

• Comparison of electric field between THEMIS satellites and their ionospheric conjugate points

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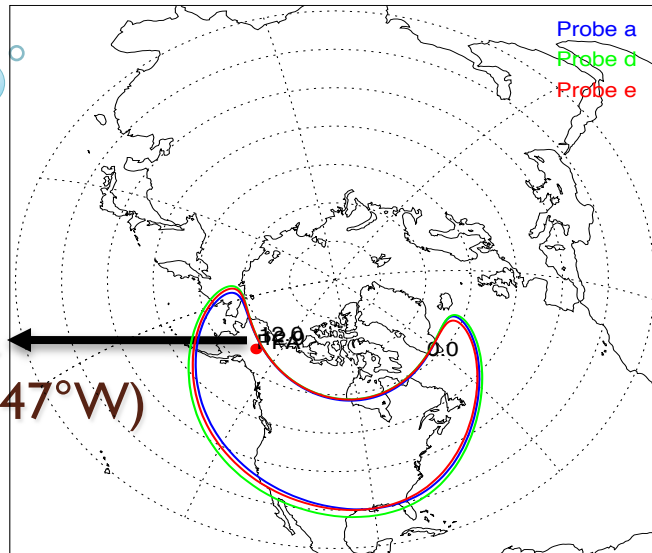
CEDAR 2012

THEMIS & ISR E-field comparison

- Compare **E-fields** between the **magnetosphere** and the **ionosphere**.
- Compare **simultaneous observations** between **THEMIS** satellites
 - ~10RE distance in the magnetosphereand **conjugate points observed by the ISR**
 - at Poker Flat (65°N, 147°W).

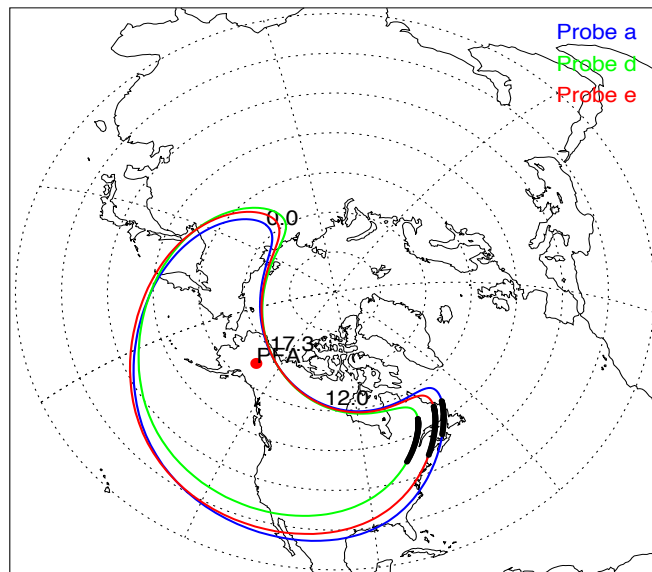
THEMIS satellite footprint

2010-04-26



pfa
(65°N, 147°W)

