AGU CHAPMAN CONFERENCE

Cascais, Portugal | 4–9 March 2018

Dynamic mechanisms of rapid dropout in the outer radiation belt observed after the Coronal Mass Ejection associated with Shock in July 2016

***Da Silva, L. A.*[1]; *Alves, L.R.*[1]; *Souza, V.M.*[1]; *Jauer, P.R.*[1]; *Marchezi, J.P.*[1]; *Da Silva, G. B.*; *Medeiros, C.*[1]; *Grala, M.*[1]; *Schmitz, R. G.*; *Rockenbach, M.*[1]; *Alves, M. V.*[1]; *Baker, D.*[3]; *Kletzing, C.*[4]; *Kanekal, S.G.*[2]; *Mei-Ching, F.*; *Sibeck, D.*[2]; *Dal Lago, A.*[1], *Vieira, L.E.A.*[1]**

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[3]Laboratory for Atmosphere and Space Physics - LASP, Bolder, CO. USA.

[4]University of Lowa, Lowa City, IA, USA

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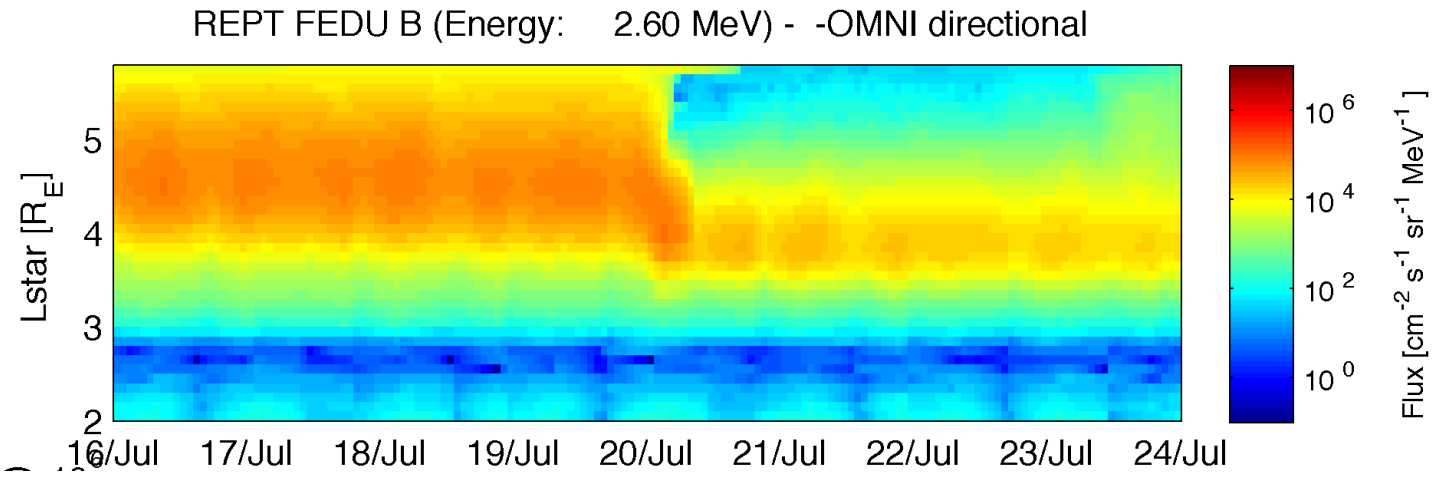
Rapid dropout observed by Van Allen Probes - VAP



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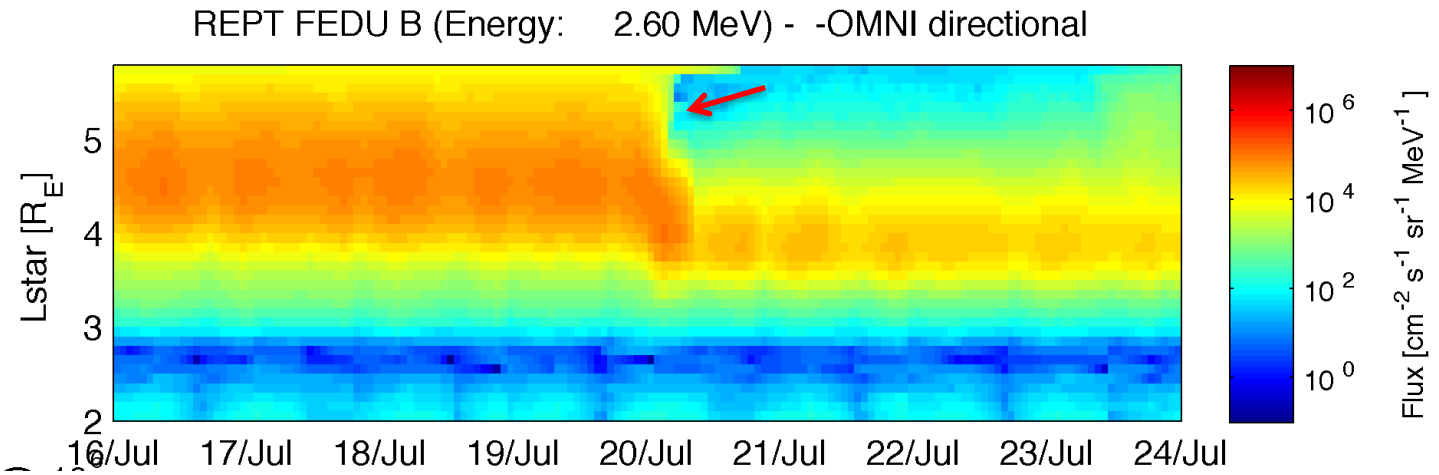
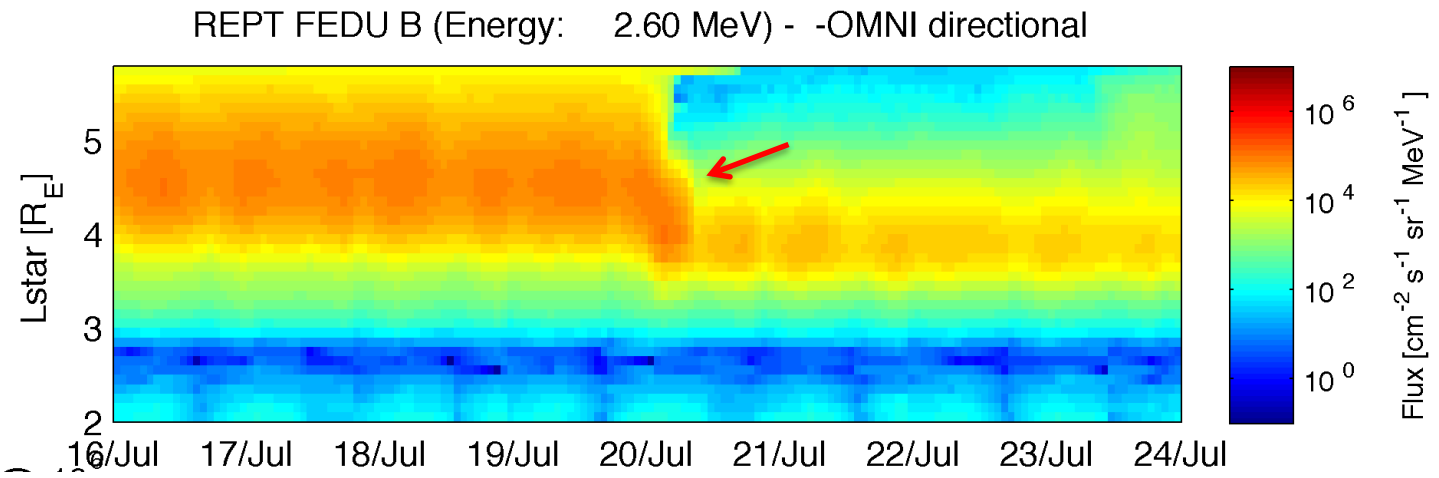
Rapid dropout observed by Van Allen Probes - VAP



