

AMPS and its use

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AMPS in CCMC



Community Coordinated Modeling Center

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i **Welcome to the new CCMC website!**

Please note that some pages may have moved during the migration. If you experience any issues with the new website, please reach out to gsfc-ccmc-support@lists.hq.nasa.gov.

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Last Updated: 06/06/2022

AMPS

Version: 2016

➔ [Runs-on-Request](#)

AMPS: Trajectories (position, velocity) of individual particles inserted into completed global magnetosphere simulation.

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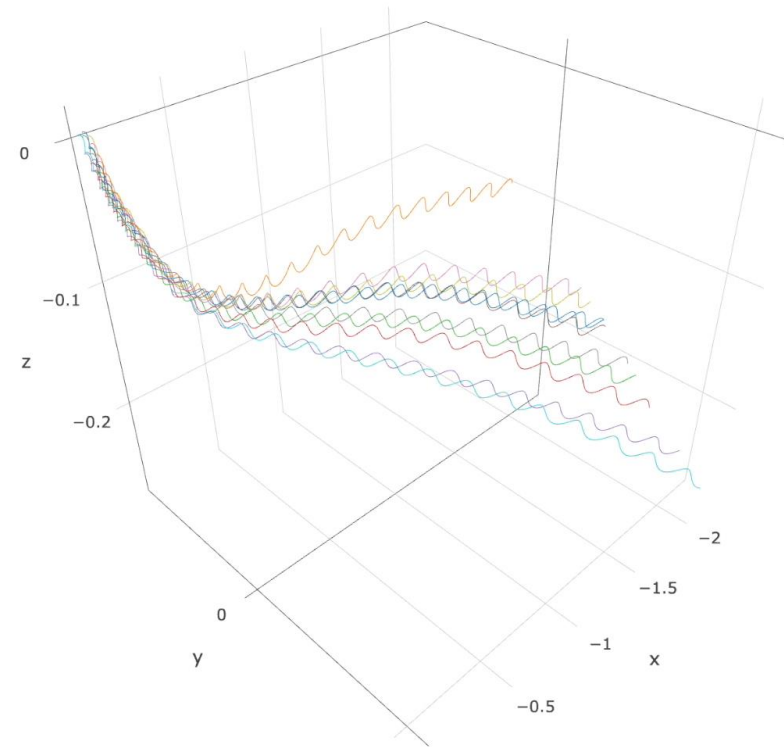
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AMPS in CCMC

- Analyze charged particle trajectories moving in plasma
 - Post processing tool: use pre-calculated plasma and magnetic field
- Import of the plasma flow simulations into AMPS
 - Time-dependent results of the plasma modeling is saved in files
- Output
 - Individual particle trajectories
 - Samples of the distribution functions
- Particle trajectory integration in AMPS
 - Trajectory affected by the Lorentz force
 - Particle tracking along a magnetic field line



