Location and dynamics of the plasmapause compared to the outer radiation belt electrons

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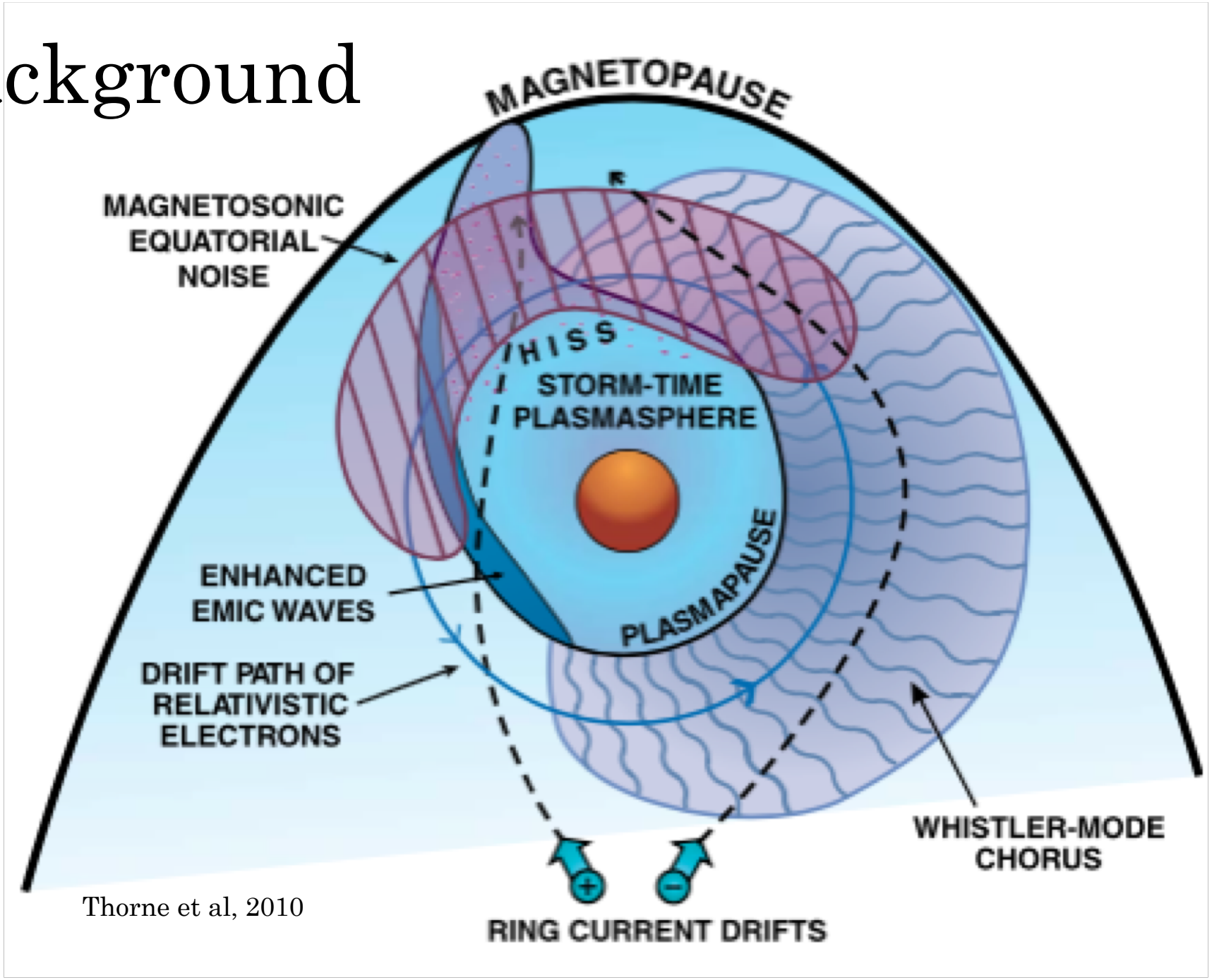
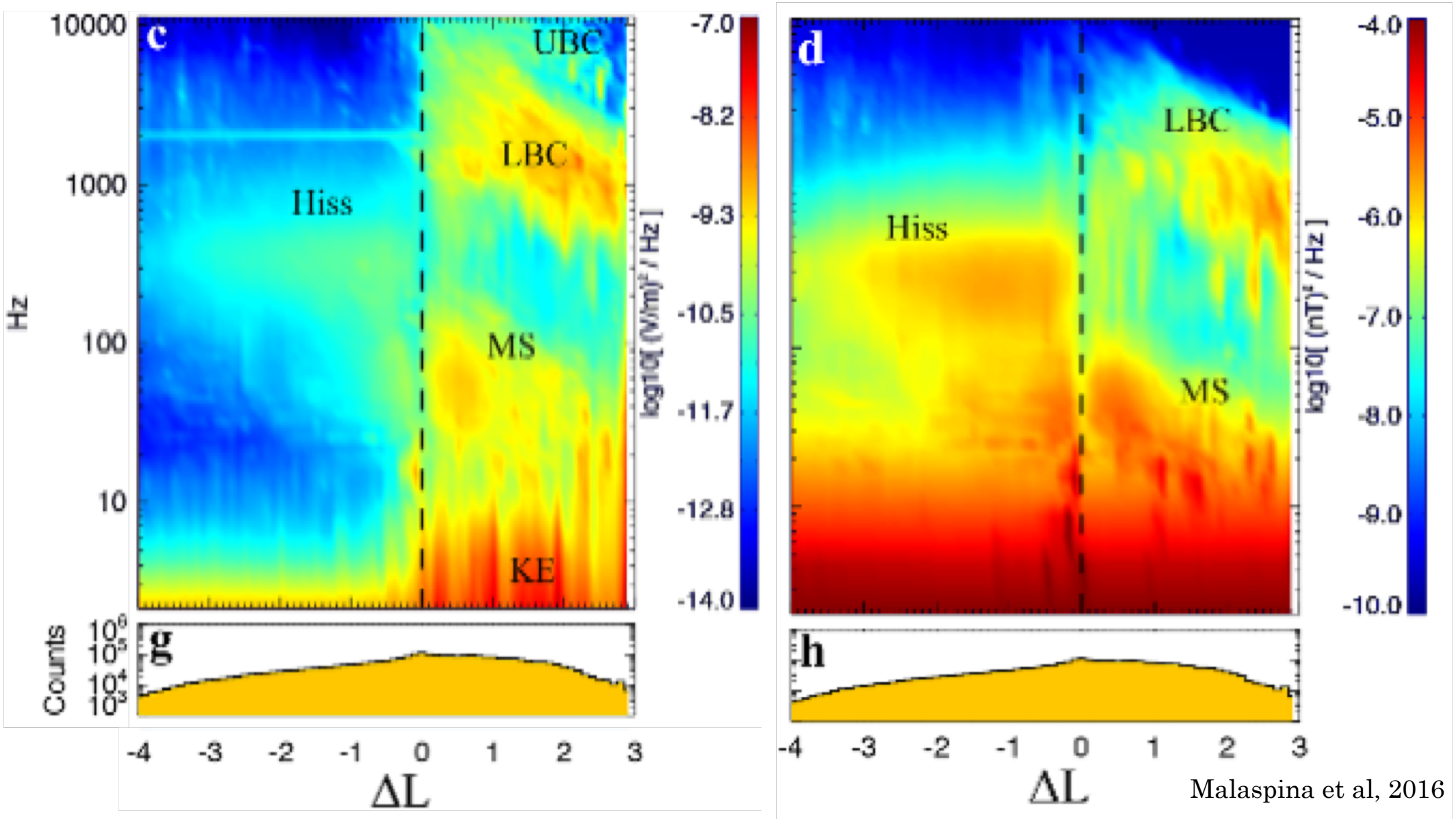
Background



