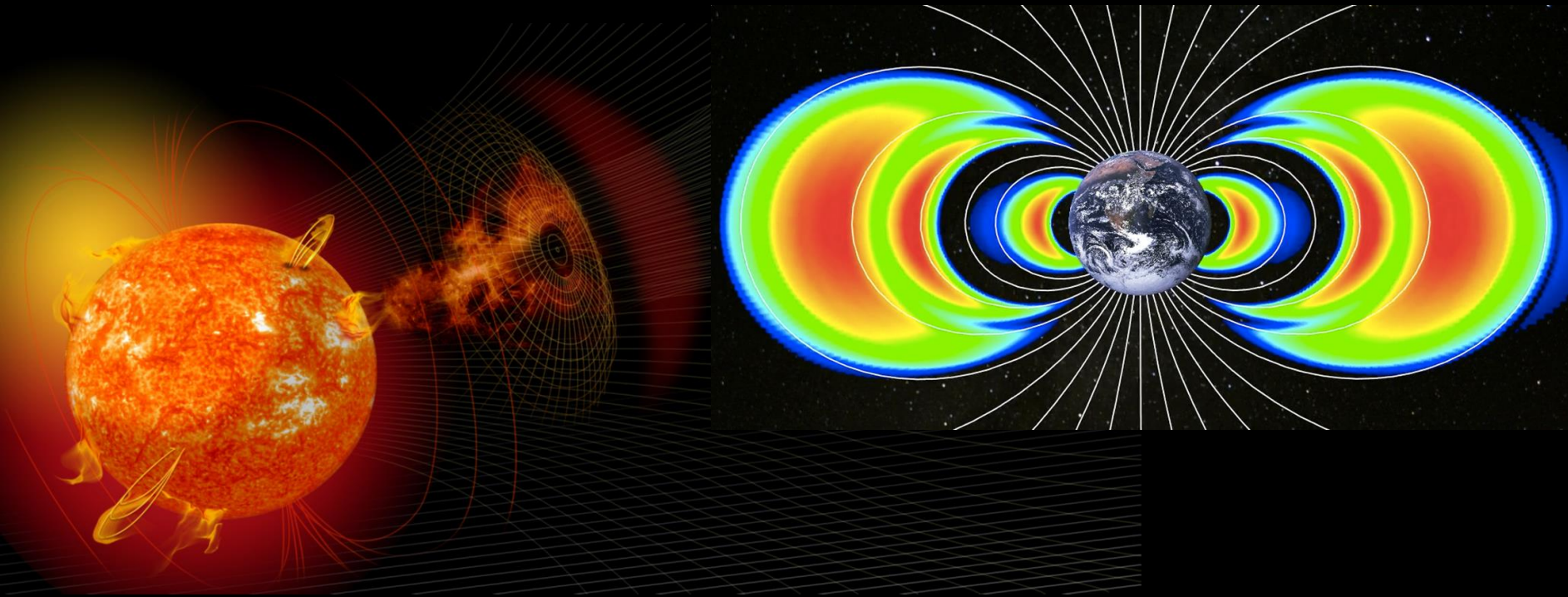




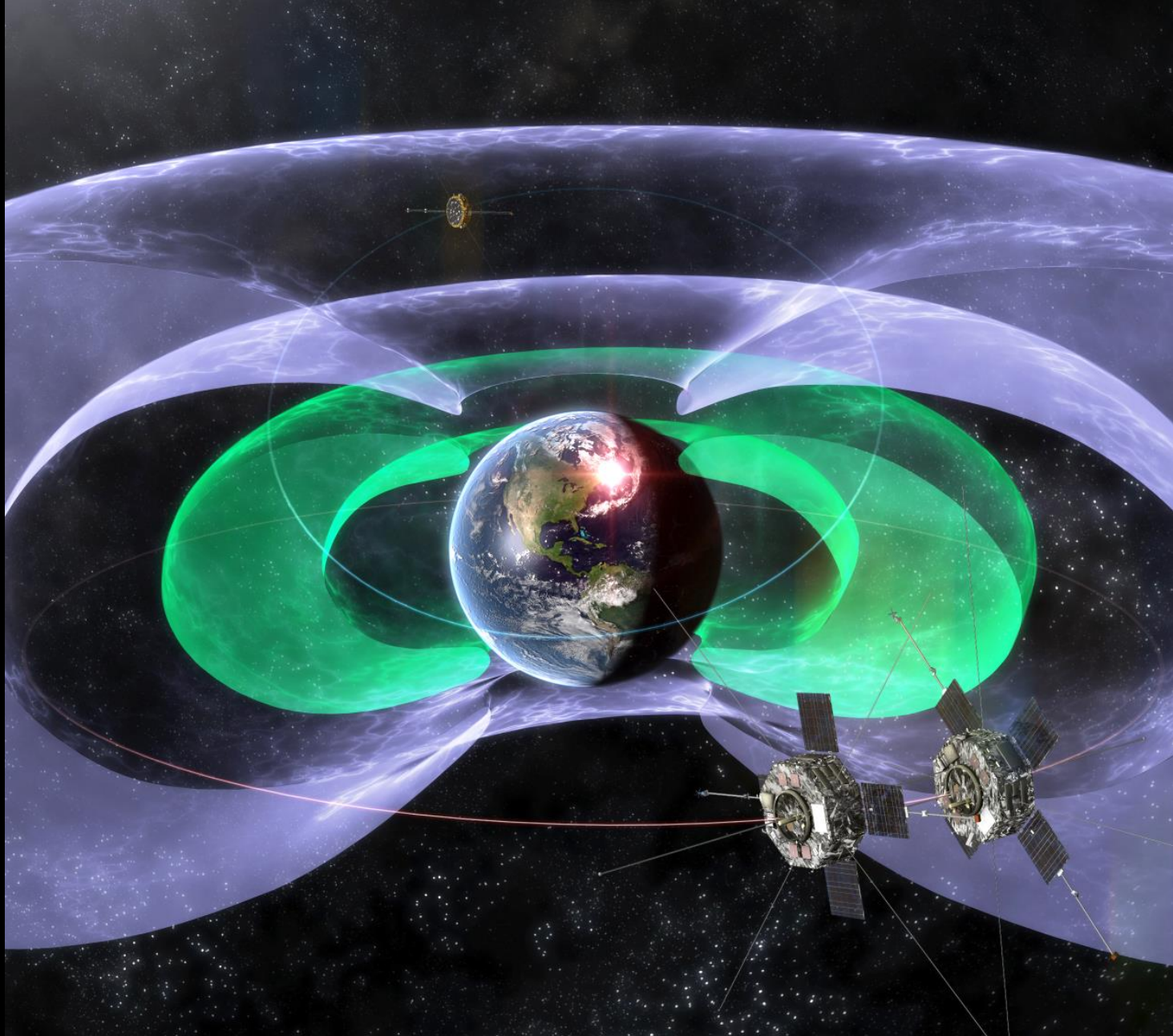
Five-Plus Years of Radiation Belt Measurements: Space Weather in Earth's Neighborhood

