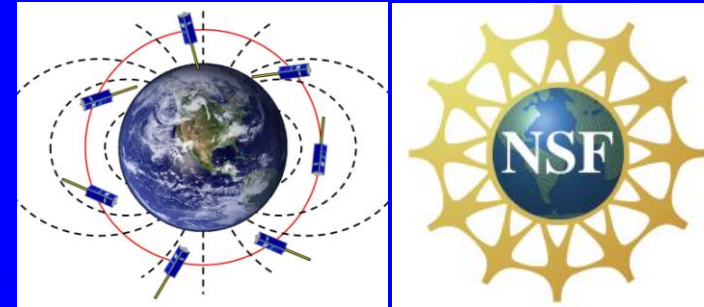


Dynamics of Relativistic Electrons During Non-Storm Times

Colorado Student Space Weather Experiment
(CSSWE), Van Allen Probes, BARREL, and THEMIS

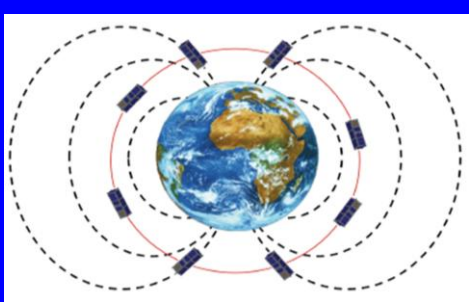


Xinlin Li^{1,2}, Quintin Schiller^{1,2}, Lauren Blum^{1,2,3}, and Allison Jaynes¹

- 1) Laboratory for Atmospheric and Space Physics (LASP), CU Boulder, USA
- 2) Dept of Aerospace Engineering Sciences, CU Boulder, USA
- 3) Space Sciences Lab, UC Berkeley, CA, USA

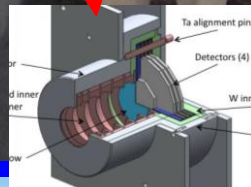
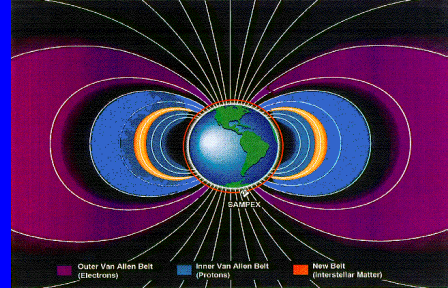
Launched: 9/13/12, NRO (Atlas V) under NASA's ELaNa program

Orbit: ~480 km x 780 km, inclination 65°



CSSWE: Colorado Student Space Weather Experiment

(Spring of 2010)



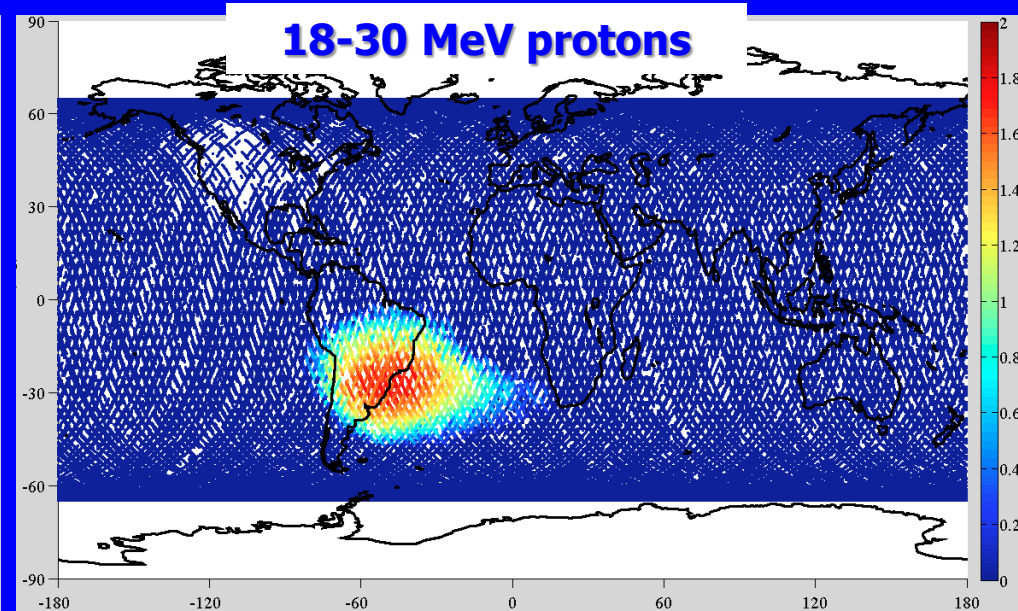
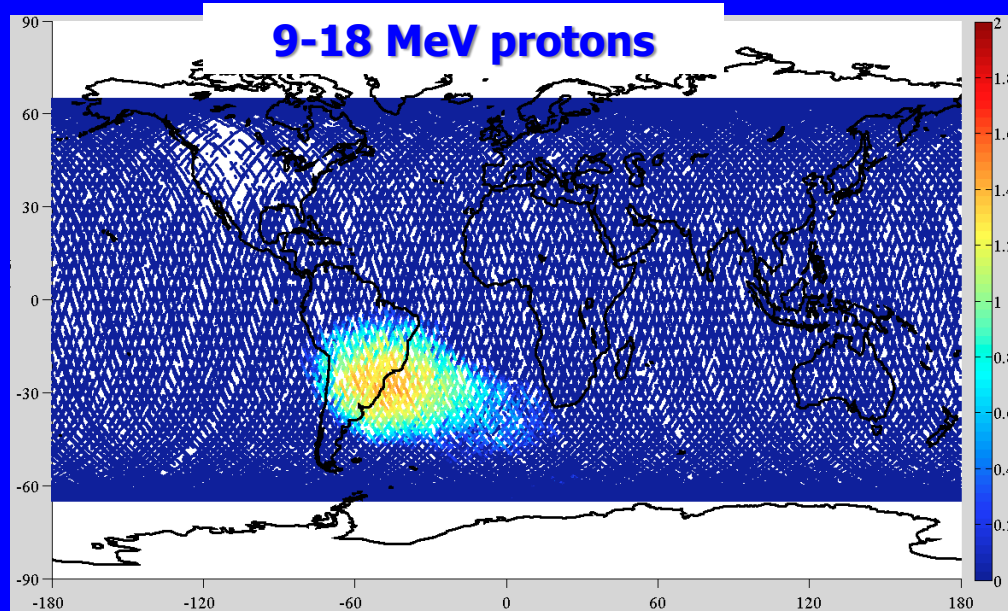
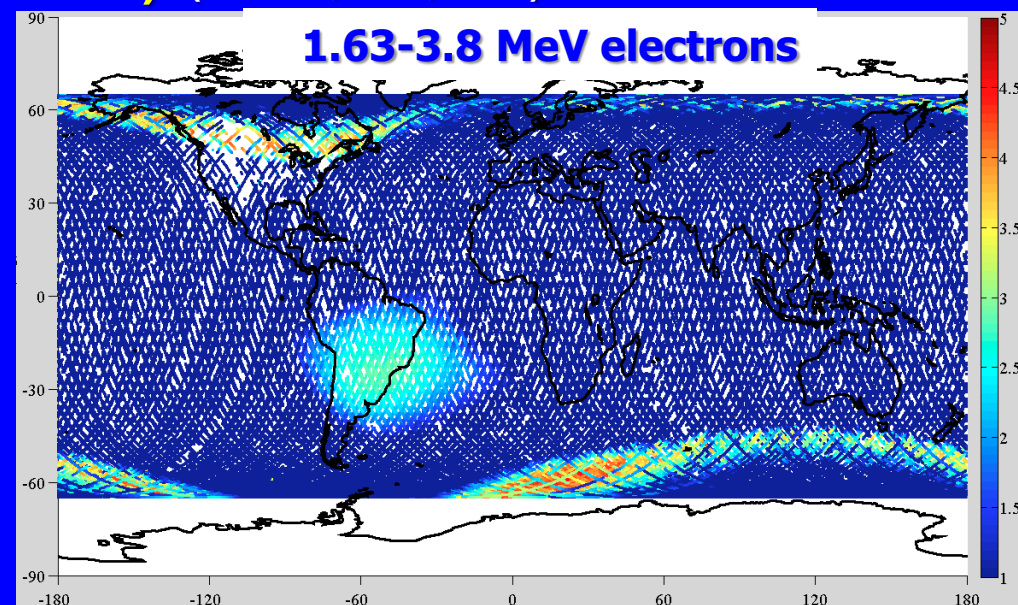
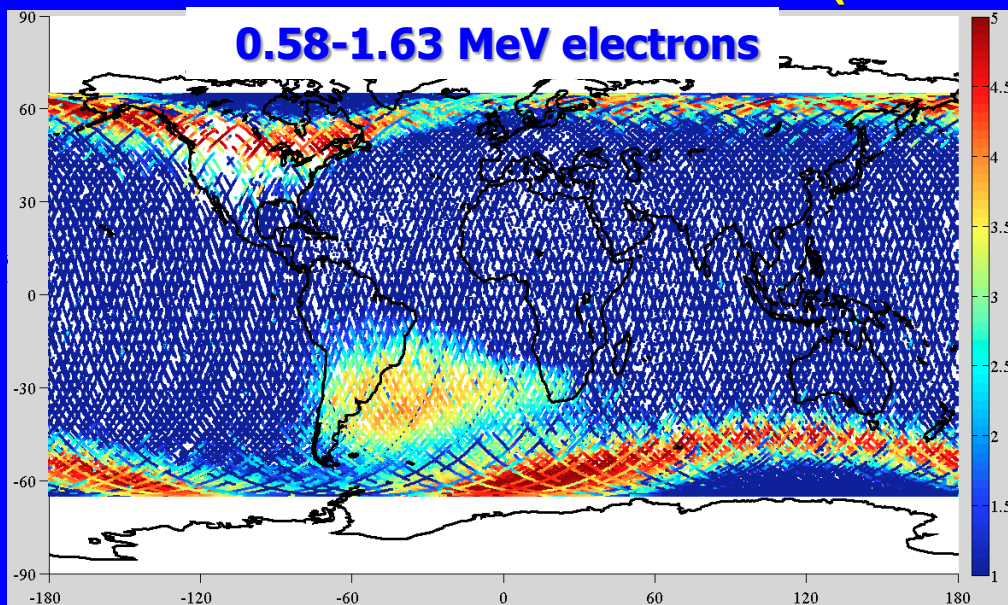
Relativistic Electron and Proton Telescope integrated little experiment (REPTile)

