CIR	-39	4.12	2.20



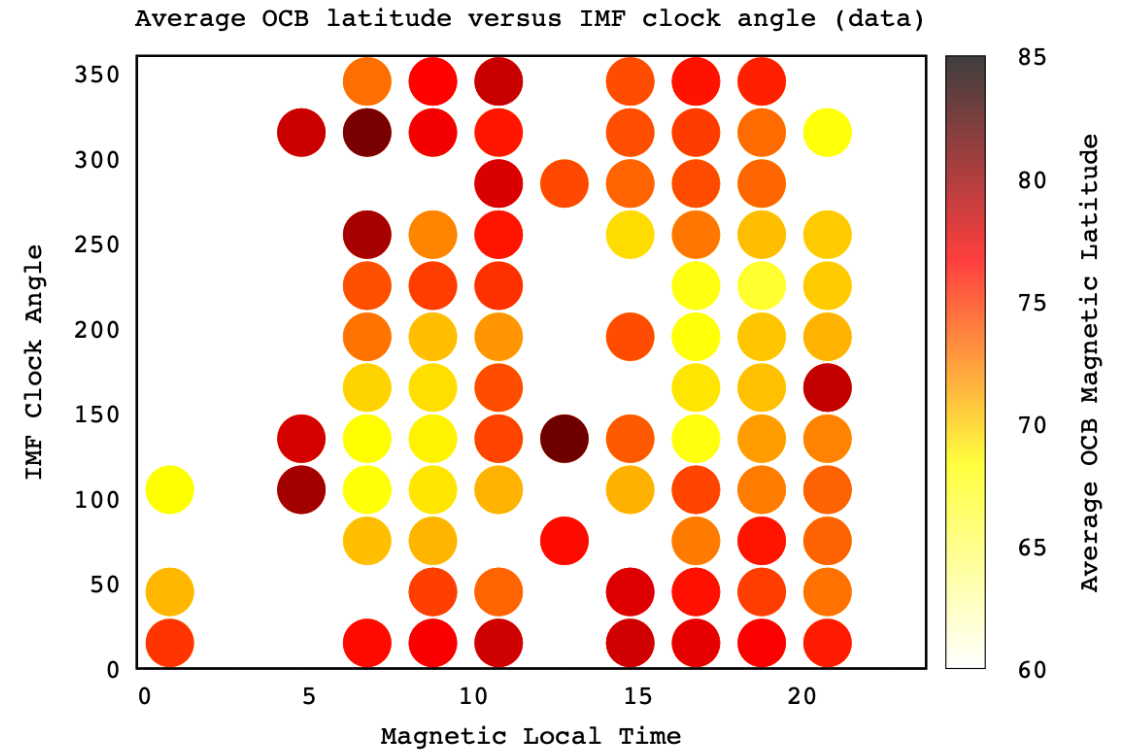
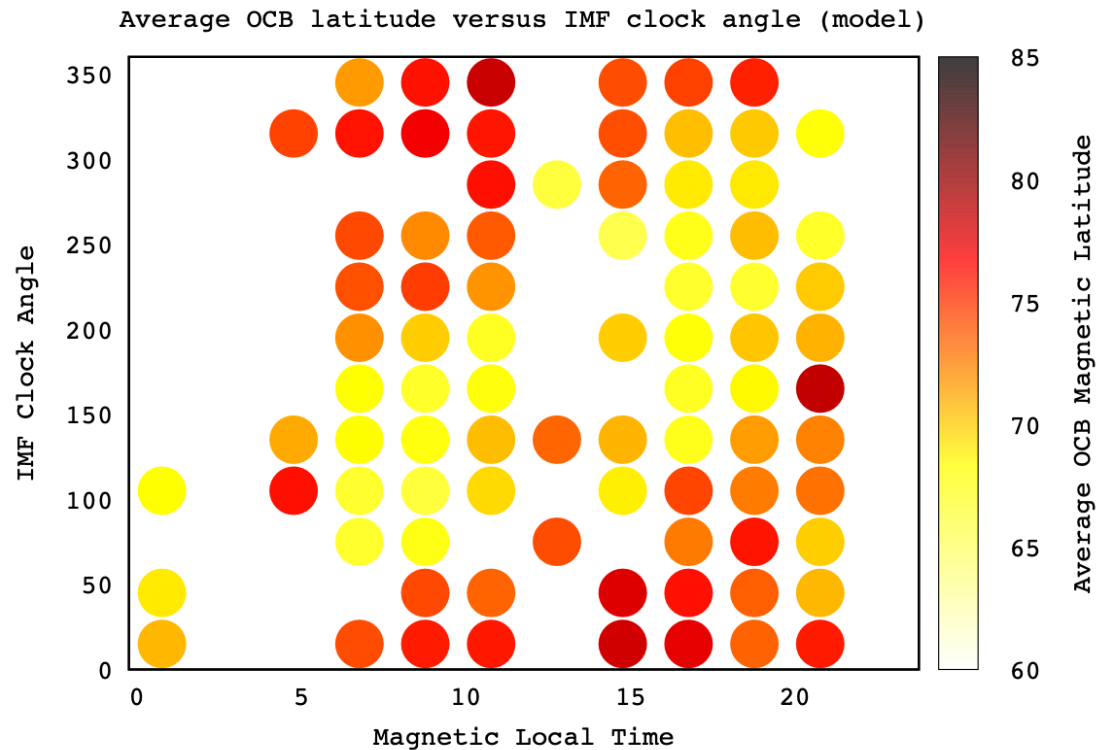
MLT Dependencies

- Using OpenGGCM simulations we find that during storms the PC latitude has a strong dependence on MLT.
- One might hypothesize that the reconnection geometry at the dayside magnetopause should be the cause.
- The reconnection geometry is in turn dependent on the IMF clock angle.
- Thus, we test the dependence for several storms by plotting an overlay of the IMF clock angle with the color-coded PC latitude.



Statistics from Data and Model

- For the 297 DMSP crossings across all events we plot the average MLAT in 12x12 bins versus MLT and IMF clock angle. Not all bins have data available.
- Both the data and the model show a consistent trend: The lowest OCB MLAT occurs along a line where IMF clock angle and MLT are proportional to each other.
- This is likely due to the reconnection geometry, which is dependent on the IMF clock angle.



Take-away

- During geomagnetically active times the OCB expansion follows the IMF clock angle.
- Paper in revision (<https://doi.org/10.5194/angeo-2022-9>):

Storm time polar cap expansion: IMF clock angle dependence

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