IMPTAM: Providing < 200 keV energetic electrons along satellites' orbits responsible for hazardous surface charging

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1. Introduction

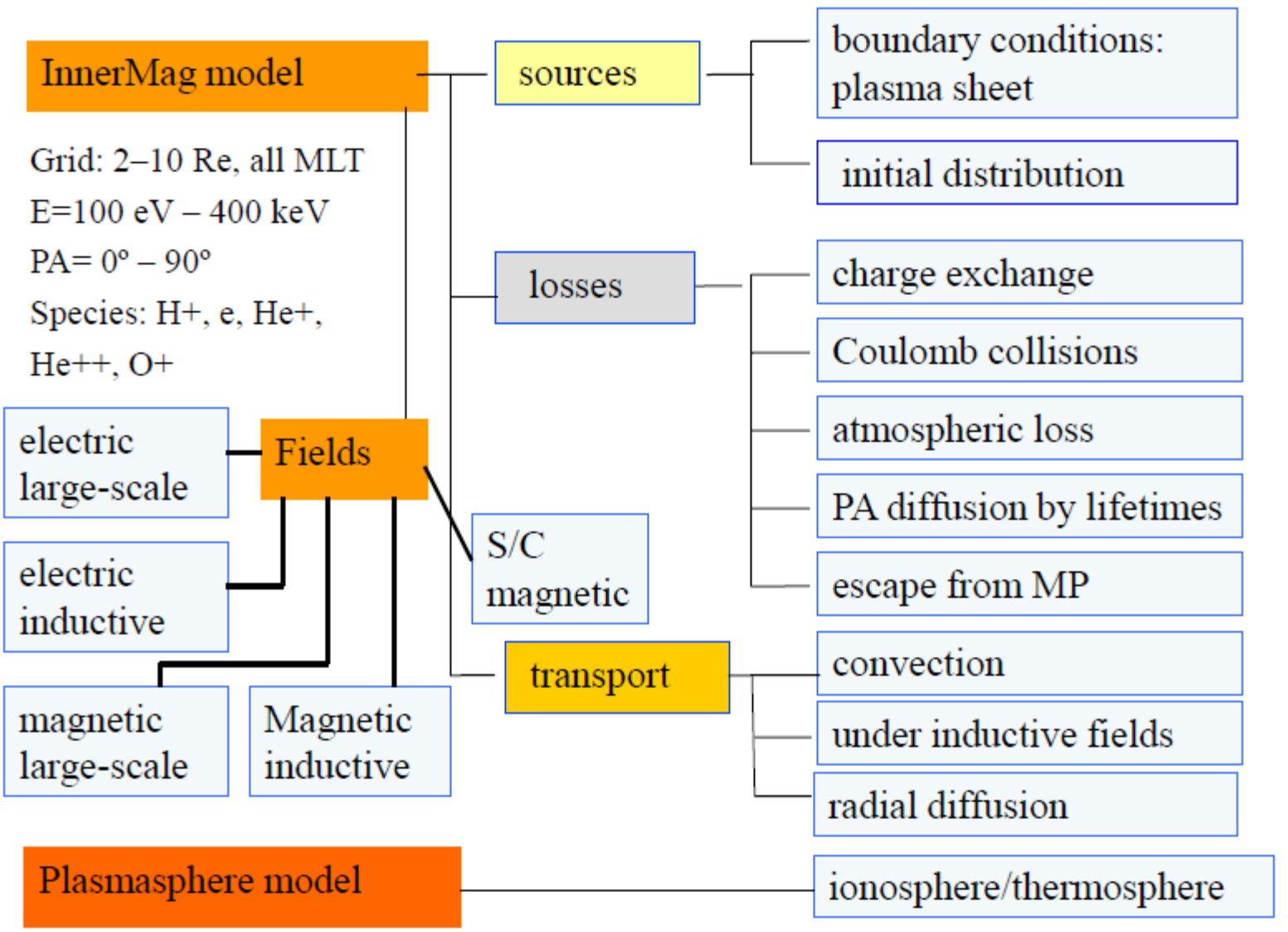
What do we present?
IMPTAM (Inner Magnetosphere Particle Transport and Acceleration model): nowcast model for low energy (< 200 keV) electrons in the inner magnetosphere, operating online under the **SPACECAST project (http://fp7-spacecast.eu)**

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 L-shells and at all satellite orbits, when necessary.

