Low energy electrons in the inner magnetosphere: Recent revisions of IMPTAM model

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The Model: IMPTAM

What do we present?
IMPTAM (Inner Magnetosphere Particle Transport and Acceleration model): nowcast model for low energy (< 200 keV) electrons in the near-Earth geospace, operating online at

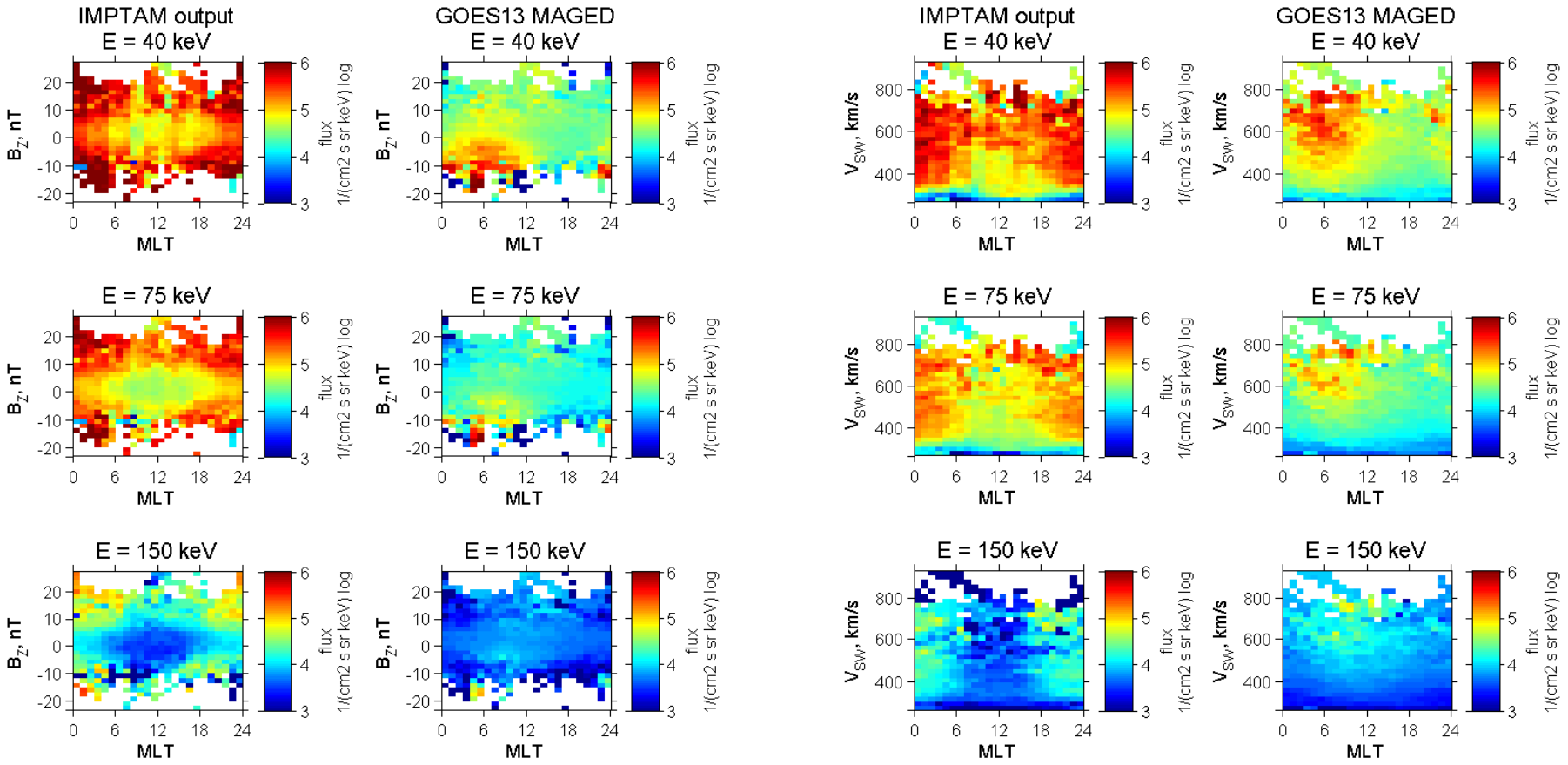
imptam.fmi.fi

Why this model is important?
Low energy electron fluxes are very important to specify when hazardous satellite **surface charging** phenomena are considered.
They constitute the low energy part of the seed population for the high energy MeV particles in the **radiation belts**