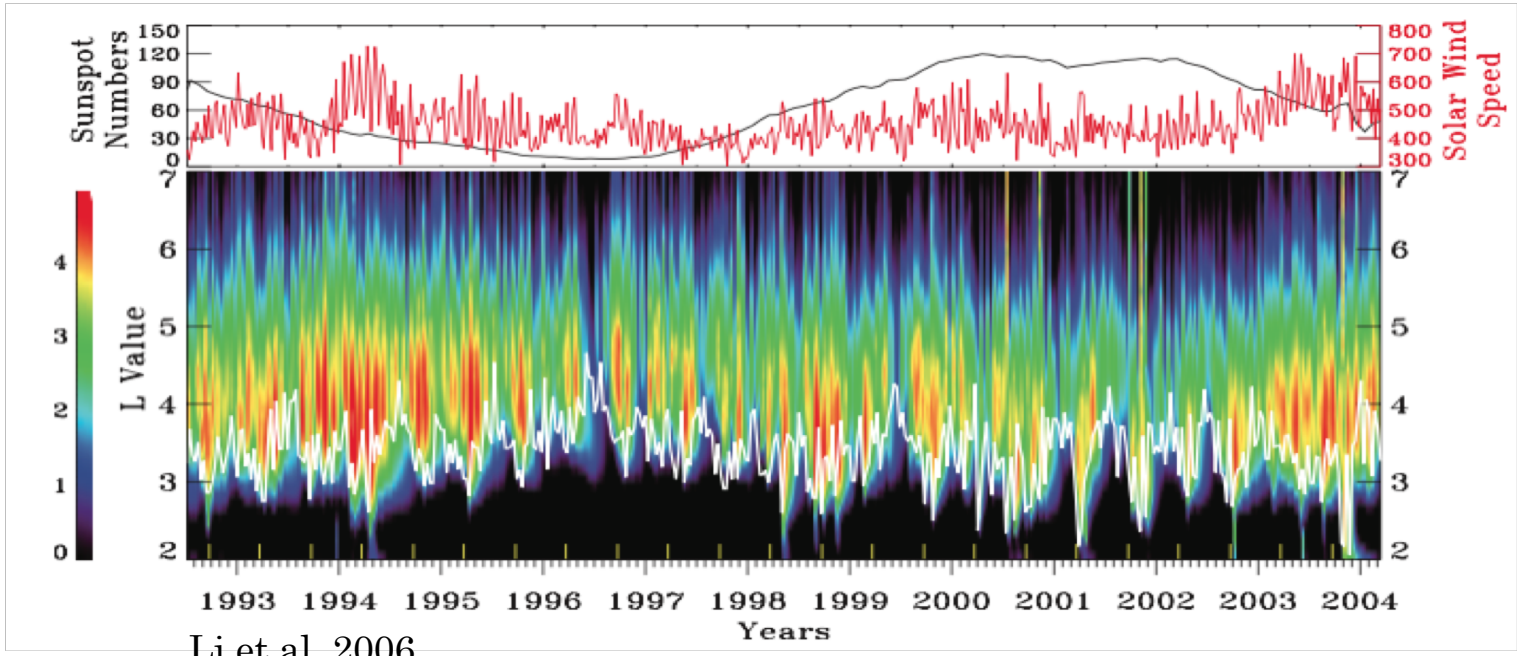
Thorne et al, 2010

Previous Studies – Chorus Waves

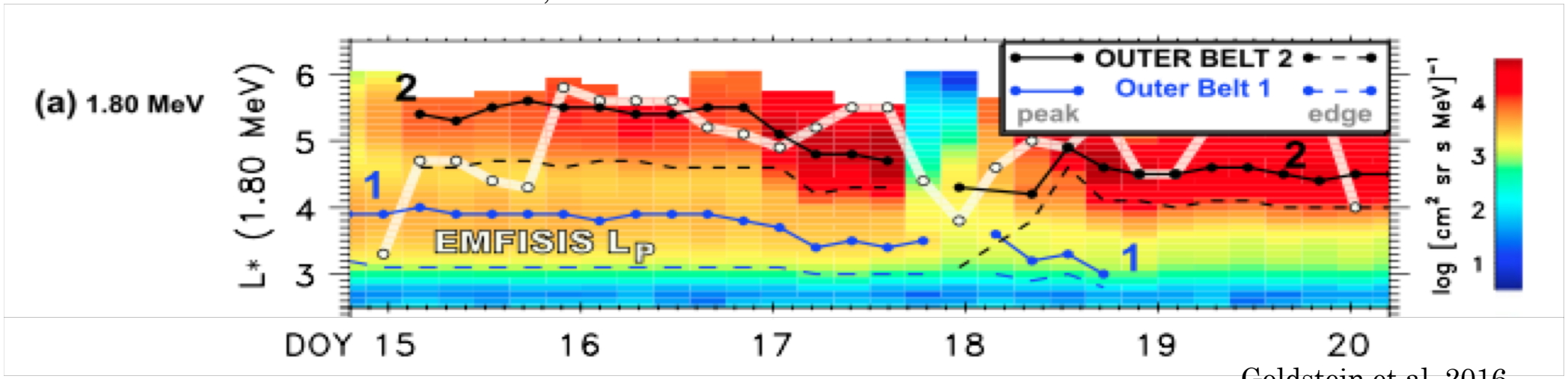


Malaspina et al, 2016

Previous Studies - Plasmapause

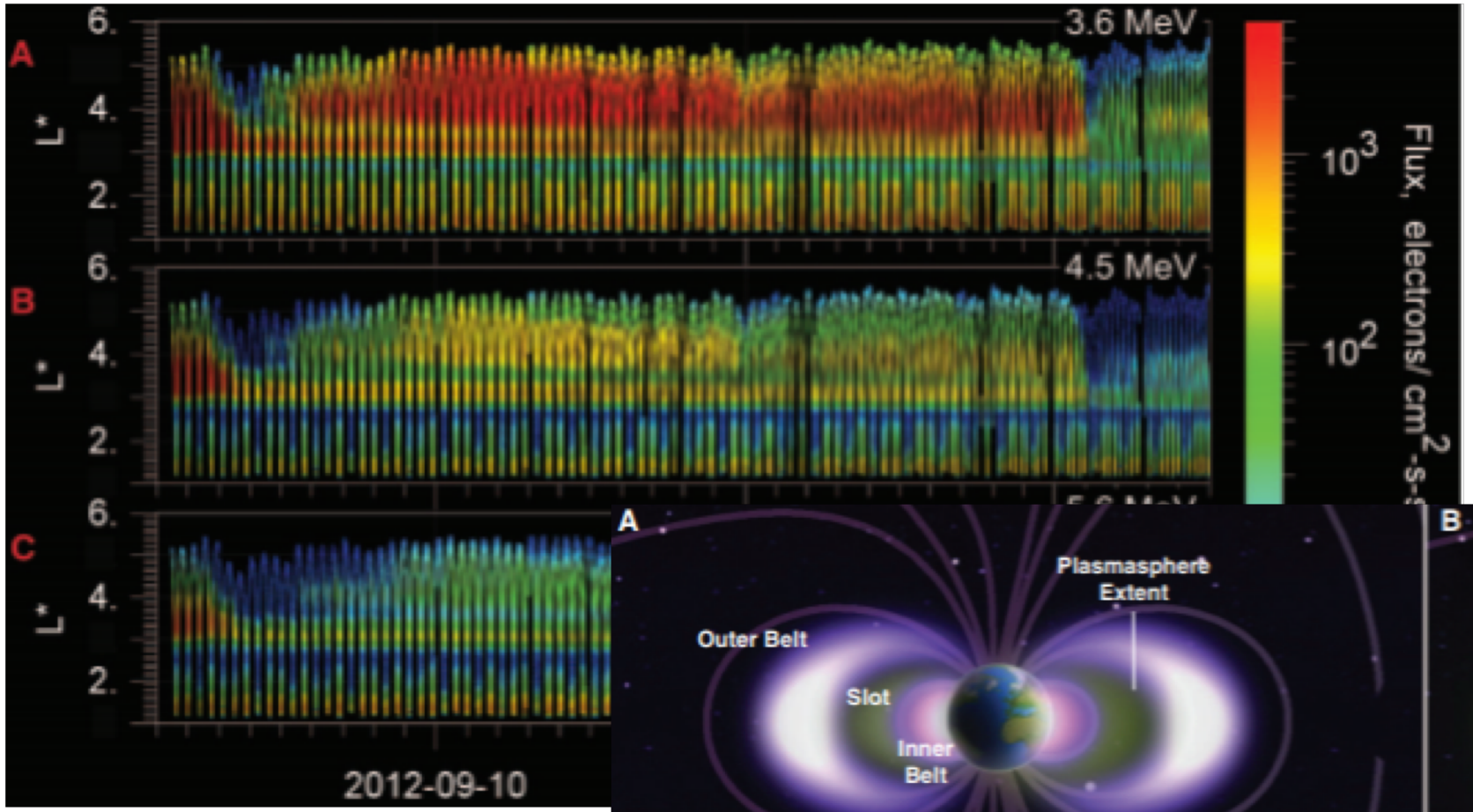


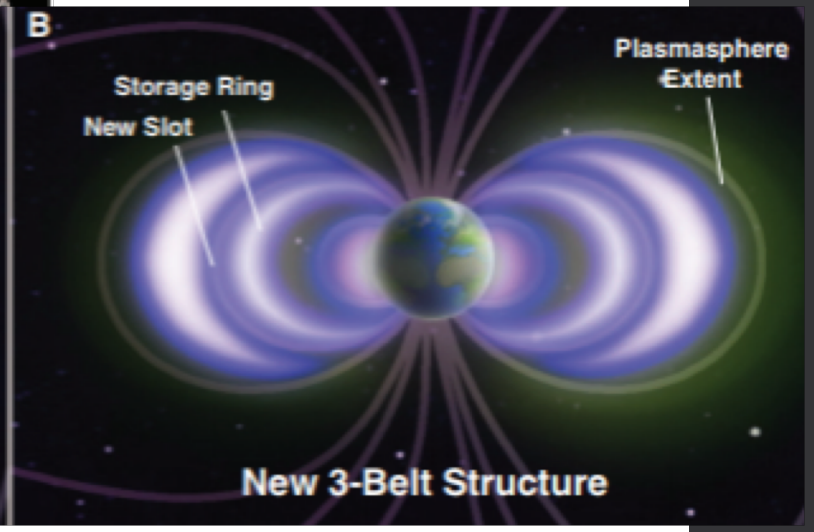
Li et al, 2006



Goldstein et al, 2016

Previous Studies – Three-Belt Structure