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

2. Inner Magnetosphere Particle Transport and Acceleration Model (IMPTAM)



♦traces ions and electrons with arbitrary pitch angles from the plasma sheet to the inner L-shell regions with energies up to hundreds of keVs in time-dependent magnetic and electric fields

♦ traces a distribution of particles in the drift approximation under the conservation of the 1st and 2nd adiabatic invariants. Liouville theorem is used to gain information of the entire distribution function

♦ for the obtained distribution function, we apply radial diffusion by solving the radial diffusion equation

♦ electron losses: convection outflow and pitch angle diffusion by the electron lifetimes.

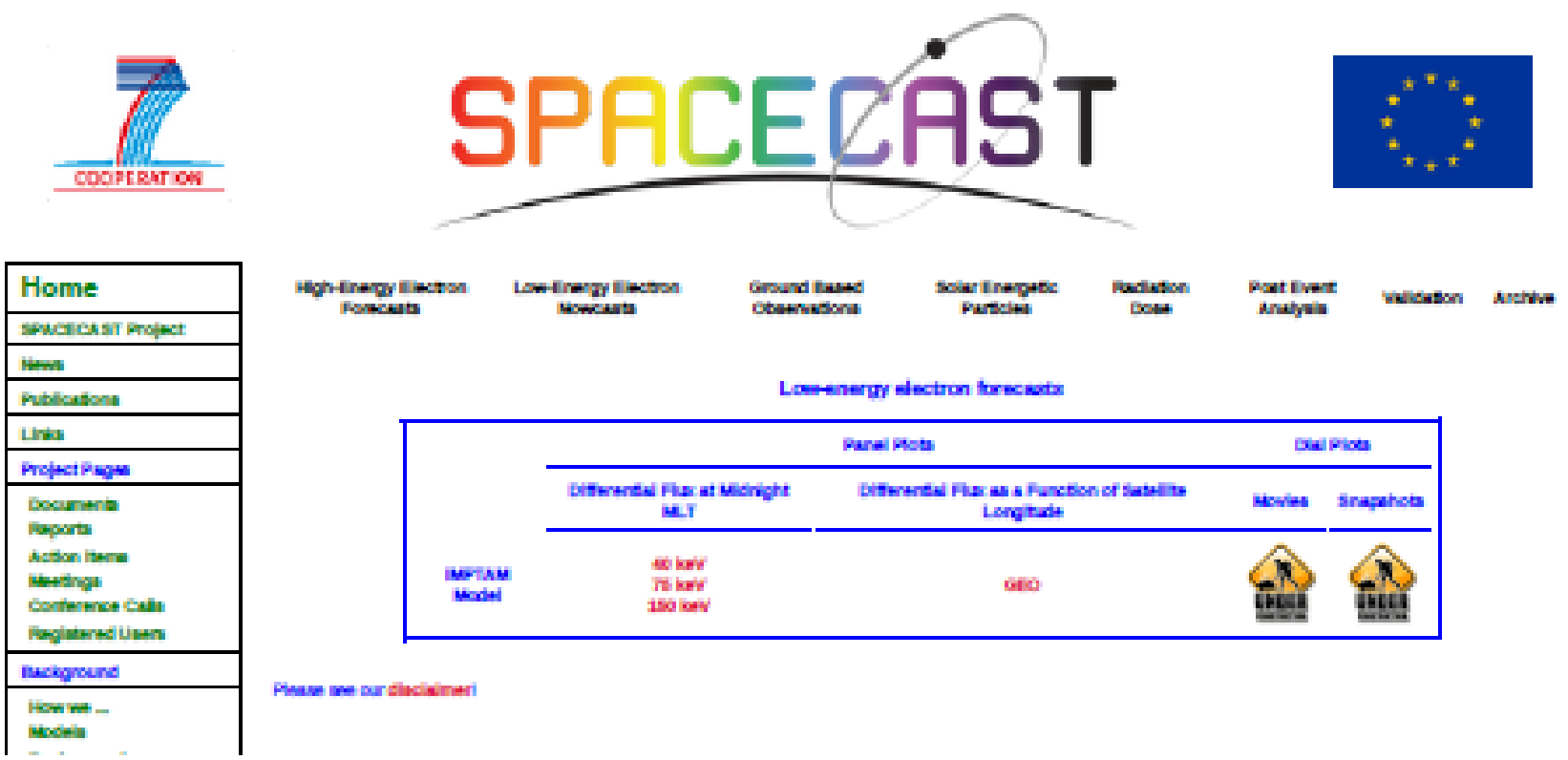
♦advantage of IMPTAM: it can utilize any magnetic or electric field model, including self-consistent magnetic field and substorm-associated electromagnetic fields.