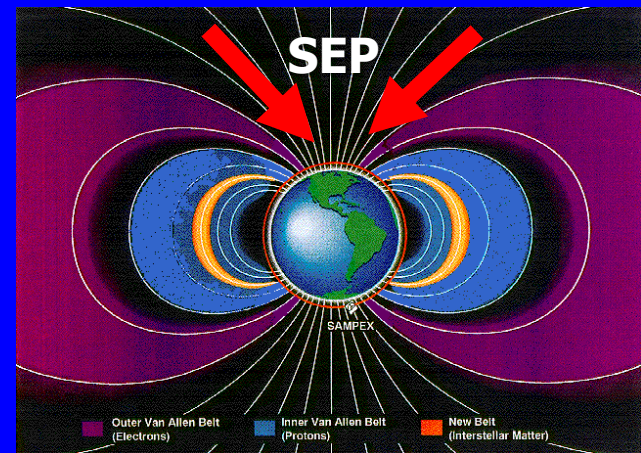
Electrons	0.58-1.63 MeV	1.63-3.8 MeV	>3.8 MeV
Protons	9-18 MeV	18-30 MeV	30-40 MeV



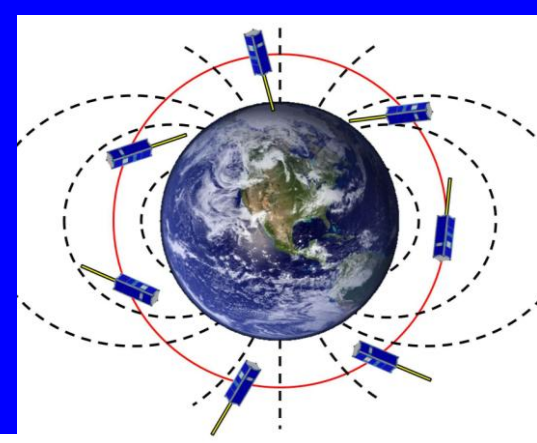


Measurements of electrons & protons from REPTile provide a clear picture of energetic particles (electrons and protons) in the near Earth environment (10/5-25/2012) (Li et al., JGR, 2013)