AMPS in CCMC – plans new development

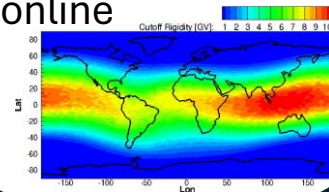
AMPS for SEP modeling in geospace

MSFC/ST13
MSFC/ST11

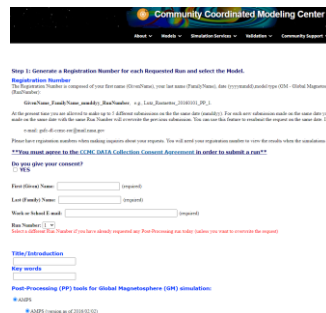
GSFC/CCMC

SEP Model

- Use GOES data stream
- Results presented online

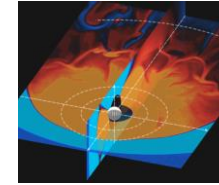


Web Interface

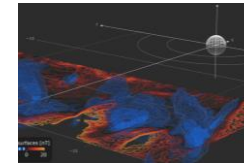


Visualization

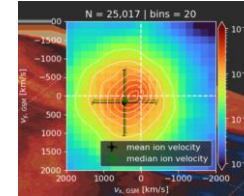
Cut through 3D data



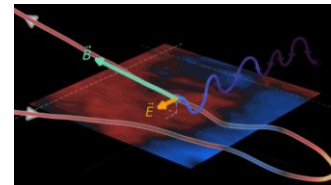
Isosurfaces



Distribution functions



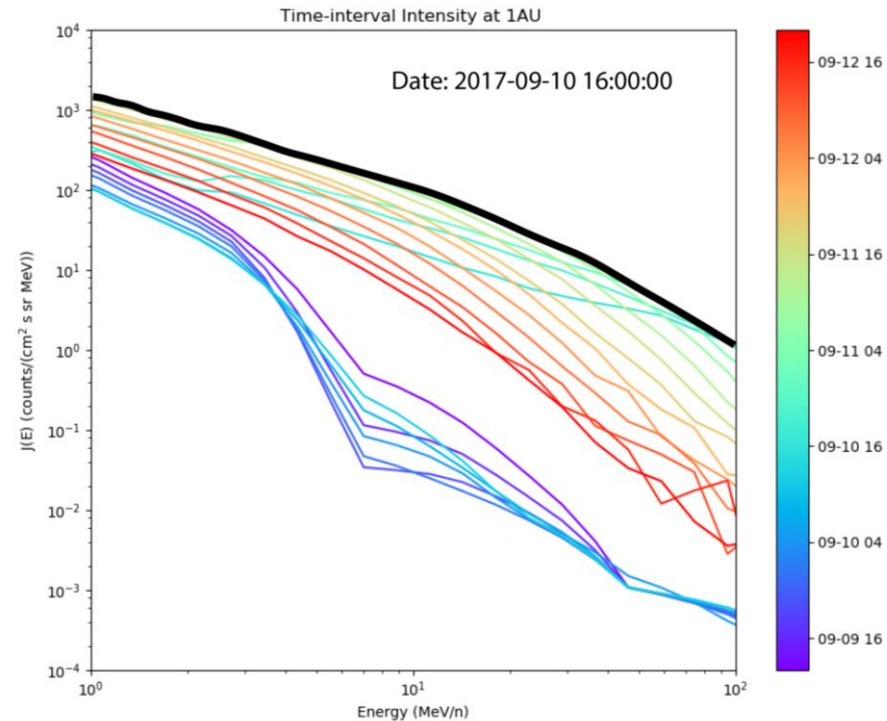
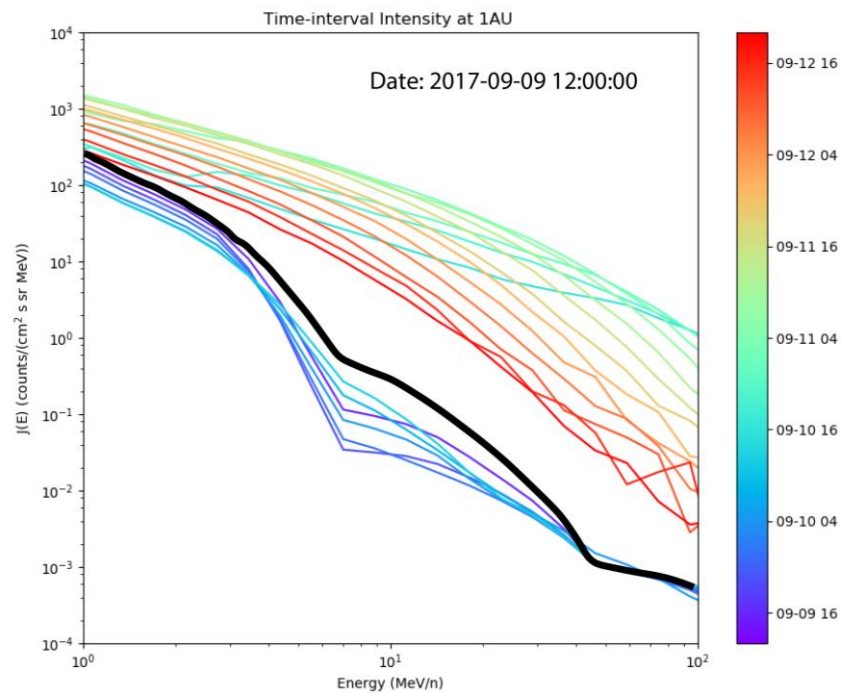
Particle trajectories