Daniel N. Baker

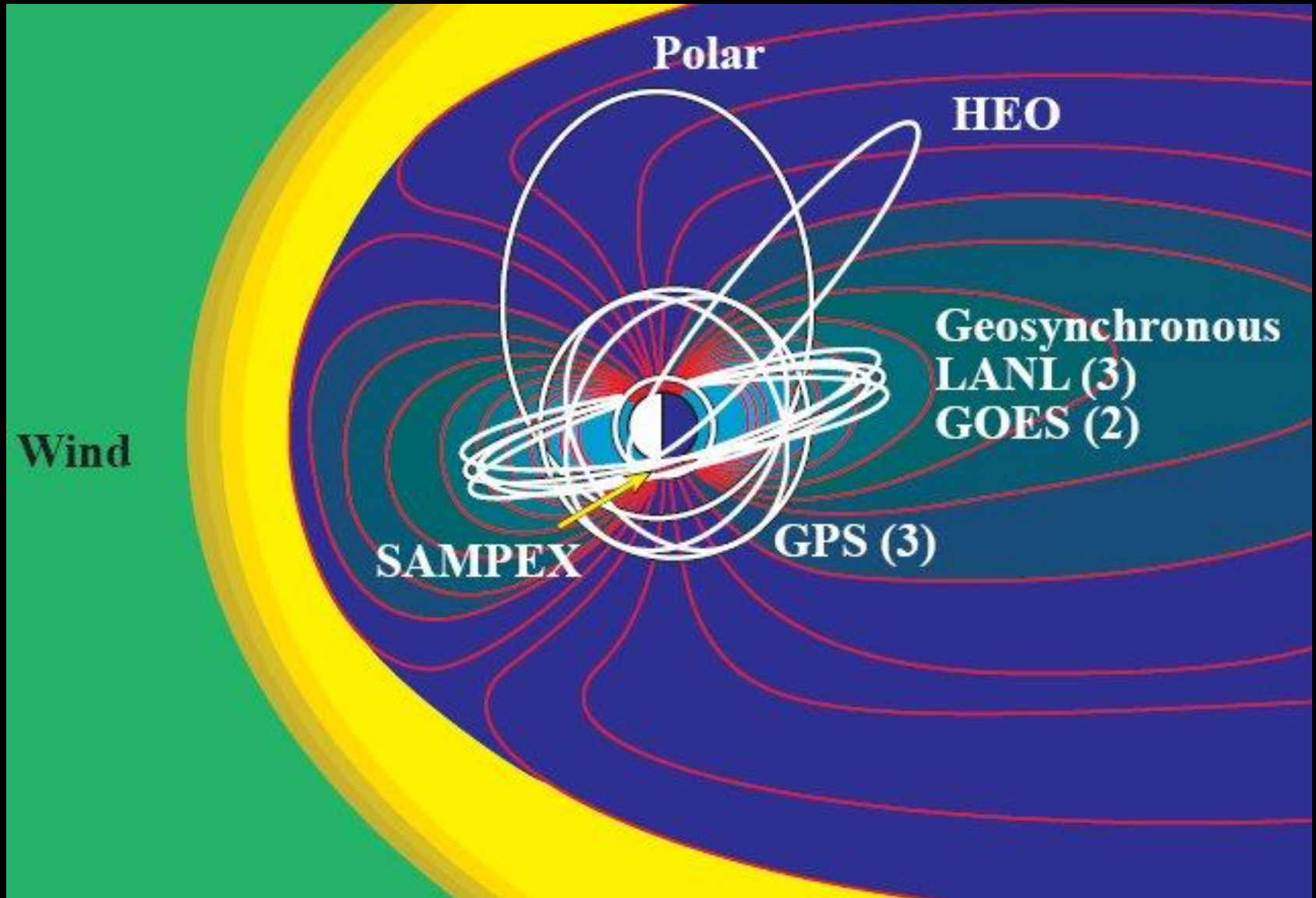
Laboratory for Atmospheric and Space Physics
University of Colorado – Boulder

Thanks to: V. Hoxie, H. Singer, and ECT Team

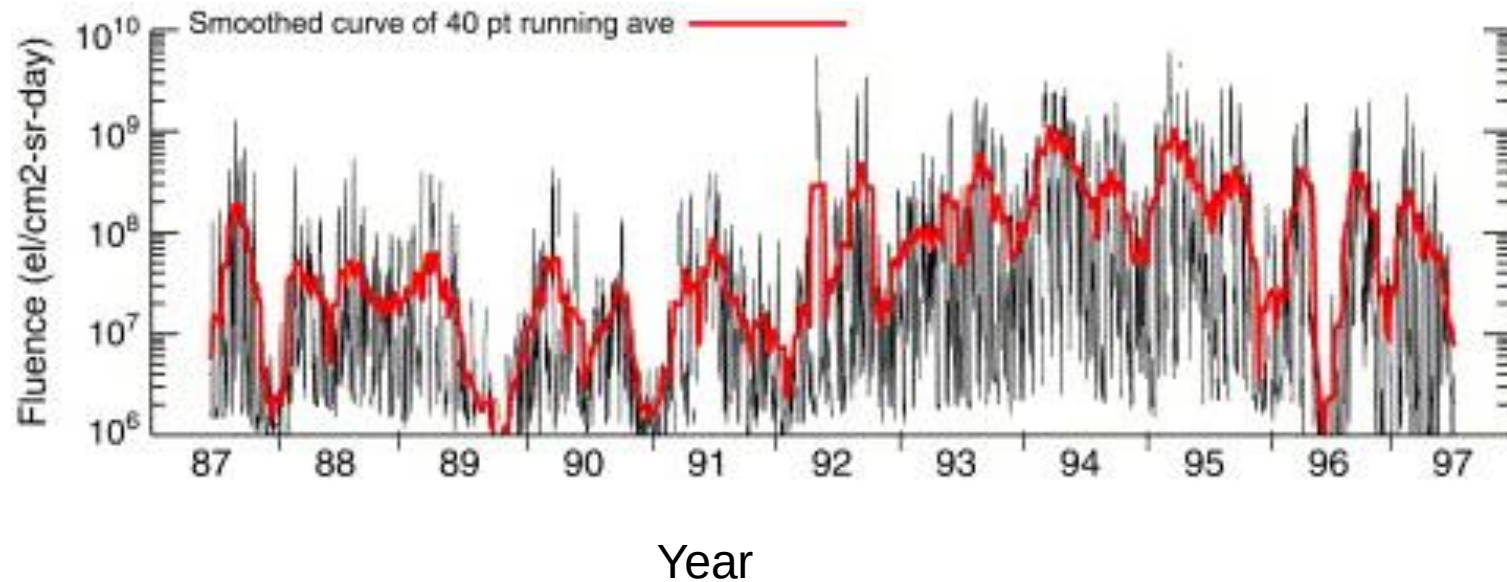
Twin Van Allen Probes (9/2012 – Present)



Rad Belt Work With Non-GTO Spacecraft

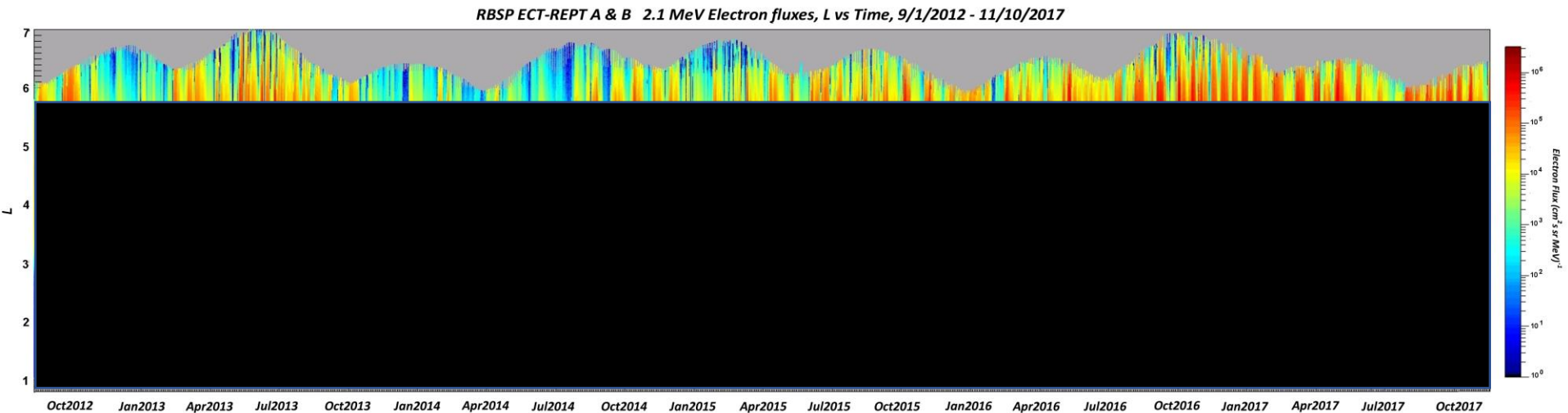


Long Runs of Geostationary Orbit Data



Example: 10 years of $E > 2$ MeV Electron Fluences [H.-L. Lam, JASTP, 2004]

