Data-model comparisons of storm-time ion dynamics

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Outline

• Motivation

• Energetic Neutral Atom (ENA) imaging

• Space Weather Modeling Framework (SWMF)

• Data-model comparisons of high speed stream storm

• Future work
Ions injected from plasma sheet to inner magnetosphere during storms

Keesee et al., JGR, 2014
Energetic Neutral Atoms (ENAs) Created by Charge-Exchange

Neutral source: the Earth’s geocorona that extends out many $R_E$.

Ion source: the plasma trapped in the magnetosphere.
Two Wide-angle Imaging Neutral Atom Spectrometers (TWINS) images ENAs

- Mission of Opportunity
- Two spacecraft in high inclination Molniya orbits
- Near-continuous coverage; intervals of stereo viewing
- 1-100 keV
- June 2008-present
Space Weather Modeling Framework (SWMF) couples multiple models together

- GM: BATS-R-US global MHD model
- IM: RCM inner magnetosphere model
- IE: RIM ionosphere electrodynamics model
TWINS-SWMF comparisons have some caveats

- TWINS data are averaged over ~25 minutes for good SNR
- SWMF output at 1 minute cadence; made into a movie over interval
- Overall temperatures are lower in simulation than in data
- SWMF temperature calculated using $T = P/n$
Early in storm, hot ions are injected Earthward
Injections from tail continue as ion temperatures on the dayside increase.
Injections from tail continue as ion temperatures on the dayside increase.
Heating observed across magnetotail rather than in channels at onset of storm main phase
SWMF observes blobs moving Earthward while TWINS observes nightside heating at the peak of the storm.
Peaks in ion temperature in midnight and post-noon sectors in the early recovery phase
Take-home messages and future work

- ENA imaging can be used to observe injections of hot ions from the magnetotail
- Ion heating is observed in localized regions, particularly at midnight
- Use HEIDI inner magnetosphere model in SWMF
  - Arbitrary (non-dipolar) magnetic field
  - Calculations away from equatorial plane
- Comparisons using various methods of ion temperature calculation