Example: Energy Spectrum of SEPs

Event: 2017-09-09 - 2017-09-12

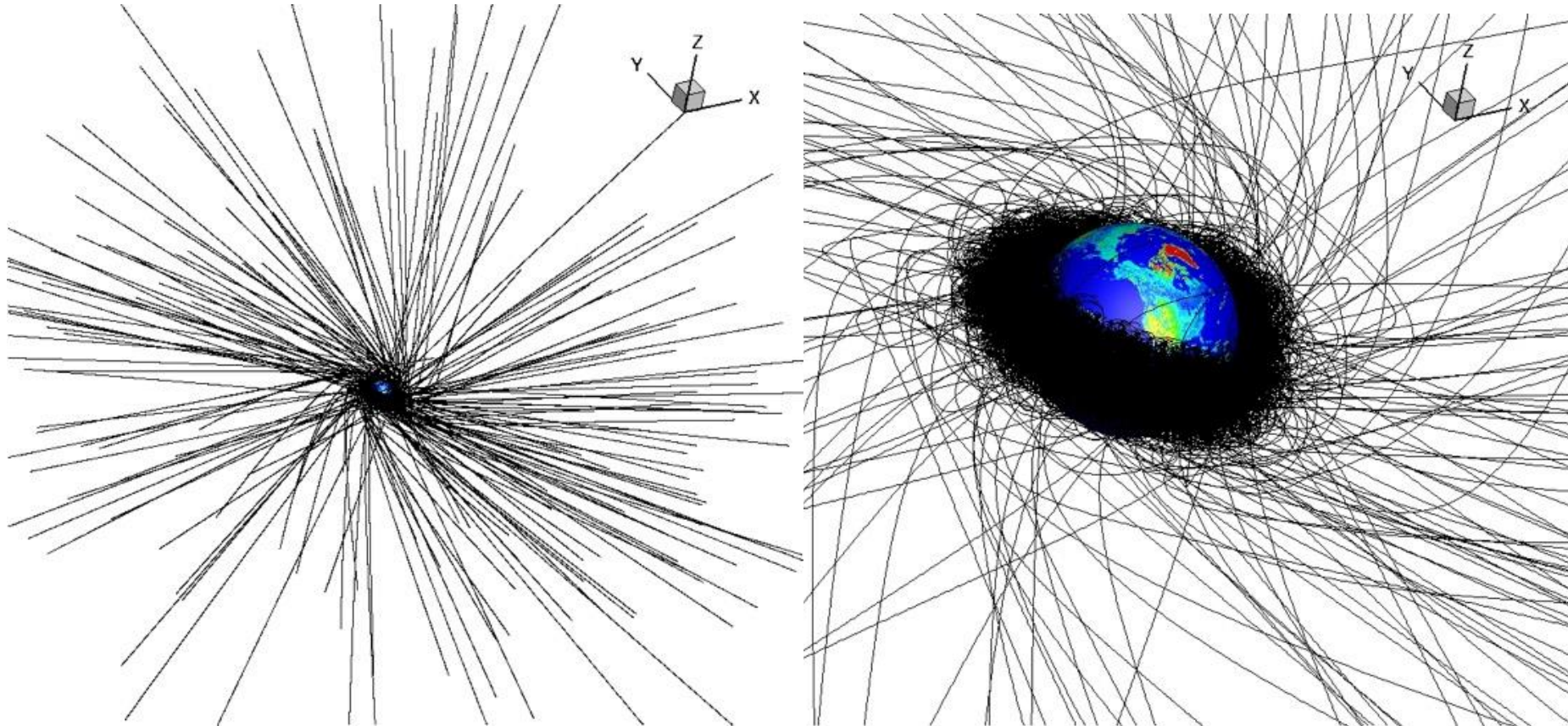
The energy spectrum of SEPs outside of the Earth's magnetosphere calculated with iPATH