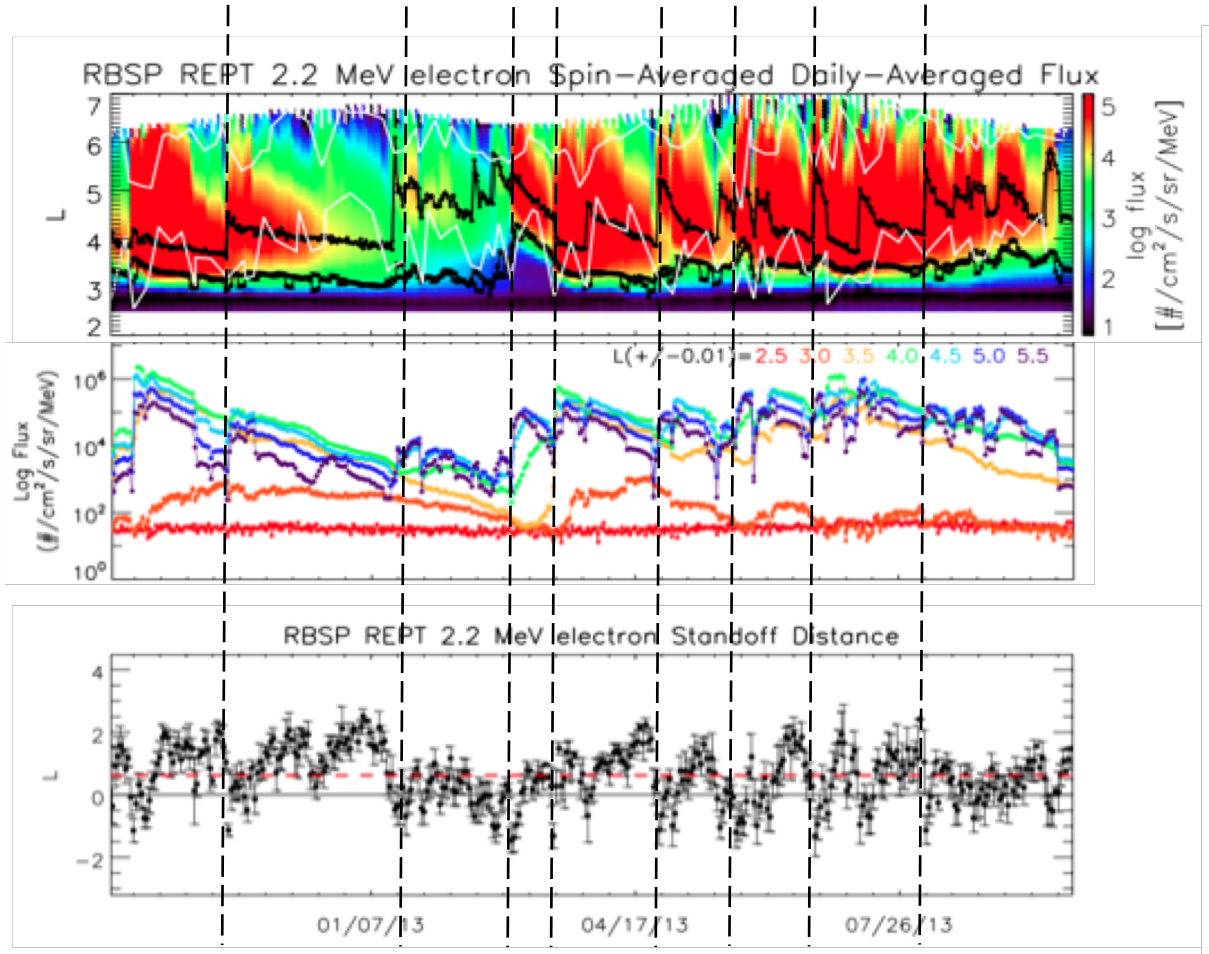
Baker et al, 2016

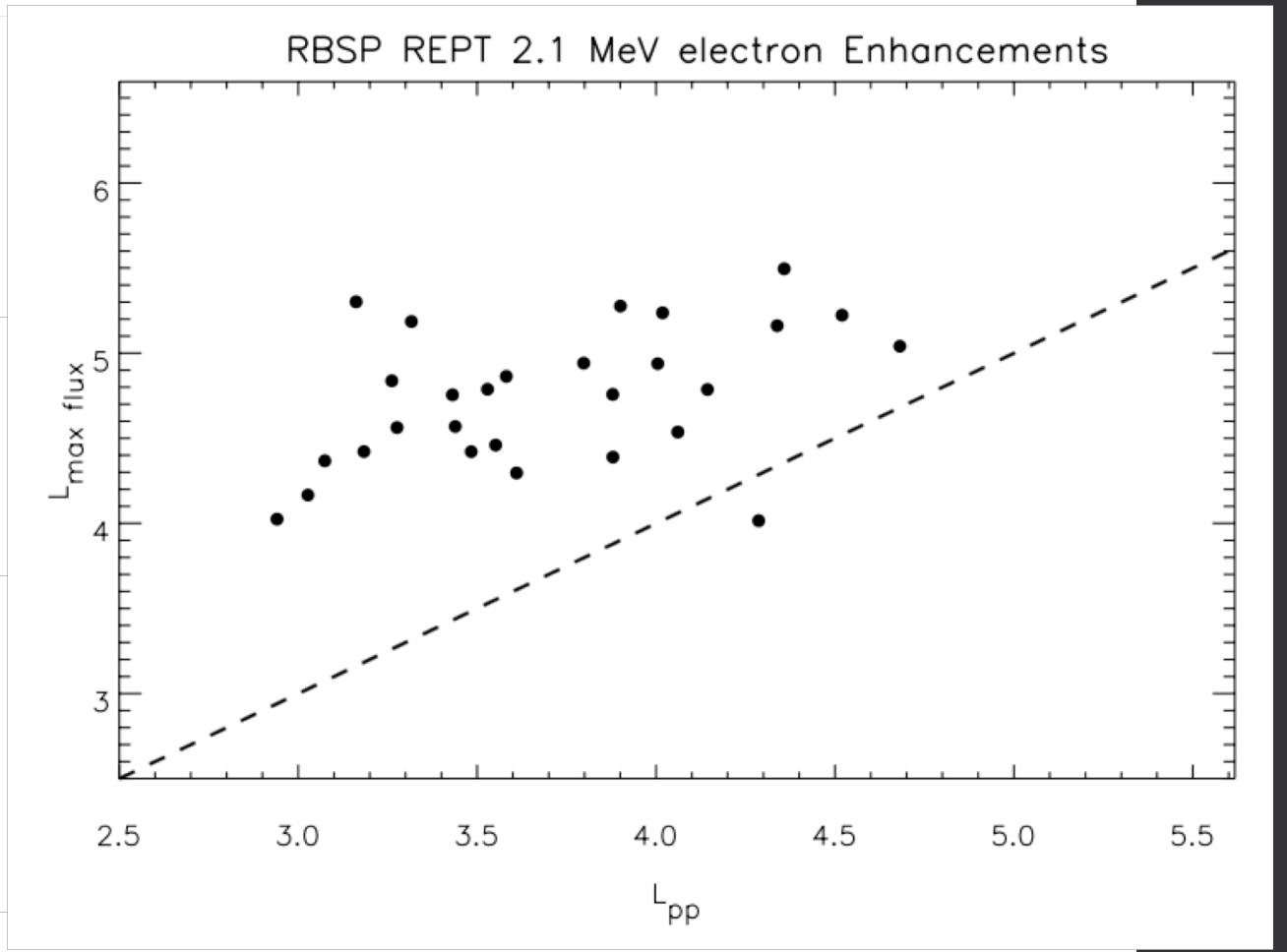
Van Allen Probe Satellites

Image Credit: NASA/JHU

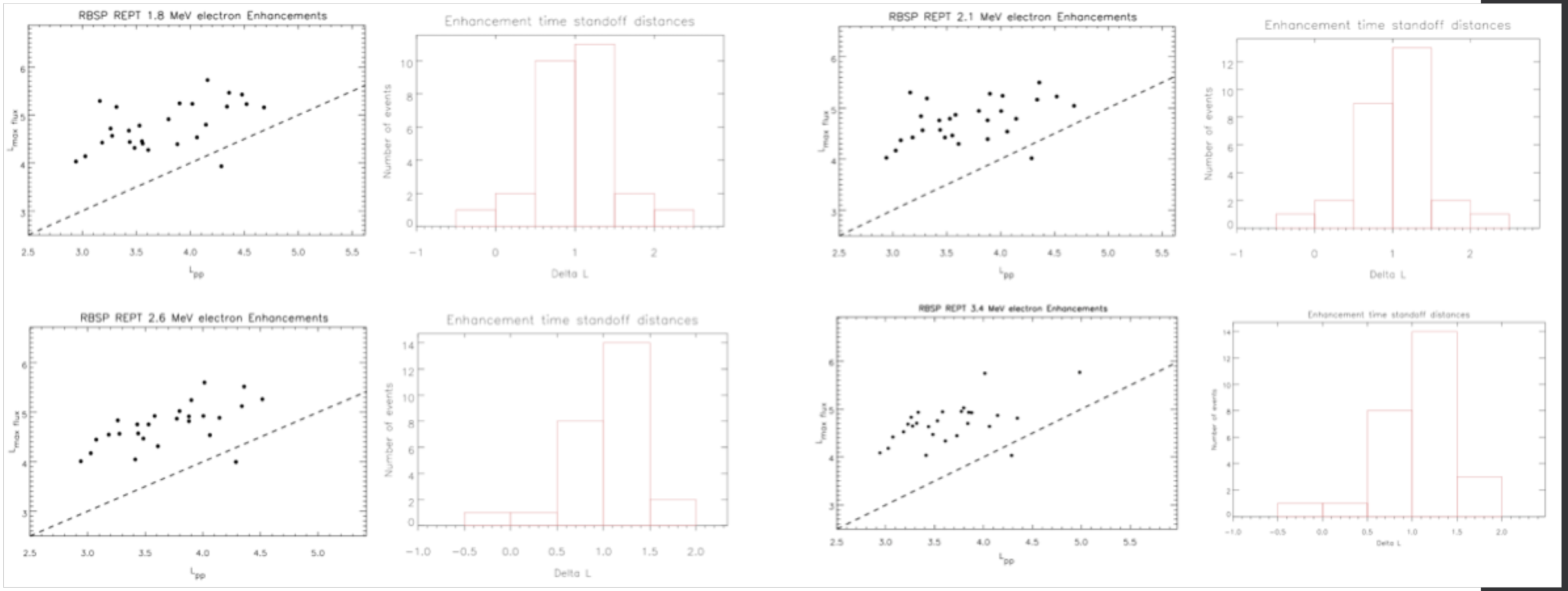
- Launched in 2012, 600 km at perigee, 5.8 R_E at apogee
- Electron flux data for MeV energy electrons from REPT (Baker et al., 2012)