♦all details are given in

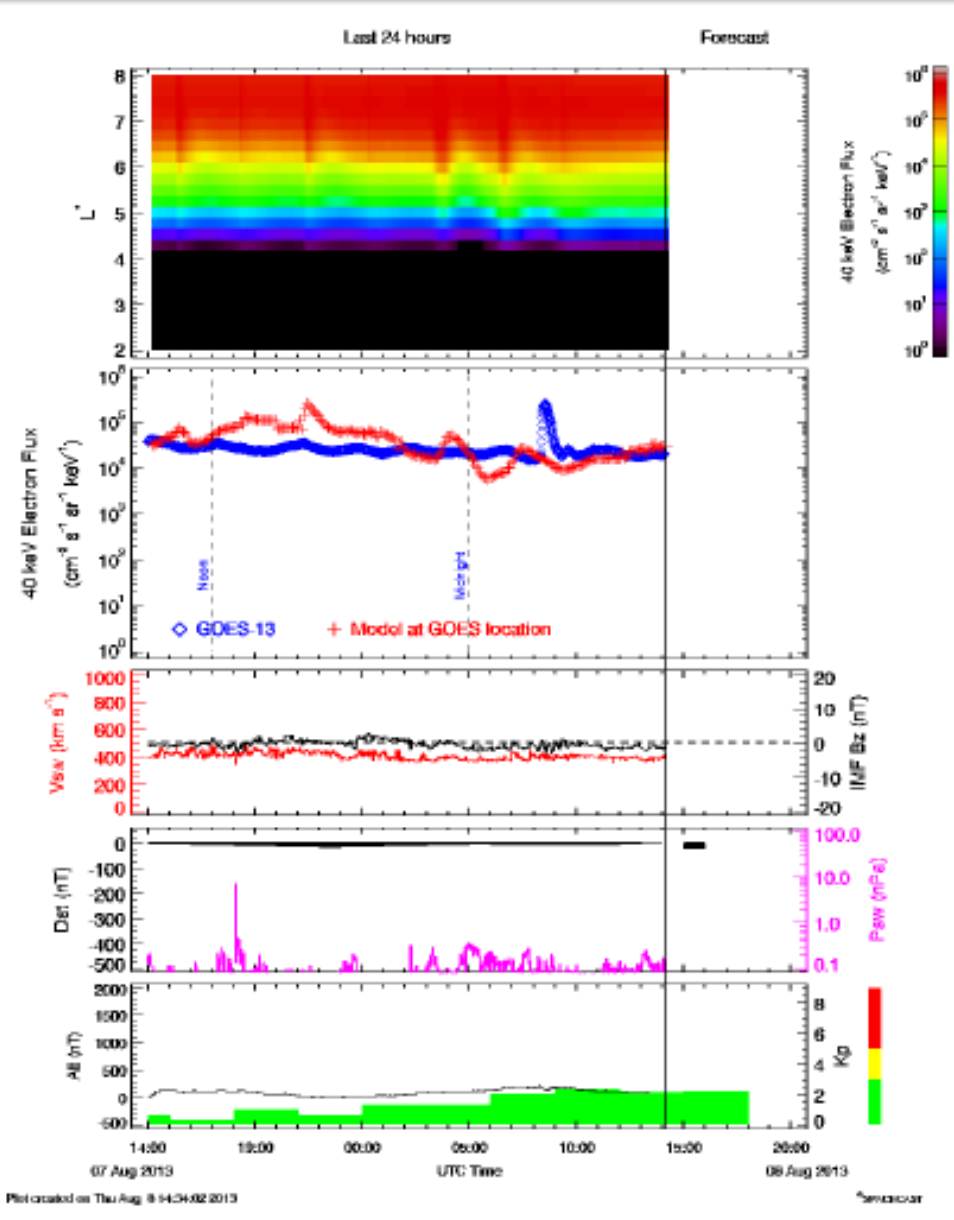
Ganushkina, N. Y., et al. (2013), Transport of the plasma sheet electrons to the geostationary distances, J. Geophys. Res., 118, doi:10.1029/2012JA017923.