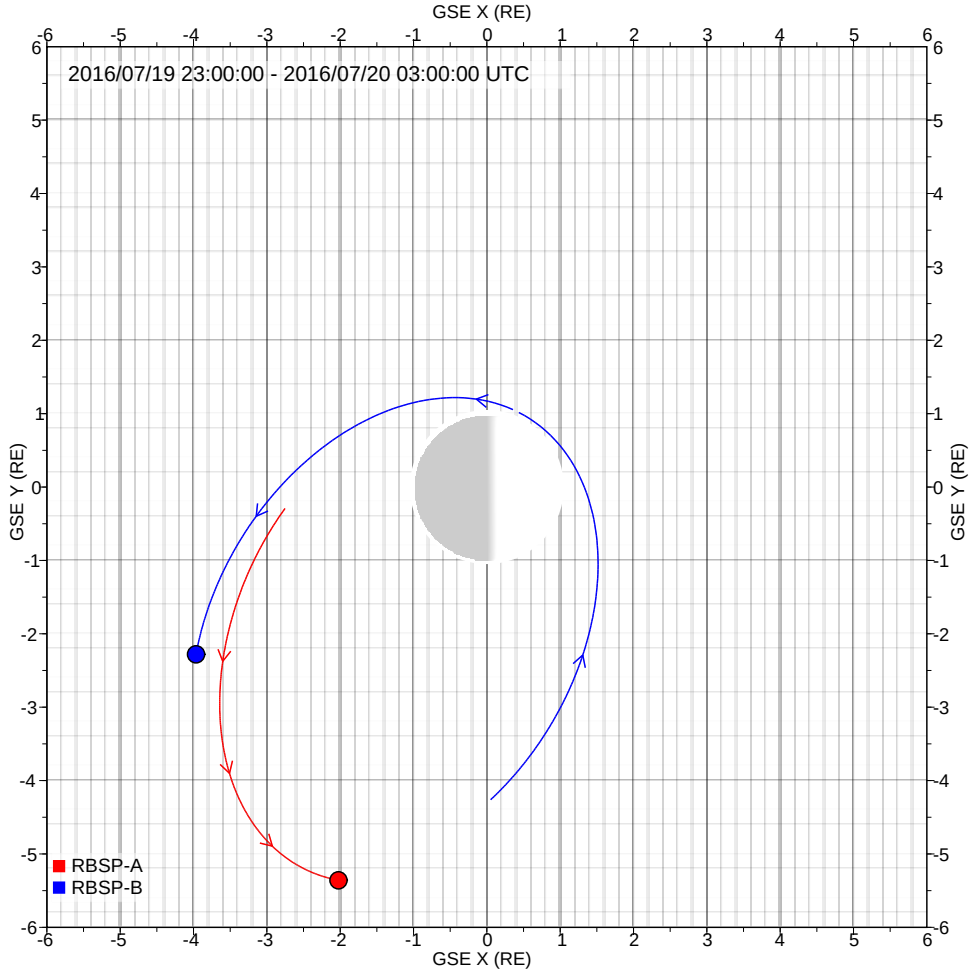
From ~23h00 – July 19, 2016

Rapid dropout observed by Van Allen Probes - VAP

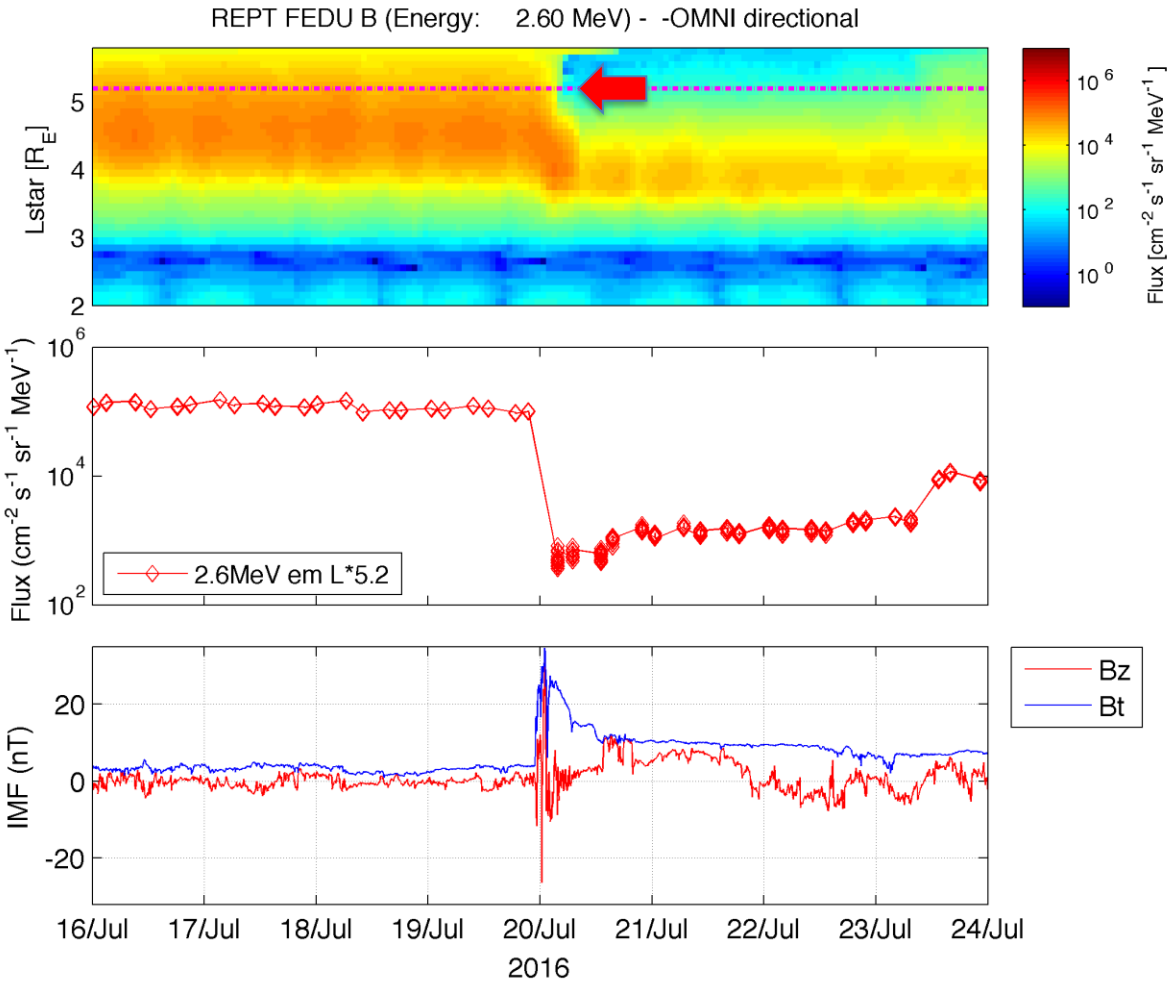


From ~02h00 – July 20, 2016

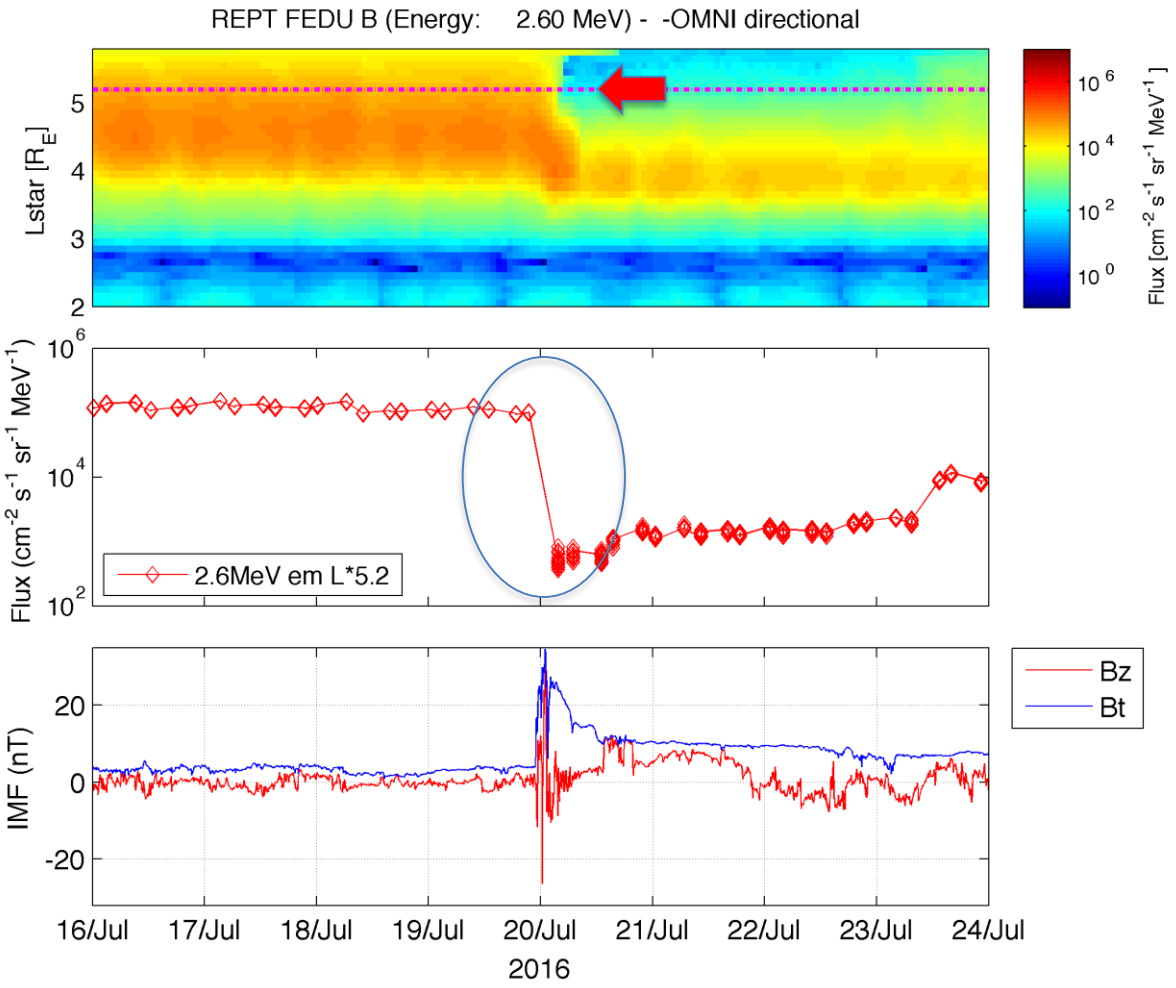
Orbit of VAP A and B



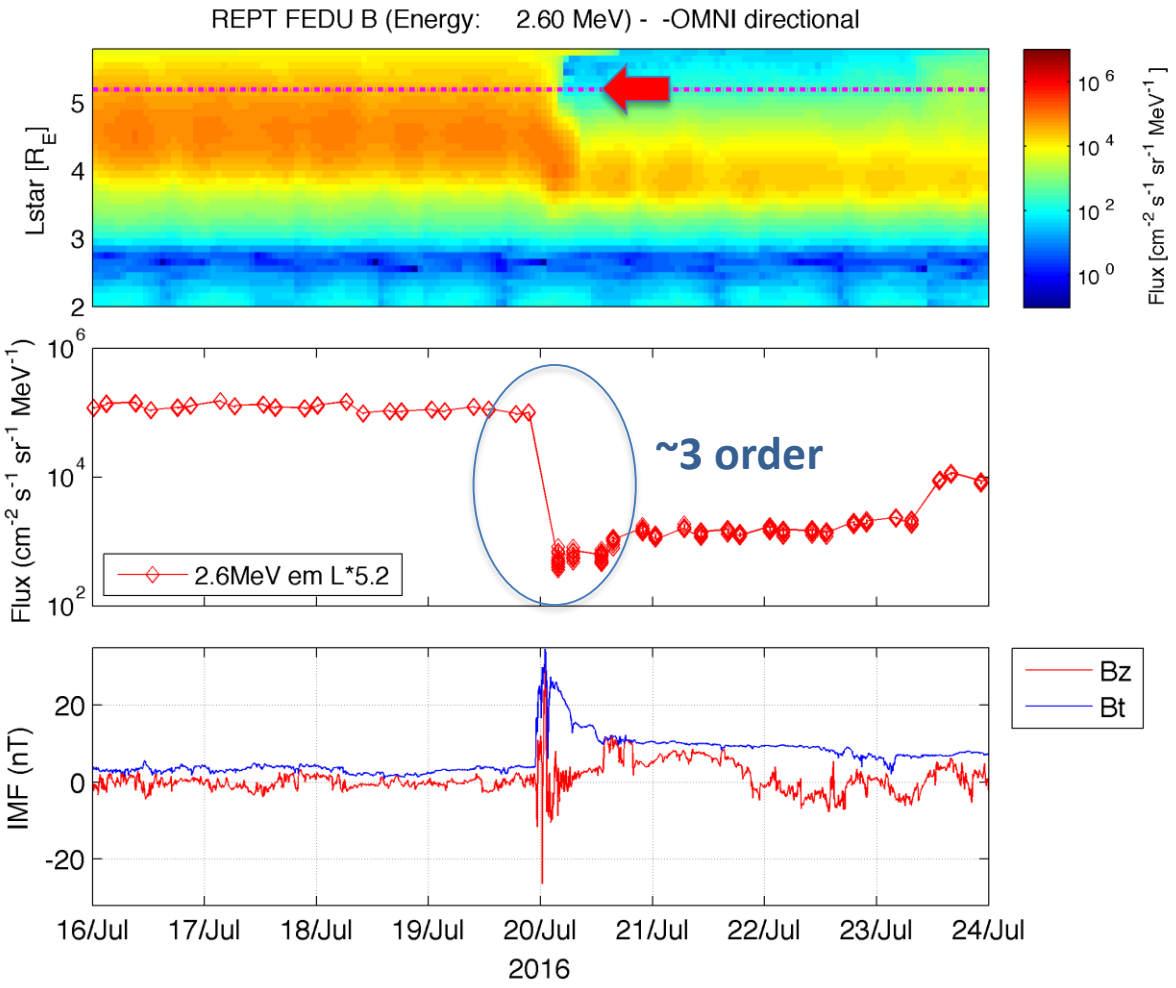
Rapid dropout during CME associated to shock