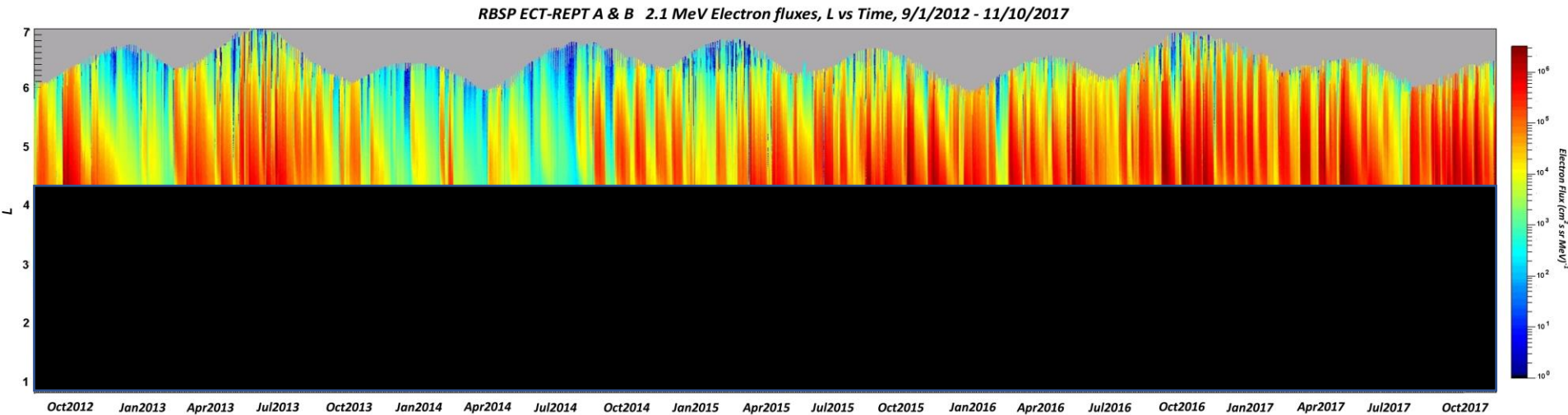
GEO: The Tip of the Iceberg



Van Allen Probes: September 2012 to November 2017

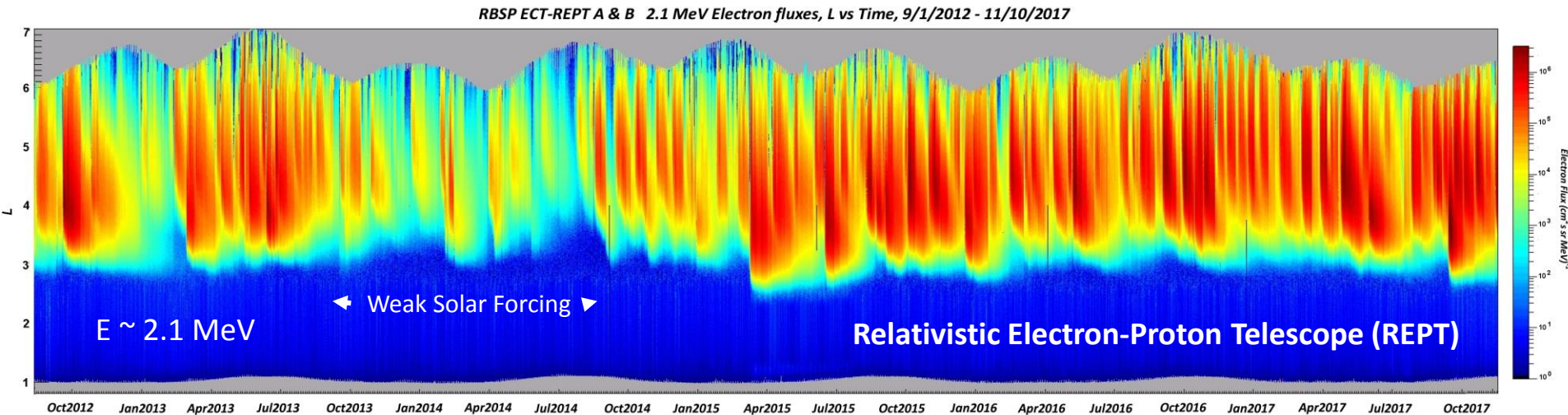
Looking at $E \sim 2$ MeV electrons just
around geostationary orbit ($L > 6.0$)

GPS: Below the Tip of the Iceberg

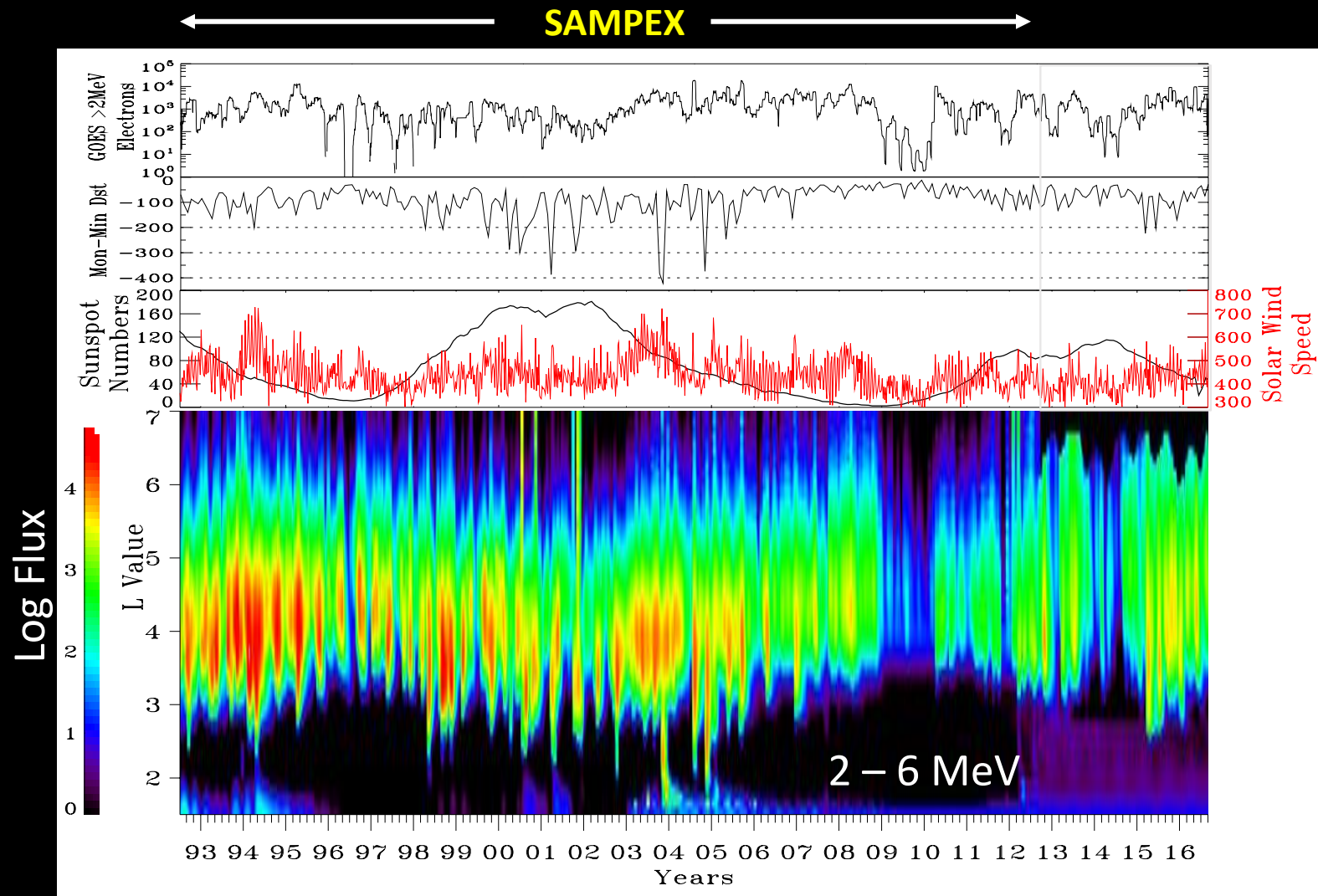


Examining $E \sim 2$ MeV electron fluxes
over the range obtainable from Global
Positioning System operational sensors
($L > \sim 4.2$)