Backward Particle Tracking

Small and Large scale energetic particle trajectory integration

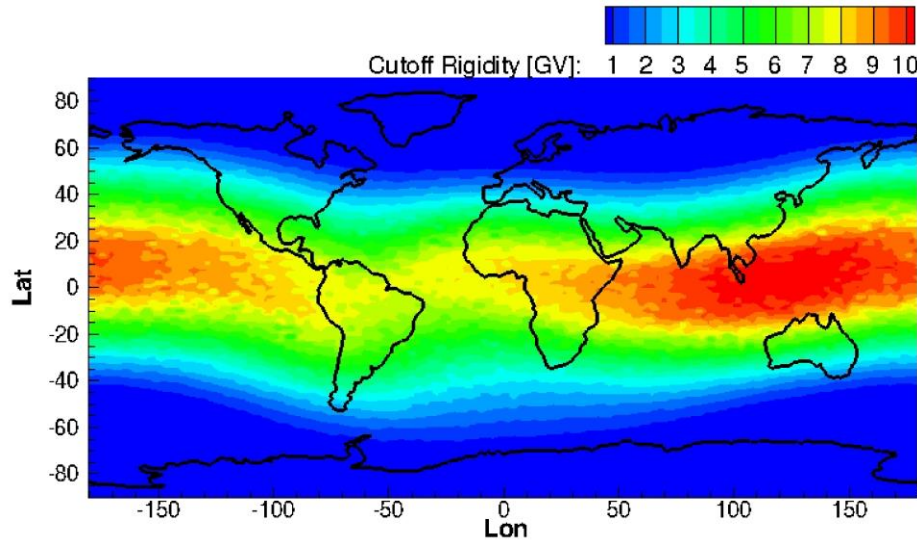
- Radiation environment in the entire Earth's magnetosphere



Rigidity cutoff

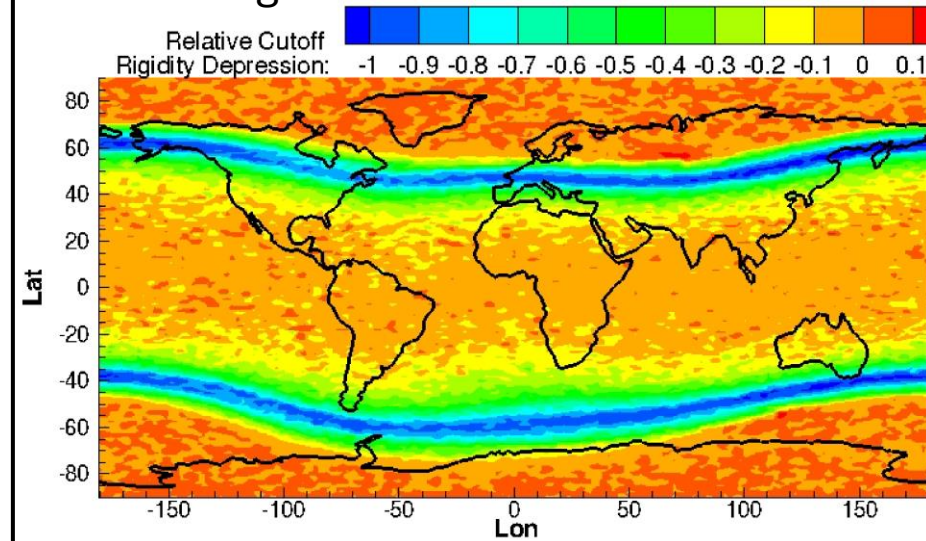
Rigidity cutoff map

1. The map is calculated for an altitude of 500 km.
2. Rigidity cutoff map calculated for quiet geomagnetic conditions.



Suppression of the rigidity cutoff during a geomagnetic storm.

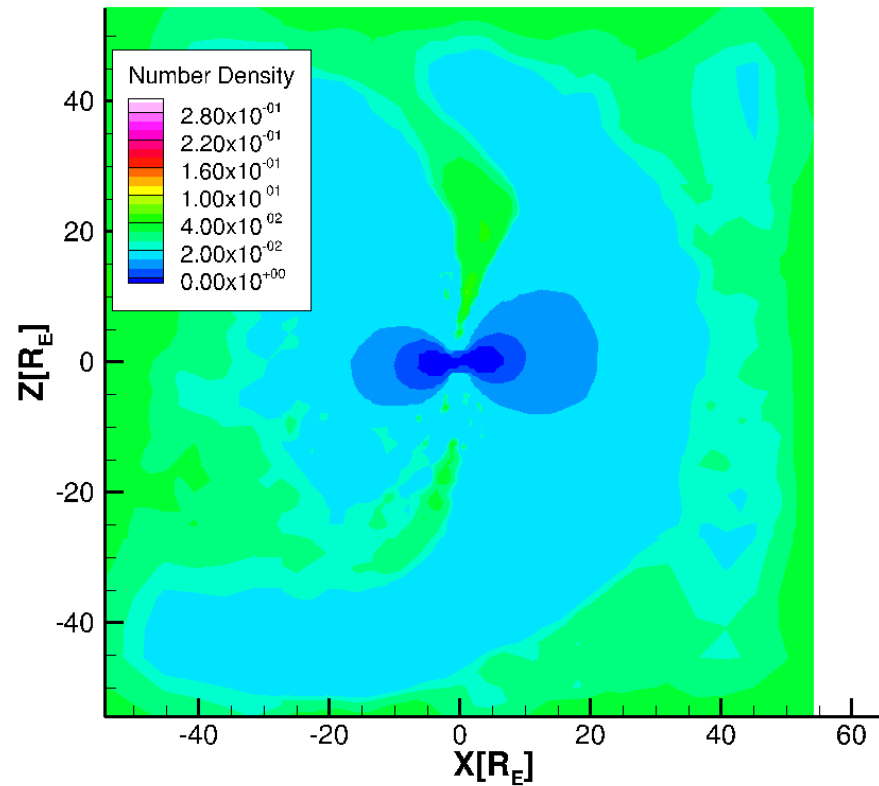
The calculation was performed for conditions of the geomagnetic storm on March 17, 2015. In general, rigidity cutoff suppression is more significant in the mid-latitude region.