Rapid dropout during CME associated to shock

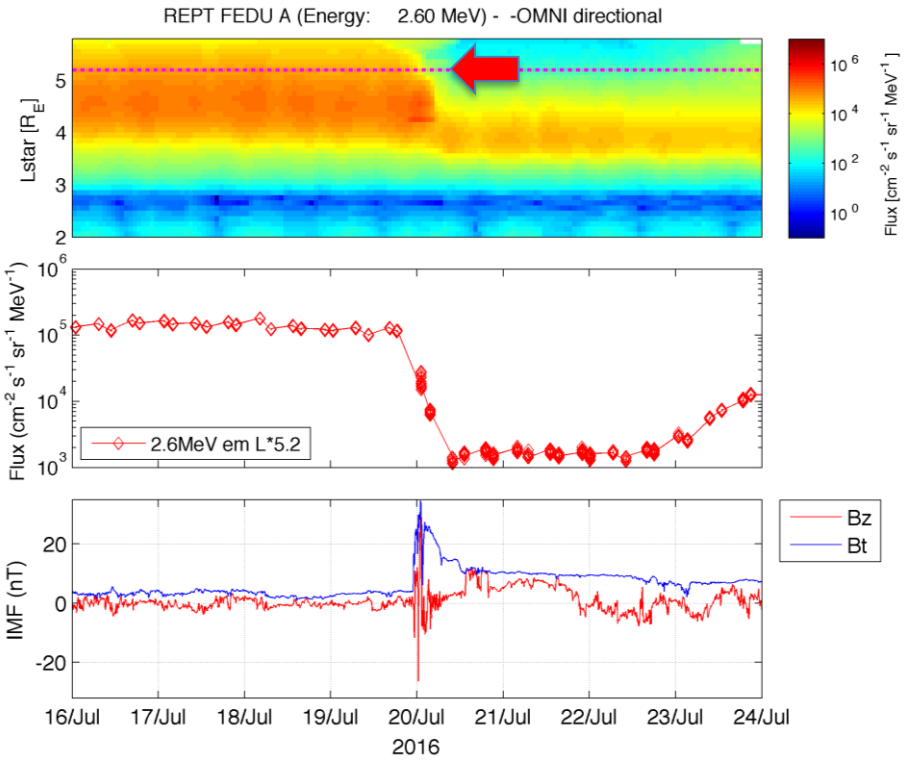


Rapid dropout during CME associated to shock

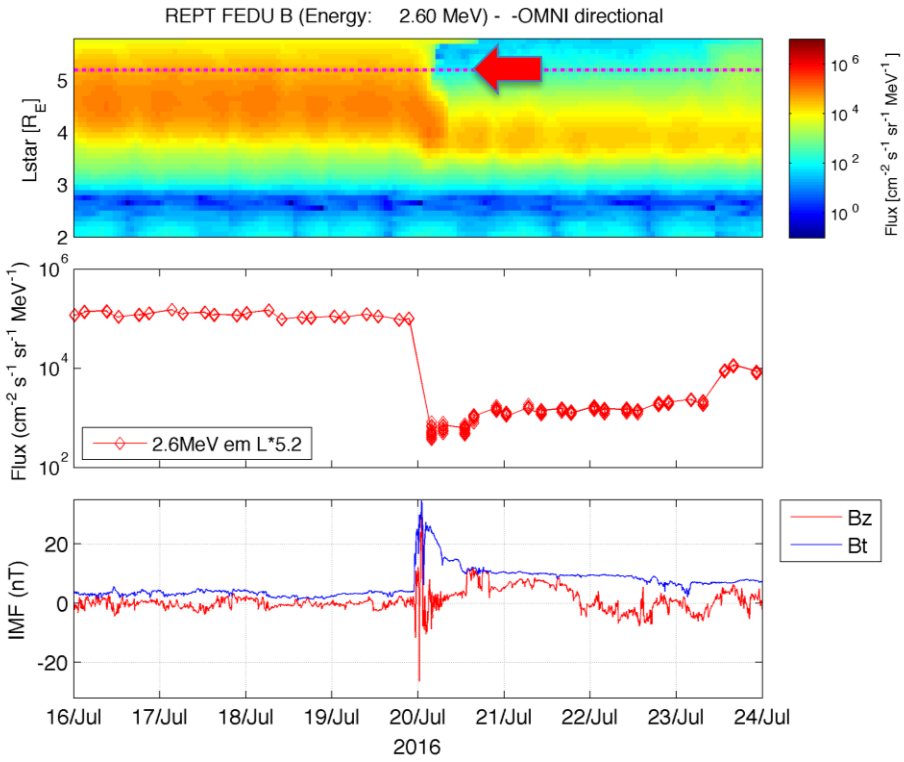


Rapid dropout
Order of magnitude L*=5.2 Re

VAP A



VAP B



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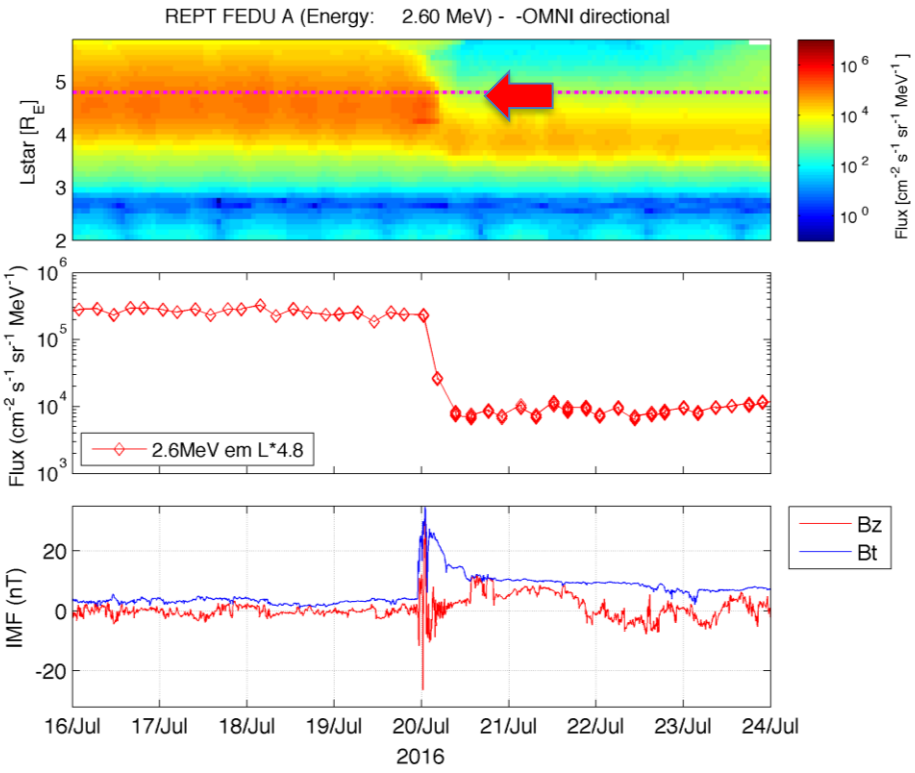
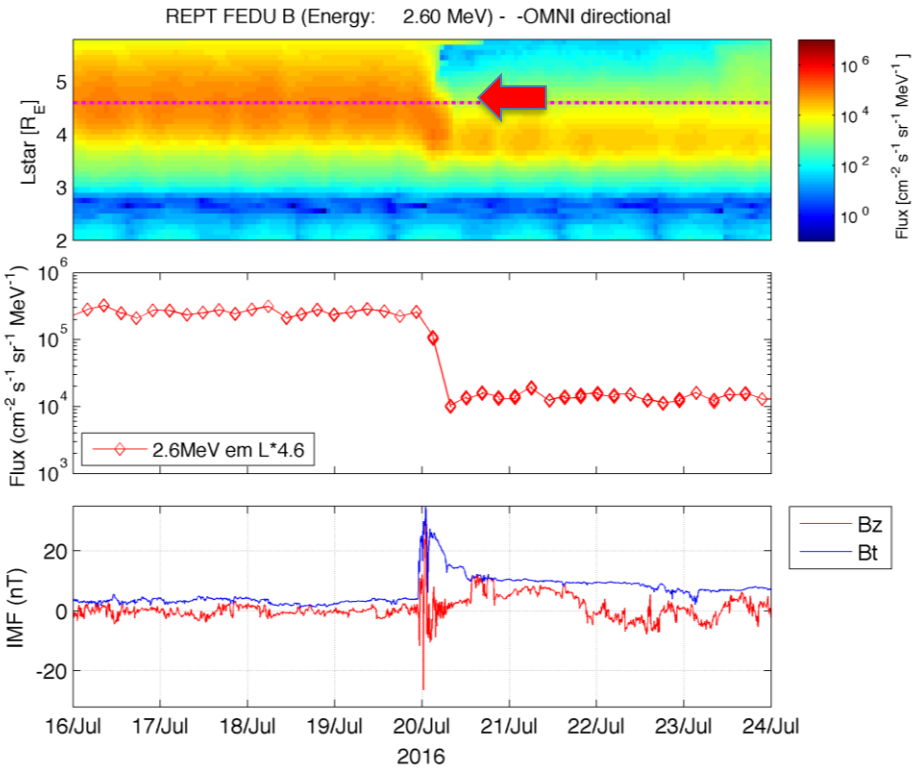
Rapid dropout
Order of magnitude L*< 5 Re