Van Allen Probes: The Whole Iceberg

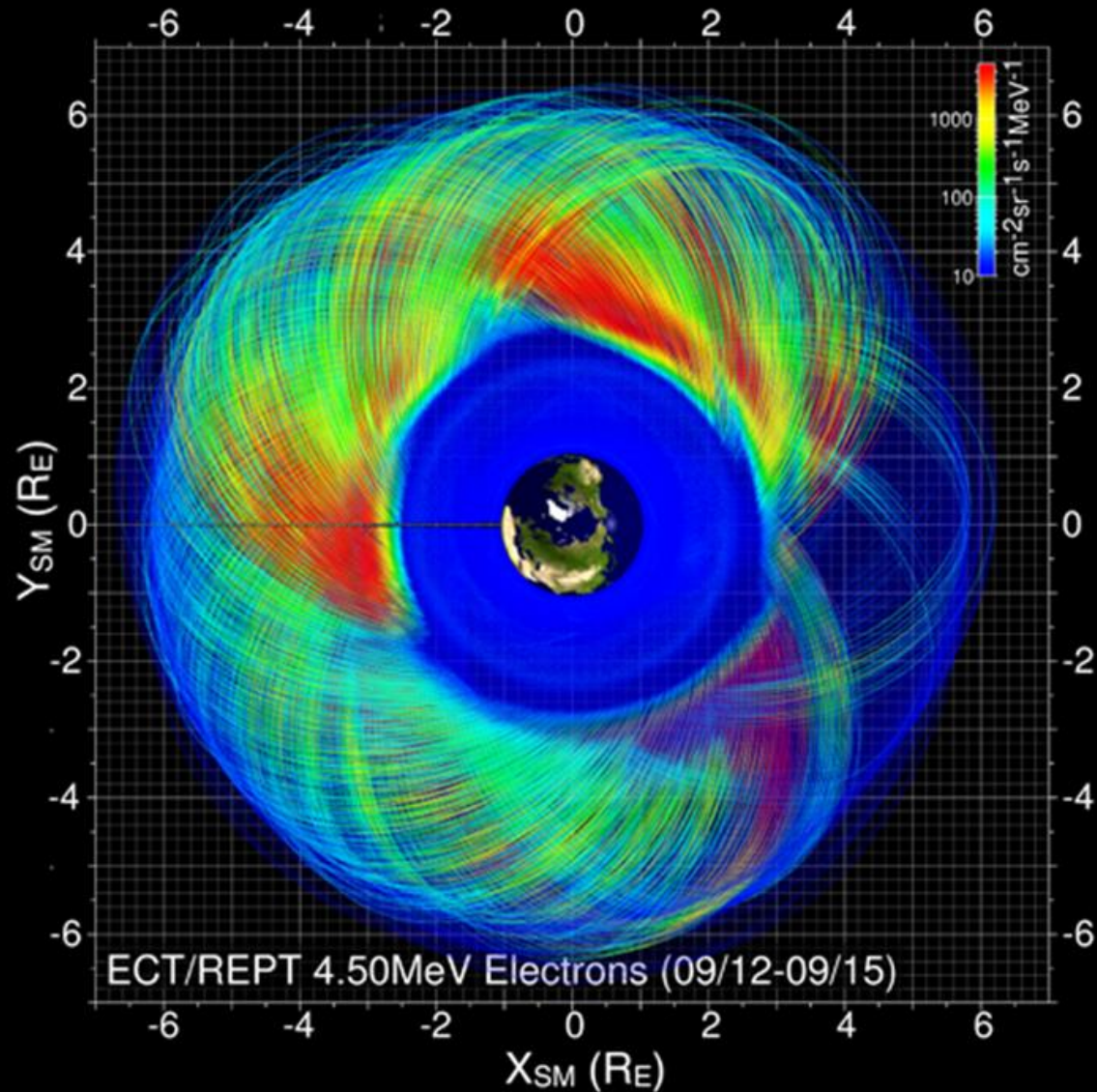


Measuring the full range of radial distances in the radiation belts for relatively fine differential energy slices has been a key contribution of the Van Allen Probes mission.

