Determining Optimal Setting for AMIENext Procedure Using AMPERE/Iridium Data

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Data – Iridium Magnetic Perturbation

Active Magnetosphere and Planetary Electrodynamics Response Experiment (AMPERE) program provides Iridium perturbation data pre-processed for scientific research with a 20-sec cadence in normal operation, 2-sec in high resolution mode.

Only cross-track component are extracted in our project because of a higher uncertainty of along-track data due to attitude control in aging spacecraft.

36-min window around 11:40 UT, May 20th, 2010 with 20-sec cadence
Impacts of the Background Model and Background Error Covariance on AMIENext Analyses

Optimal interpolation (OI) analyses of magnetic potential and FAC are generated from the new AMIENext procedure (Matsuo, 2015) by assimilating observations over 4 minutes every 2 minutes.

AMIENext magnetic potential pattern in line contours and FAC pattern in color contours for both hemispheres at 11:40 UT on May 29th, 2010.
Background Model and Error Covariance

assimilation procedure settings including

- **Use of sample mean vs. empirical model as background**
- **Use of different windows for estimation of mean and Empirical Orthogonal Functions (EOFs)**
- **Number of EOFs used to parameterize the background covariance**

<table>
<thead>
<tr>
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<th>Background Model</th>
<th>Background Covariance</th>
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</thead>
<tbody>
<tr>
<td>20min</td>
<td>+/- 10-min data mean</td>
<td>+/- 10-min data 3 EOFs</td>
</tr>
<tr>
<td>36min</td>
<td>+/- 18-min data mean</td>
<td>+/- 18-min data 3 EOFs</td>
</tr>
<tr>
<td>1day</td>
<td>One day data mean</td>
<td>One day data 3 EOFs</td>
</tr>
<tr>
<td>1day5EOF</td>
<td>One day data mean</td>
<td>One day data 5 EOFs</td>
</tr>
<tr>
<td>1week7EOF</td>
<td>One week data mean</td>
<td>One week data 7 EOFs</td>
</tr>
<tr>
<td>Weimer</td>
<td>Weimer (2005) model</td>
<td>+/- 18-min data 3 EOFs</td>
</tr>
</tbody>
</table>
Results Good Model-Validation Agreement

- Iridium Observation Cross Validation

<table>
<thead>
<tr>
<th></th>
<th>Mean RMSE (nT)</th>
<th>Median RMSE (nT)</th>
</tr>
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<tbody>
<tr>
<td>NH</td>
<td>147.65</td>
<td>97.02</td>
</tr>
<tr>
<td>SH</td>
<td>128.21</td>
<td>76.70</td>
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</tbody>
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DMSP Comparison comparable to the agreement found between Iridium and DMSP observations during the same time period discussed in Knipp et al. (2014)
Future work

• We will look into the influence of constructing the background error covariance $\mathbf{B}$ in different ways in terms of the time-dependent coefficients $\alpha^{(i)}$.

\[
\mathbf{B} = \Psi \text{cov}(\alpha, \alpha^T)\Psi^T
\]

• Optimal settings will be determined for various time scales and characteristics of different solar wind drivers, in particular (Richardson and Cane, 2012)
  * corotating high-speed stream
  * slow flow
  * transient flows originating with CMEs.
We thank the AMPERE team and the AMPERE Science Center for providing the Iridium-derived data products.