- Plasmapause location from density data derived from EFW (Wygant et al., 2013)

Methods – Enhancement Events



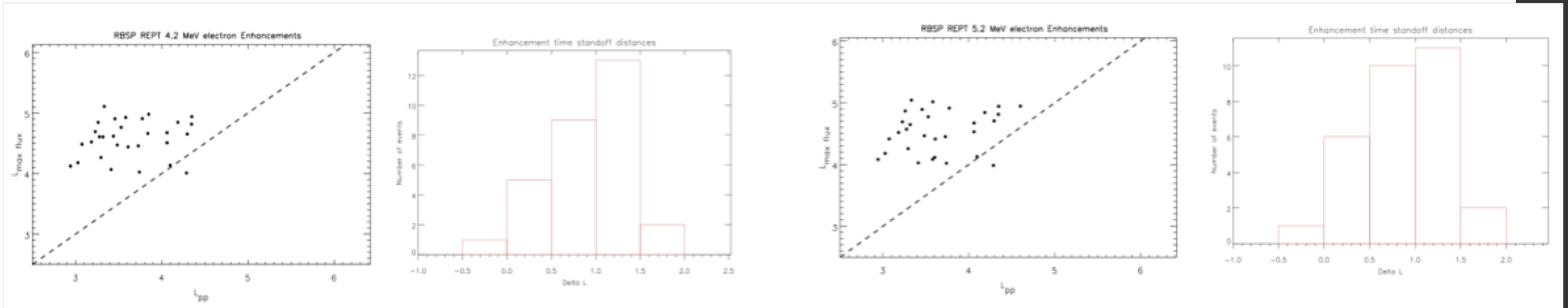


Results – Enhancement Events (Lower energy channels)



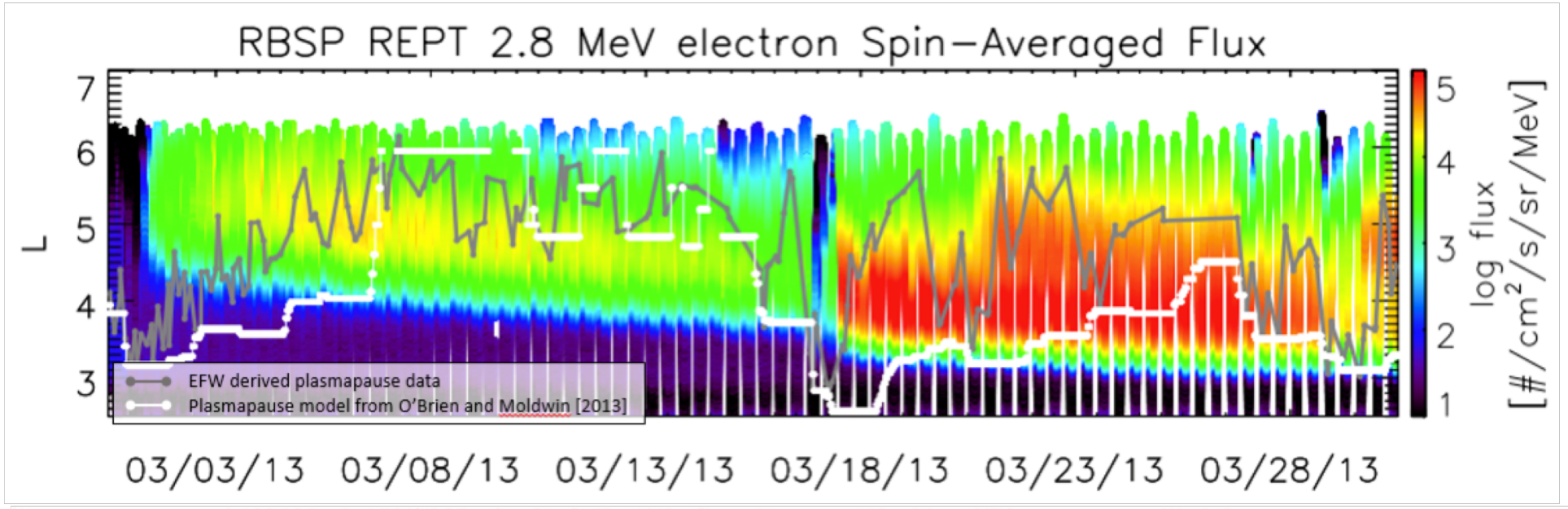
- Wide range of L values
- $\Delta L = 1.0 +/- 0.4$
- All outside plasmapause (except one), within $\Delta L=2.5$