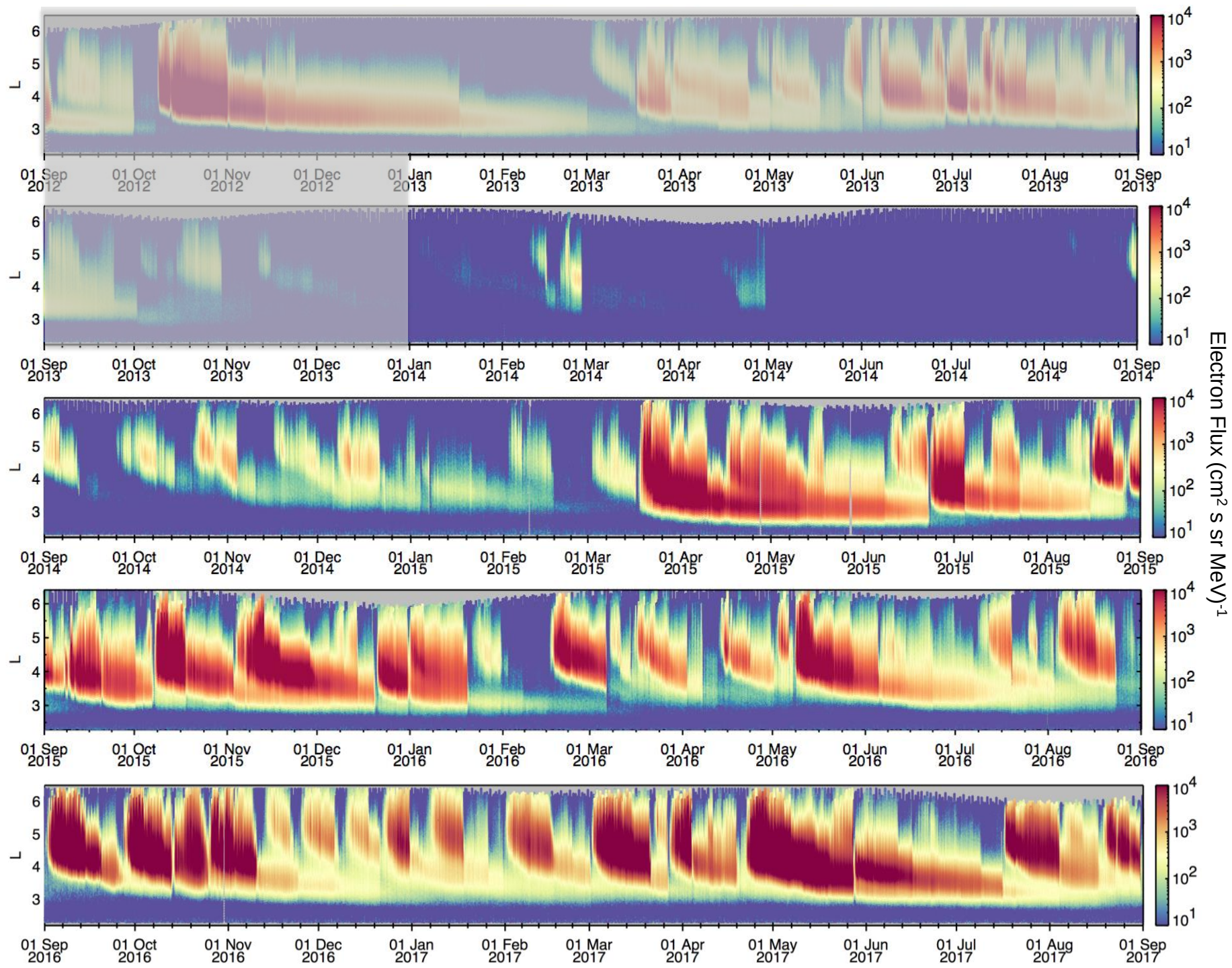


Courtesy: Xinlin Li

Van Allen REPT Data: 3 Years



REPT A & B 4.2 MeV Electrons

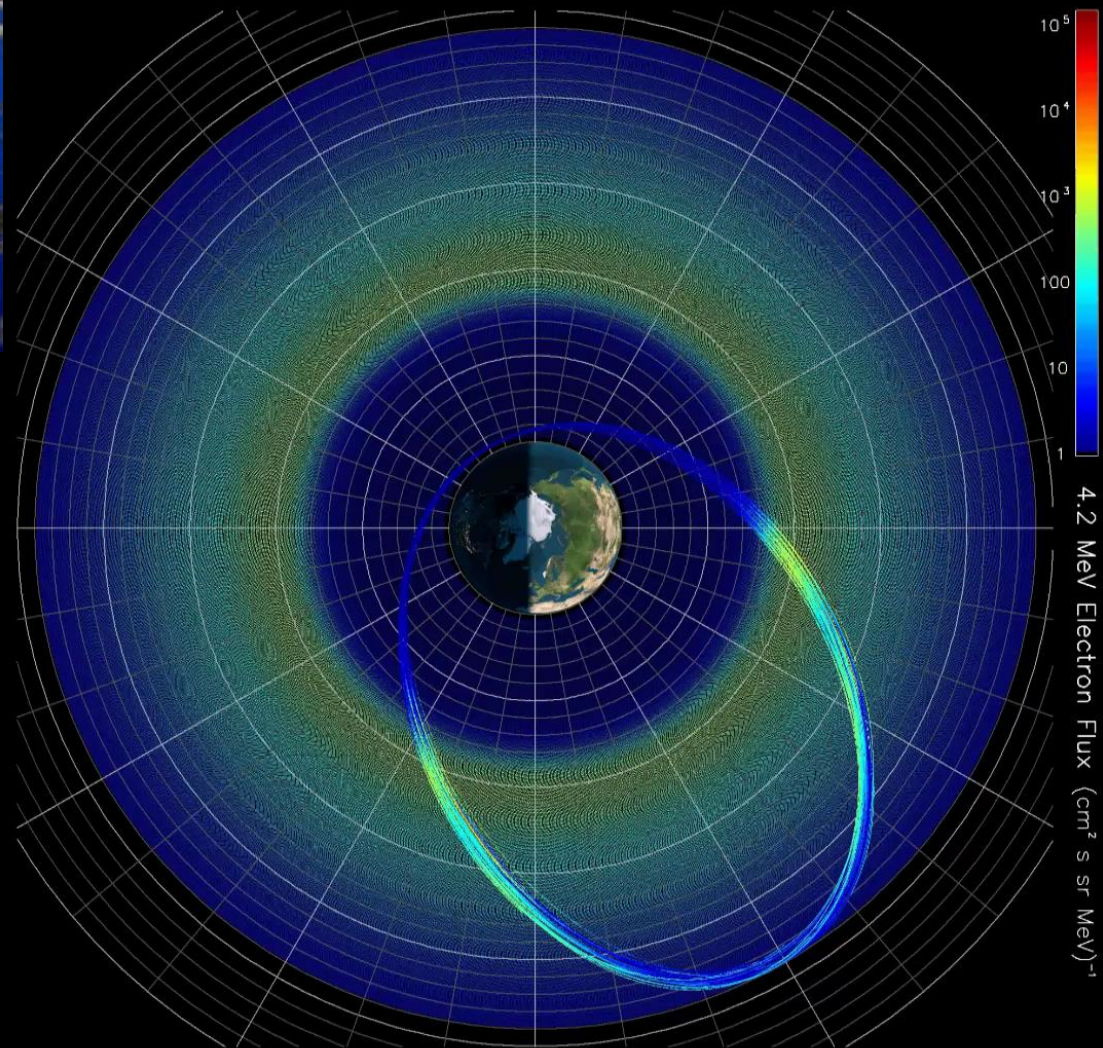


REPT – The Space Weather Movie

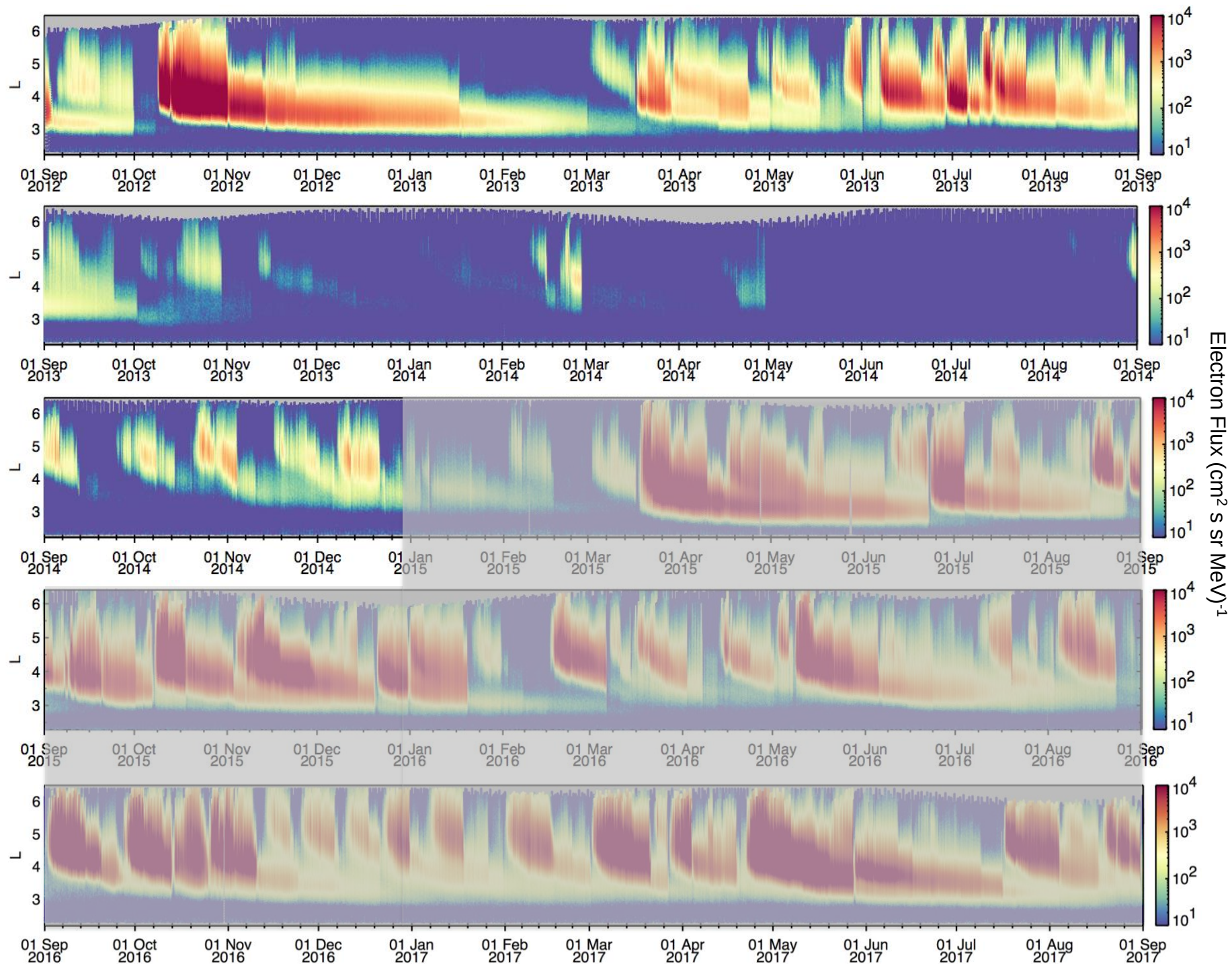


Van Allen Probes ECT-REPT A & B

2012-09-08



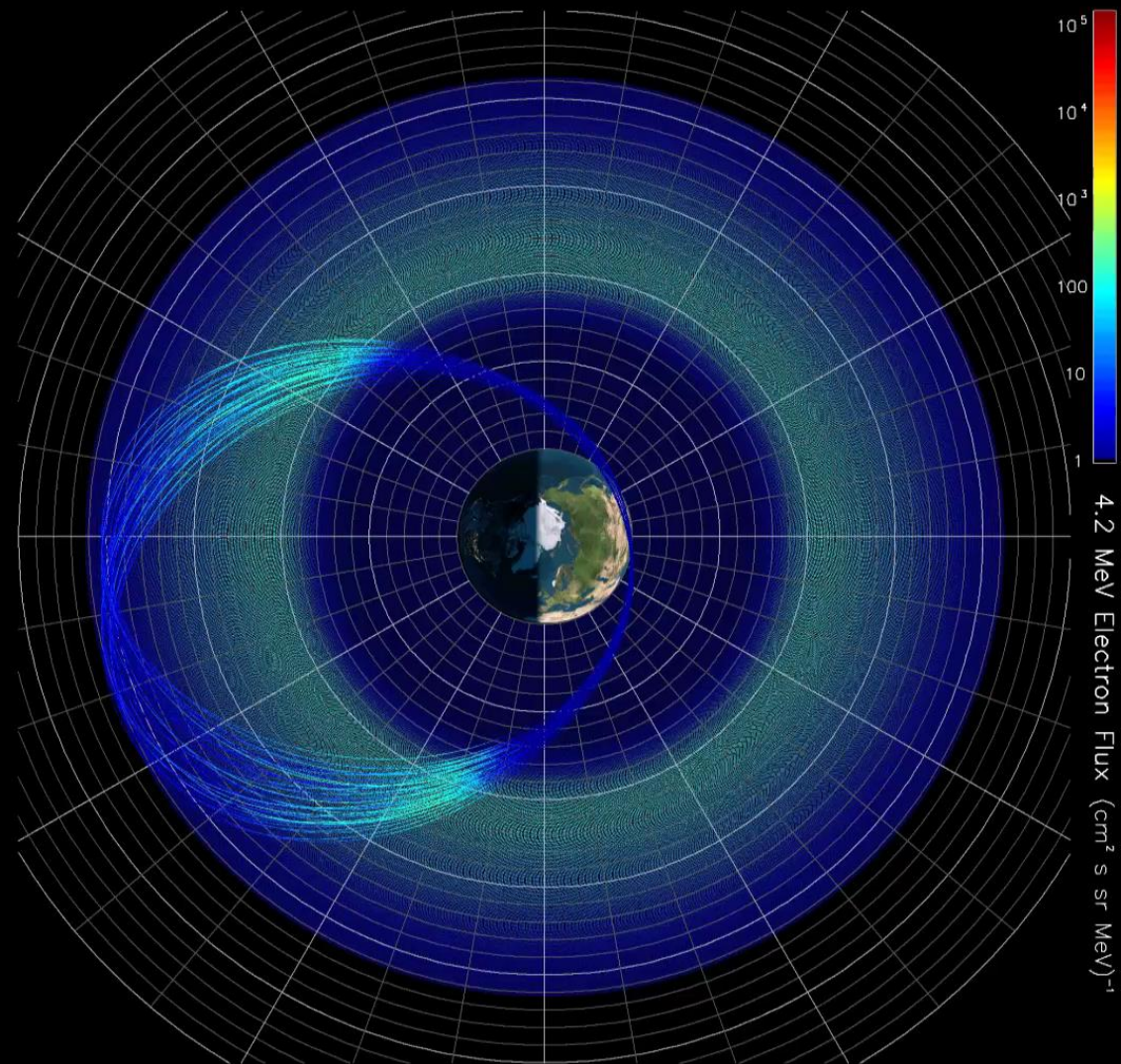
REPT A & B 4.2 MeV Electrons