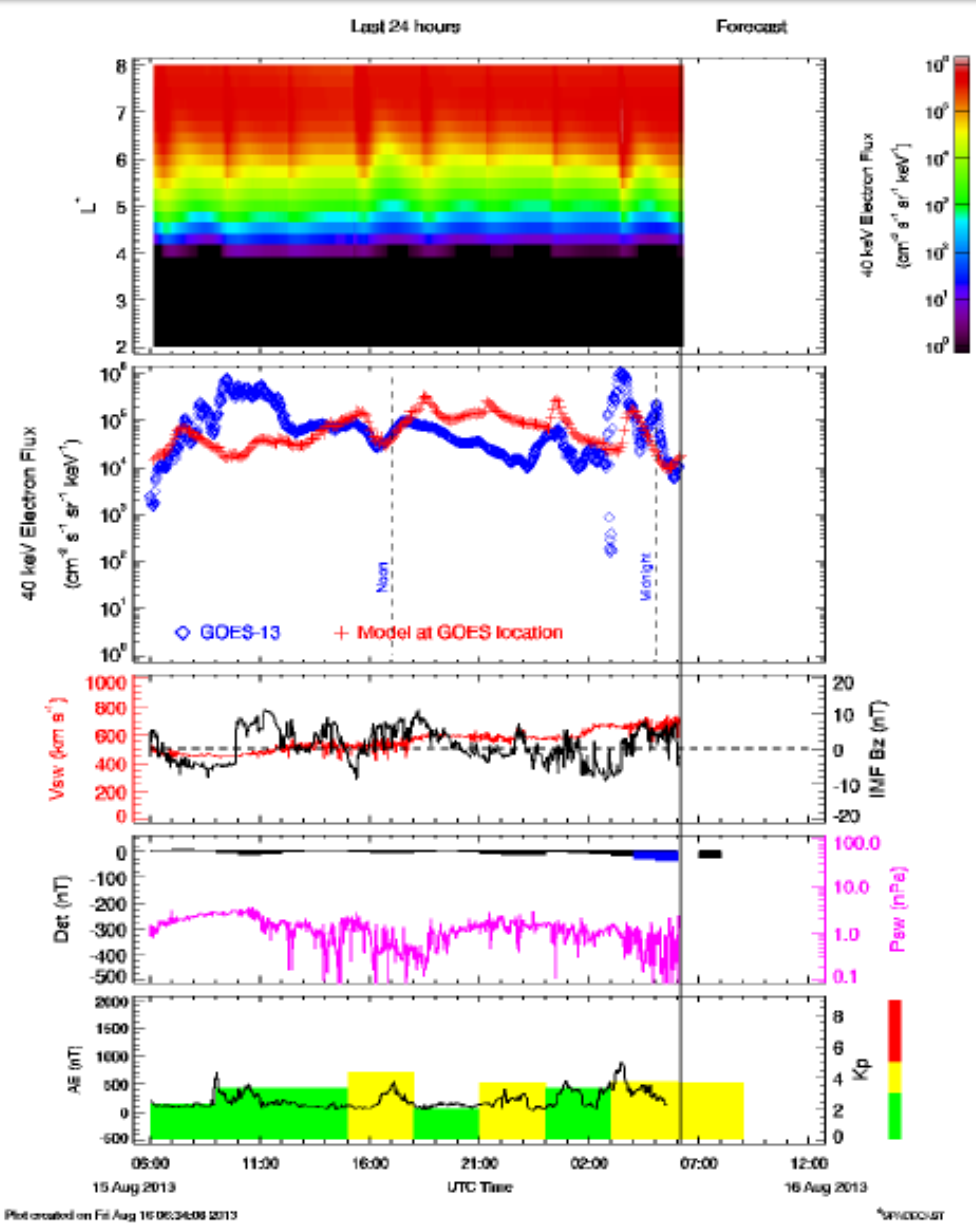
Ganushkina, N. Yu, Liemohn, M. W., and Pulkkinen, T. I., Storm-Time Ring Current: Model-Dependent Results, Annales Geophysicae, 30, 177-202, 2012.

3. Online nowcast model for low energy electrons (< 200 keV) in the inner magnetosphere, SPACECAST project (http://fp7-spacecast.eu)