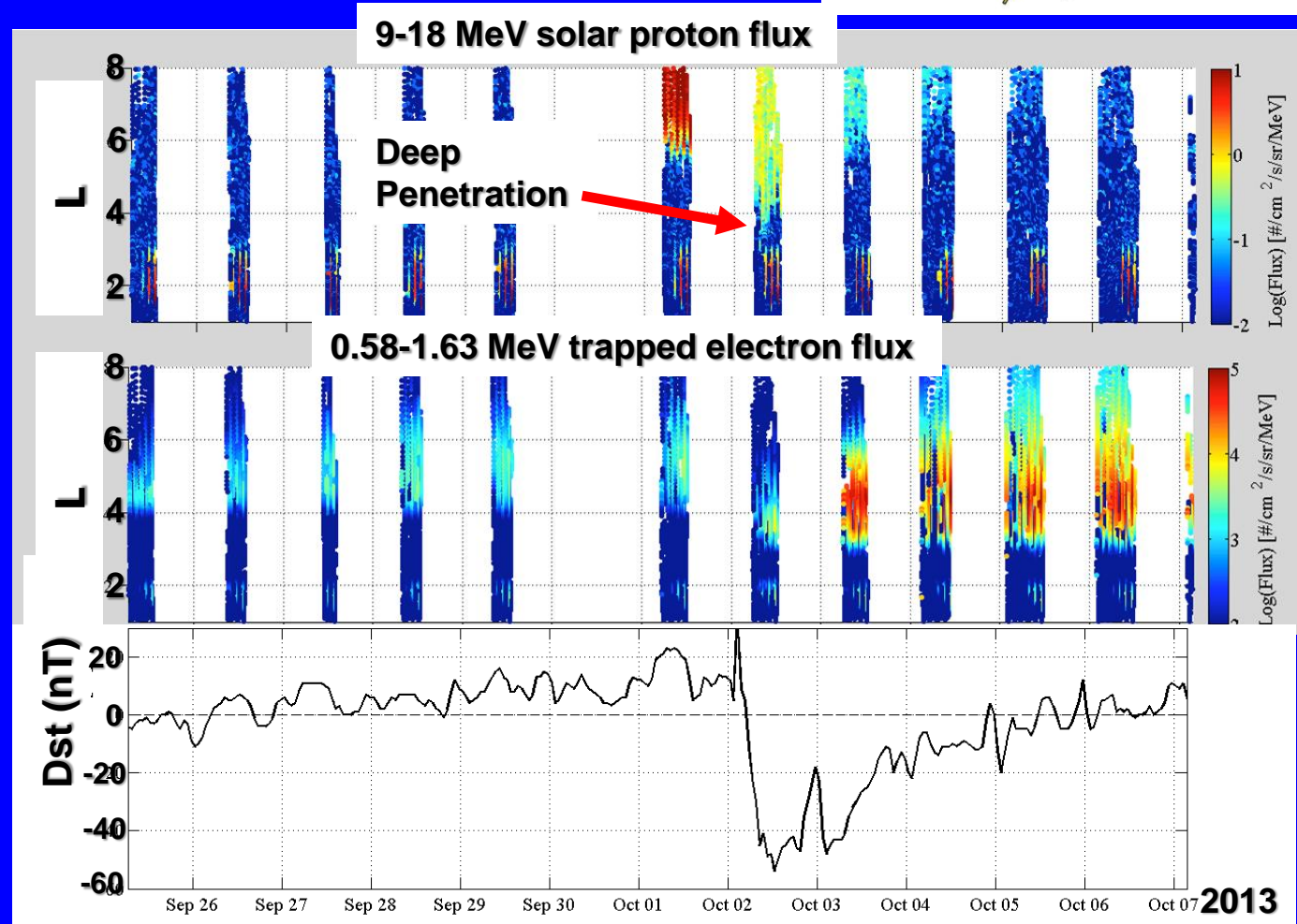




Solar Energetic Particle (SEP) Event



Clear separation of species during a SEP event

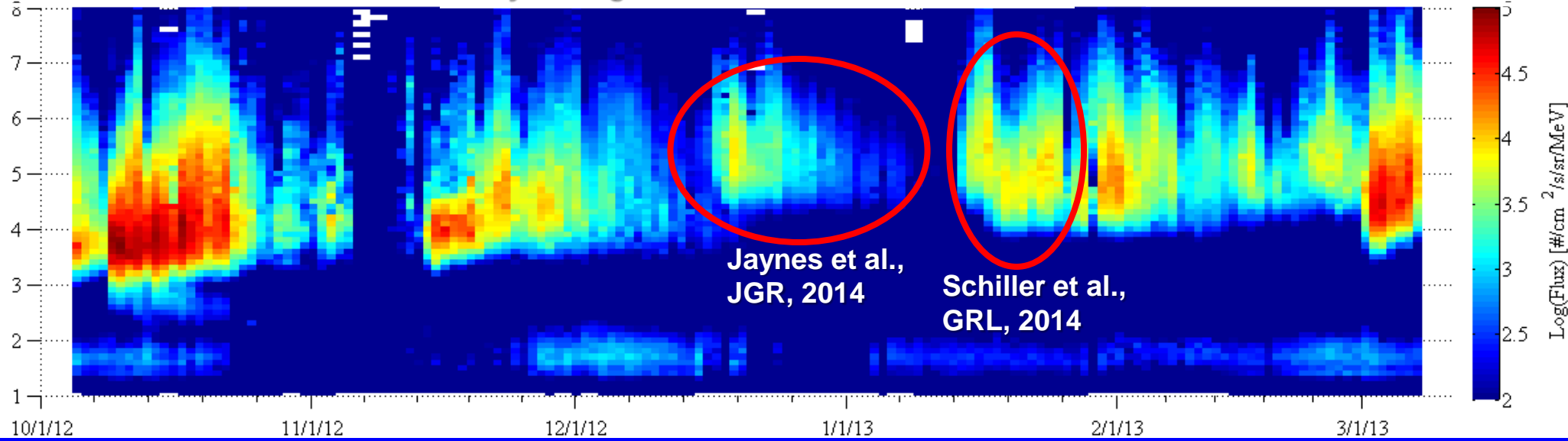


REPTile electron measurements for the first five months

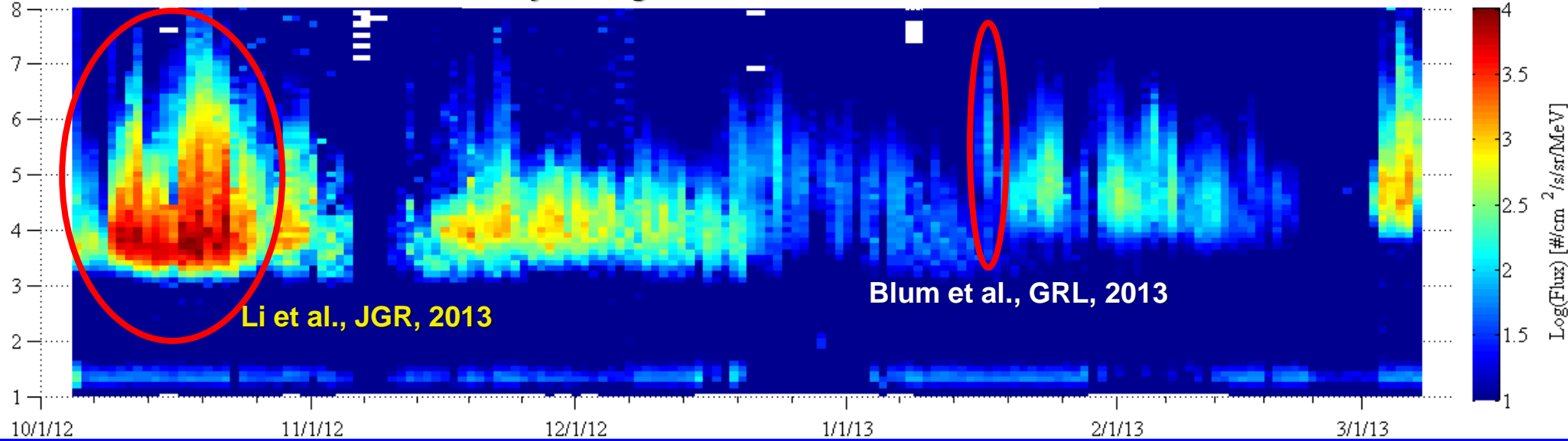
10/05/2012

Daily Average Electron Flux: 0.58-1.63 MeV

Through 03/10/2013

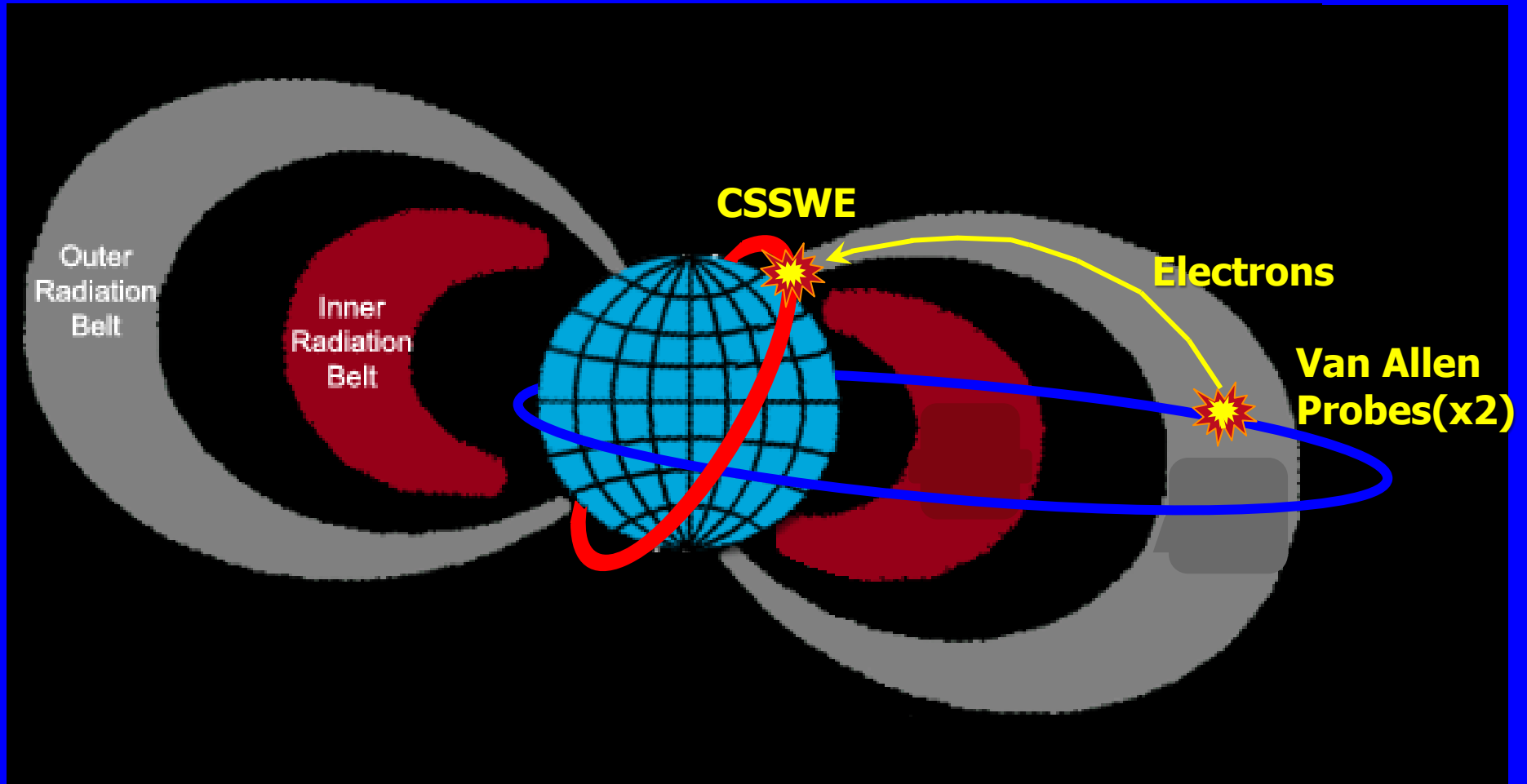


Daily Average Electron Flux: 1.63-3.8 MeV