REPT – 2015 to 2017

Van Allen Probes ECT-REPT A & B

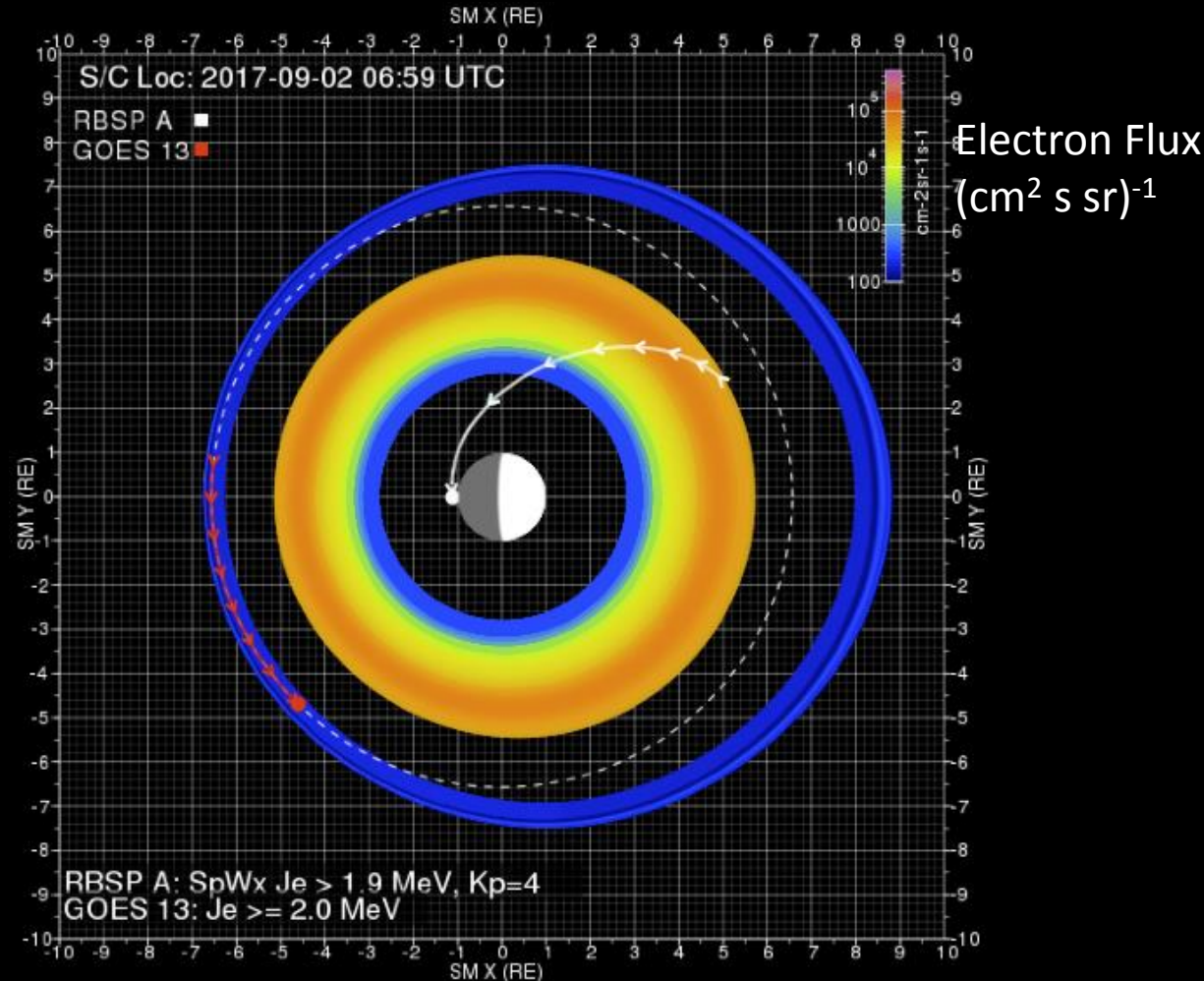
2015-01-01



SWPC Experimental Test Product >2 MeV Electrons

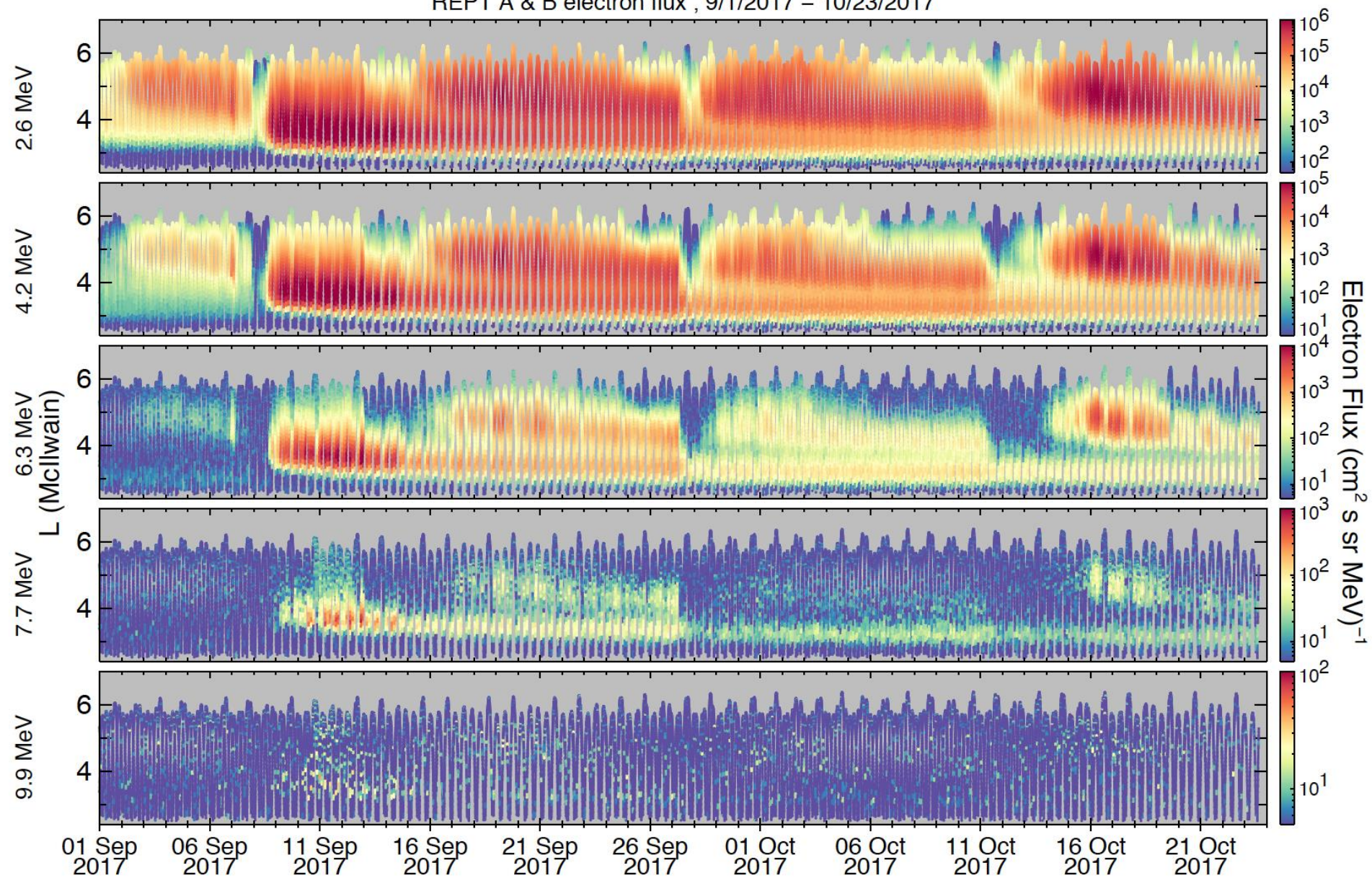
NASA Van Allen Probe Inside GEO and GOES

- **Complements GOES observations of electron flux at GEO with flux inside GEO**