2011-03-01

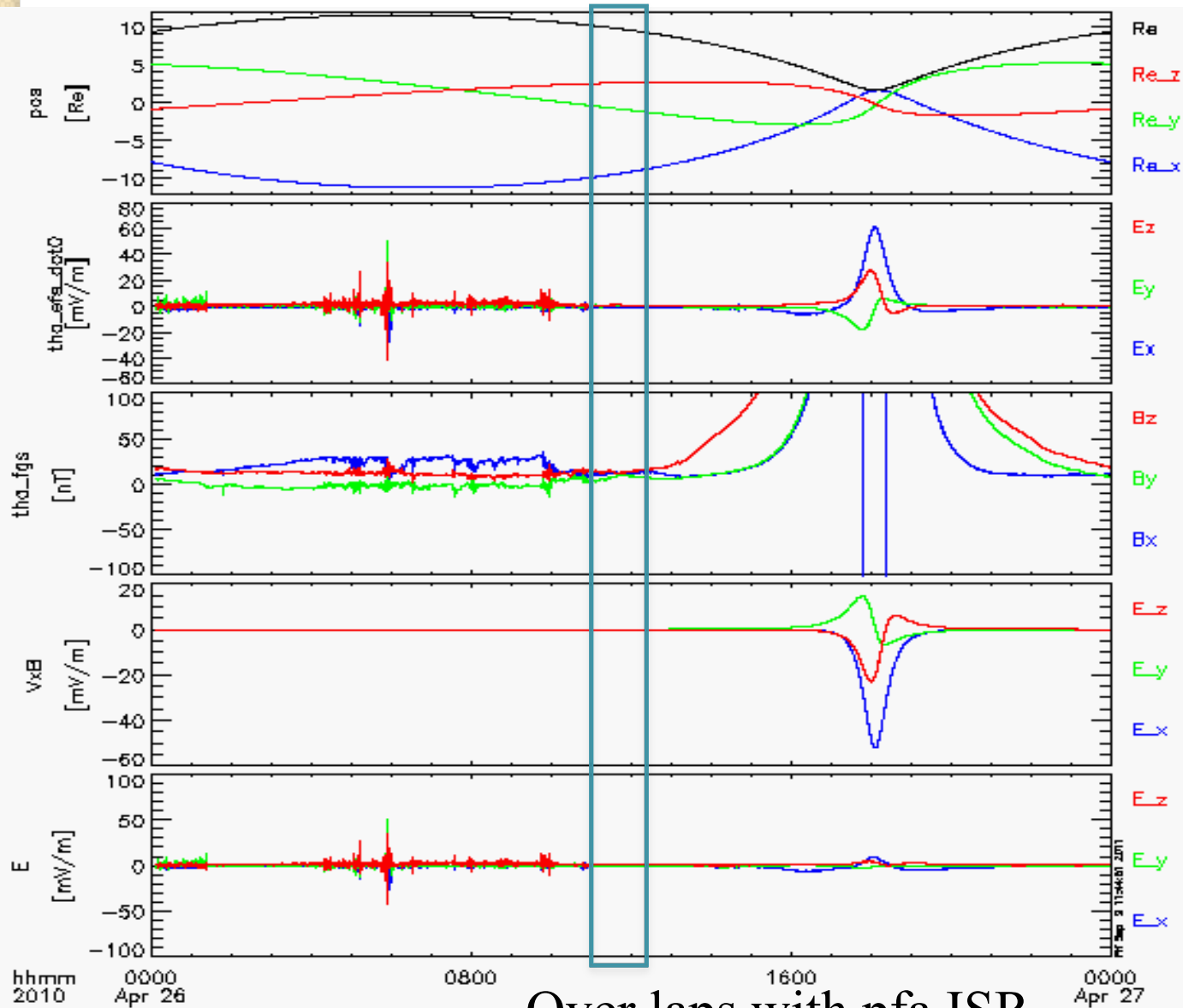


Footprints of the THEMIS satellites (a, d, e) for one day. The top plot is for Apr 26, 2010. The bottom one is for a different day. The red dot gives the location of the ISR at Poker Flat (65°N, 147°W).