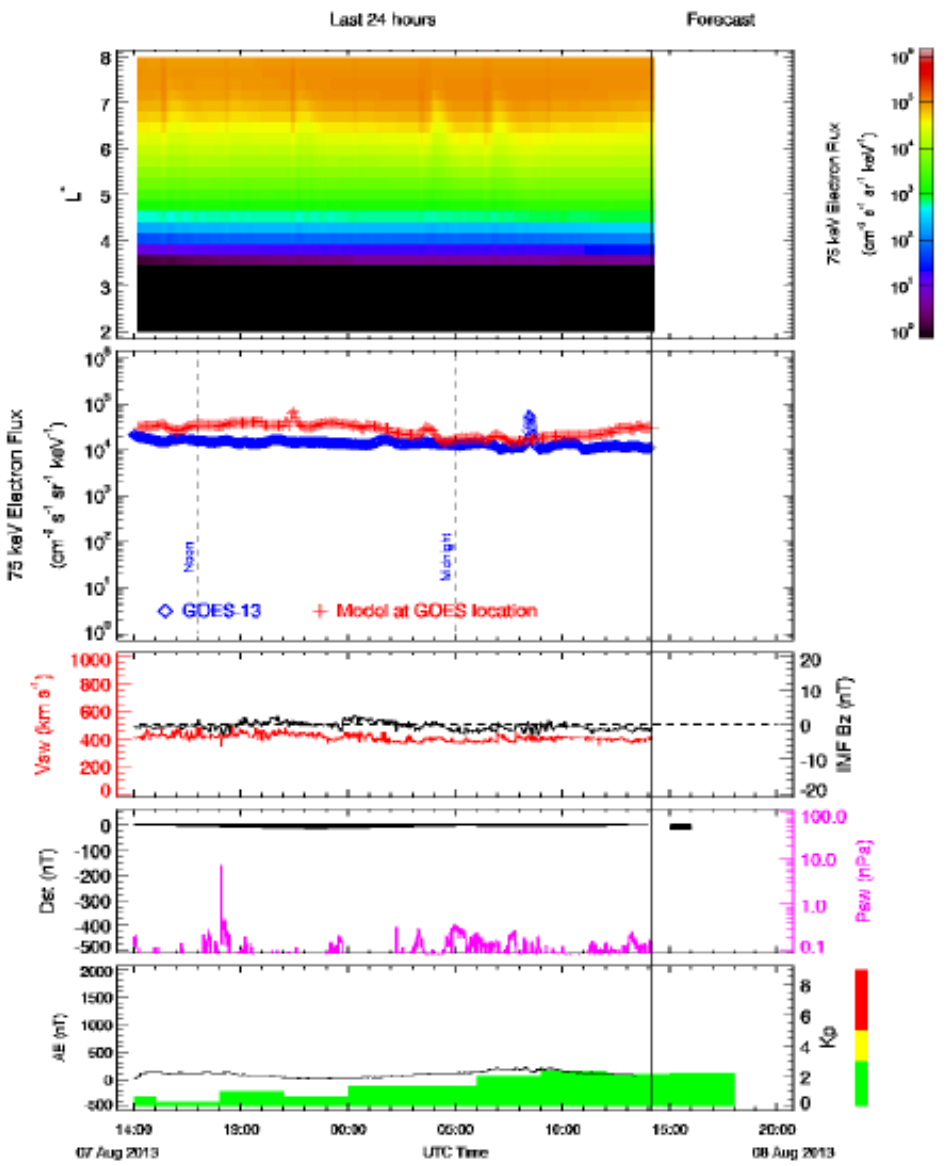


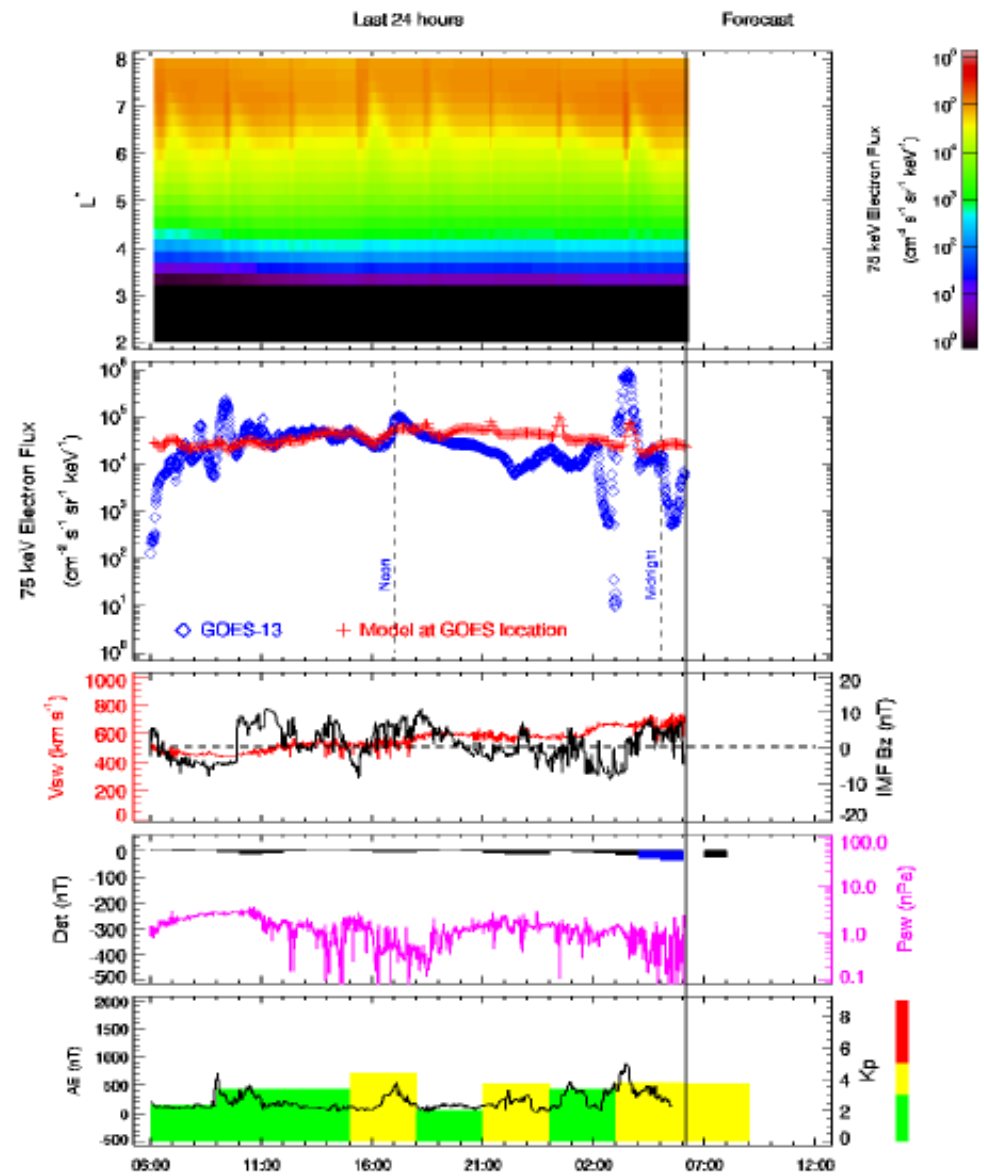