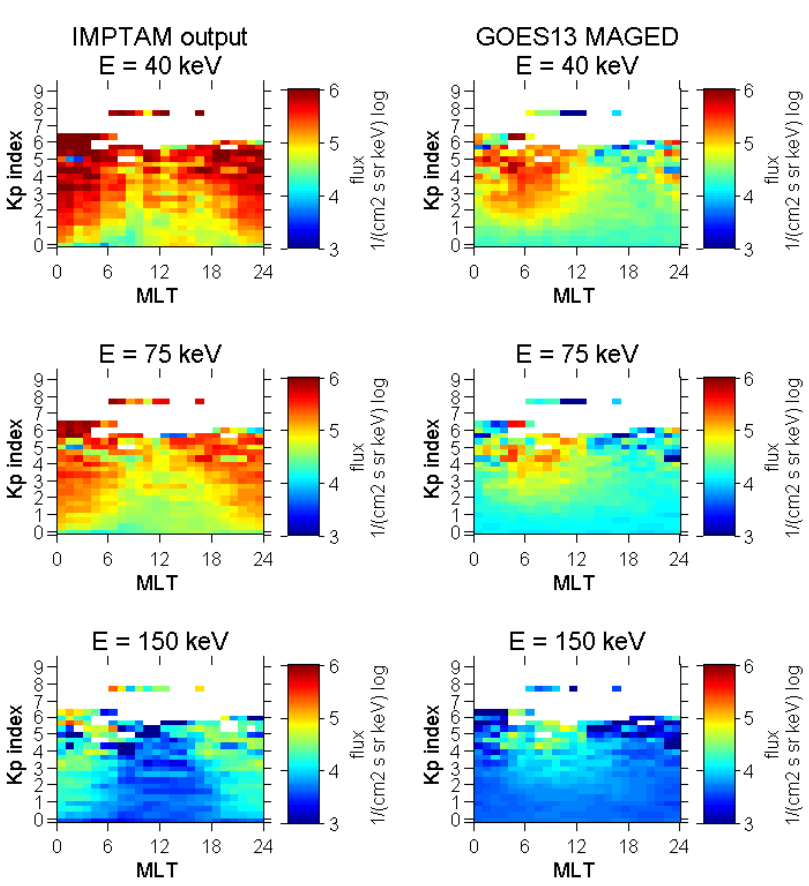
What does the model provide?
The presented model provides the low energy electron flux at all locations and at all satellite orbits, when necessary, in the near-Earth space.