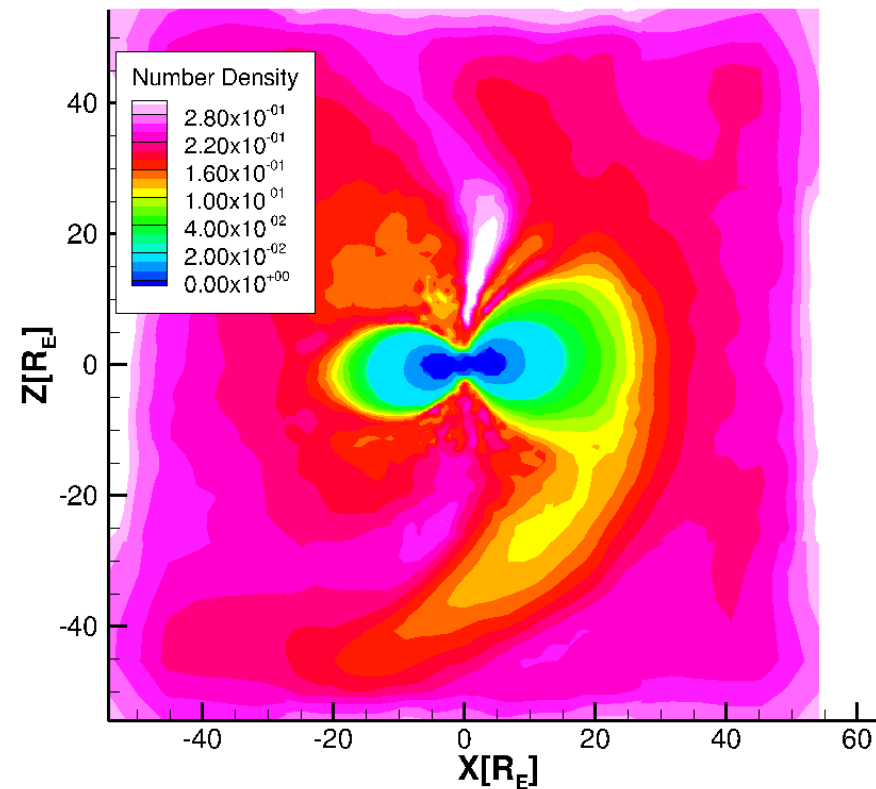
Simulated distribution of SEPs in geospace

