ARTEMIS observations for a northward IMF event:
IMF remains northward for 48 hr from 13 Feb to 14 Feb 2014
The two ARTEMIS probes at $X = -60 \text{ R}_E$ moving from $Y = 23$ to $3 \text{ R}_E$ and are close
to the plasma sheet.
The two probes (separation $\sim 1$ to $3 \text{ R}_E$) provide determination of spatial and
temporal variations.

We would like to investigate the ability of global models (both MHD and hybrid
models) on the following questions:

1. How does the mid-tail configuration response to changes in IMF $B_y$ and solar
wind dynamic pressure?
2. What processes cause the 10 to 30 min perturbations in the mid-tail plasma
sheet?
3. What are characteristics of plasma flows in mid-tail plasma sheet?
SW/IMF conditions, 13-14 Feb 2014

- IMF Bx
- IMF By
- IMF Bz
- Nsw
- V_{SW,x}
- V_{SW,y}
- V_{SW,z}
- Psw

**Time Periods:**
- 00:00 UT Feb 13
- 06:00 UT Feb 13
- 12:00 UT Feb 13
- 18:00 UT Feb 13
- 00:00 UT Feb 14
- 06:00 UT Feb 14
- 12:00 UT Feb 14
- 18:00 UT Feb 14
- 00:00 UT Feb 15
locations of ARTEMIS P1 and P2

Separation between P1 and P2
1. How do mid-tail respond to IMF By and Psw changes?

P1 and P2 responses to the 1st change

- P1 P2 moved from N hemisphere to S hemisphere ~30 min after IMF By direction change
- In response to the P_{sw} increase from ~1 to 2 nPa, N increases from 0.3 to 0.9 cm^{-3} but Ti decreases from 0.3 to 0.1 keV, Pi increases slightly from 0.016 to 0.02 nPa
1. How do mid-tail respond to IMF By and Psw changes?
   P1 and P2 responses to the 2nd changes

- P1 P2 moved from N hemisphere to S hemisphere ~3 hr after IMF By direction change. Why did it take much longer than the 1st one? Because of smaller YIY?

- In response to gradual Psw increase from ~0.9 to 1.5 nPa before 08 UT, N increases from 0.17 to 0.22 cm$^{-3}$ and Ti increases from 0.4 to 0.6 keV, Pi increases from 0.017 to 0.03 nPa
2. What processes cause the 10-30 min perturbations in the mid-tail plasma sheet during a period when SW/IMF are steady?

- From ~04-09 UT on 13 Feb all SW/IMF parameters are relatively steady
- quasi-periodic fluctuations in magnetic field and plasma with appearance of cold plasma.
2. What processes cause the 10-30 min perturbations in the mid-tail plasma sheet during a period when SW/IMF are steady?

• P2 closer to the Earth and saw perturbations first, indicating the perturbations propagate tailward.
2. What processes cause the 10-30 min perturbations in the mid-tail plasma sheet during a period when SW/IMF are steady?

- Flow direction perturbations consistent with a tailward moving vortex

- From the delay time between P1 and P2 (1.5 min) the speed of vortex is
  \[ V_{\text{vortex}} = 3 \, R_E / 1.5\text{min} = 140 \, \text{km/s} \]

- From 6 min between two \(|V_y|\) peak, the X-scale of the vortex is
  \[ X_{\text{vortex}} = V_{\text{vortex}} \times 6 \, \text{min} = 8 \, R_E \]

- Are the fluctuations caused by K-H waves?
2. What processes cause the 10-30 min perturbations in the mid-tail plasma sheet during a period when there are small SW/IMF perturbations?

- Another period of magnetic field and plasma fluctuations, more irregular. Are the fluctuations current sheet flapping motion?

- Are the fluctuations caused by the small fluctuations in IMF By or Vsw, y?
3. What are characteristics of plasma flows in mid-tail plasma sheet?

**P2 Perpendicular velocity, 13-14 Feb 2014**

- **Y > 10 RE**
  - Tailward
  - Occurrence rate
  - Towards midnight
  - $V_{\perp x}$

- **Y < 10 RE**
  - Earthward
  - Occurrence rate
  - Towards flank
  - $V_{\perp y}$
participating global models

1. LFM: Slava Merkin
2. OpenGGCM: Joseph Jensen
3. GUMICS: Ilja Honkonen
4. BATS-R-US: (Daniel Welling)
5. Auburn University hybrid code: Yu Lin, Xueyi Wang
global models on CCMC

- Also run LFM, OpenGGCM, BATS-R-US, and GUMICS on CCMC as baseline

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<thead>
<tr>
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<th>cells</th>
<th>$\Delta X (R_E)$ at $X = -60 , R_E$</th>
<th>$\Delta Y (R_E)$</th>
<th>$\Delta Z (R_E)$</th>
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<td>GSE</td>
<td>9M 0.6</td>
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<td>GSM</td>
<td>2M 0.5-2</td>
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