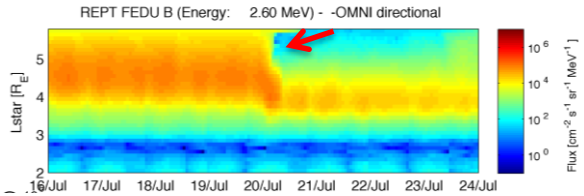
VAP A



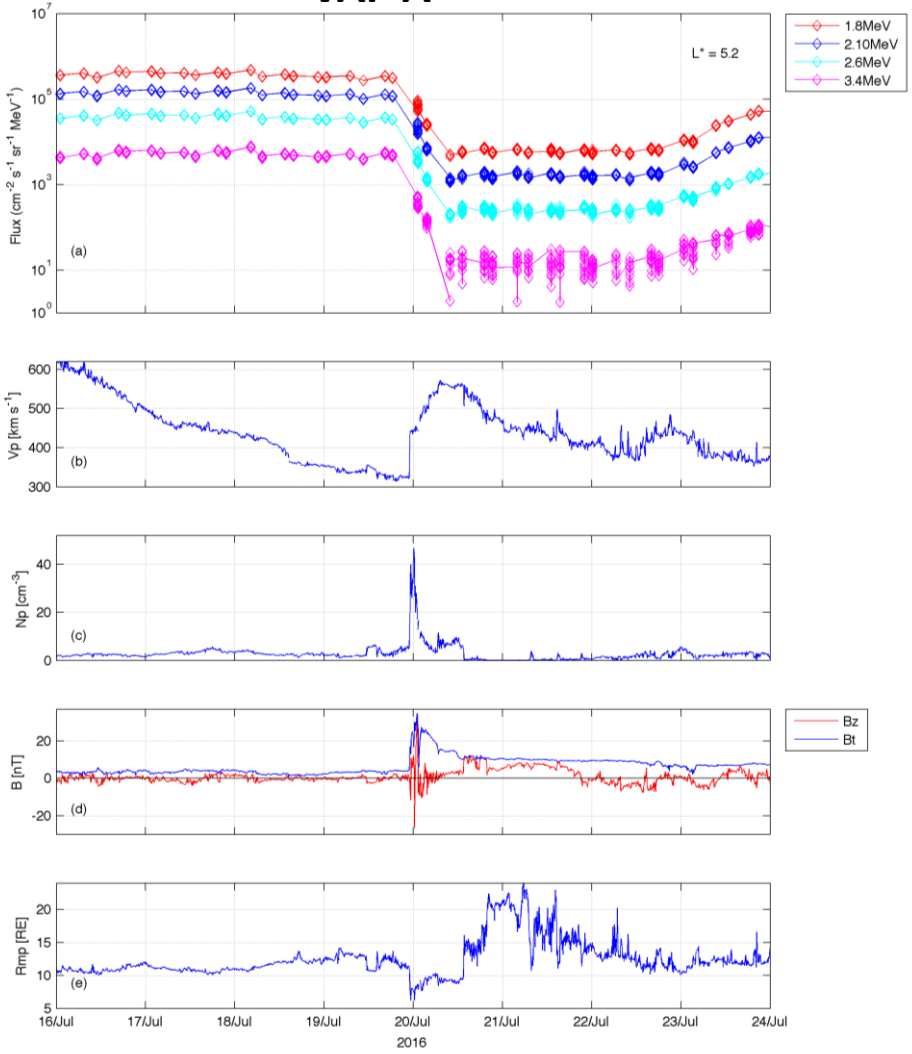
VAP B



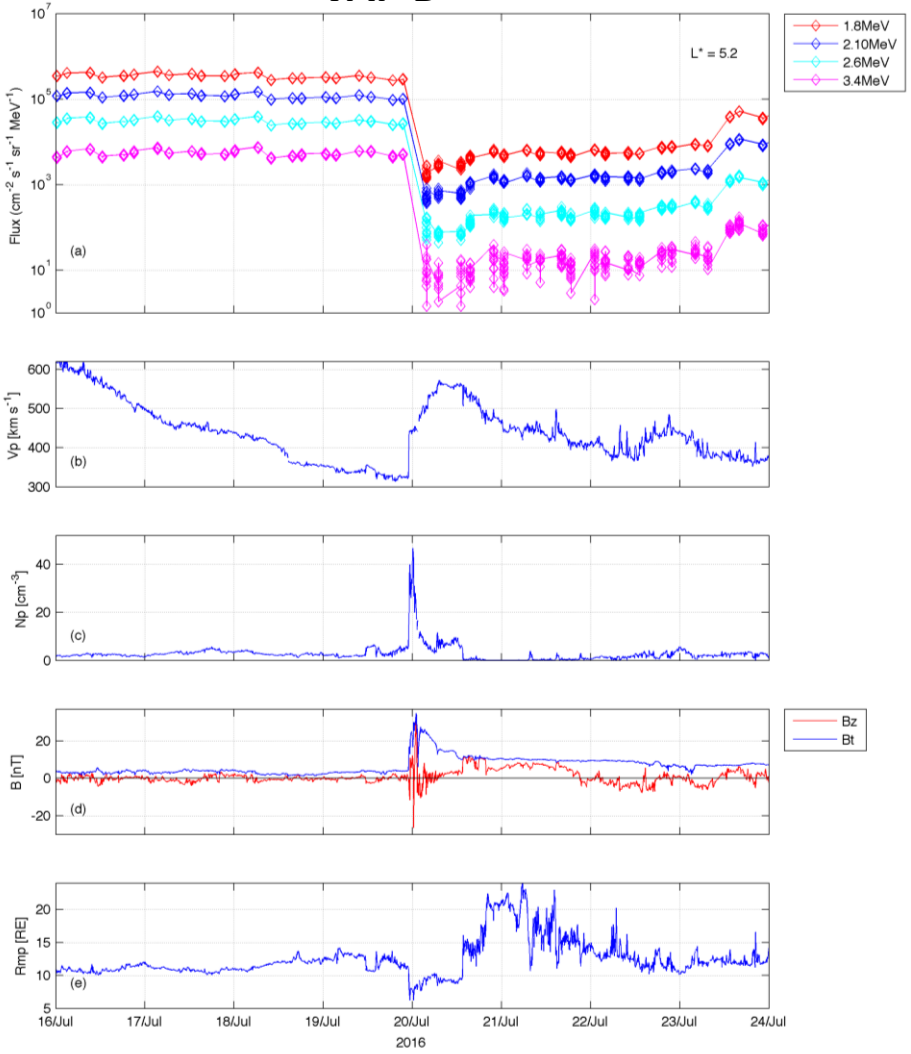
High energy electron flux
Interplanetary Medium Conditions – ACE satelite



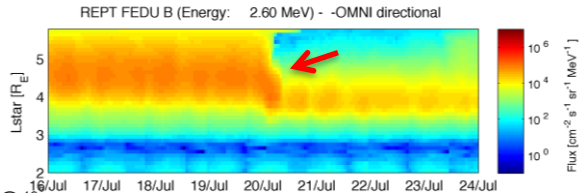
VAP A



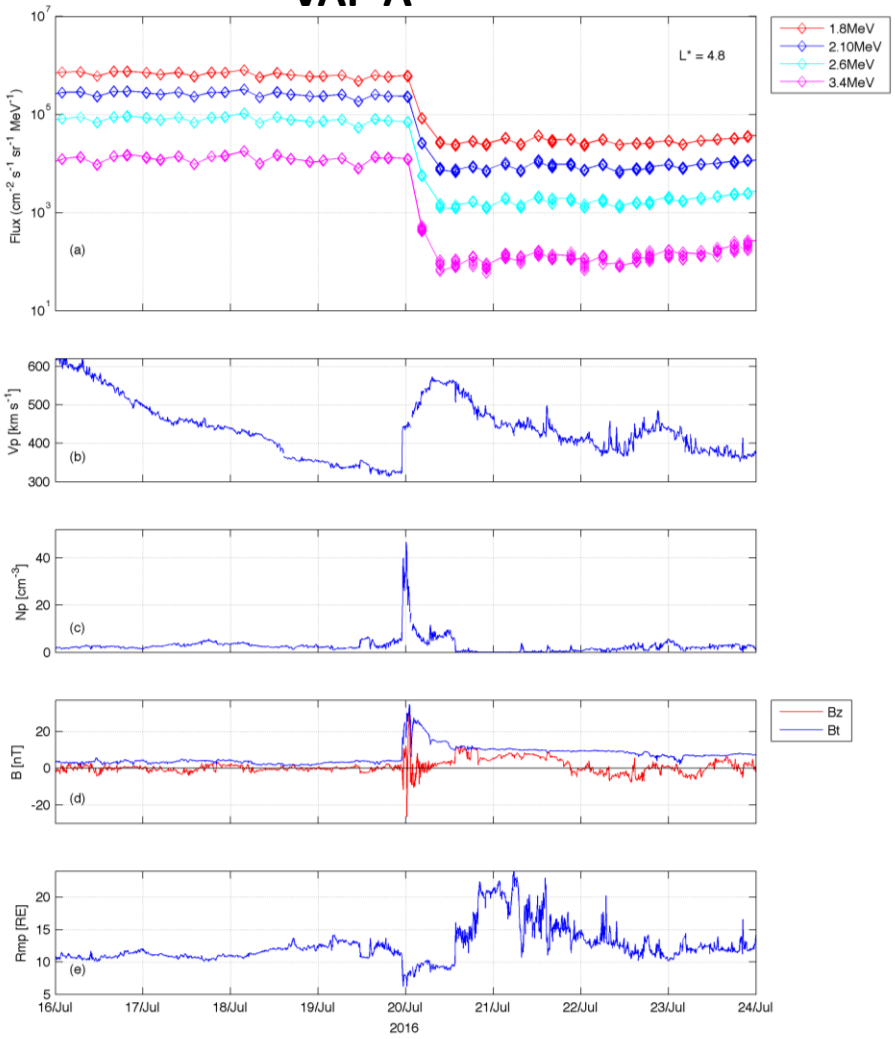
VAP B



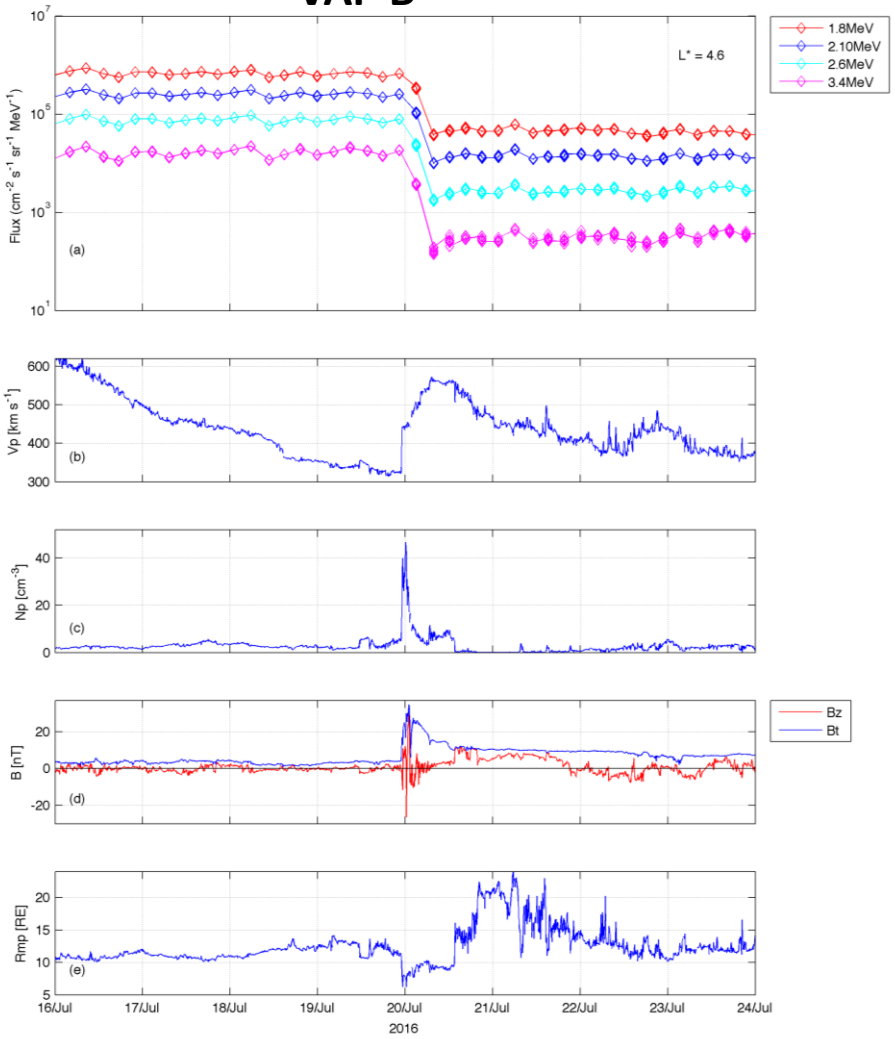
High energy electron flux
Interplanetary Medium Conditions – ACE satelite