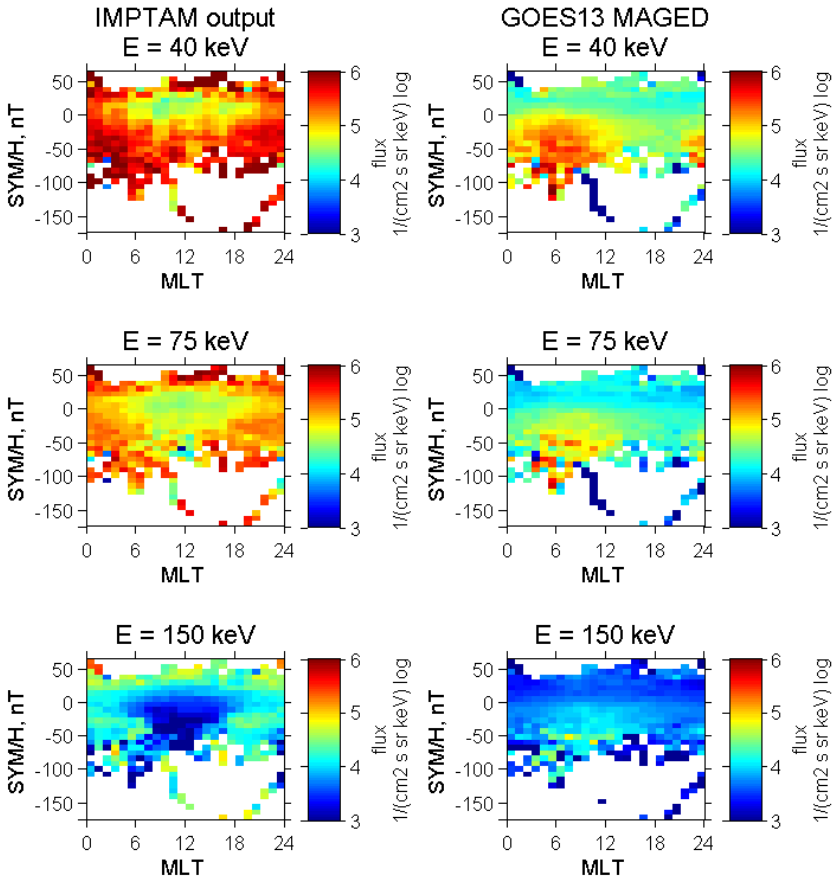
What are the drivers of the model?
The model is driven by the real time solar wind and Interplanetary Magnetic Field parameters with 1 hour time shift for propagation to the Earth's magnetopause, and by the real time geomagnetic activity index Dst.

IMPTAM vs GOES 13 MAGED: electron fluxes (IMF Bz, MLT), (Vsw, MLT)