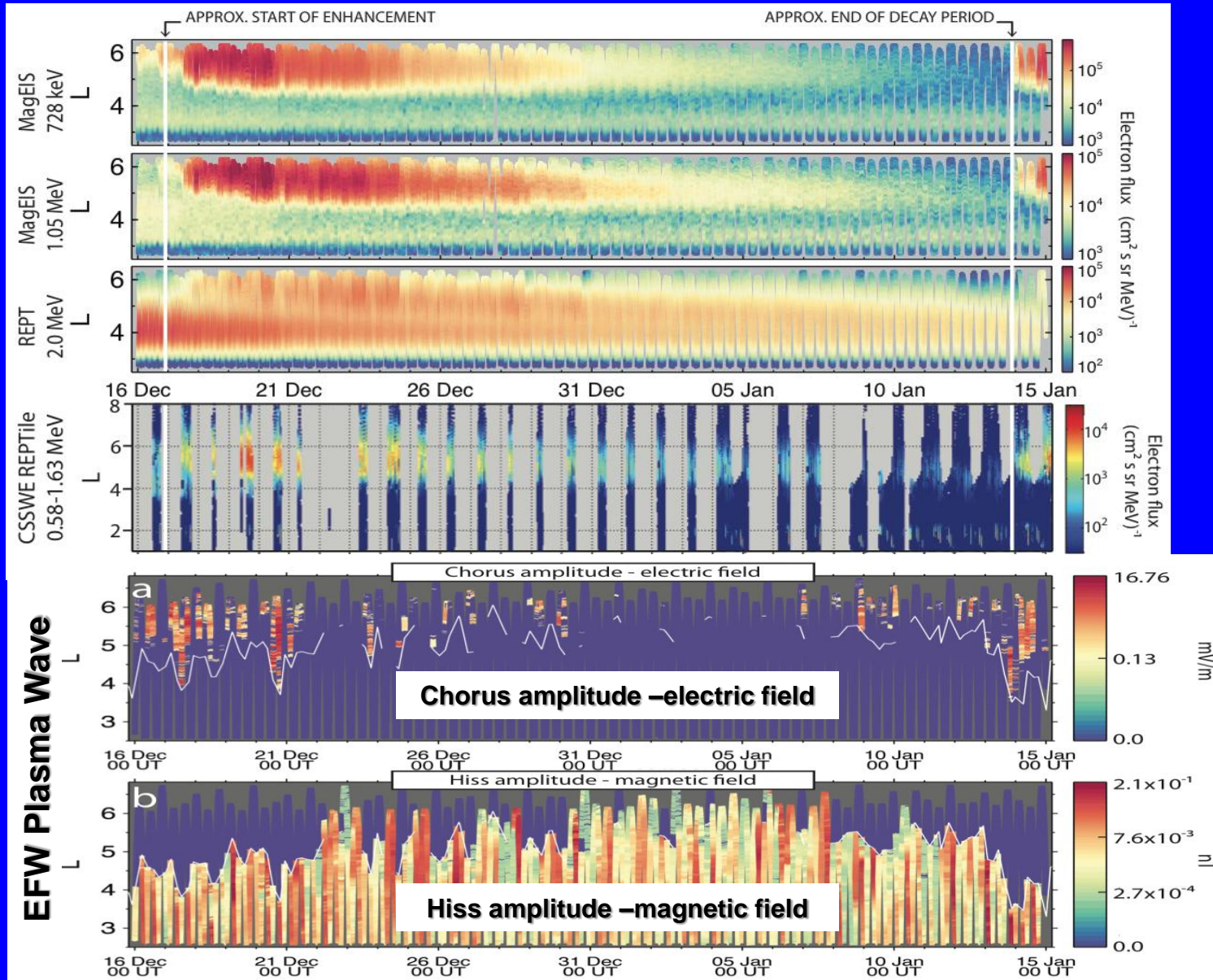


Concurrent measurements with NASA/Van Allen Probes

(orbits: 605km x 30410km and 635km x 30540km, inclination: 10°)

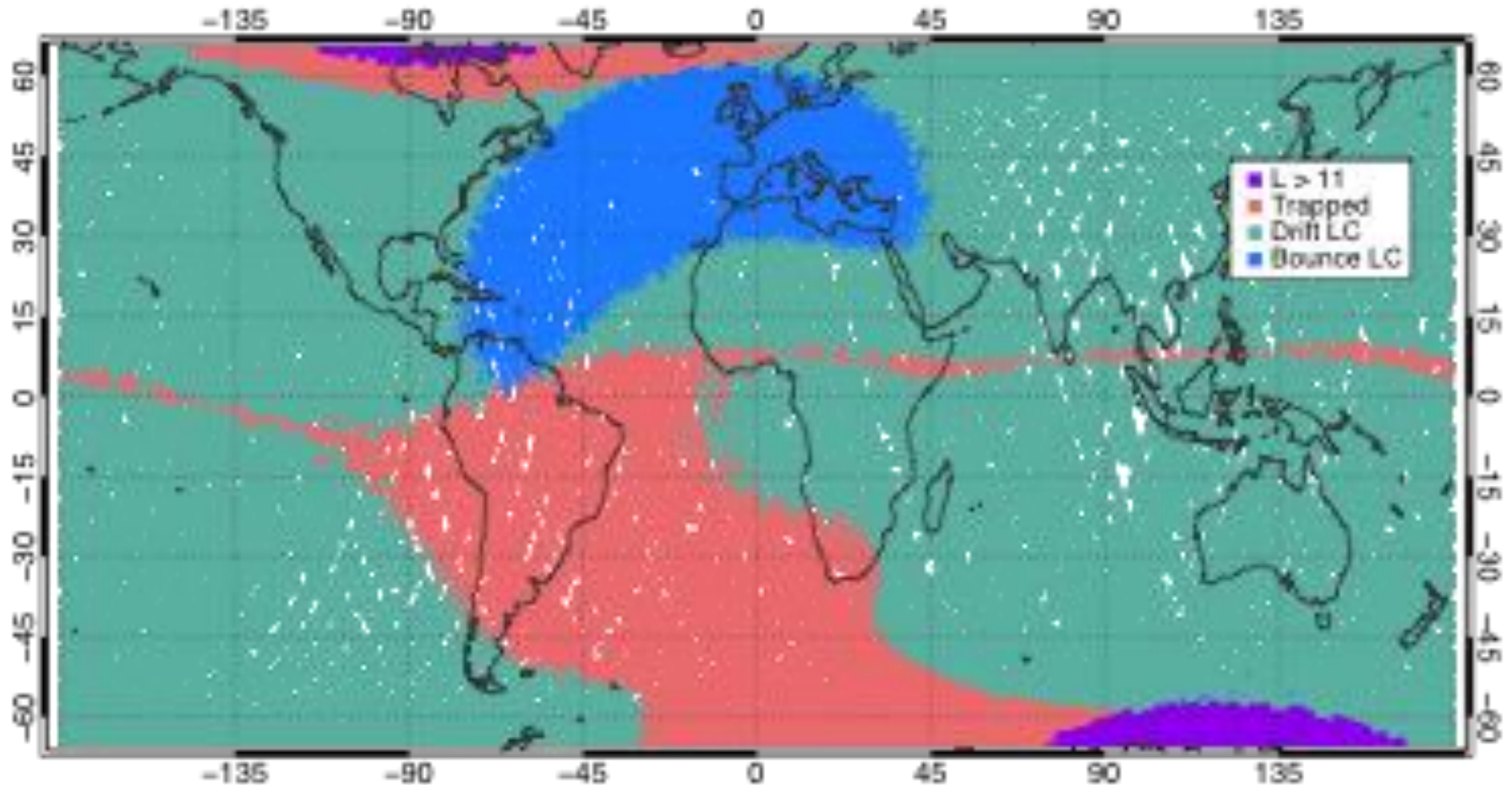


Evolution of relativistic outer belt electrons during an extended quiescent period (Jaynes et al., JGR, accepted, 2014)



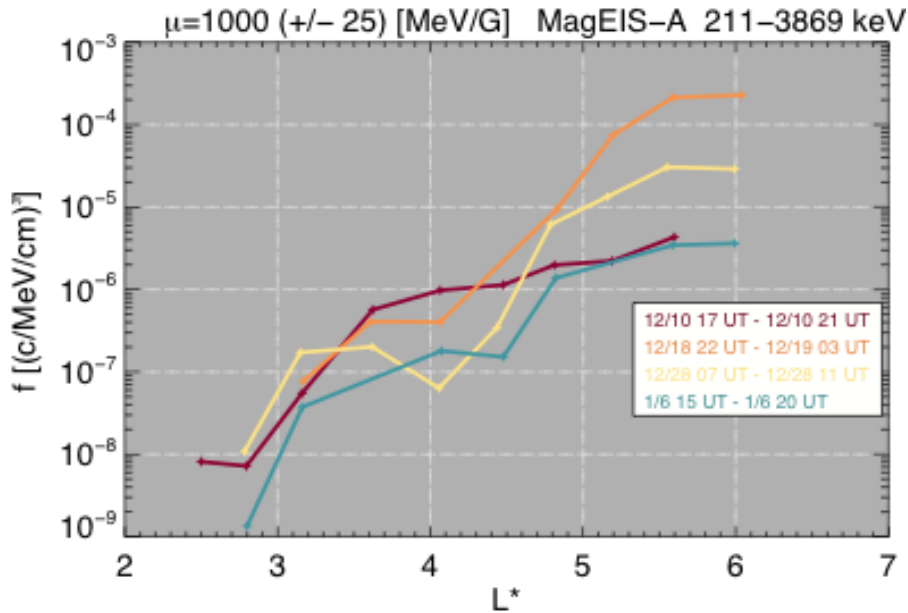
The electron populations measured by REPTile (at LEO):

Trapped, Quasi-trapped (DLC), and Untrapped (BLC)