VAP A



VAP B

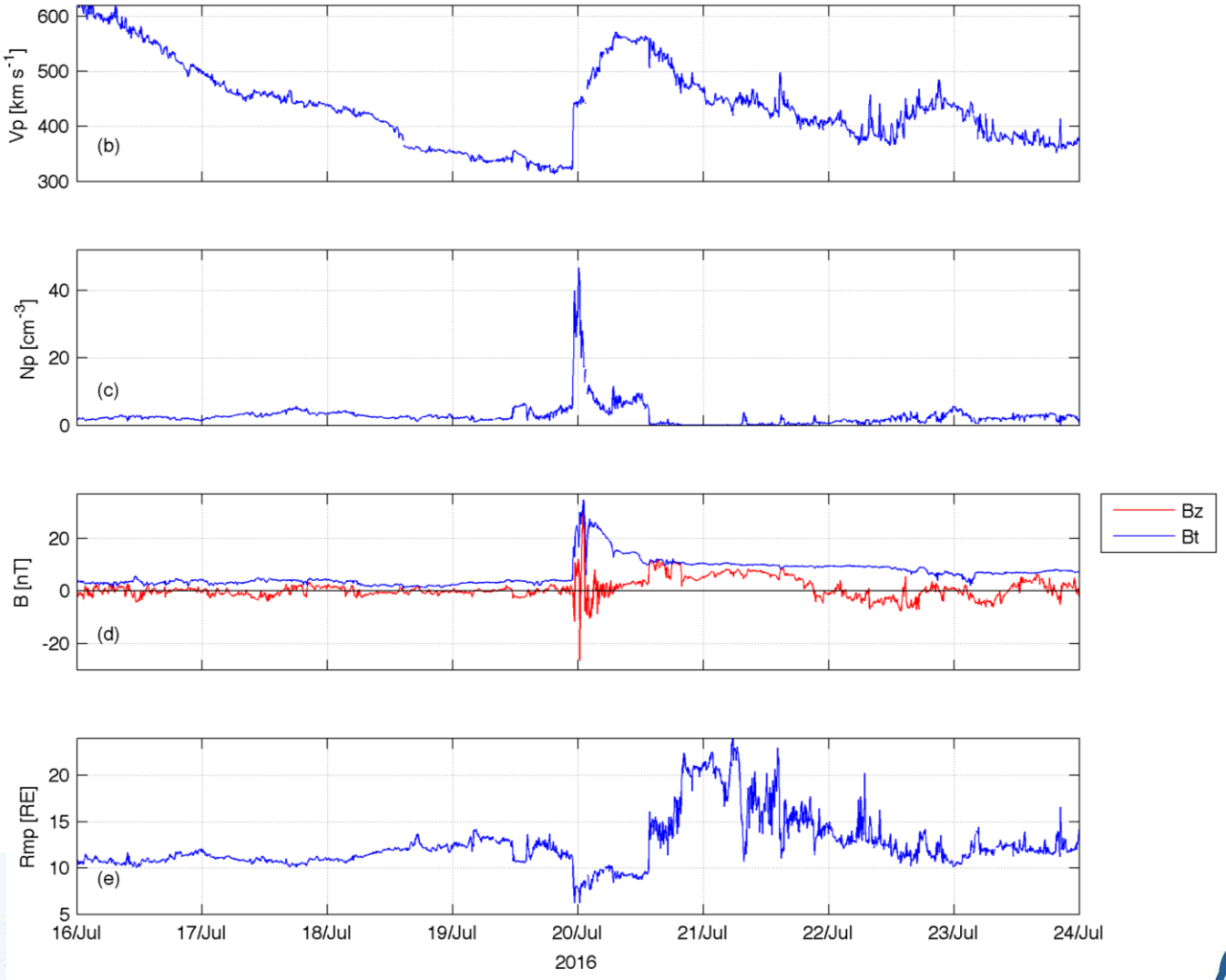


Mechanisms investigated

- Magnetopause Shadowing
  - Magnetopause standoff distance
- Outward Radial diffusion
  - ULF waves

- Magnetopause Shadowing
  - Magnetopause standoff distance
    - Shue et al, 1998 Model
    - Magnetohydrodynamic Model (BATS-R-US)

Magnetopause standoff distance
-Shue Model-



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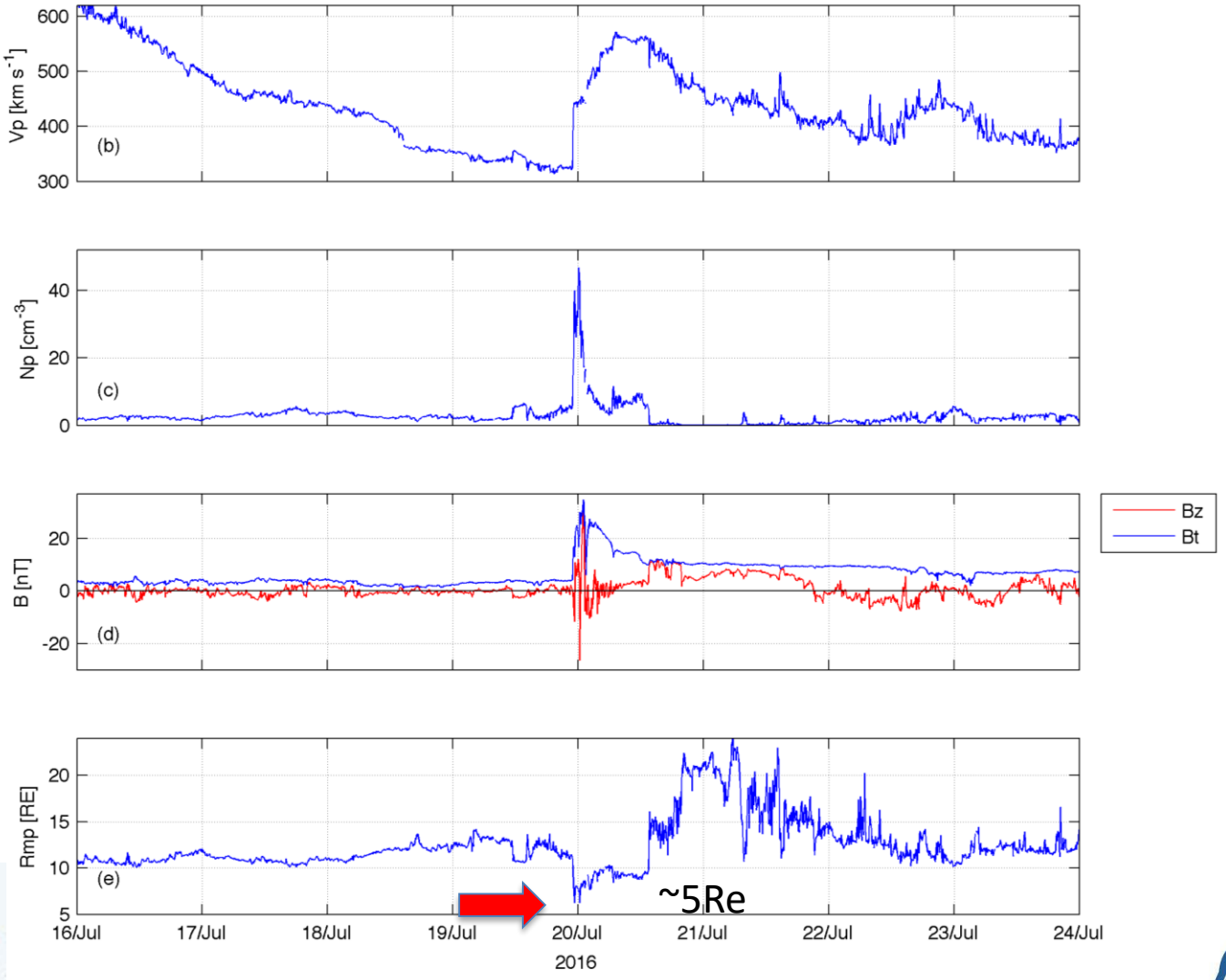
Magnetopause standoff distance
-Shue Model-



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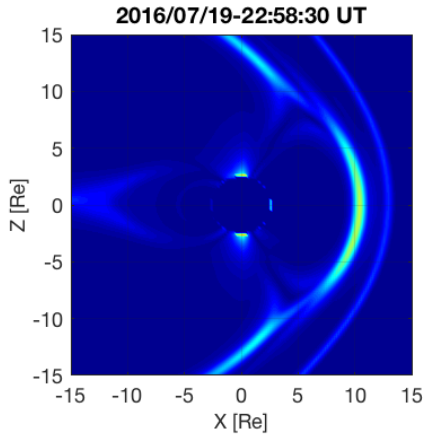
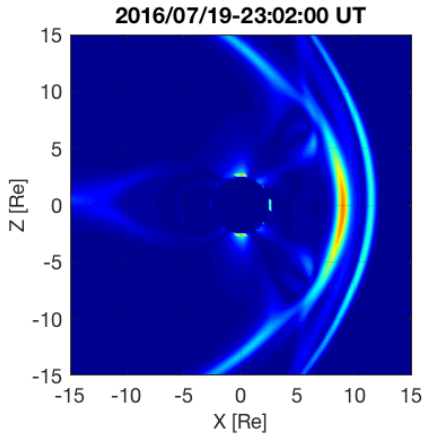
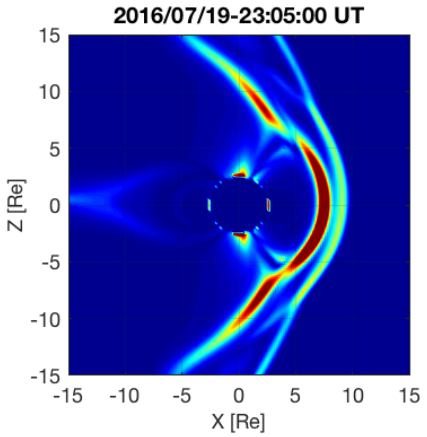
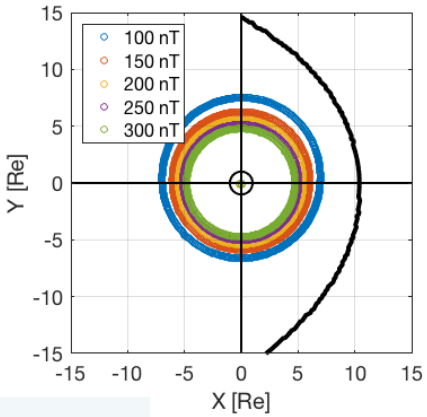
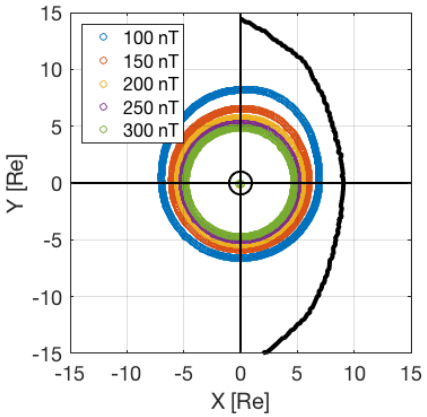
Magnetopause standoff distance
-MHD-