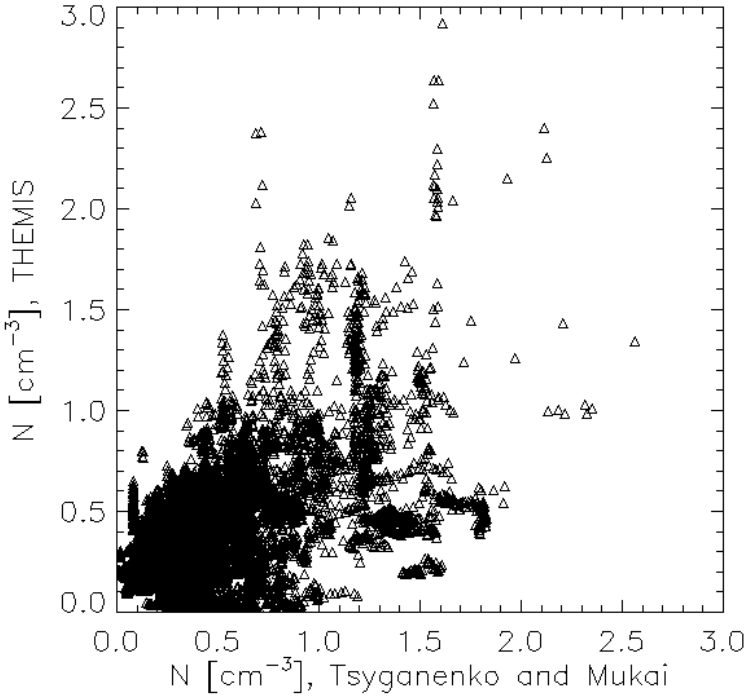


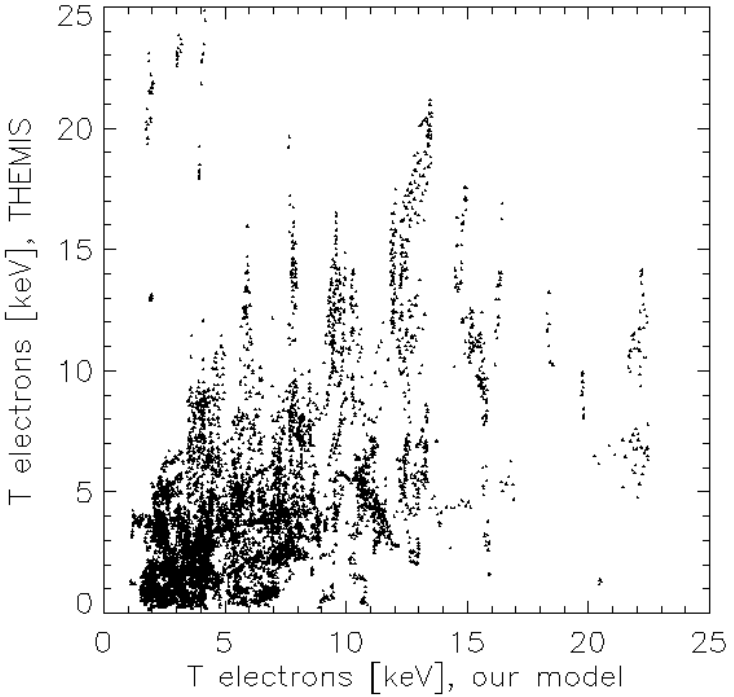
IMPTAM vs GOES 13 MAGED: electron fluxes (Kp, MLT), (SYM-H, MLT)





Number density and temperature of electrons from THEMIS data and of ions from *Tsyganenko and Mukai* [2003] model





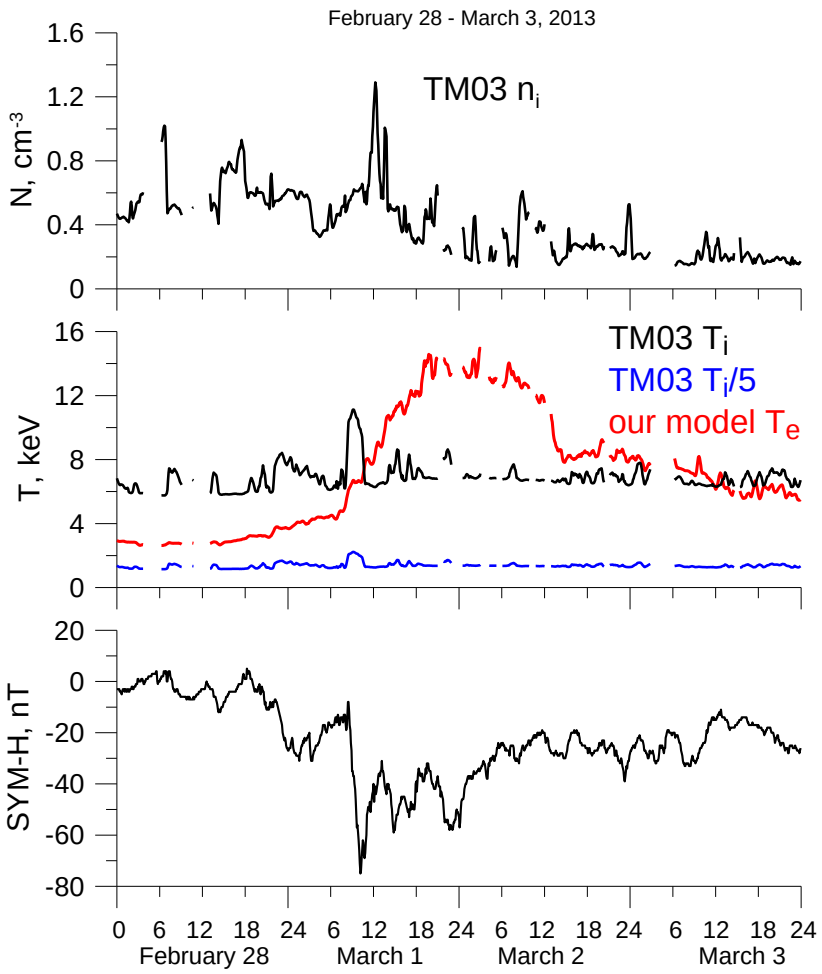
The TM03 equation for number density for ions can be used for electrons for IMPTAM simulation.