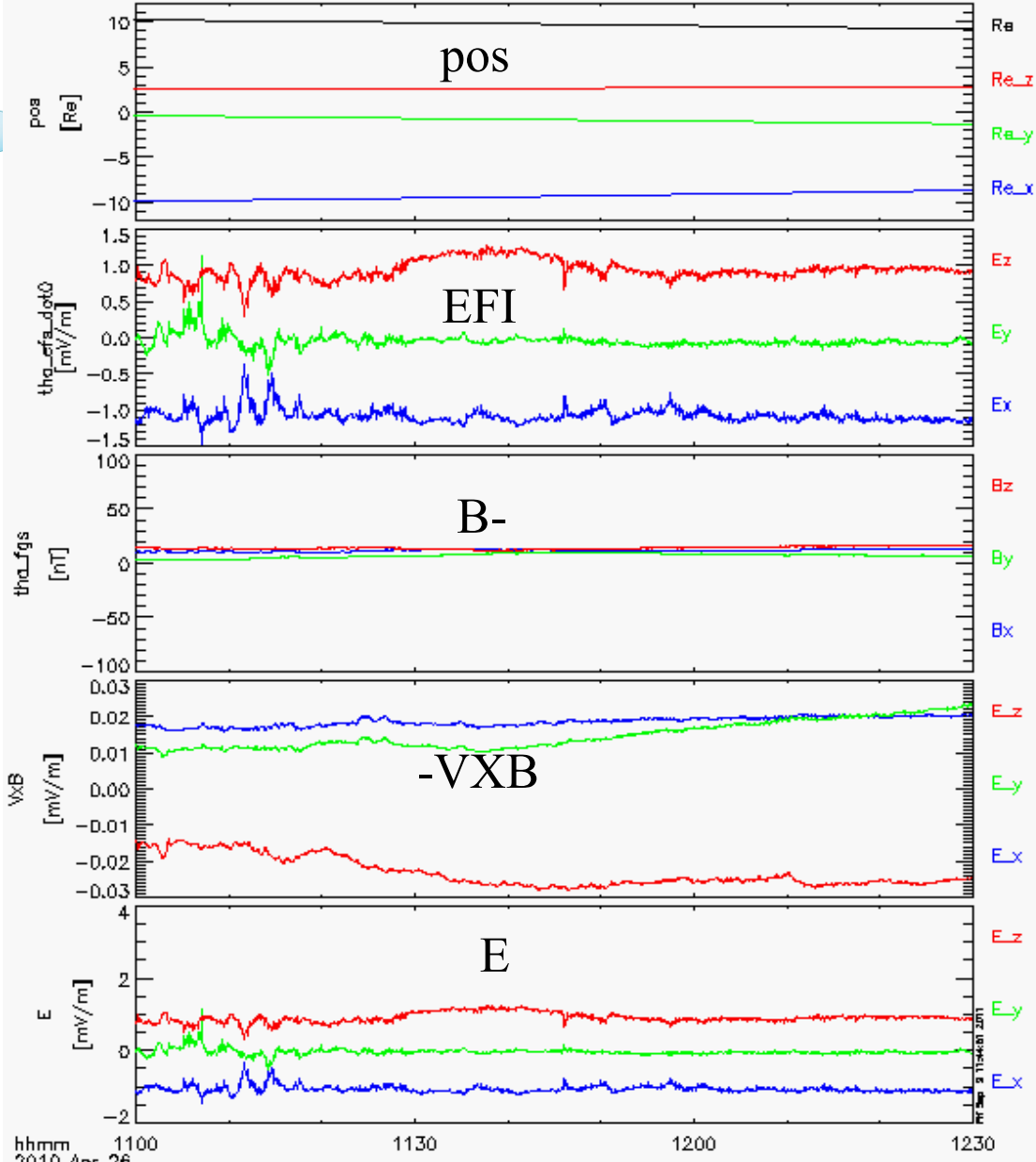
- For the day of Apr 26, 2010, the THEMIS satellites have observations falling within the range of the ISR measurements at same times.
- We have looked at year 2010, and looked for overlapped observations between THEMIS satellites and the ISR at Poker Flat.

THEMIS Observations (THA)

April 26, 2010



tha – pfa overlaps 11:00-12:30 (Apr 26, 2010)



- Satellite distance is $\sim 7-10R_E$ during these overlaps.
- E-field assuming $\text{edotb}=0$ measured by the onboard EFI.
- B- measured by the onboard FGS.
- Remove $E=-VXB$ produced by SC movement.
- Actual E- field has the magnitude of \sim a few mV/m.