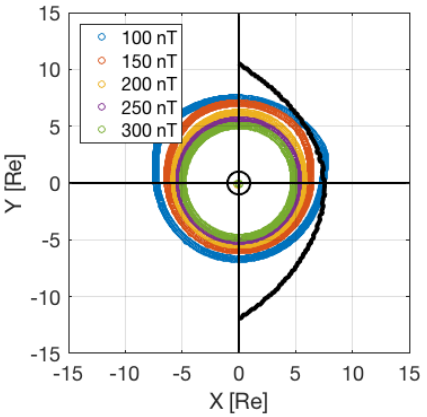












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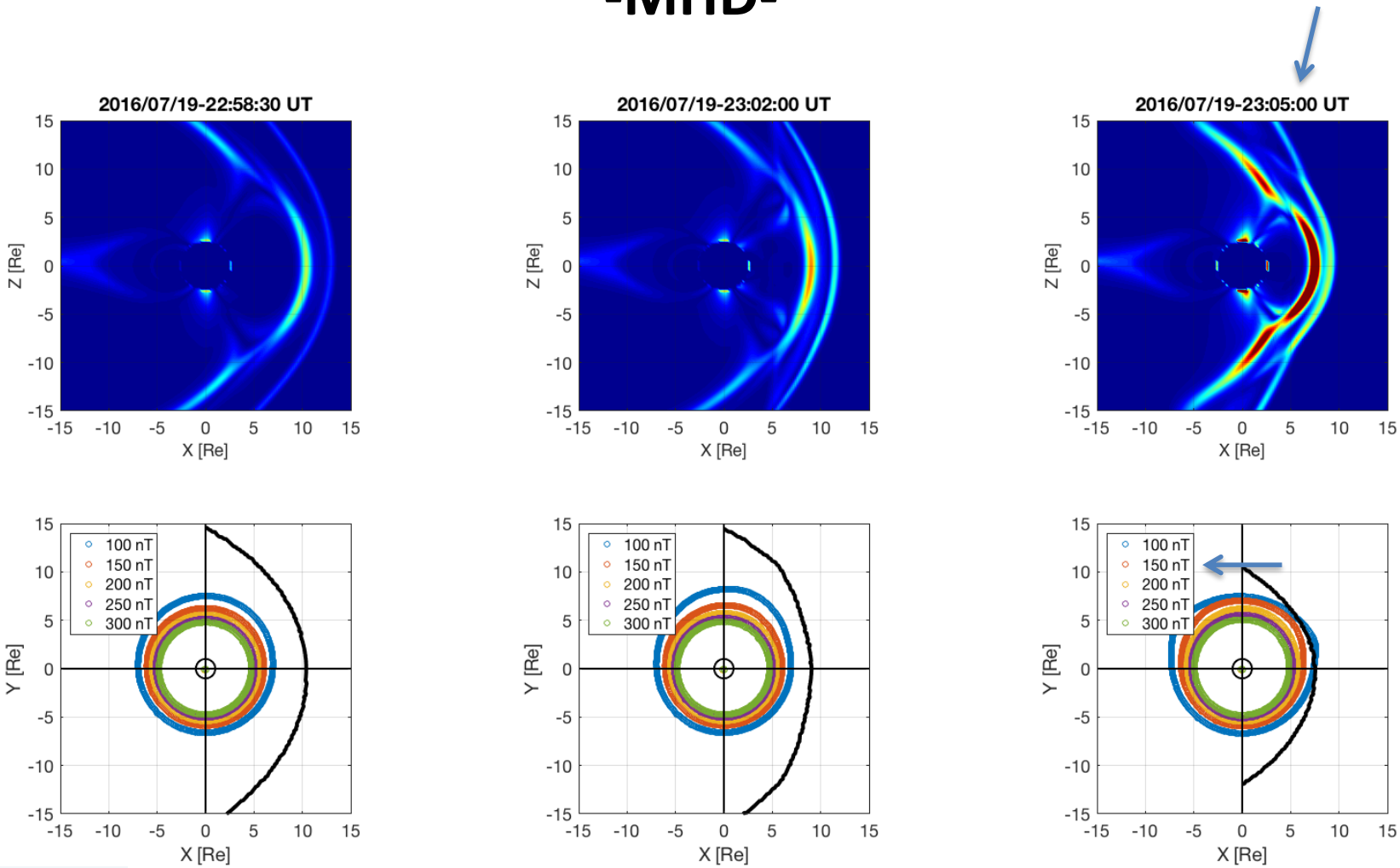
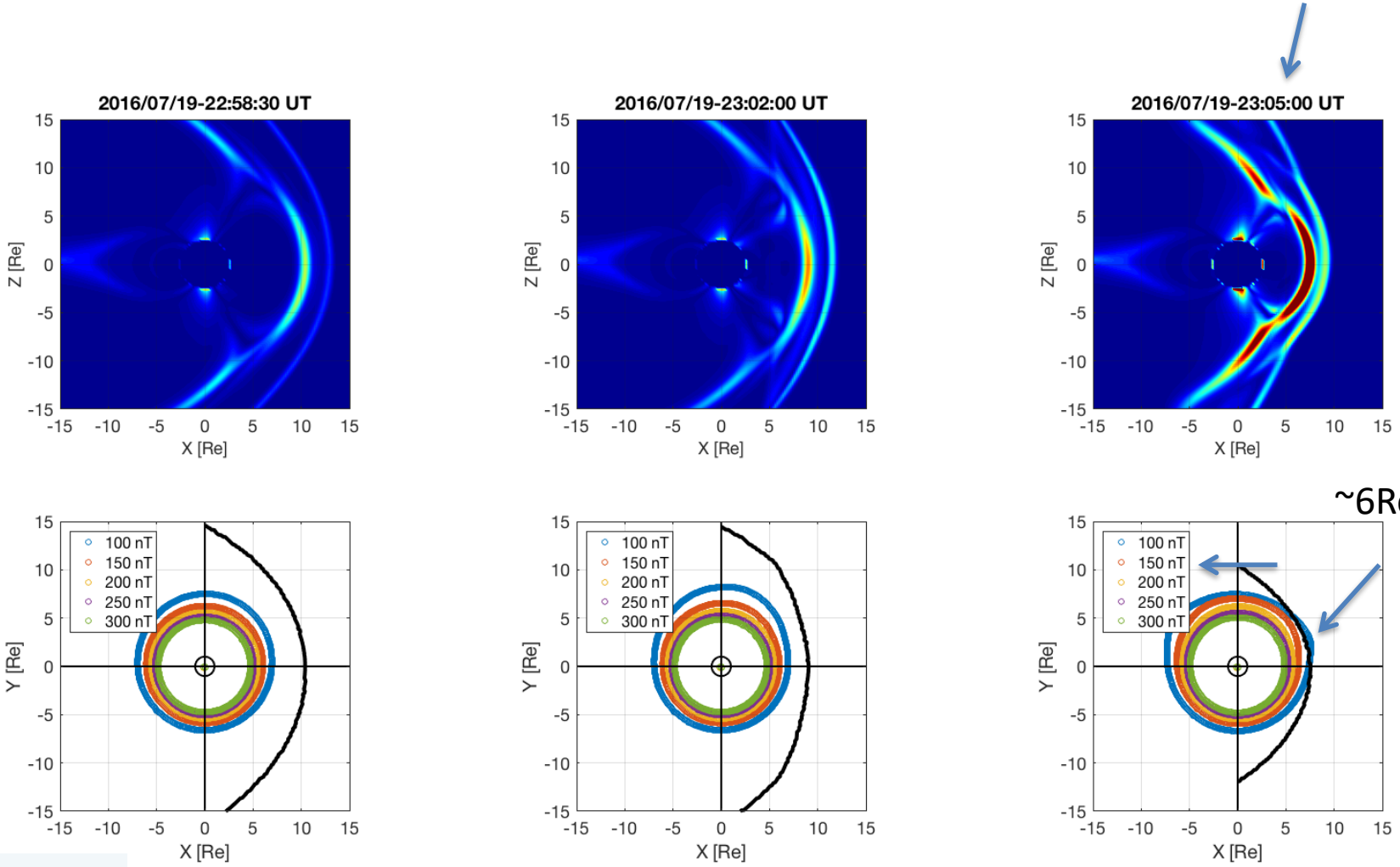
Magnetopause standoff distance
-MHD-



Magnetopause standoff distance
-MHD-

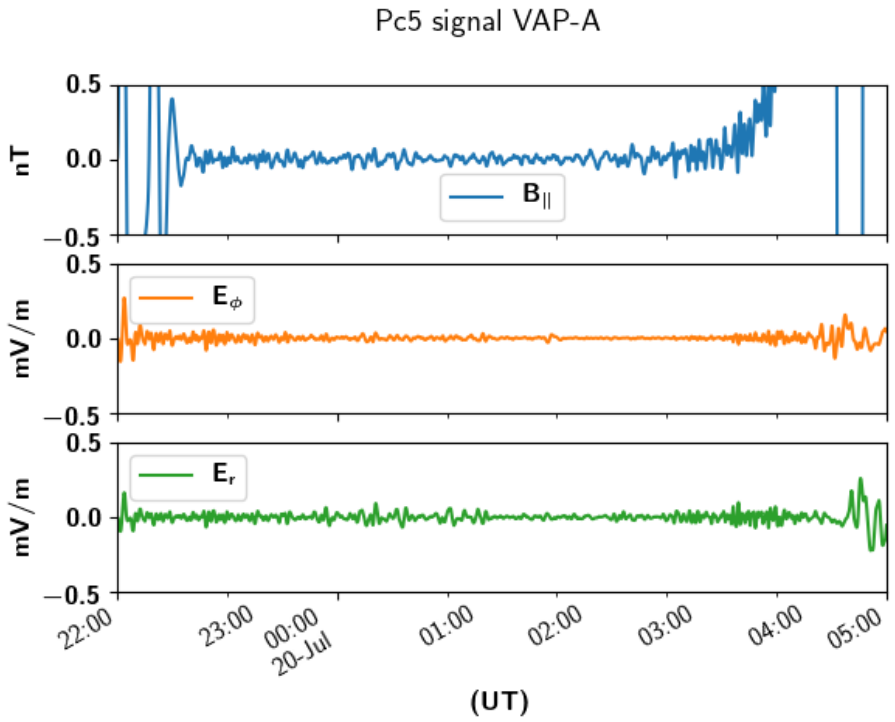


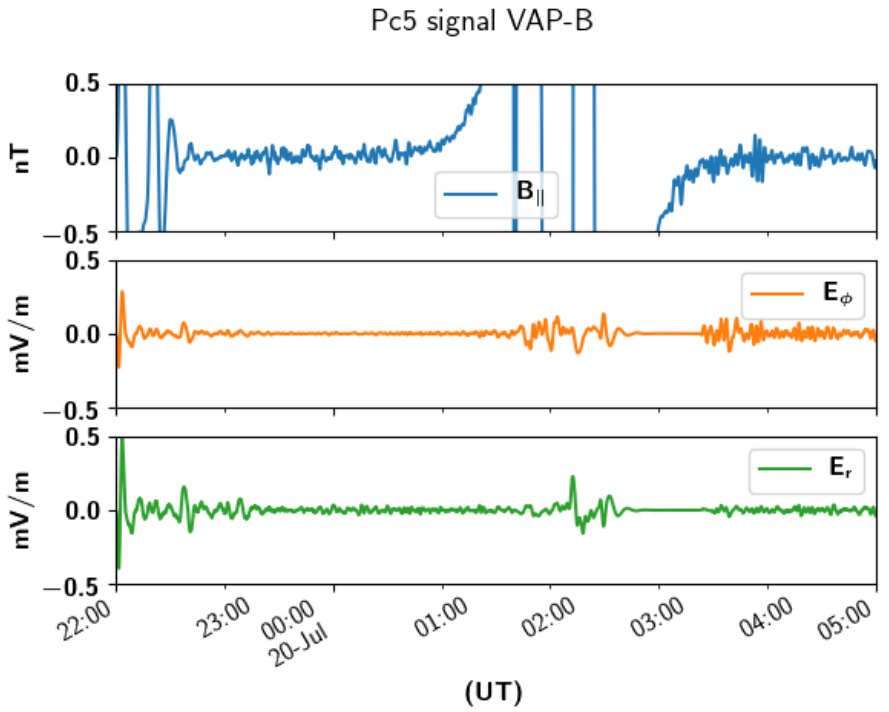
- Radial Diffusion

  – ULF waves activity (Pc5)

    - Van Allen Probes - Emfisis (In situ)
    - IMAGE network (Ground data)
    - Magnetohydrodynamic Model (SWMF/BATS-R-US) (Gombosi et al., 2004; Tóth et al ., 2011)
    - Radial diffusion coefficient D_{LL} by Ozeke et al., 2014