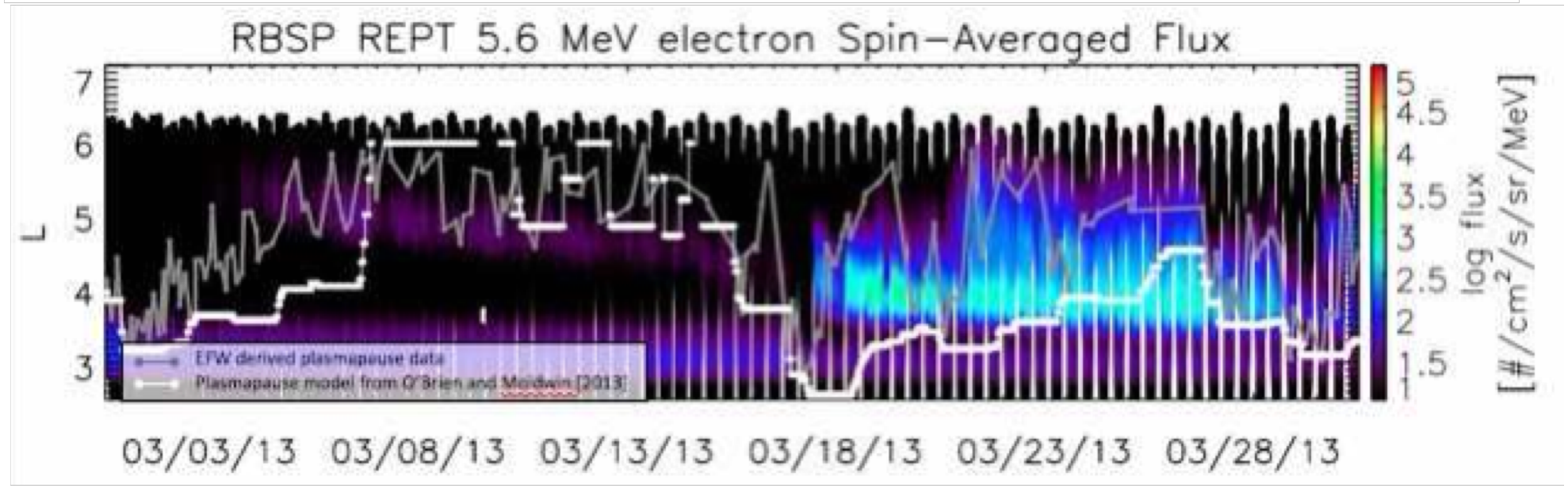
Results – Enhancement Events (Higher energy channels)



- All outside plasmapause (except one), within ΔL=2.0
- Smaller range of L values
- ΔL=0.9 +/- 0.5
- Smaller standoff distance because plasmapause moved out before electrons accelerated to higher energies

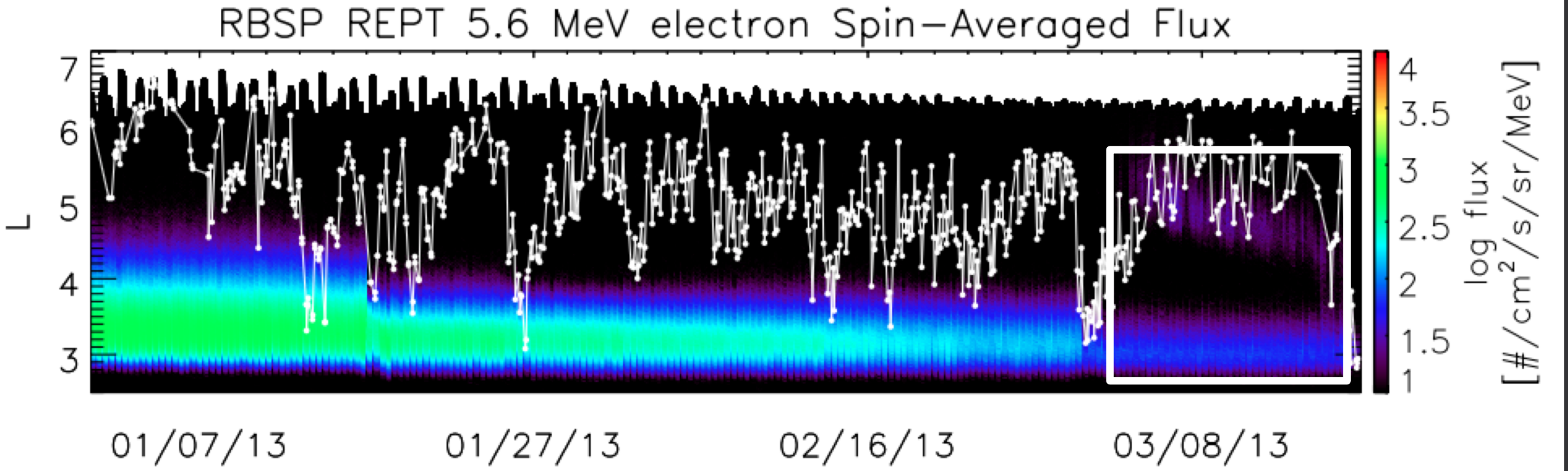
Results – Enhancement Events



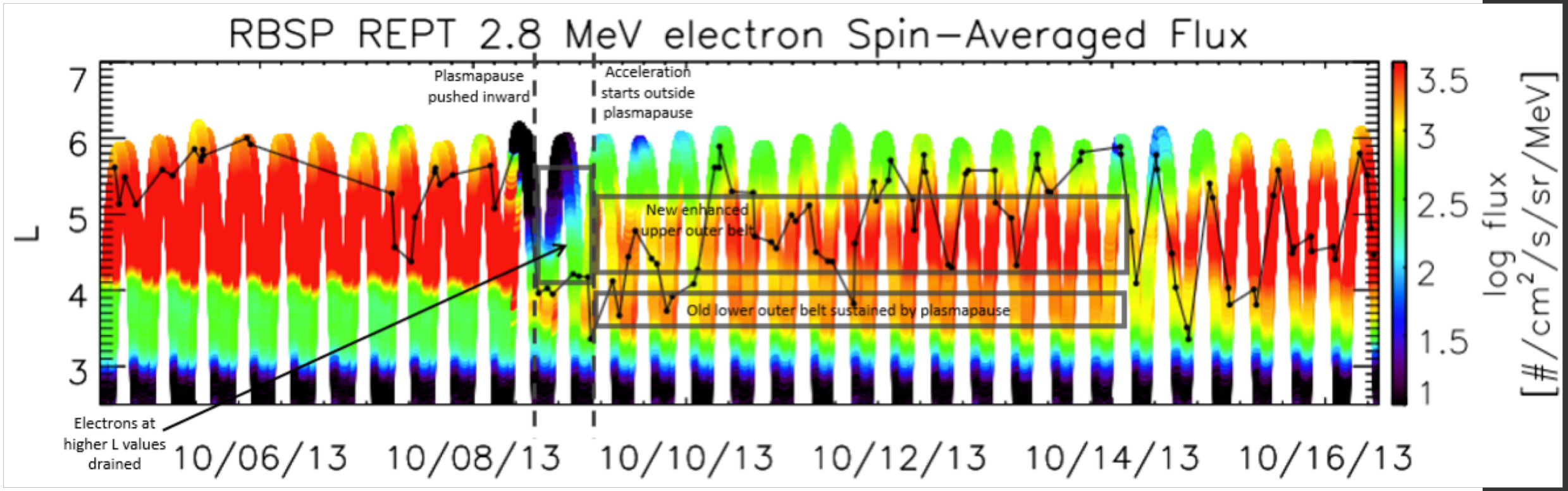


Methods – Three Belt Structure Events

- 2 month plots at E=2.1 and 5.6 MeV
- Logged start and end time, duration, low/high energy for each of 45 identified events
- Overplotted plasmapause location data
- Annotated significant plasmapause dynamics in relation to observed electron flux changes