3.1 40 keV electrons at GOES orbit

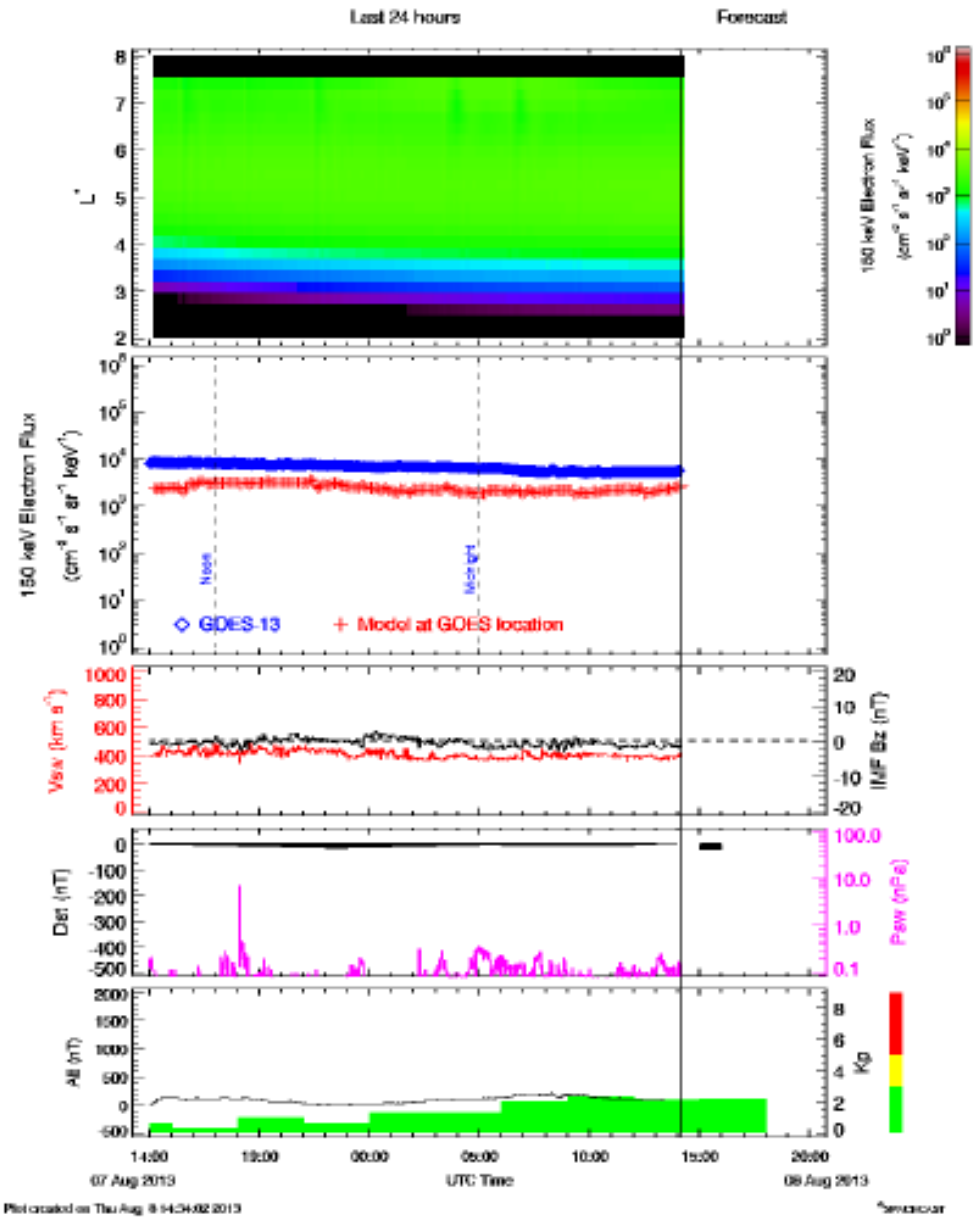