ULF waves activity – Polarization modes





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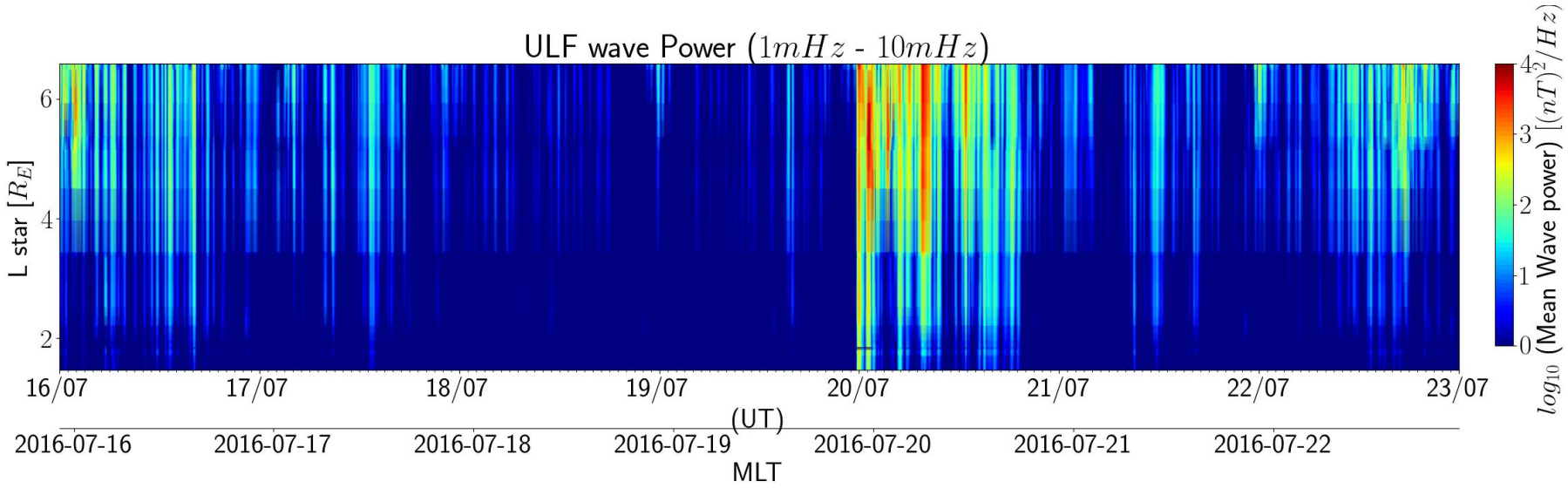
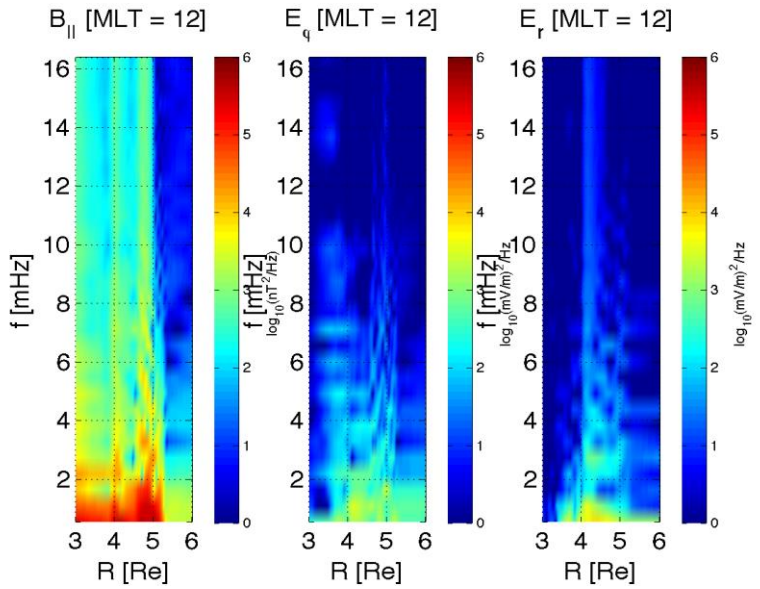
ULF Power Spectral Density – PSD
IMAGE network



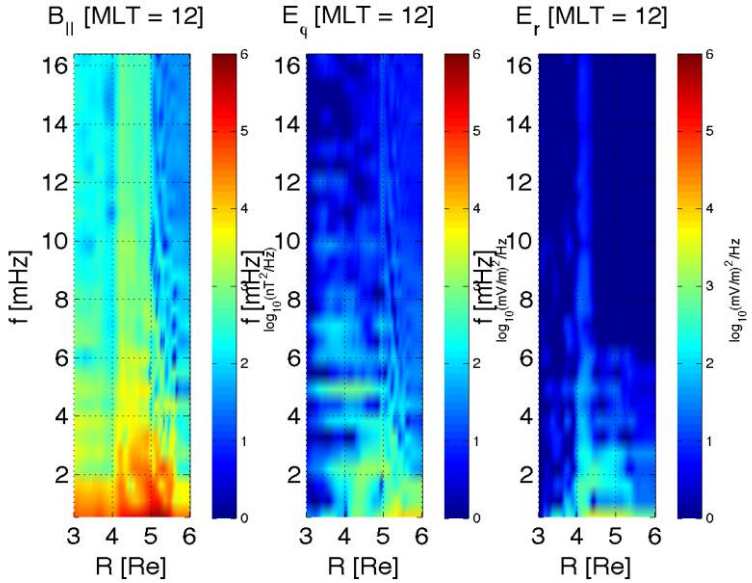
ULF power spectral density calculated from global MHD simulation **SWMF/BATS-R-US**

- Power spectral density were calculated for different magnetic local time (MLT)
- Calculation were performed for the compressional, toroidal and azimutal ULF wave modes
- In the following we present the PSD for MLT 12, considering the CME arrival at the Earth's magnetosphere.
- Neither Van Allen Probes A and B were at the magnetospheric dayside during the shock arrival
- The time interval considered in the FFT is shown for each PSD plot
- ULF waves evolve in the radiation belts region as a function of the solar wind structure arrival

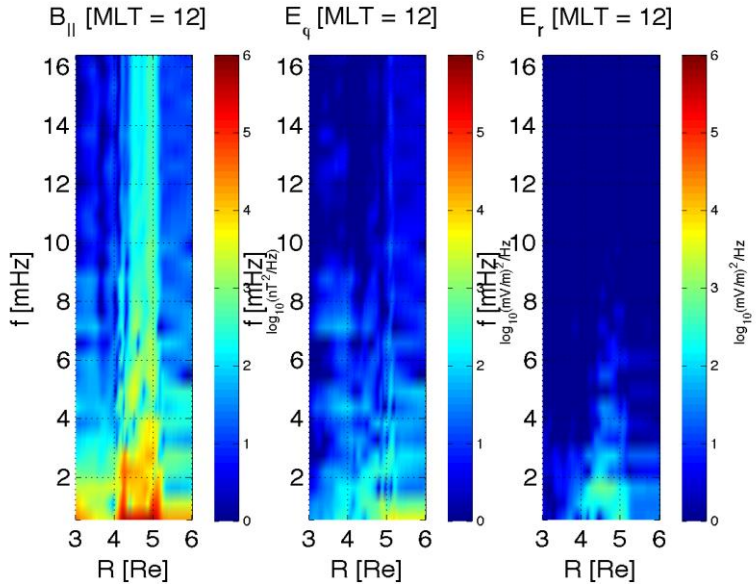
24:30 to 01:00



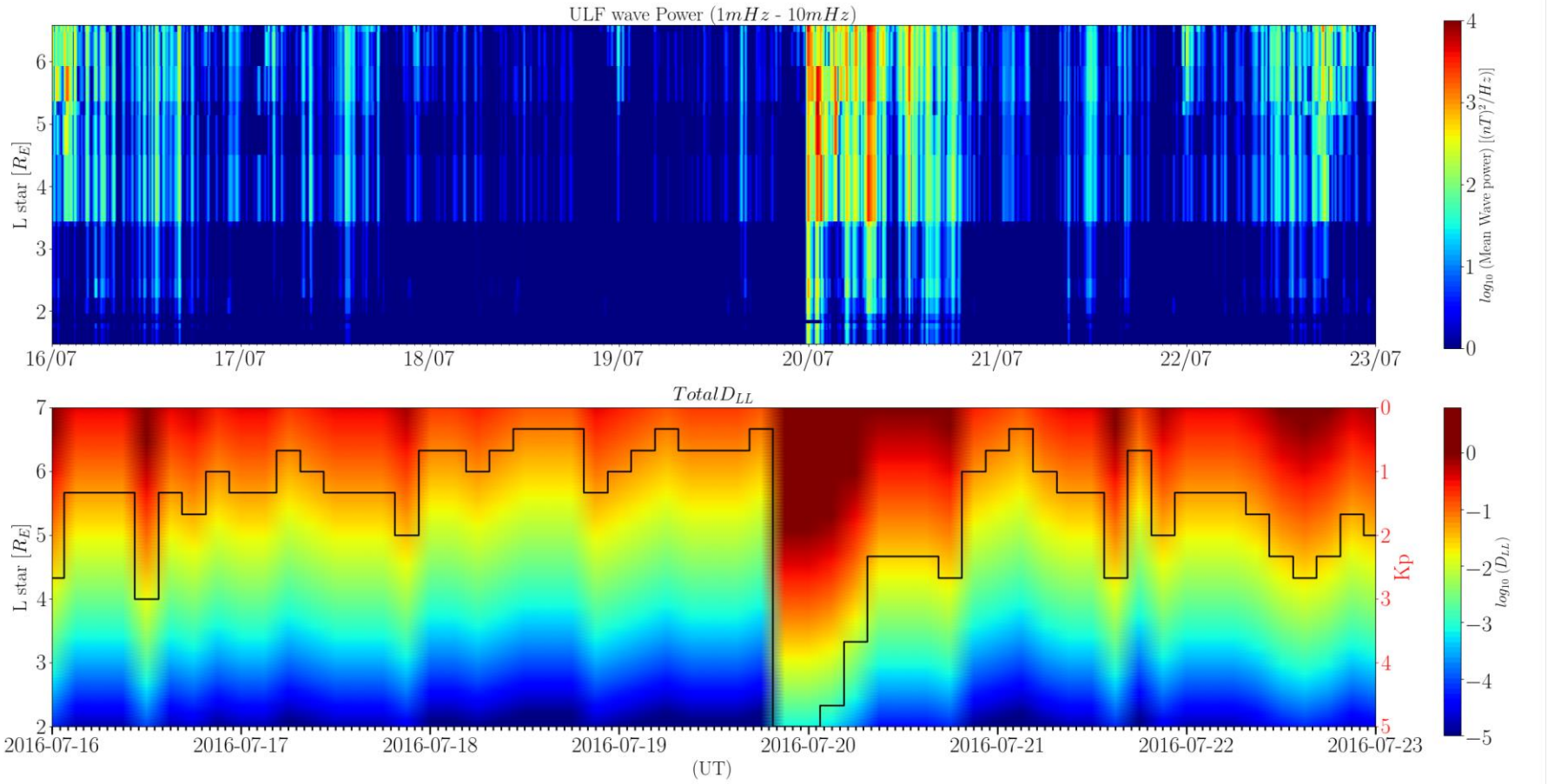
01:00 to 01:30



01:30 to 02:00



Radial diffusion Coefficient (D_{LL})
Ozeke et al., 2014

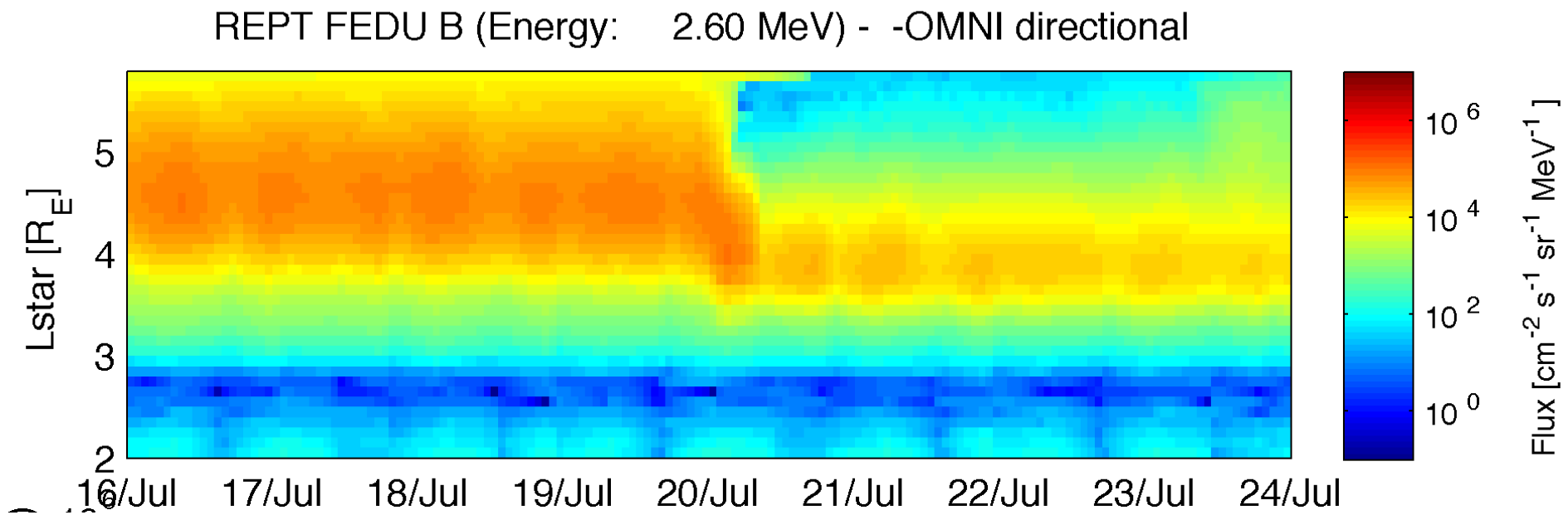


Mechanism investigated

- Magnetopause Shadowing
  - Magnetopause standoff distance
- Outward Radial diffusion
  - ULF waves