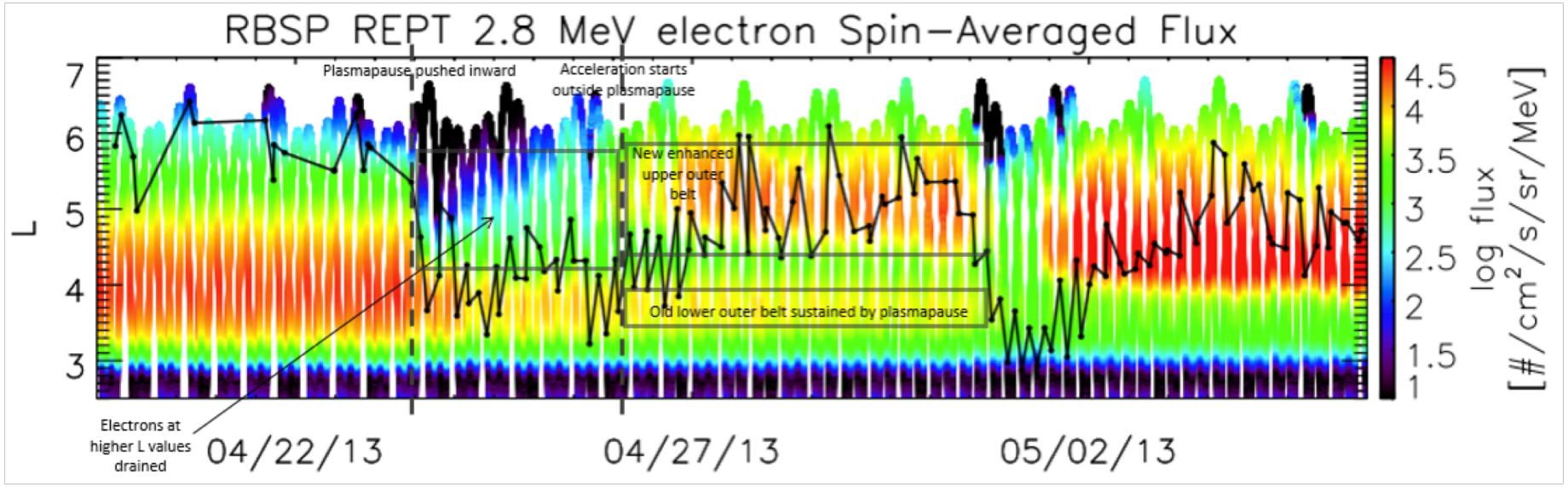


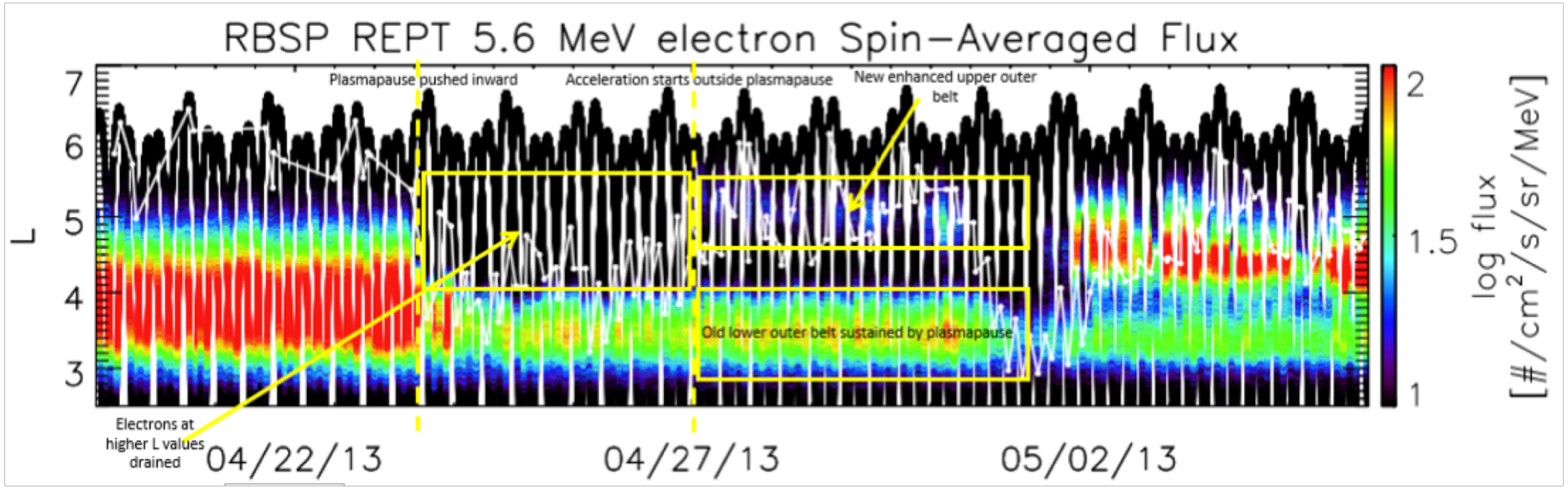
Results – Three Belt Structure Events



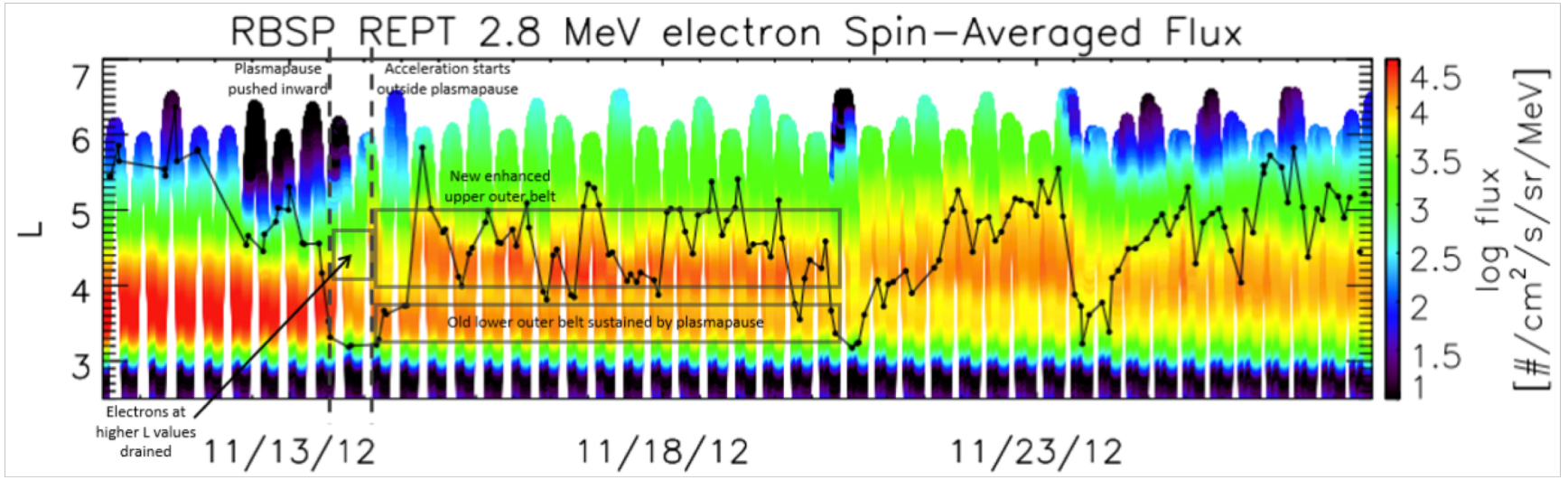
- Plasmapause pushed inward, electrons at higher L values drained
- Electrons at lower L values are sustained in the old lower outer belt
- Acceleration starts outside plasmapause to generate new upper enhanced outer belt