Compare E-field bw THEMIS & ISR

- Overlaps (coincidence in time and space) between THEMIS satellites and the Poker Flat ISR (pfa).
Year 2010 for each satellite:
 - ~27 days of data, in the first half year (Jan to July)
 - ~1 hr/day (3min interval) – 20 points (comparison)/day
 - ~30X20 (600) data points.
- Comparison
 - East direction,
 - North direction,
 - Magnitude.

Find east/north directions in space

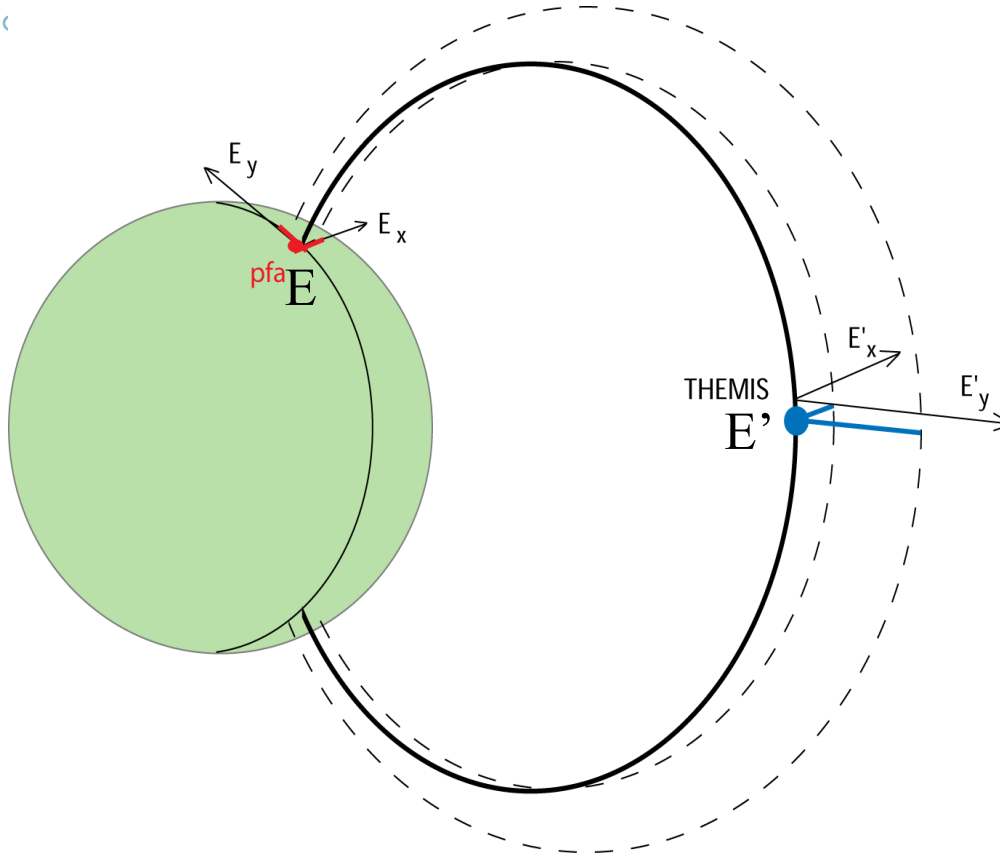
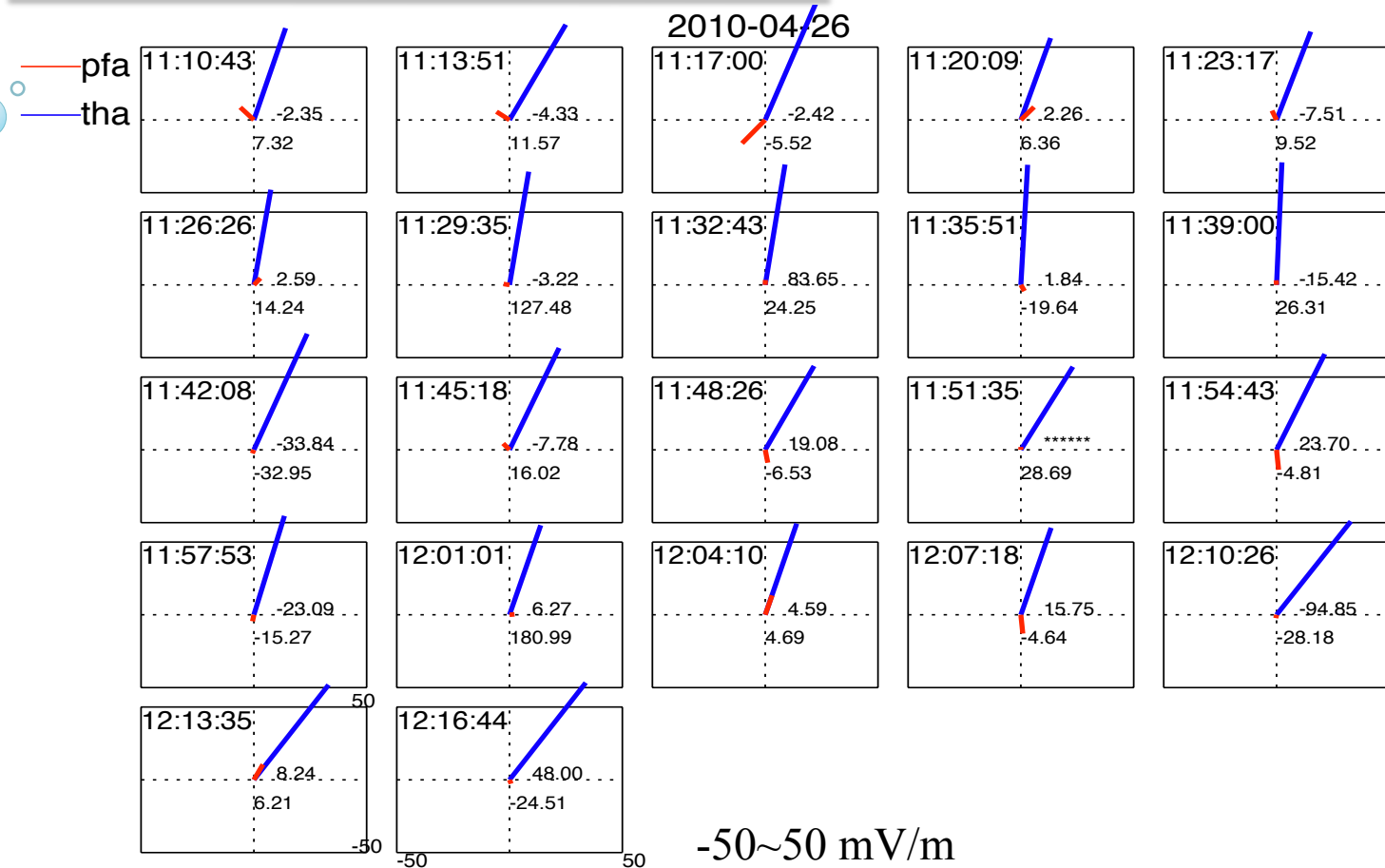