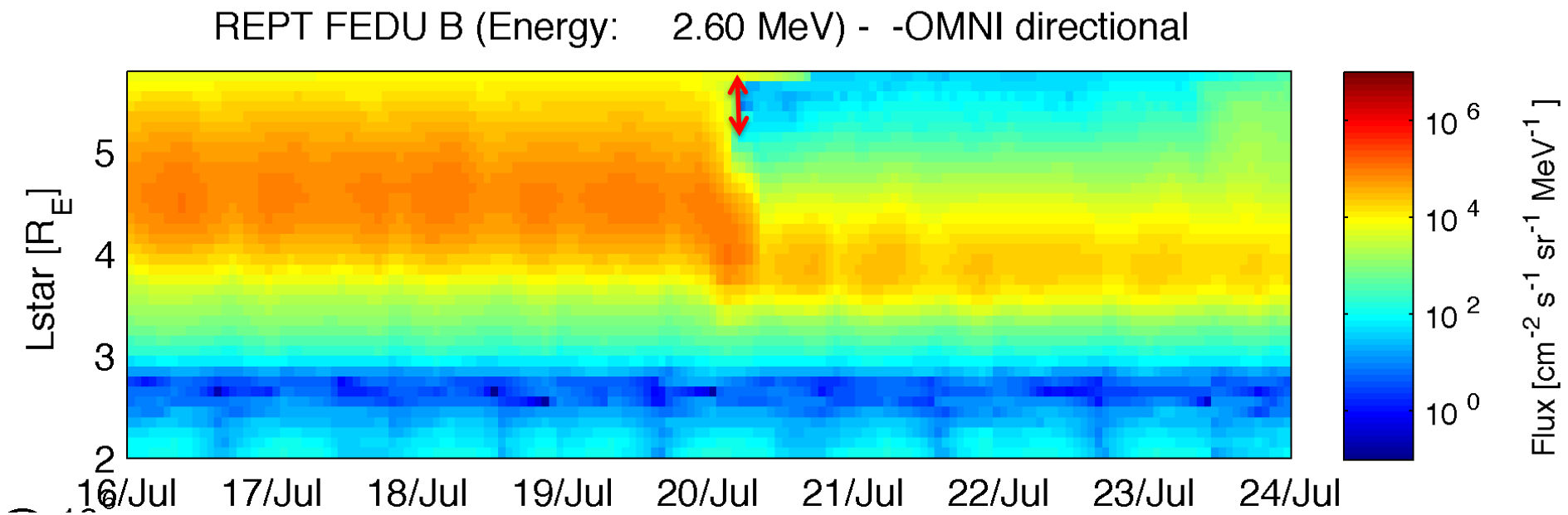
Suggestions

Magnetopause shadowing contribution: L*= ~5-6 Re



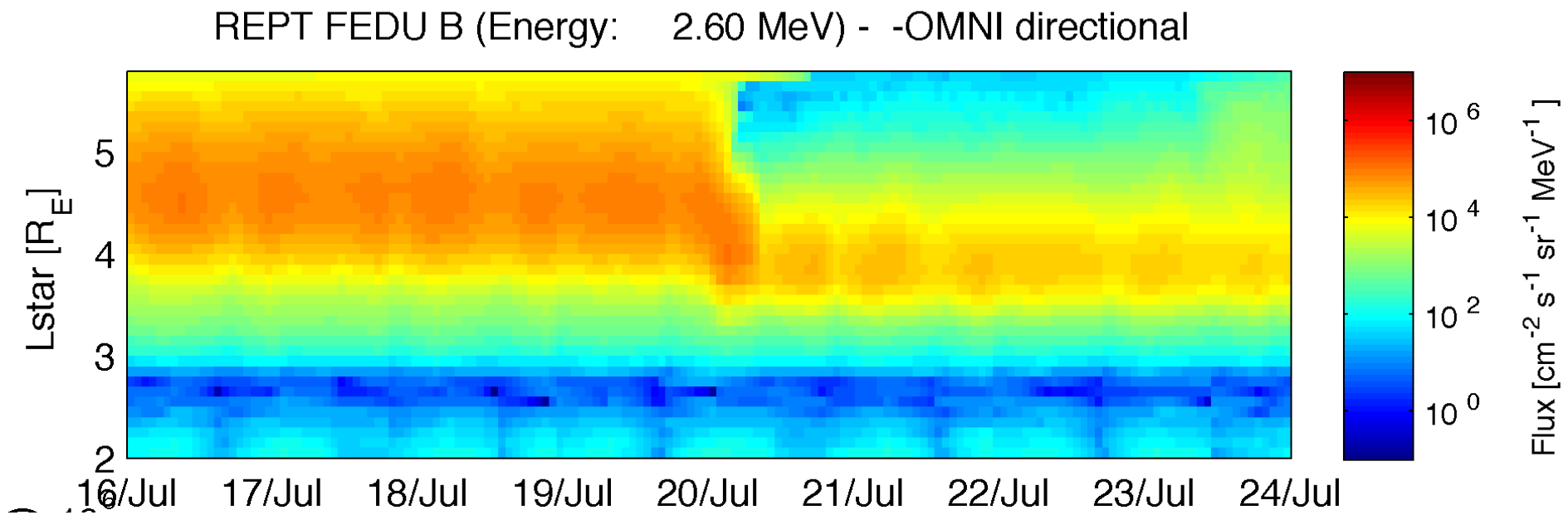
Suggestions

Magnetopause shadowing contribution: L*= ~5-6 Re



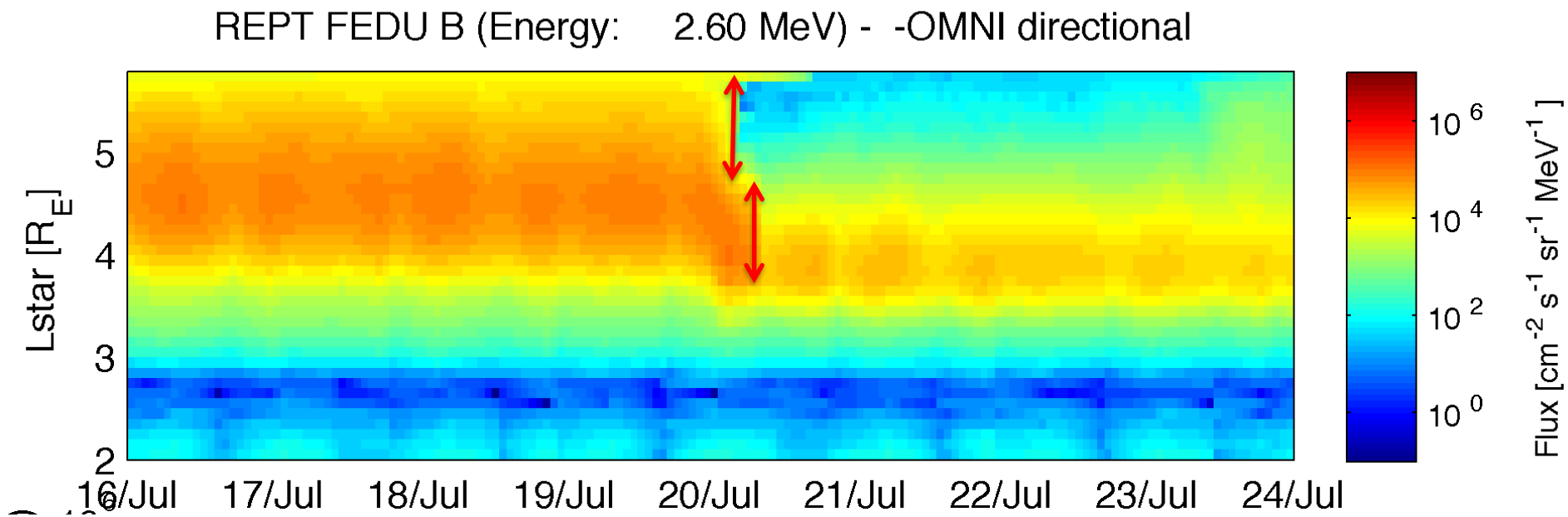
Suggestions

ULF contribution: L*= ~4-6 Re



Suggestions

ULF contribution: L*= ~4-6 Re



To do list

- EMIC wave activity
- 1D radial diffusion simulation (D_{LL} – Ozeke et al., 2014)

Thank you !!

E-mail: ligia.alves01@gmail.com
ligia.silva@inpe.br

MHD Model Description

To perform this numerical study we used:

1- Space Weather Modeling Framework/Block-Adaptive Tree-solar Wind Roe-Type Upwind Scheme (SWMF/BATS-R-US)(Gombosi et al., 2004; Tóth et al ., 2011 and references therein).

2- Simulation domain was set to: $-224 \leq x \leq 32$(RE); $-64 \leq y \leq 64$(Re) ; $-64 \leq z \leq 64$ (RE), where x, y and z are Geocentric Solar Magnetospheric (GSM) Coordinates.

3- Inner Boundary of the Global Magnetosphere (GM) is located at ~ 2,5 RE.

4-The models that are coupled to the inner magnetosphere are:

5- Ionospheric Model (IE)(Ridley and Liemohn, 2002; Ridley, Gombosi, and DeZeeuw, 2004).

6- Rice Convection Model (RCM, De Zeeuw et al. (2004).

7- We used the resolution of the 1/8 RE in a box surrounding the Earth with the following dimensions: $-7 \leq x \leq 7$ RE, $-7 \leq y \leq 7$ RE, and $-3 \leq z \leq 3$ RE. This high resolution grid that we chose wish was to resolve electric and magnetic field fluctuations in the ULF range within the Van Allen belts region, which is entirely confined inside this box.

Power Spectral Density

- Quanto ao Psd dos dados de solo,
- São 18 magnetômetros da rede IMAGE. Combrem uma faixa latitudinal entre ~35° e ~67° N.
- Para cada magnetômetro é feito o espectro de potência e extrai a densidade na frequência média do intervalo.
- Essa densidade média é organizada de acordo com a latitude (convertida em L-Shell).
- A resolução dos dados é de 1s, tanto para os dados de solo como os da VAP.