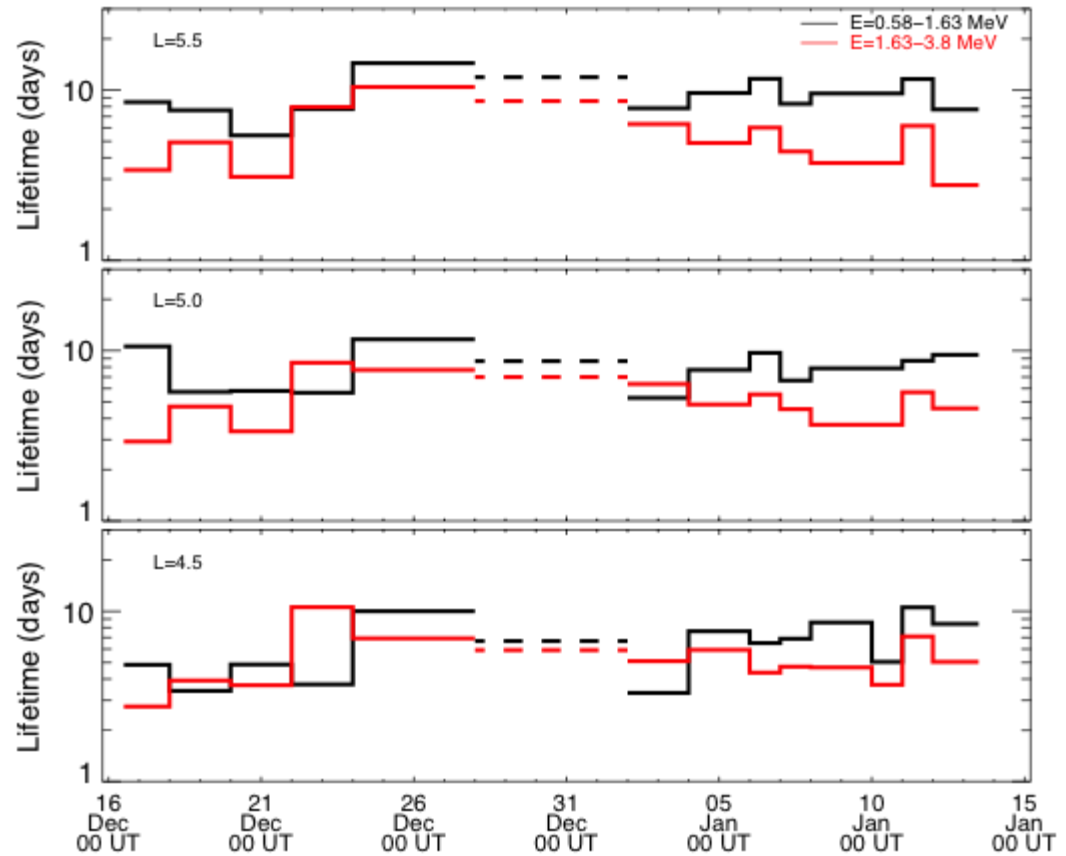


The electron lifetimes quantified by Loss-Index Method based on REPTile measurements

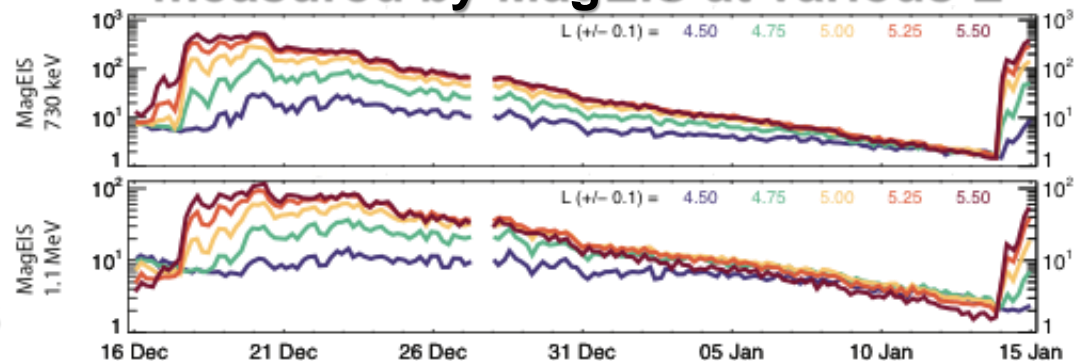
Radial profile of PSD derived from MagEIS measurements



