B_edi & B_fgm comparison using Cluster 200308 data

Lukas Giner (TU-Graz), Rumi Nakamura (IWF/OeAW)
Edita Georgescu (MPS)

Purpose: try to determine spin-axis offset from EDI
EGD (electron gyrotime data)
• Check the stability of the spin-plane offset (preparation)
• Determine spin-axis offset from EGD assuming
FGM spin-plane offset is correct
Dependence of spin plane –offset on the hours from perigee

- Data set: 200308 data
- Calibration: daily-cal
- X: spin axis, Y, Z: spin-plane component

- Summary:
  spin-plane offset is quite stable <0.1 nT for the apogee data (low field region).

  ... this curve needs to be more seriously determined for low-perigee orbit spacecraft like MMS.
FGM spin-plane offset evolution from perigee
B edi & B fgm comparison

• Data set: 200308 data
• Calibration: daily-cal
• X: spin axis, Y, Z: spin-plane component
• High (22Hz, 67 Hz) resolution data used

B edi: from CAA EGD data
Bx edi: \( \sqrt{B_{edi}^2 - B_{fgm}^2 - B_{z fgm}^2} \)
B fgm, Bx fgm, By fgm, Bz fgm: time-matched data, i.e.
High-res. data from the closest time of B edi data.
Data
20030810: low field
20030812: high field

\[
\text{acos (Bx/B)}
\]

20030810: 90

B_{edi} - B_{fgm}

Is different depending
On EDI “range”,
meaning EDI
code repetition freq. B_{edi}
- B_{fgm}
200308 offset
Cluster 1
Daily & monthly average
Using EDI “range”, i.e. criteria given in Georgescu et al. paper (PG), daily average for the entire month & monthly average are calculated.

Problem: stdv. Too large
Because we mix all the days and EDI operate not always as in PG criteria
200308 offset Cluster 2

- Daily & monthly average
200308 offset Cluster 3

• Daily & monthly average
20030810 quiet lobe condition (4~9 UT)

Due to the problems mentioned before, we select a very quiet lobe day for calibration
20030810 quiet lobe period

Cluster 3)

$\langle \text{Bedi} \rangle = 81.99$  stdV 0.13
n 1020

$\langle \text{Bdfm} \rangle = 81.85$  stdV 0.12

$\langle \text{Bedi} - \text{Bfgm} \rangle = 0.143$

• StdV small enough to see clearly the difference (offset). In all three: comparison, i.e.
  B:\edi and closest –time FGM (top), 22Hz FGH (middle) and 1Hz averaged data (bottom).
Different calibration

For this day, CAA cal. data, have smaller stdv than daily cal, but difference from B_EDI was larger than for daily-cal.
angle dependence $\text{acos}(B_x/B)$ of offset

$\text{acos}(B_x/B)=90$
$\langle\text{Bedi}\rangle = 302.47 \text{ stdV 1.06}$
$\langle\text{Bedi}\rangle - \langle\text{Bfgm}\rangle = 1.63$

$\text{FGM} \quad \text{EDI} \quad t_{\text{edi}}$

$1/22\text{s}$

$\text{acos}(B_x/B)=50$
$\langle\text{Bedi}\rangle = 324.03 \text{ stdV 1.07}$
$\langle\text{Bedi}\rangle - \langle\text{Bfgm}\rangle = 1.28$

$\text{acos}(B_x/B)=20$
$\langle\text{Bedi}\rangle = 329.89 \text{ stdV 0.83}$
$\langle\text{Bedi}\rangle - \langle\text{Bfgm}\rangle = 1.07$
Try to limit EDI data in the same “range”:
32<Bfgm=<61 nT,  stdev =< 0.07 nT  sigma_EGD =1.5 ,  t = 5 min  n >= 350

\[ \Delta B = \langle Bedi - Bfgm \rangle \quad \text{cosb} = \frac{\langle Bfgm_x \rangle}{B} \]

\[ \Delta Bx1 = \sqrt{\Delta B^2 - 2 \Delta B \langle Bfgm \rangle + \langle Bfgm^2 \rangle \cos^2 \text{cosb}} - \langle Bfgm \rangle \cos \text{cosb} \]

\[ \Delta Bx3 = \langle Bedi_x - Bfgm_x \rangle \]

As in 20030812 example, offset & stdv varies with cosb.

But, the two lower figure suggest that for \( \text{cosb} > \sim 0.2 \), the offset is quite stable
Effect from EDI “range”, i.e. code repetition frequency change

- EDI “range” change, i.e. change in the code repetition frequency (CRF) or named “sigma” parameter in the EDI-CAA file, can happen during the same B value.
- That is, the stdv can change significantly due to this range change. So it is only meaningful to use EDI_B data set from the same CRF value.
Special calibration

daily cal

daily cal + special cal

- Offset can be better seen with the best FGM cal.