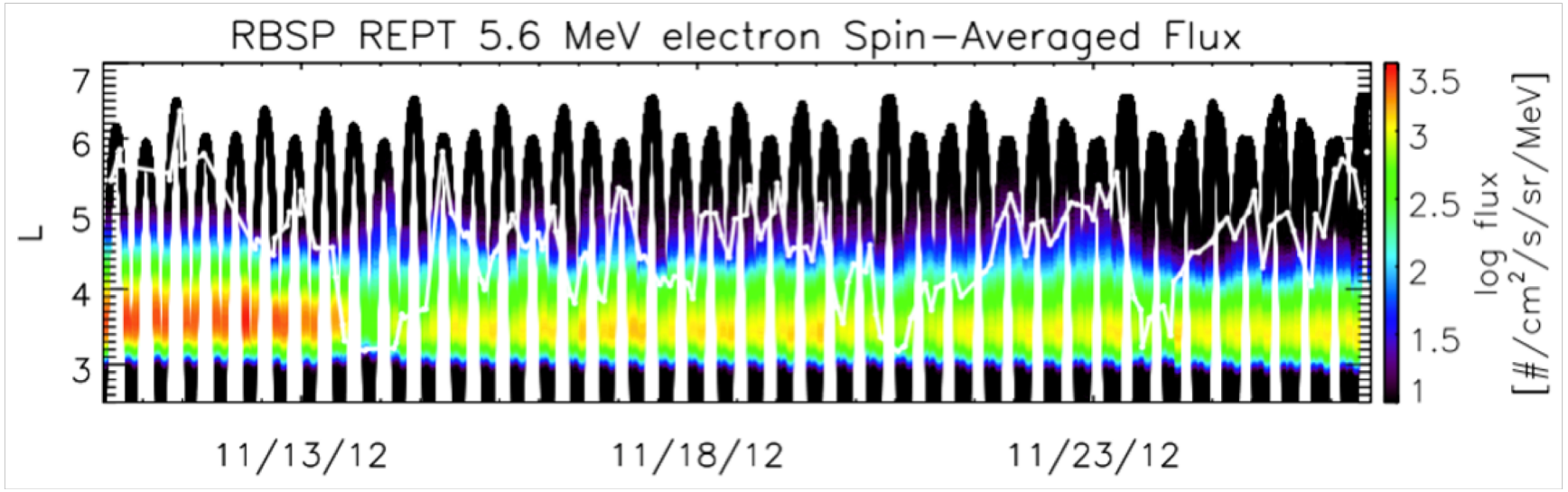
Results – Three Belt Structure Events



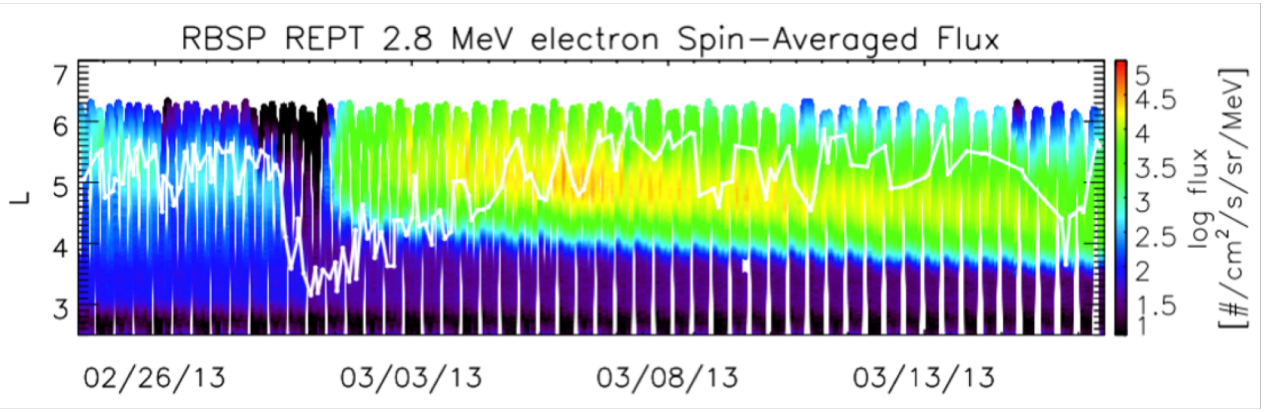


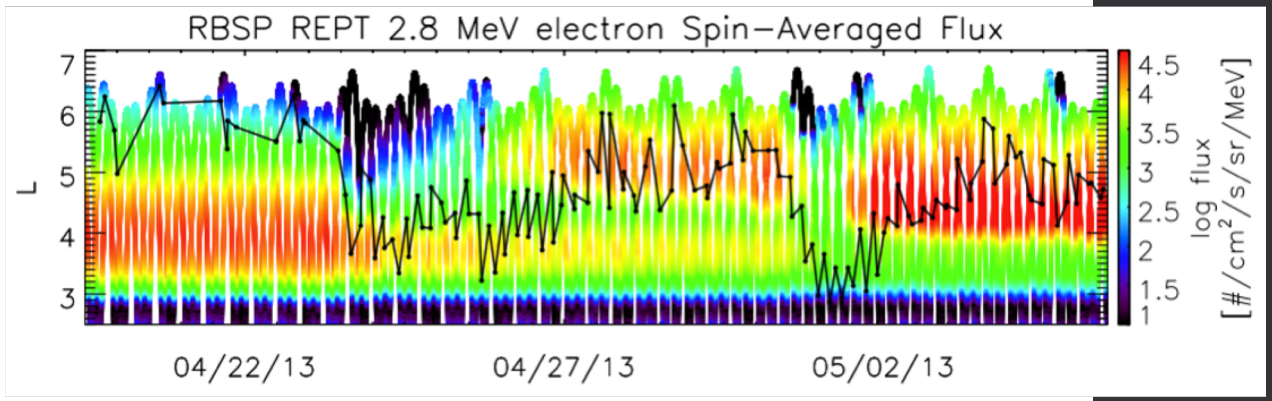
Results – Three Belt Structure Events

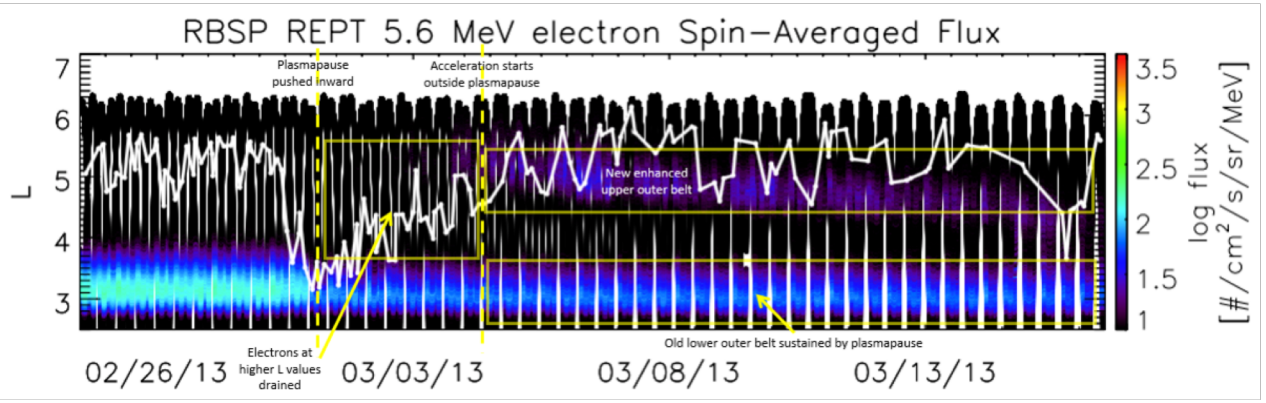


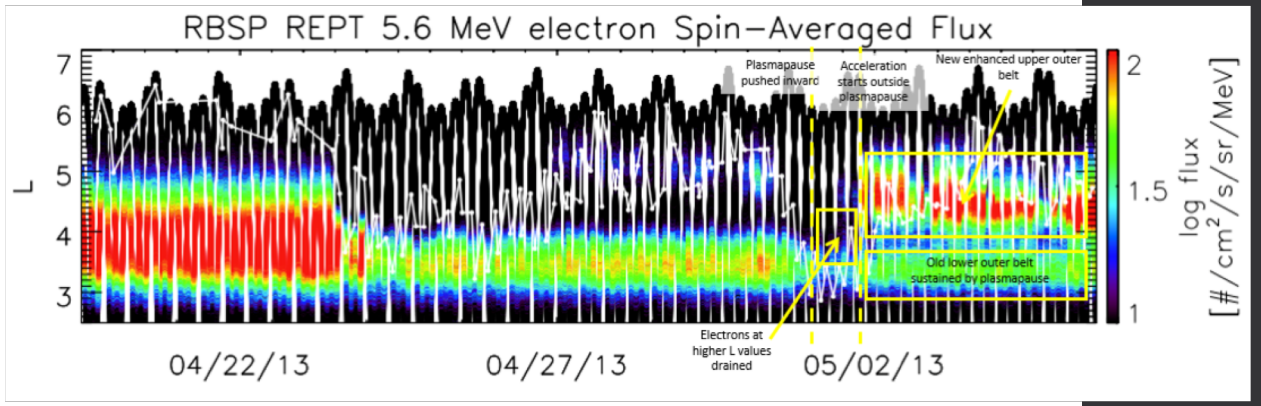


Results – Three Belt Structure Events



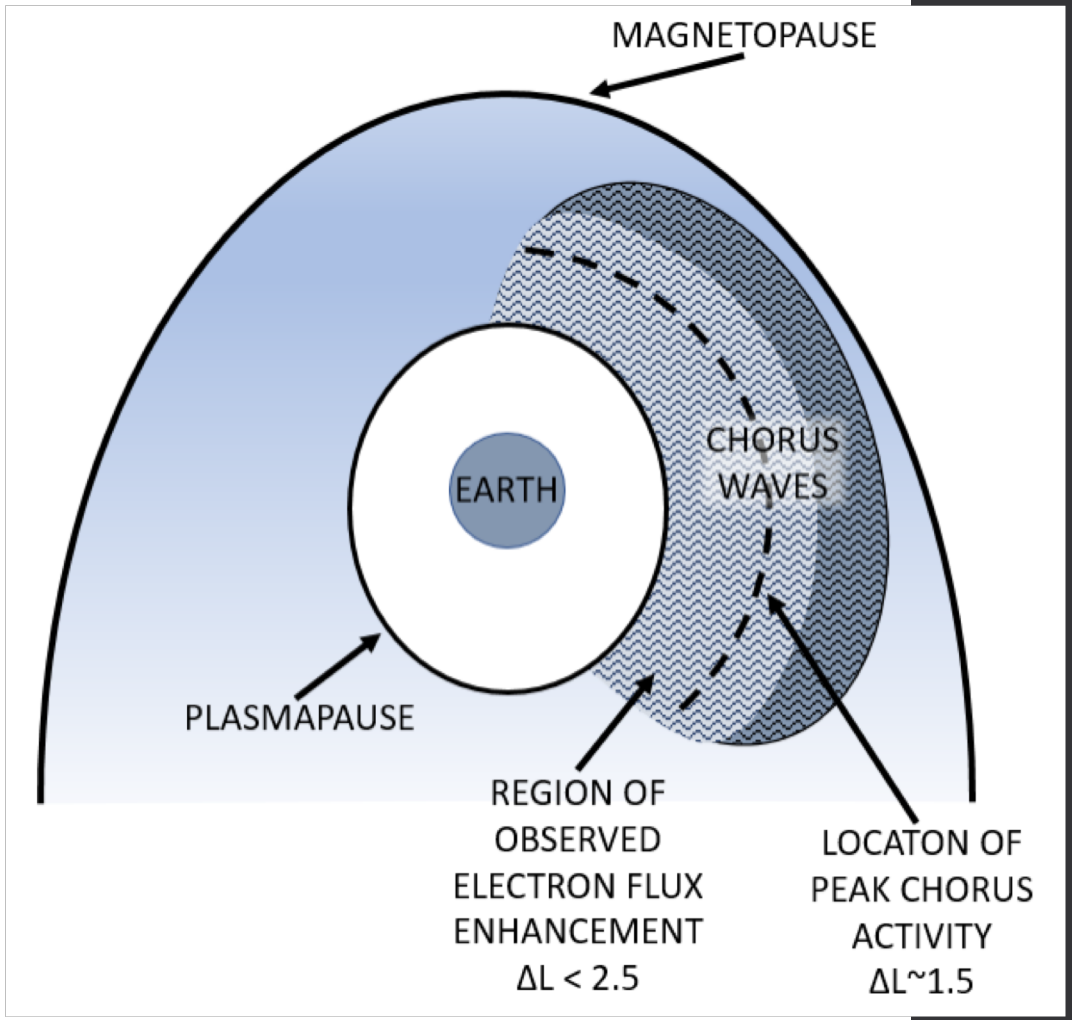






Conclusions

- Enhancements occur outside plasmapause, consistent with chorus enhancement model
- Acceleration stands off by 1.0 +/- 0.5 R_E, within 2.5 R_E, consistent with chorus observations
- Repeated plasmapause dynamics associated with specific changes in electron flux that generate and sustain 3 belt structure