The accumulated loss accounts for 92-98% of the total measured electron fluxes



Line plots of electron fluxes measured by MagEIS at various L

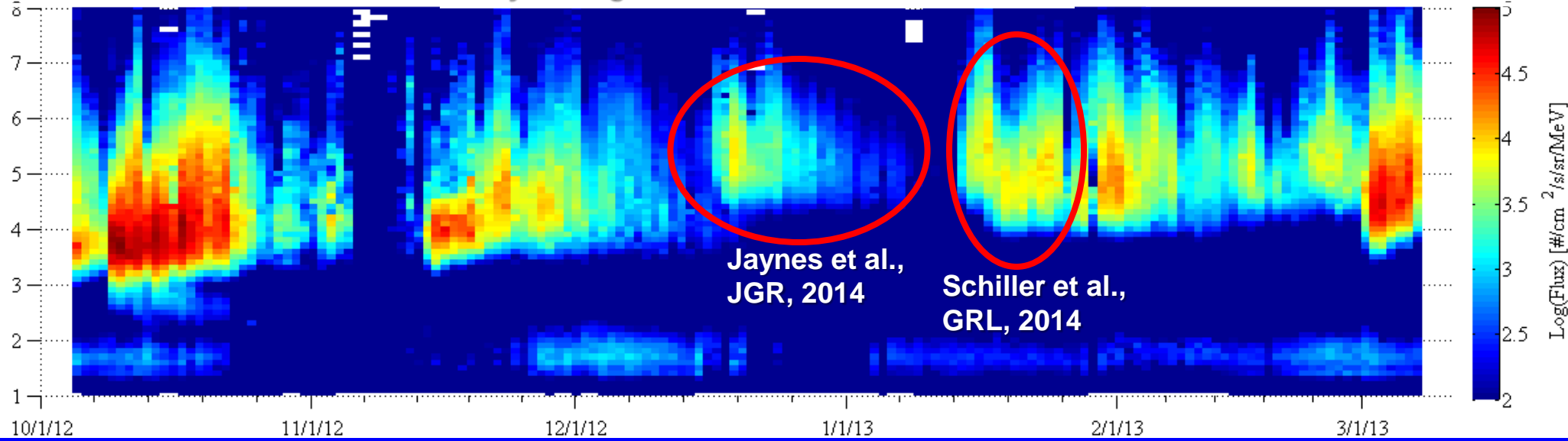


REPTile electron measurements for first five months

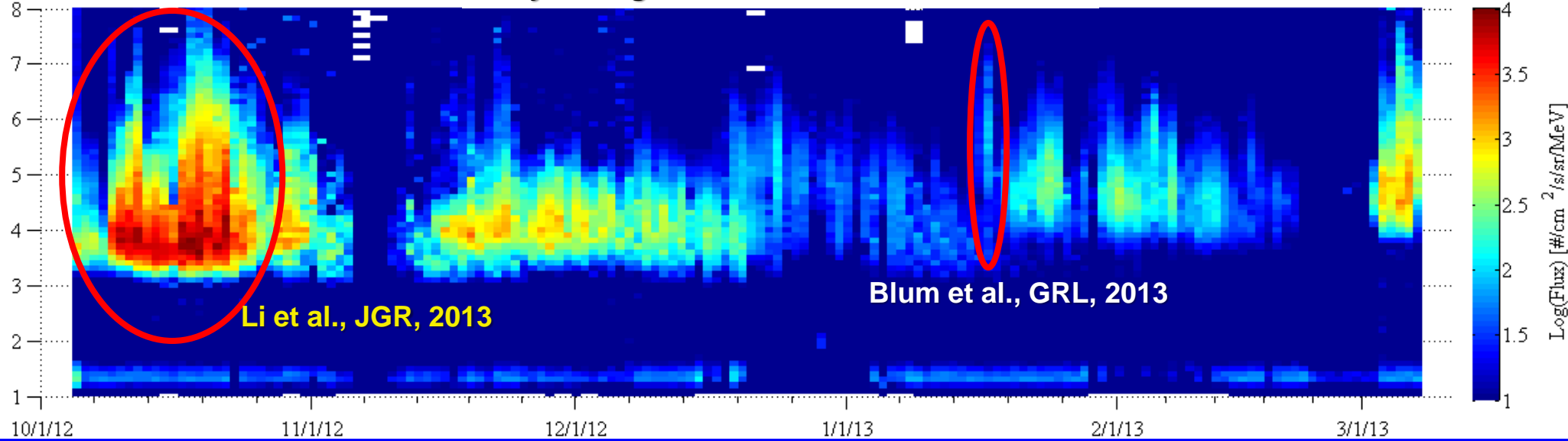
10/05/2012

Daily Average Electron Flux: 0.58-1.63 MeV

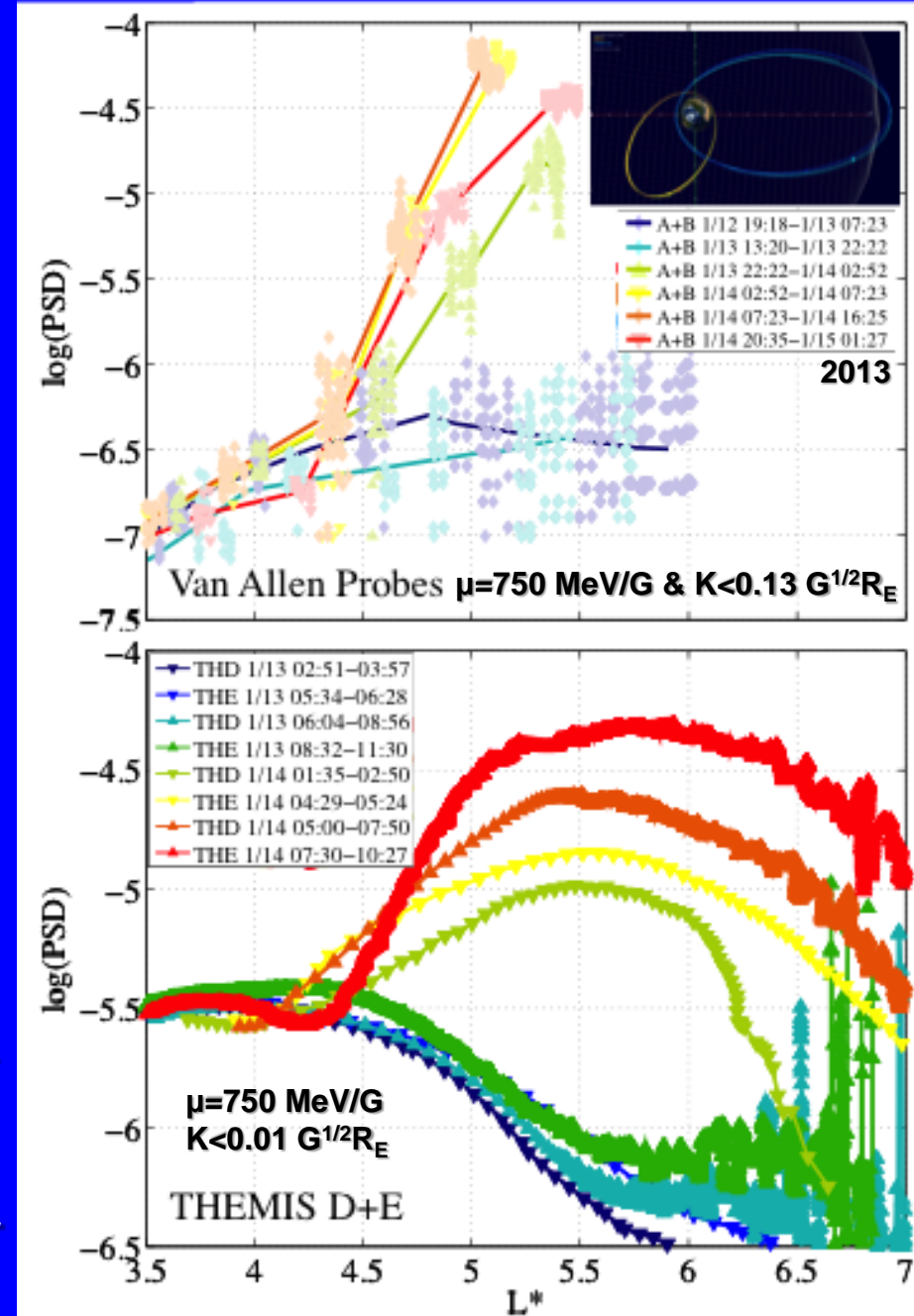
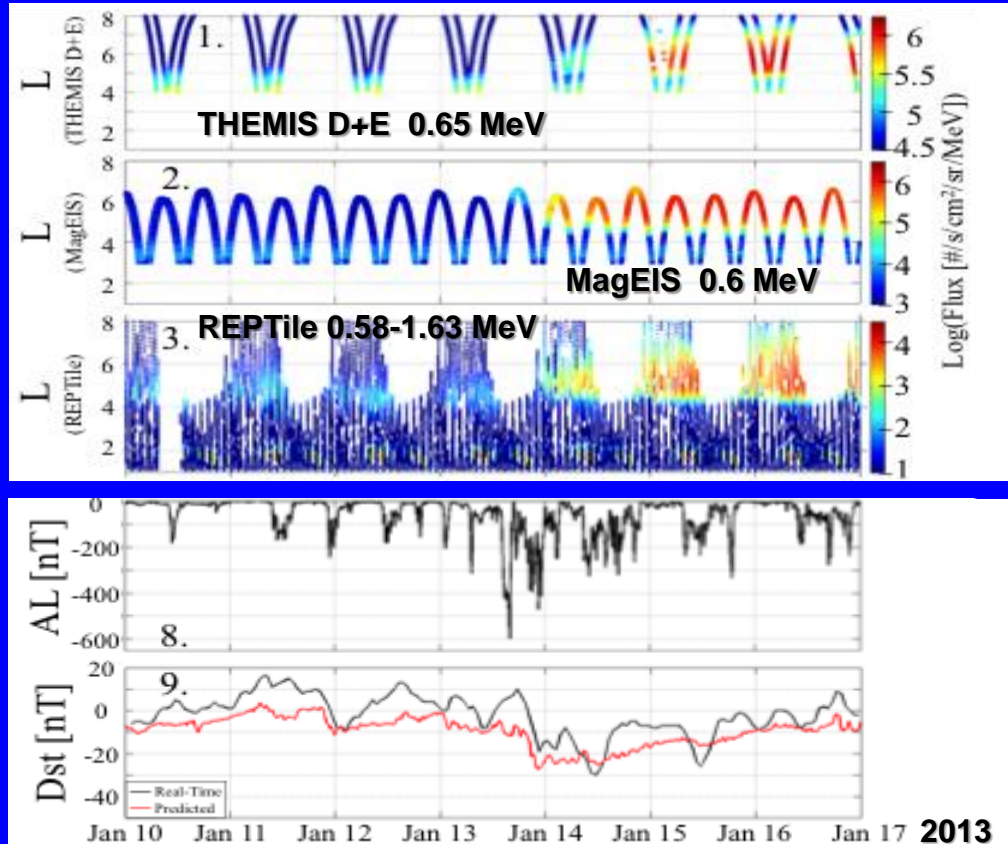
Through 03/10/2013



Daily Average Electron Flux: 1.63-3.8 MeV



A non-storm time enhancement of relativistic electrons in the outer radiation belt (Schiller et al., GRL, 2014)