- **GOES and Van Allen Probe Orbits shown; sun on right; bottom of scale (blue) is alert threshold**
- **New test product for forecasters and satellite operators inside of GEO**



SWPC (Singer, Steenburgh, and Onsager) collaboration with JHUAPL and NASA (Ukhorskiy, Romeo, Fox, and Kessel)

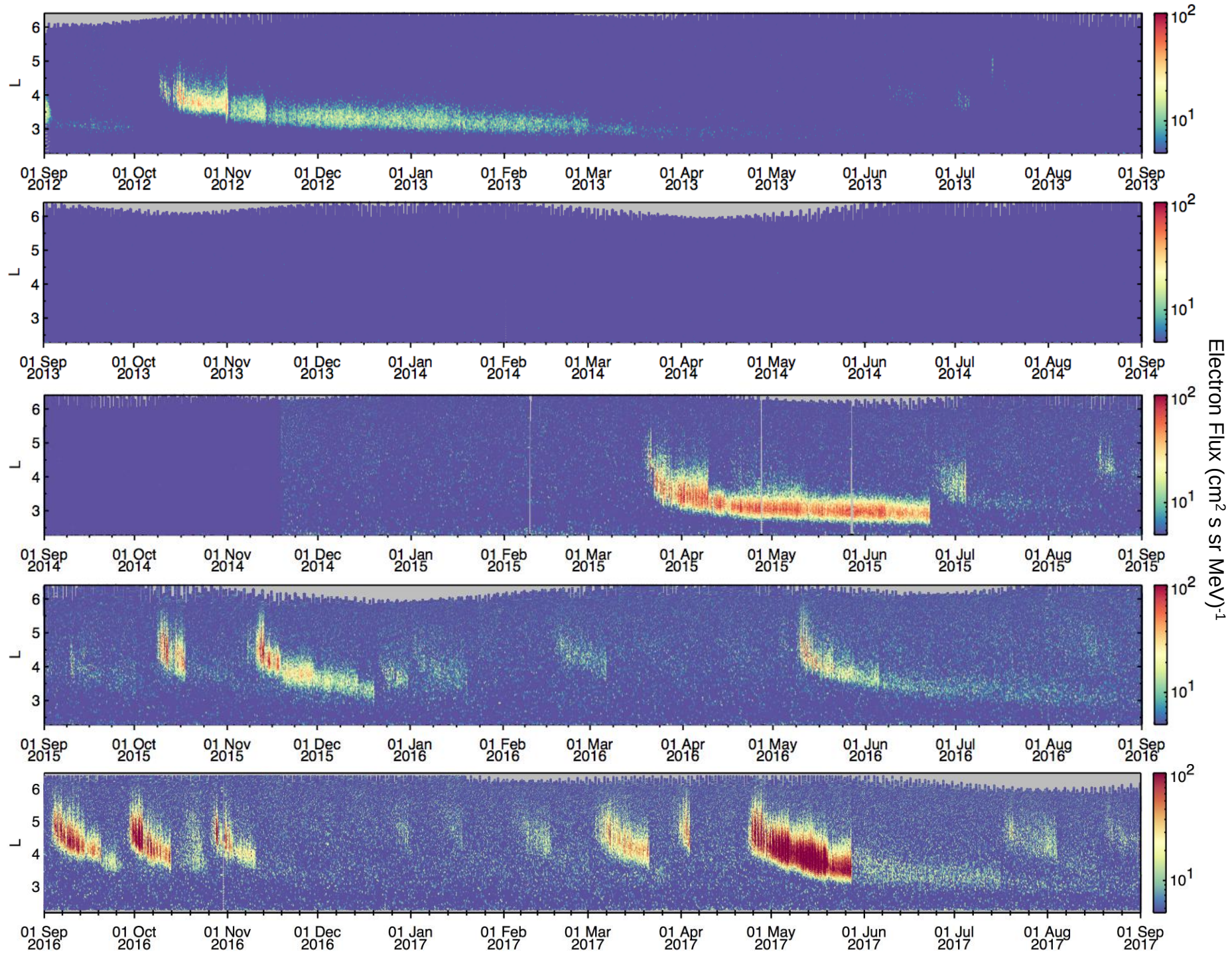
REPT A & B electron flux , 9/1/2017 – 10/23/2017