- Do not consistently see plasmapause outside upper outer belt
- Energy dependence
  - Lower average enhancement standoff distance for higher energies, plasmapause already started moving back out
  - 3 belt structure at higher energies only if plasmapause remains low long enough
  - Hiss and EMIC interaction responsible for 3 belt structures only at high energies



Future Work

- Consider chorus wave power and MLT of satellites at enhancement times
- Look at future three belt structure events to determine relation between plasmapause and upper outer belt

Acknowledgements

Plasmapause data from D. M. Malaspina (LASP)
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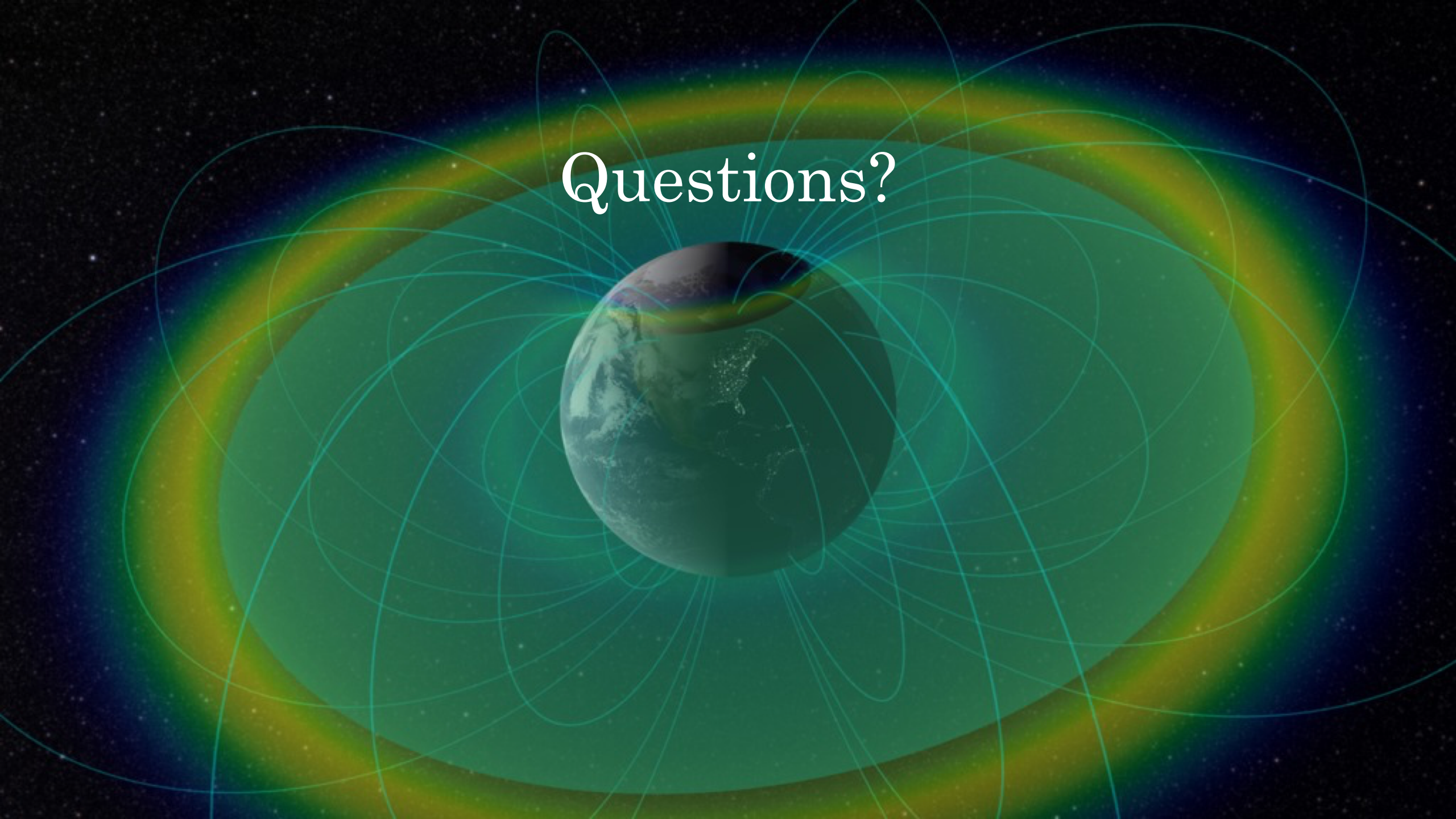
Questions?