Event: 2017-09-09 - 2017-09-12

Density of the energetic particles increased by an order of magnitude



Before the event

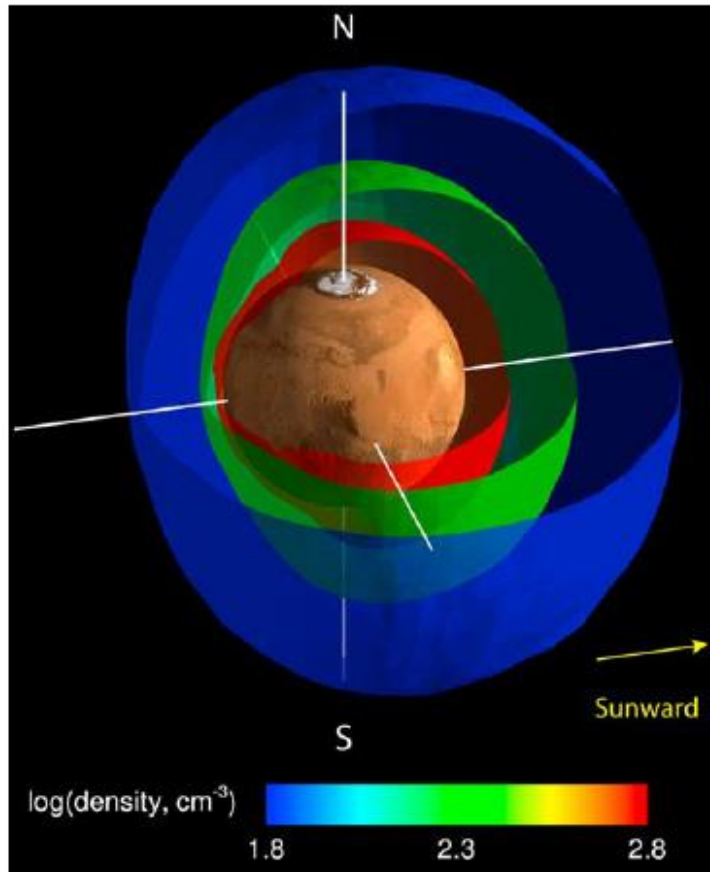


Main phase of the event

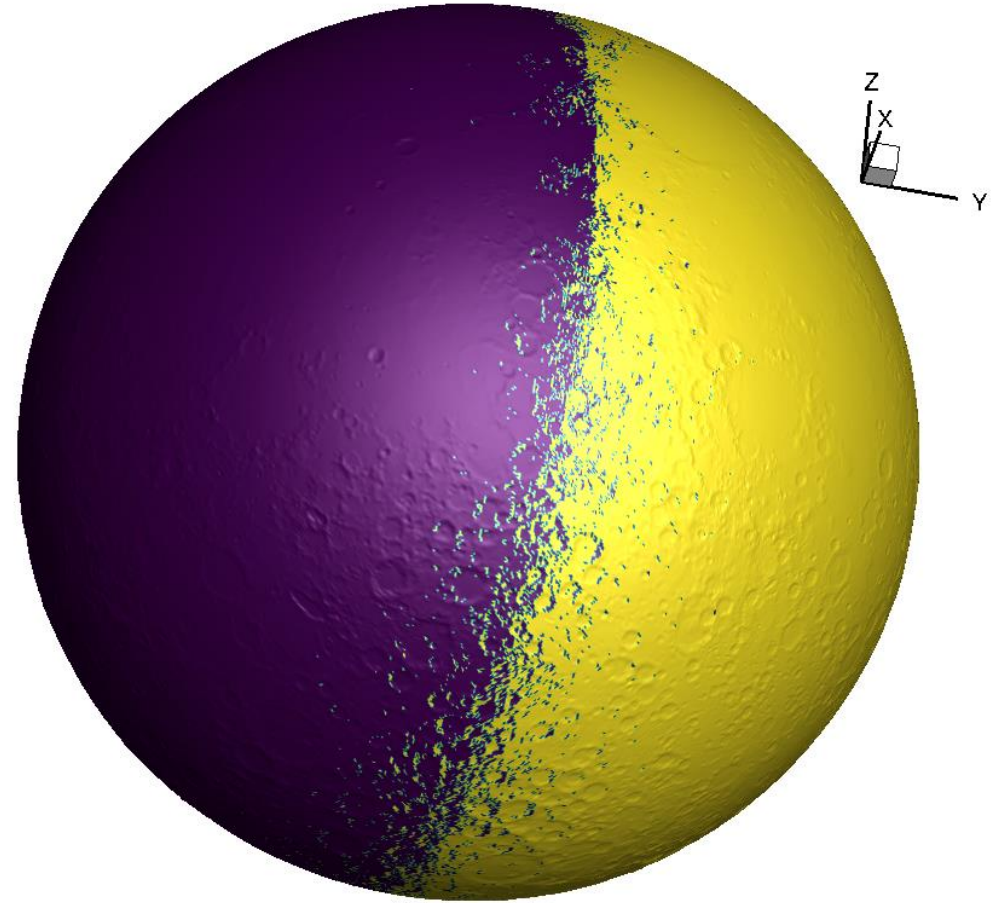
AMPS in Planetary Applications

Applications:

1. Planetary exospheres:



Three-dimensional representation of the Martian hot corona.