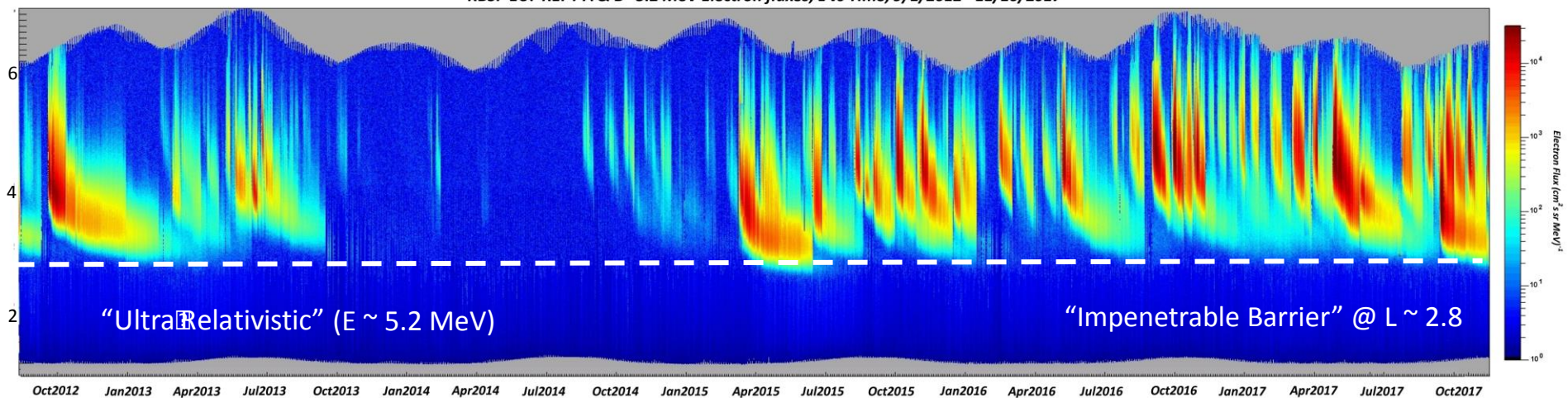
Conclusions

- Results from the Van Allen Probes mission demonstrate remarkable, previously unobserved features about radiation belt structure, acceleration, transport, and rapid loss.
- Long-term observations reveal distinctive behavior: Multi-belt structure and impenetrable barrier to inward penetration of ultra-relativistic electrons at $L \sim 2.8$: No cases of high fluxes of $E > 1.5$ MeV electrons inside of $L \sim 2.5$ in over five years of measurements.
- Van Allen Probes data clearly show there are extended periods of gradual change in the (super- and ultra-) relativistic electron populations punctuated by abrupt losses and rapid subsequent acceleration.
- Van Allen Probes data show that ultra-relativistic electrons were low around 2014 sunspot max and have now been increasing dramatically due to strong solar wind streams in declining sunspot phase (southern solar hemisphere). **We will rue the day that such SWx info is gone.**

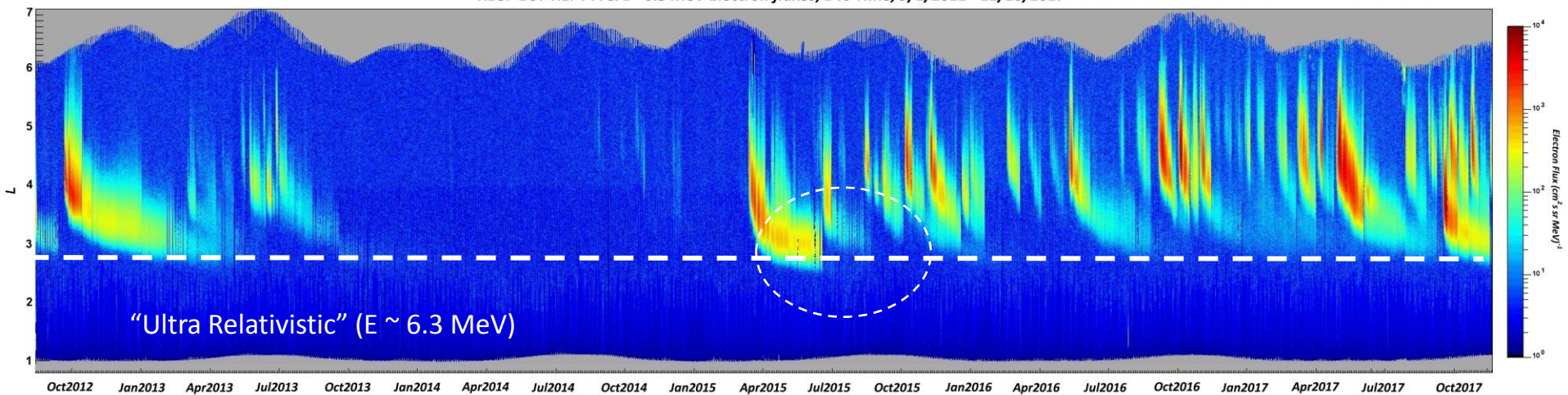
Questions?



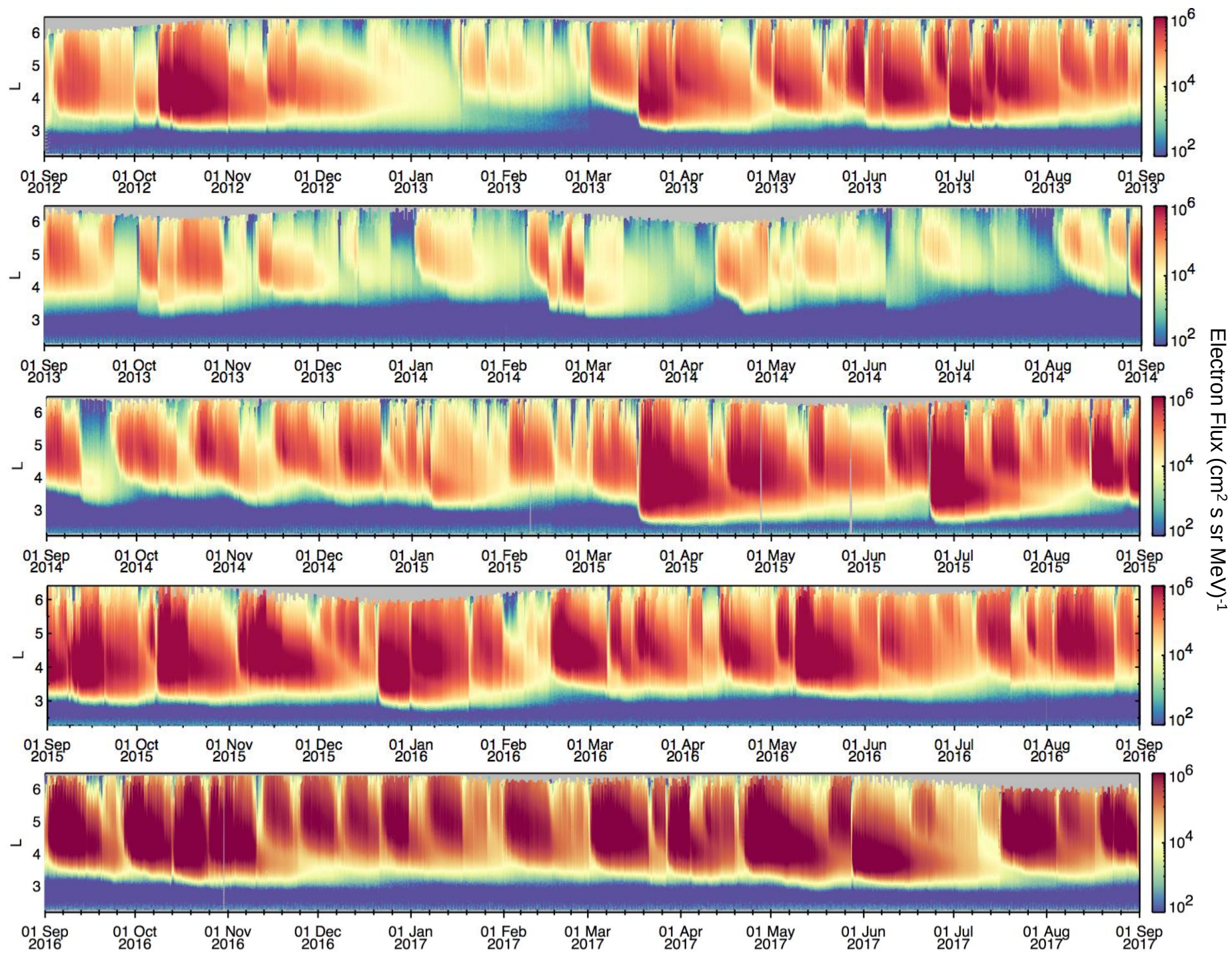
RBSP ECT-REPT A & B 5.2 MeV Electron fluxes, L vs Time, 9/1/2012 - 11/10/2017



RBSP ECT-REPT A & B 6.3 MeV Electron fluxes, L vs Time, 9/1/2012 - 11/10/2017



REPT A & B 1.8 MeV Electrons



Van Allen Probes Observations:

Acceleration, Remanence, and Sudden Loss