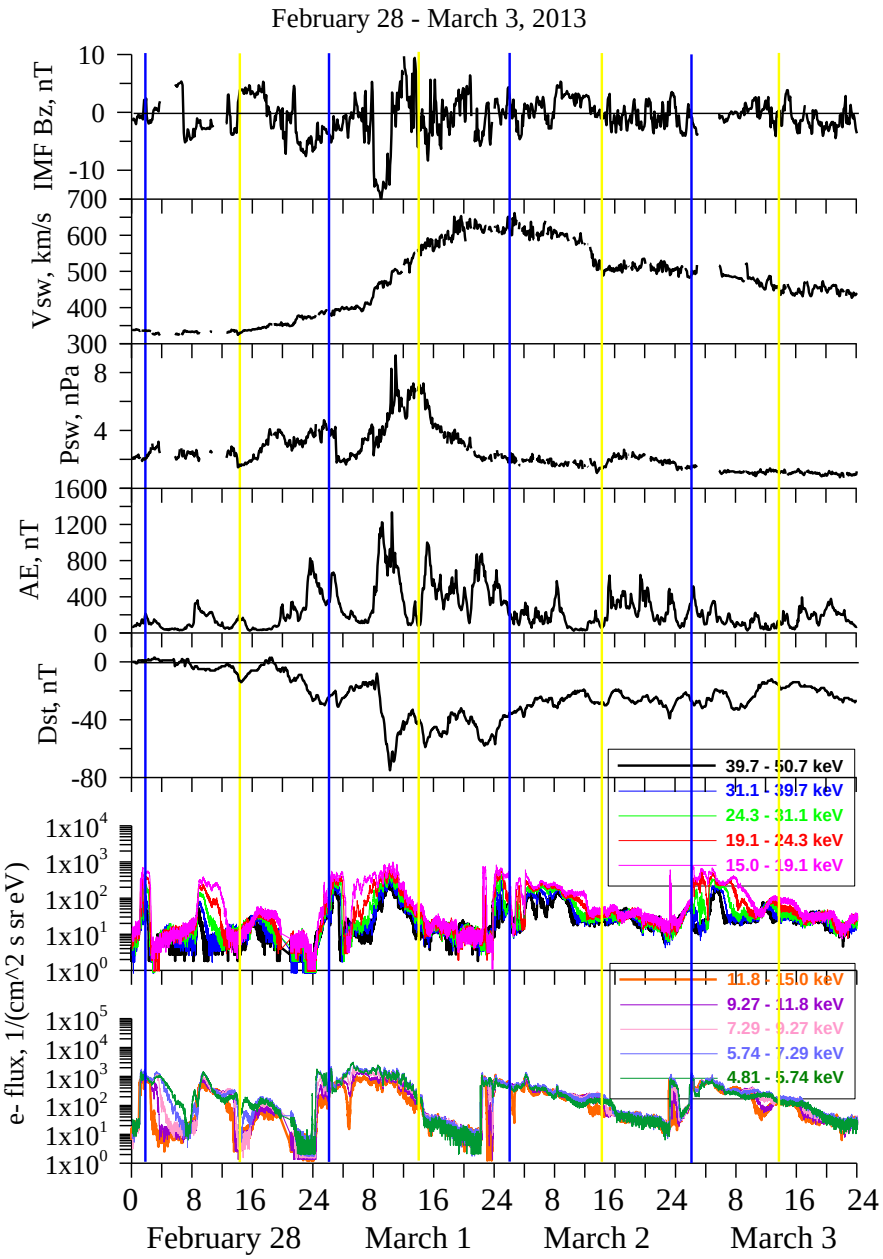
$$\Psi = arctg\left(-\frac{Y_{GSM}}{X_{GSM}}\right)$$

$$T_e = \left[\begin{array}{l} 2.84 - 2.90R - 0.0045\Psi + 0.00501\Psi^2 - 0.00386\Psi^2 R + \\ \left(2.34R - 0.00183\Psi^2\right)Vsw \end{array}\right]^{2.5}$$