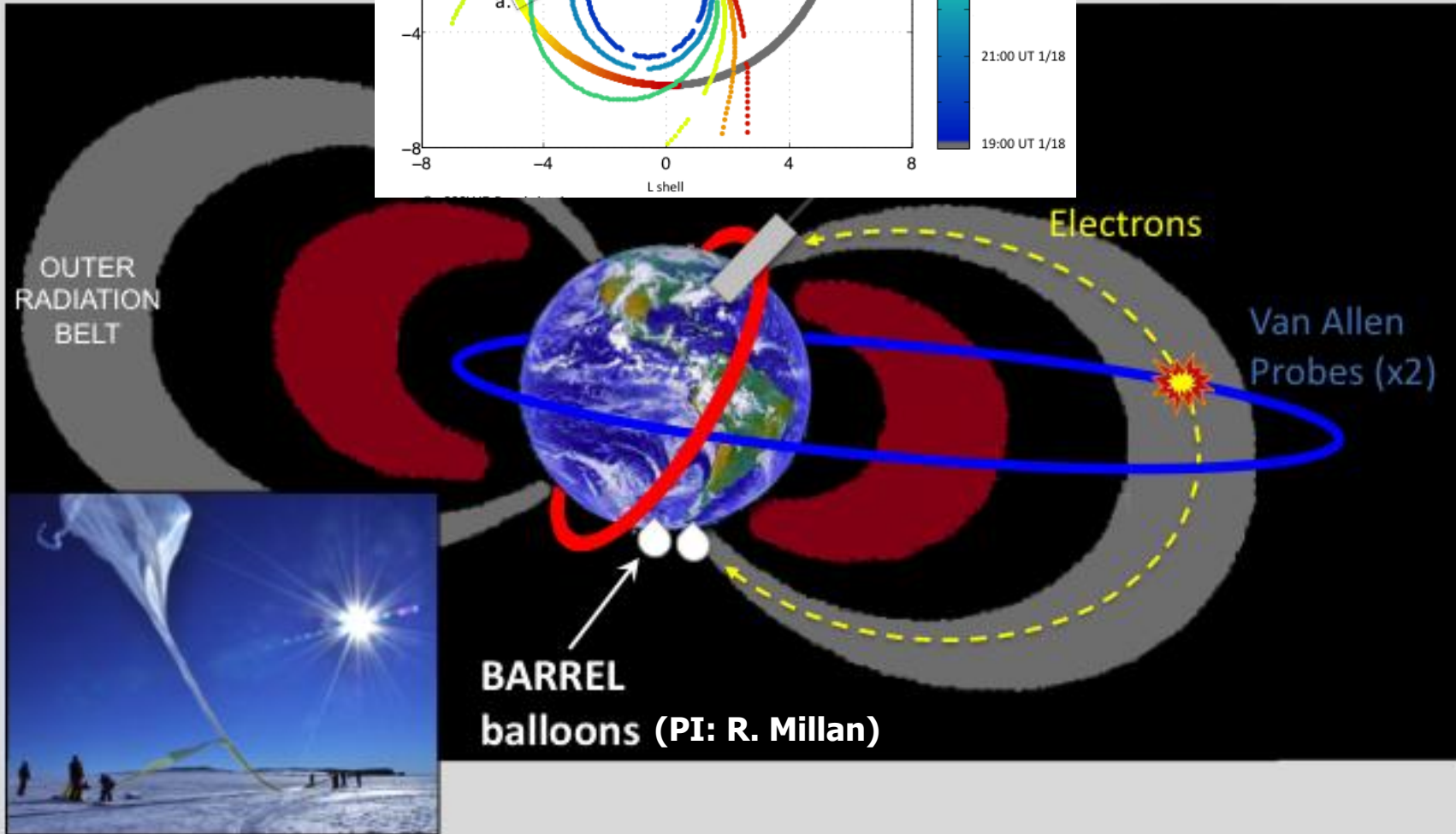
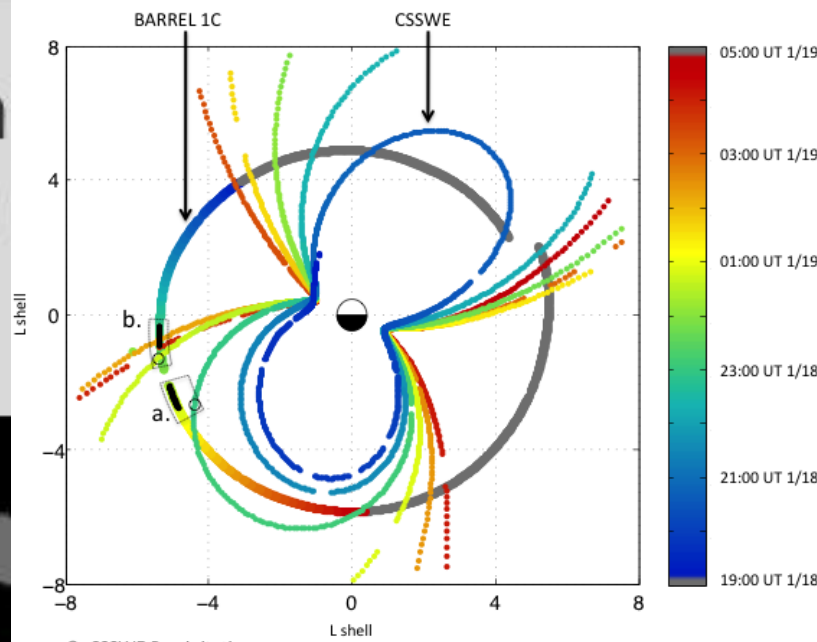


- (1) over 2.5 orders of magnitude enhancement in 13 hr
→ geomagnetic storms are not necessary
- (2) PSD peaked at L~5.5, then fast inward transport
- (3) Up to 16% more actual enhancement to account for the precipitation loss

Conjun Radiation

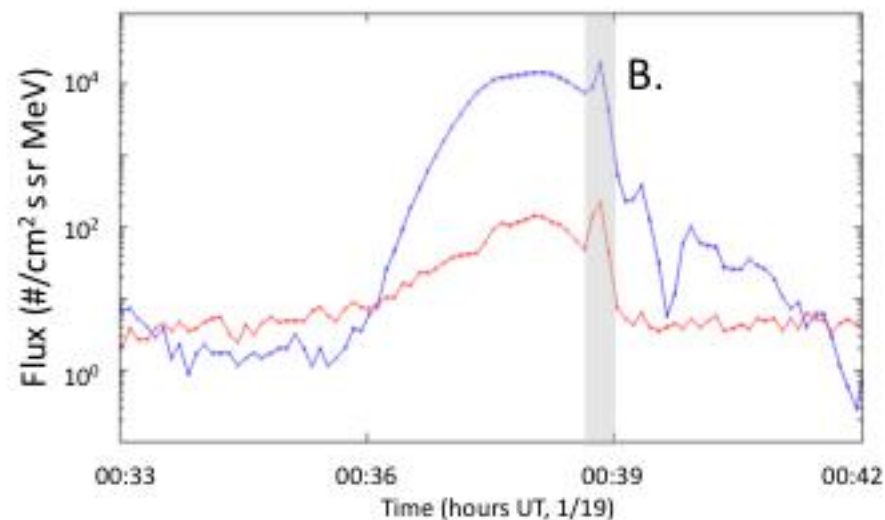
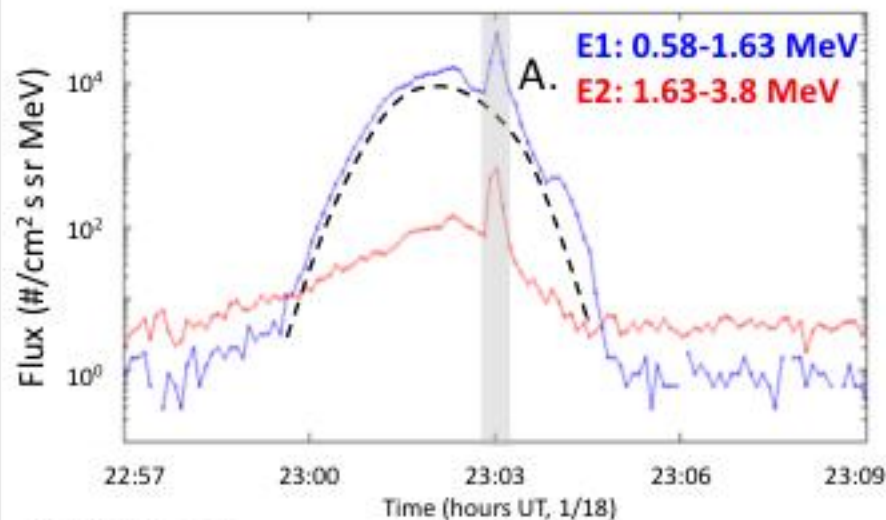
acterize ation Loss

(Blum et al., GRL, 2013)