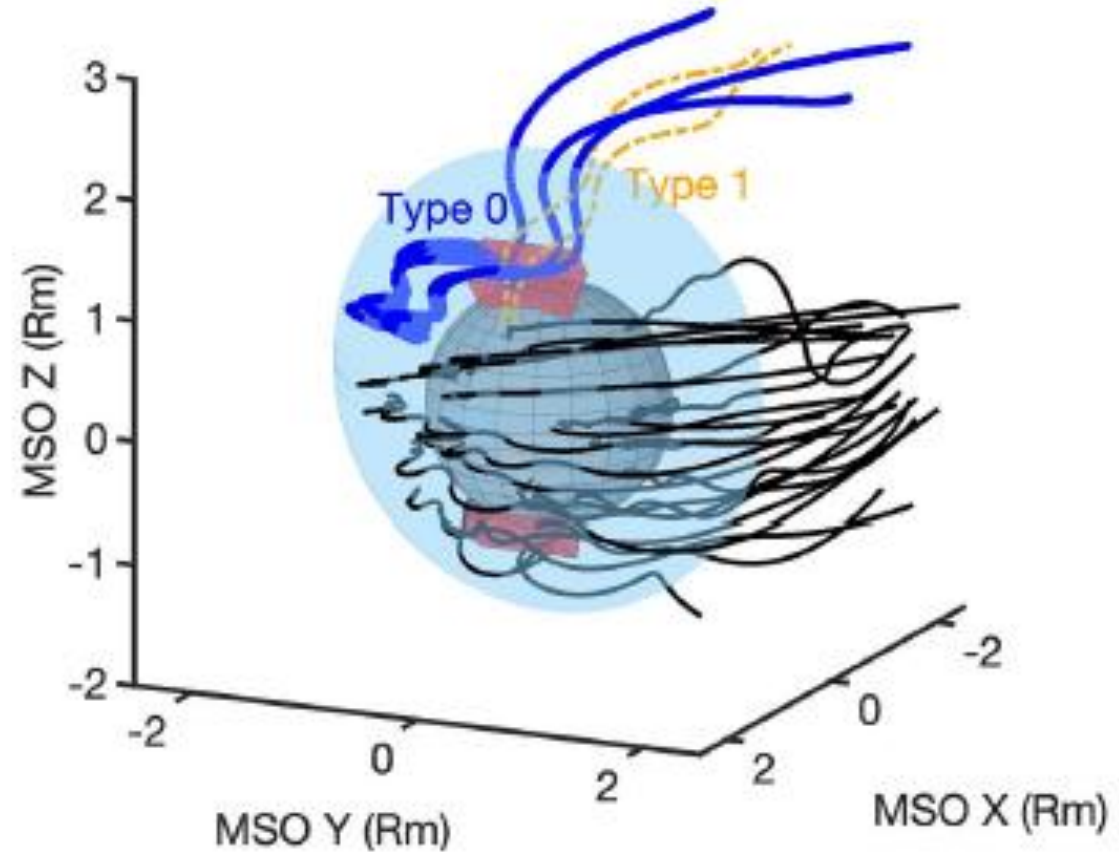
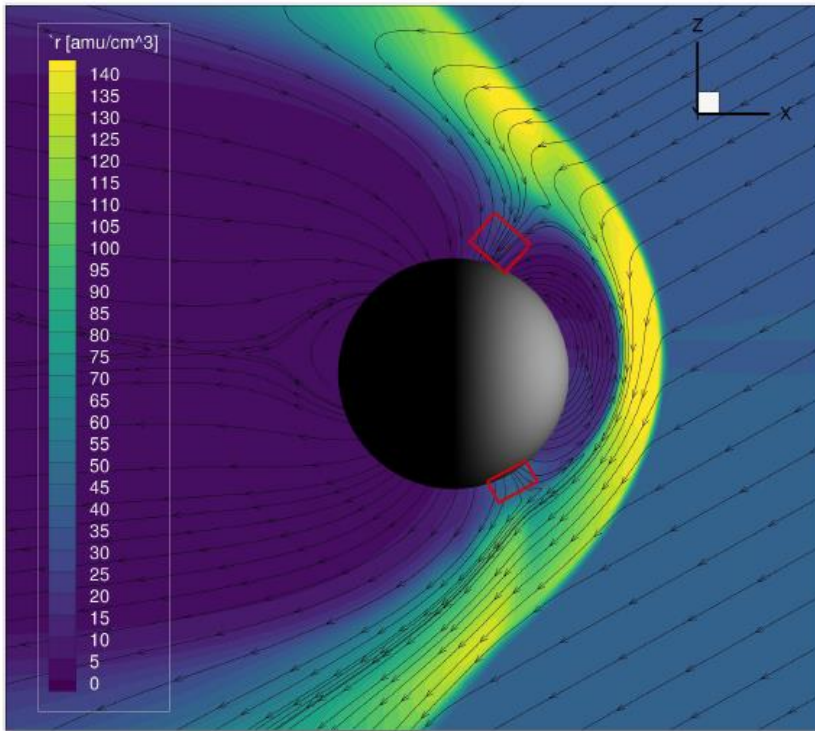