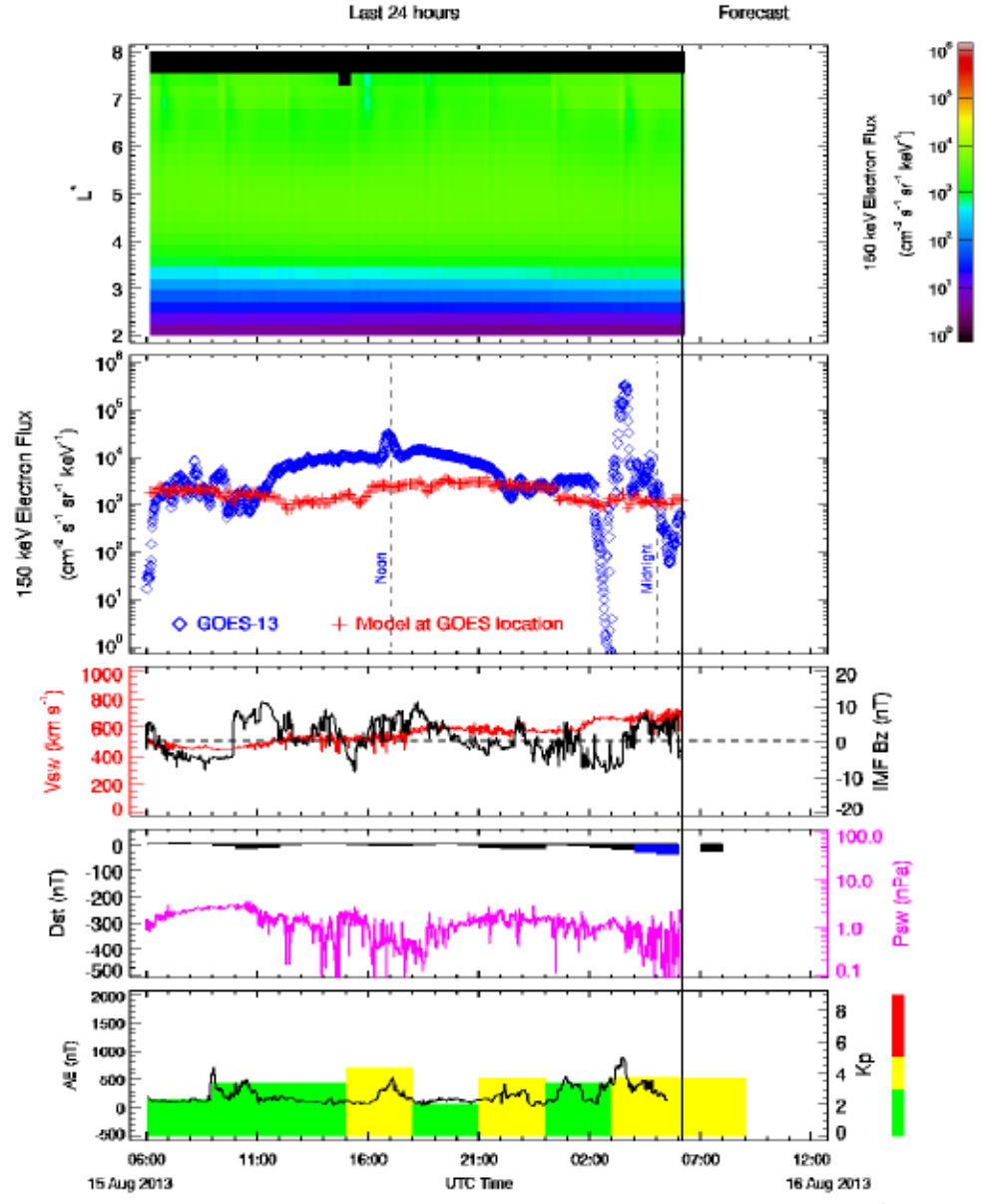


3.2. 75 and 150 