AMC 12 CEASE II ESA data

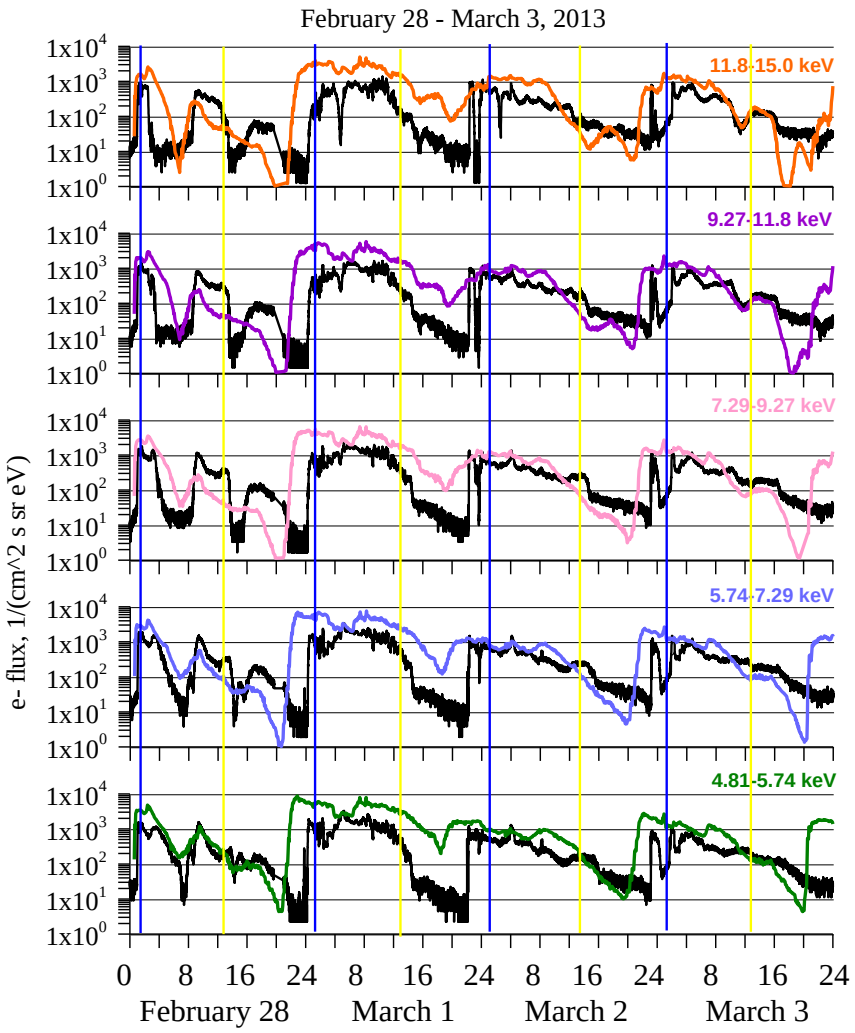
AMC 12 geostationary satellite, CEASE-II instrument contains an Electrostatic Analyzer (ESA) for measuring low energy electron fluxes in 10 channels, 5 - 50 keV.