Illustration of mapping the THEMIS satellite position to the ground and finding the East/North directions of E-field in space.

- We use the Tsyganenko magnetic field model (T89) to map satellite positions to the ground.
- Suppose E is one point on the ground (close to pfa). It maps to E' (at THEMIS position) along the magnetic field line.
- On the ground, we move 1° east of E and 1° north of E. At pfa, these are **$\sim 47\text{km}$** and **111km** distances.
- Find E'_x and E'_y in space, and their distances to E'. Scale THEMIS data by these distances compared to the ground.

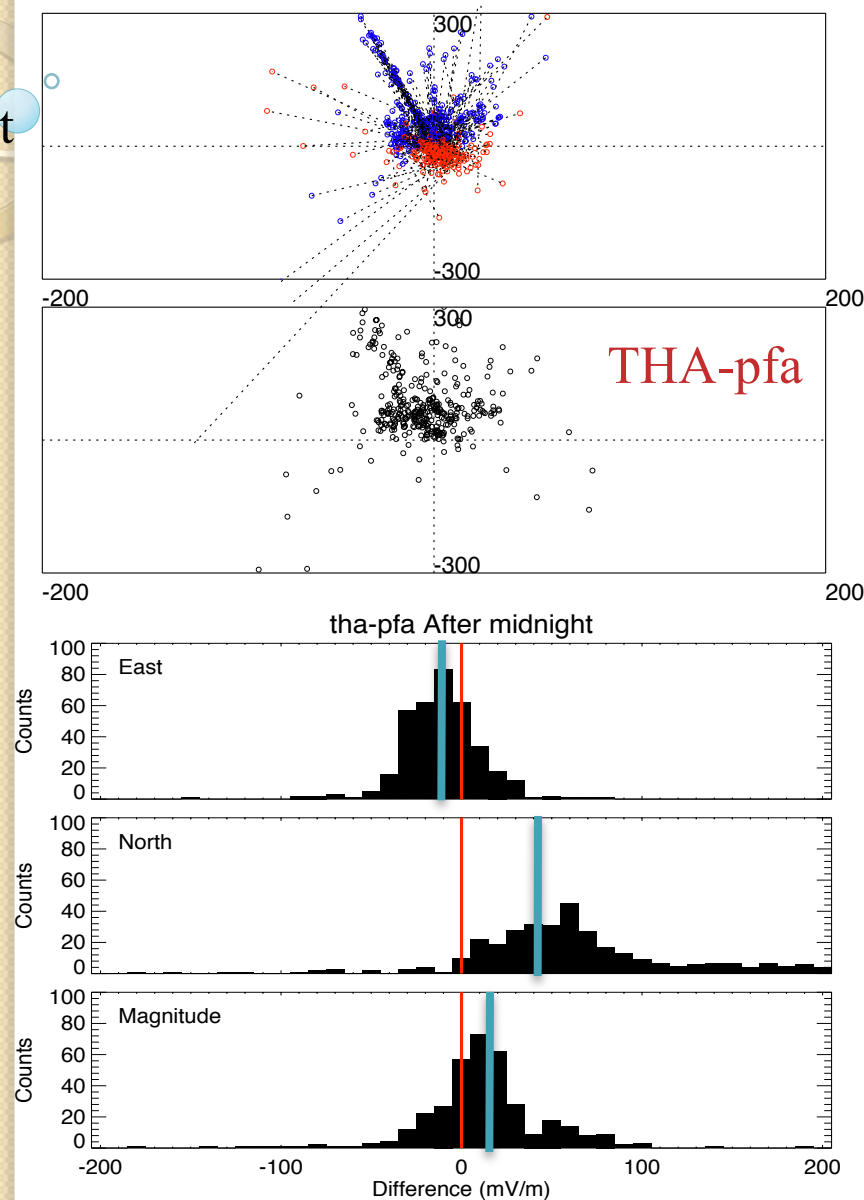
E-east and E-north comparison



E-x (east) and E-y (north) for THEMIS (blue) and ISR (red) for each 3-min overlap on Apr 26, 2010. The plotting range is 50 mV/m for both directions.

Comparison for 2010

Post-midnight



E-x and E-y by THA (blue) and the ISR (red). The difference (tha-pfa) is plotted as a black dot at the bottom panel.

- x-direction, differences are both positive and negative. y-direction, most positive. THEMIS are mostly greater than ISR for the North component.

Histogram of differences (**THA-pfa**) for x-(east), y-(north), and magnitude.

- THEMIS is larger by ~ 50 mV/m in North and 20 mV/m in magnitude.

Discussion

- Differences are found for both directions and magnitude.
- Field lines are not equal-potential. Over a region of a few tens of km, the potential difference could be as much as 1kv along the field line.