Use of space-based magnetometer data by AFRL

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Bottom Line Up Front

- **Magnetic field data at GEO is used in modeling the space hazard environment for:**
  - **Providing ULF/VLF wave data as input to particle diffusion models.**
  - **Mapping in situ particle data across locations.**
  - **Assessing geomagnetic field models employed for interpreting particle measurements and models.**

ULF/VLF Wave Observations

- **ULF-enhanced radial diffusion**
  - **Radial diffusion coefficients often expect ULF (mHz) wave power as input.**
  - **These waves have electrostatic and electromagnetic components (e.g., *Brautigam and Albert,* 2000).**
    - **Both need to be accounted for to produce transport coefficients.**
    - **Magnetometers can partially discern these waves.**
- **Wave-driven pitch angle/energy diffusion**
  - **Modern radiation belt models incorporate pitch angle/energy diffusion as well as radial diffusion, which arises from interactions with waves in the Hz (i.e., EMIC) to kHz (i.e., whistler) frequency range.**
  - **Observations of these waves would likely require instrumentation other than a traditional magnetometer (e.g., search coil and dipole antennae).**
- **ULF and/or VLF wave data products could improve radiation belt models used to specify the internal charging environment.**
- **Could a wave instrument capable of measuring electric and magnetic wave power be included in the payload?**

Brautigam, D. H. and J. M. Albert [2000], Radial diffusion analysis of outer radiation belt electrons during the October 9, 1990, magnetic storm, *J. Geophys. Res.*, 105(A1), 291-309.

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Magnetic Mapping

- **Mapping Around GEO**
  - ***Su et al.* [2014] recently described a method of mapping data in local time parameterized by Kp.**
  - **Incorporating magnetometer data to a mapping algorithm would likely improve accuracy.**
- **Mapping from GEO to other orbits**
  - **MAG data enables more accurate magnetic coordinate determination.**
  - **We are exploring efforts to map environment data between GEO and other orbits.**

Su, Y.-J. et al. [2014], Specification of >2MeV electron flux as a function of local time and geomagnetic activity at geosynchronous orbit, *Space Weather*, 12, 470-486.

Geomagnetic Field Models

- **Magnetometer data is a critical "ground truth" for field model development and validation.**
- **Directionality**
  - **The pitch angle distribution of energetic particles affects how they impact space assets.**
  - **Knowledge of this information at GOES requires magnetometer data; at other locations, a field model for mapping.**
- **SEPs**
  - **Understanding impacts from exposure to solar proton fluxes requires modeling the geomagnetic cutoff.**
  - **The cutoff depends on the global configuration of the field.**
- **Magnetopause Crossing**
  - **Magnetometer data is by far the best way to observe magnetopause crossings.**
  - **These observations are required to validate magnetopause models.**
    - **Specific models (e.g., the Shue model).**
    - **Geomagnetic models with magnetopause crossing as a performance metric.**

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