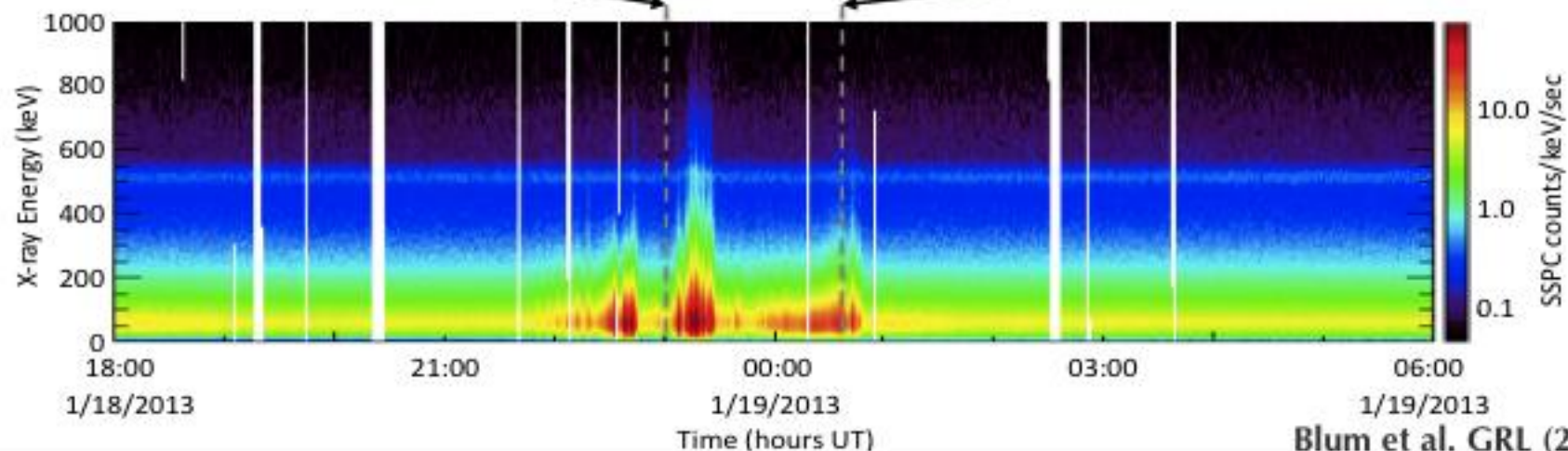


CSSWE - BARREL Conjunction: Jan 18-19, 2013

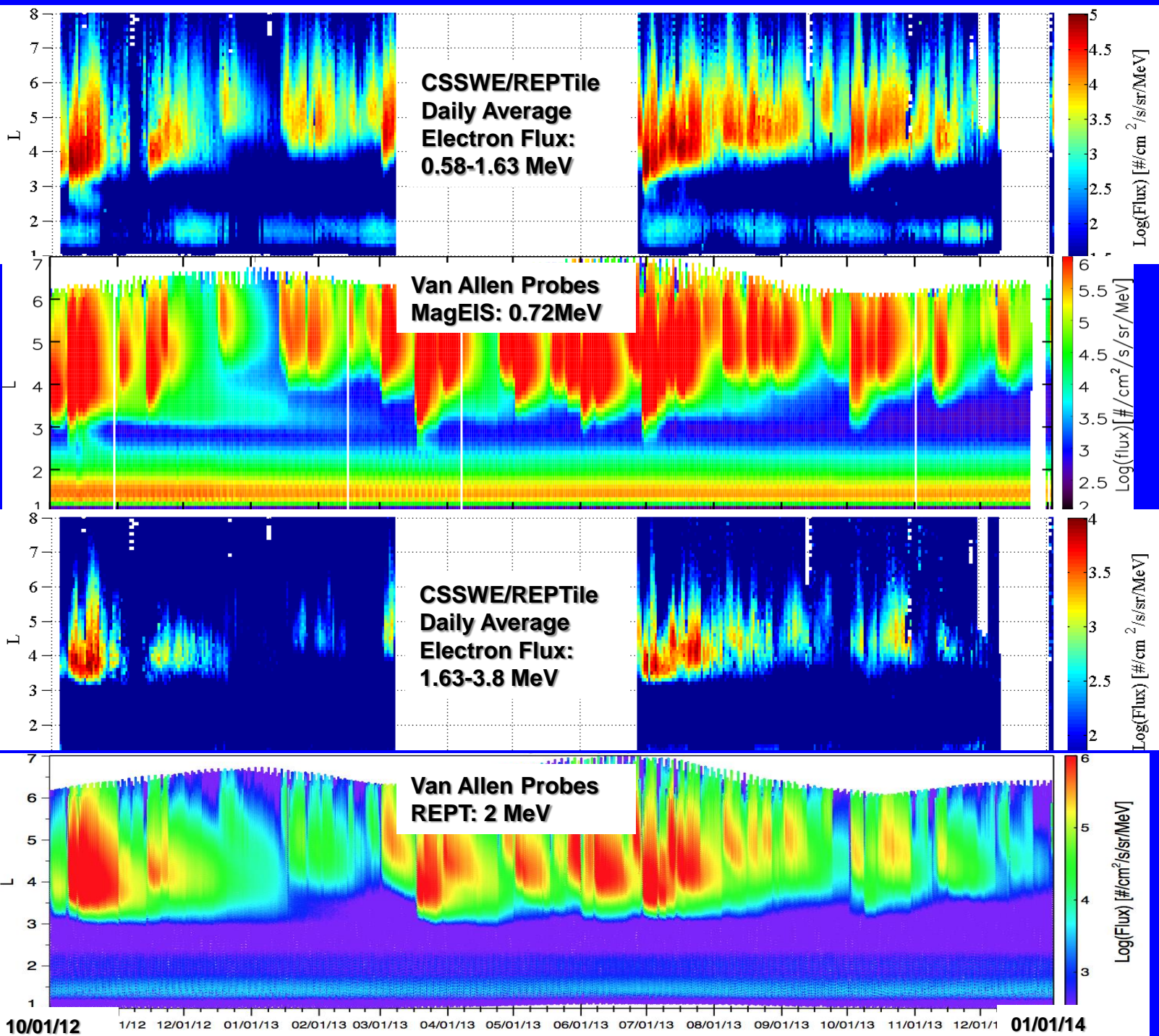
CSSWE



BARREL 1C



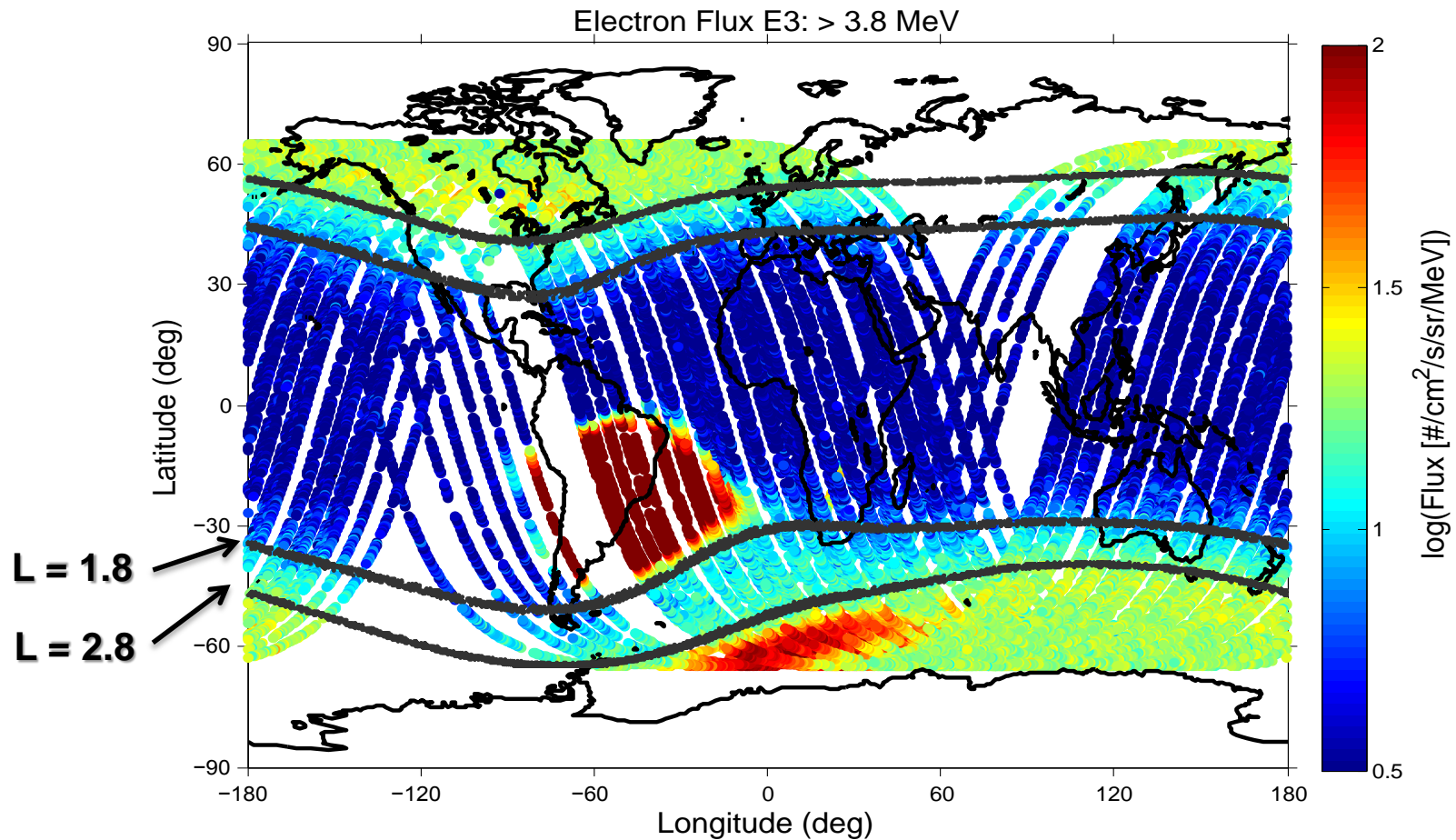
Blum et al. GRL (2013)



Long term comparison between CSSWE and Van Allen Probes measurements

Nature-Extended Data Fig 2 (Baker et al., accepted, 2014)

REPTile Data – September 1-23, 2013



Conclusions

Our CubeSat has been in space for over 24 months, providing clean measurements of energetic electrons and protons → a success in education, engineering, and science!

Combined measurements with other missions such as NASA/Van Allen Probes, BARREL, THEMIS have resulted in better understanding of the Dynamics of Relativistic Electrons During Non-Storm Times, such as,

- (1) Quantified the precipitation loss of outer belt electrons**
- (2) Detailed demonstration of non-storm enhancements of relativistic electrons**

Data analysis and modeling of our CubeSat measurements continue ...

CubeSat Mission Website: <http://lasp.colorado.edu/home/csswe/>