Using the surface topology and shadow calculations in modeling exospheres

AMPS in Planetary Applications

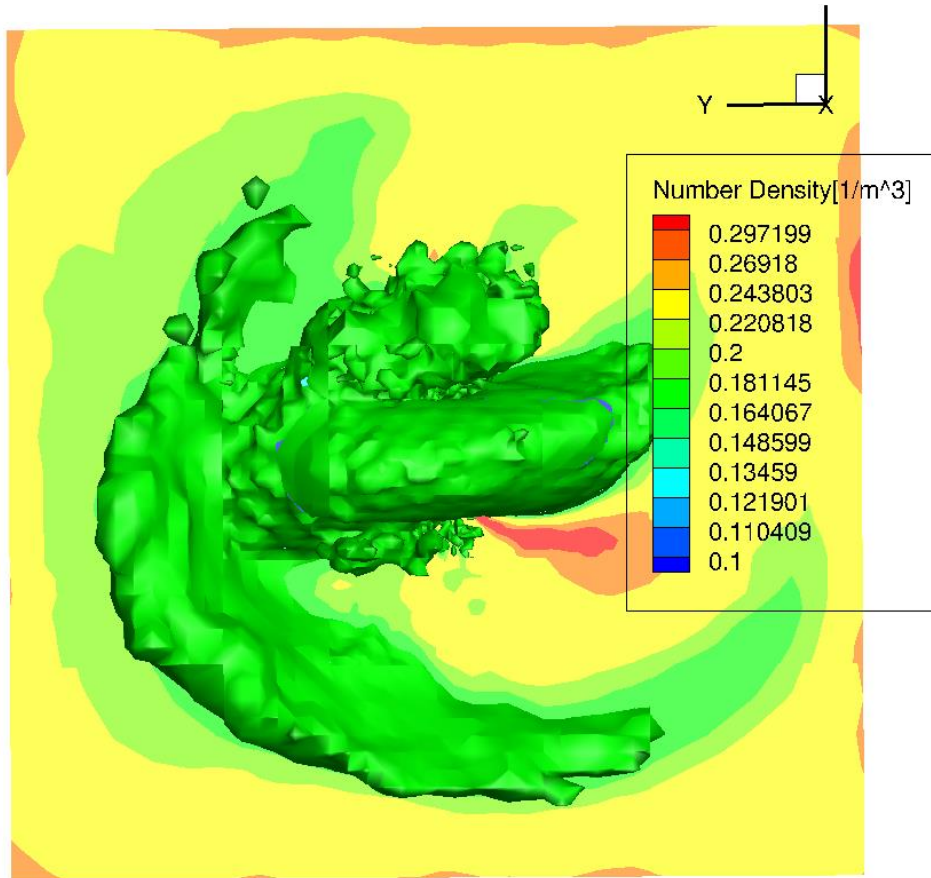
Applications:

1. Planetary exospheres
2. Kinetic ion dynamics in magnetospheres



A global view of sample NA⁺ ion trajectories in Mercury's magnetosphere

Conclusion



Structure of energetic particles' density
in geospace

- ***AMPS in the CCMC as of now:***
 - Tracking charged particle trajectories
- ***Near-term plan [CCMC+MSFC]:***
 - SEP modeling in geospace
 - TS05, TA15
 - AMPS+BATSRUS
 - MHD model results at the CCMC
- Improved visualization and user interface
- User-defined SEP spectrum, or that derived from GOES-R, can be used
- Progress toward practical space weather applications