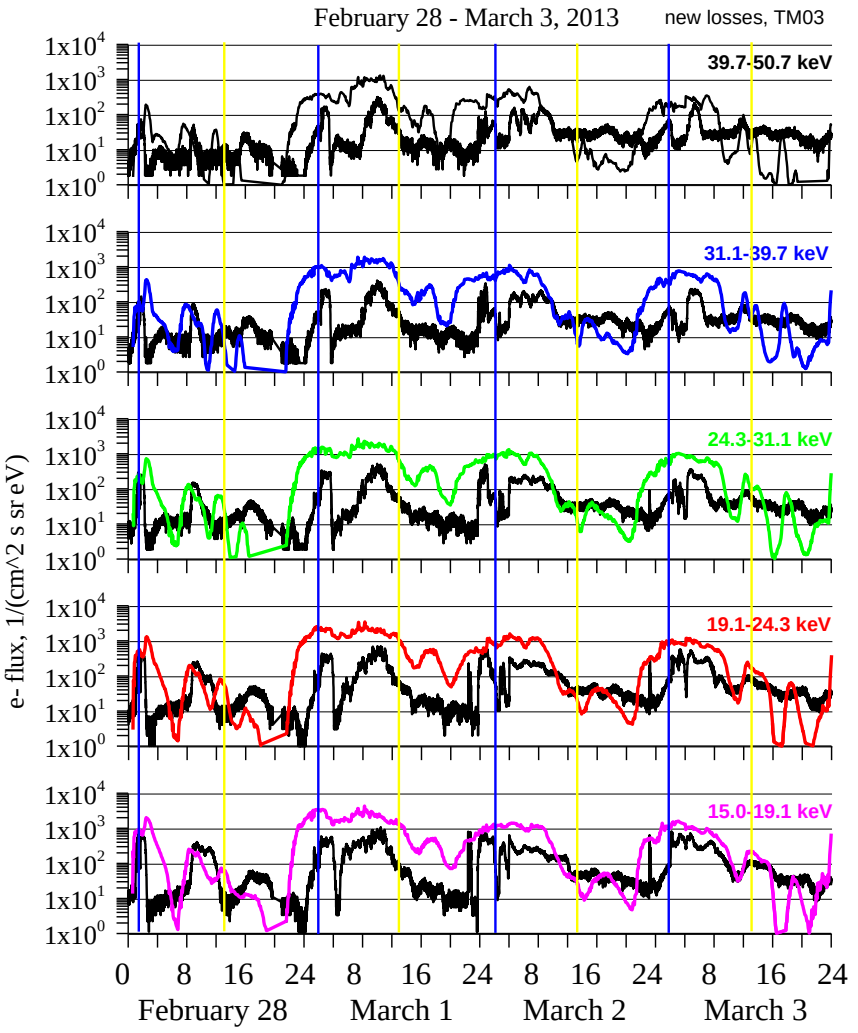




Electron fluxes observed by AMC 12 CEASE II ESA instrument for 15-50 keV energies and modeled

With **THEMIS** model and ***Orlova and Shprits*** **[2014] and *Orlova et al.* [2014]** electron lifetimes





Summary

1. A revision of the source model at 10 Re in the plasma sheet was done. The particle data from THEMIS ESA and SST instruments were analyzed for years 2007-2013 and a new empirical model for electron temperature and number density in the plasma sheet was developed. We plan to conduct more validation studies comparing the model output with data from other satellites which were not used for the development of the model such as Cluster, Polar, Geotail.

2. Most advanced representation of loss processes for low energy electrons due to wave-particle interactions with chorus and hiss were incorporated using electron lifetimes following *Orlova and Shprits* [2014] and *Orlova et al*. [2014]. When these losses and new boundary conditions incorporated into IMPTAM, the modeled fluxes follow reasonable well the observed ones. The comparison was done for AMC 12 CEASE II electron data for 5-50 keV. At the same time, there are time intervals, especially during storm main phase, when there are deviations of modeled fluxes from the observed. We plan to continue working under correct loss processes for low energy electrons by incorporating pitch angle diffusion coefficients from radiation belts models.