keV electrons at GOES orbit

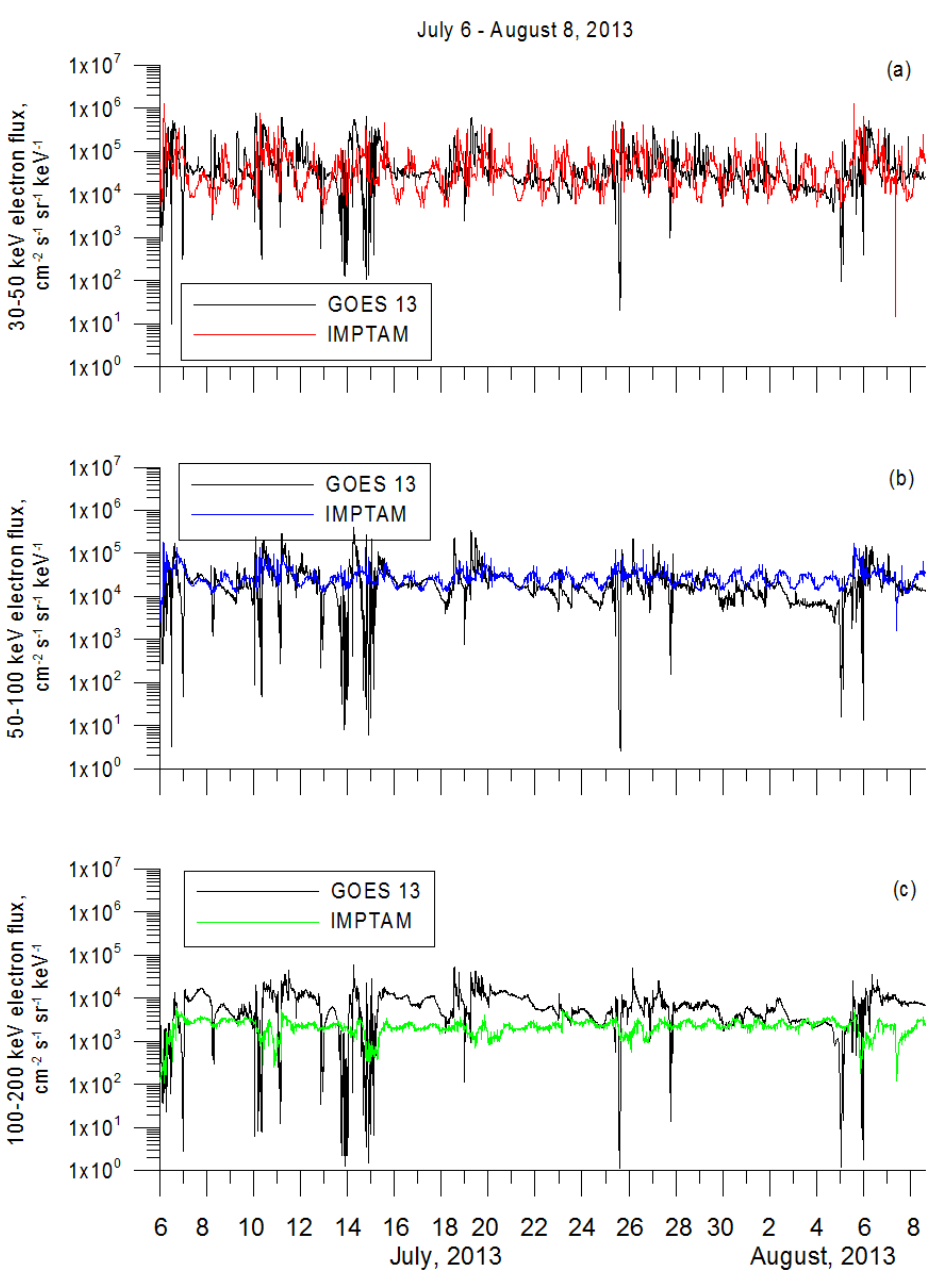


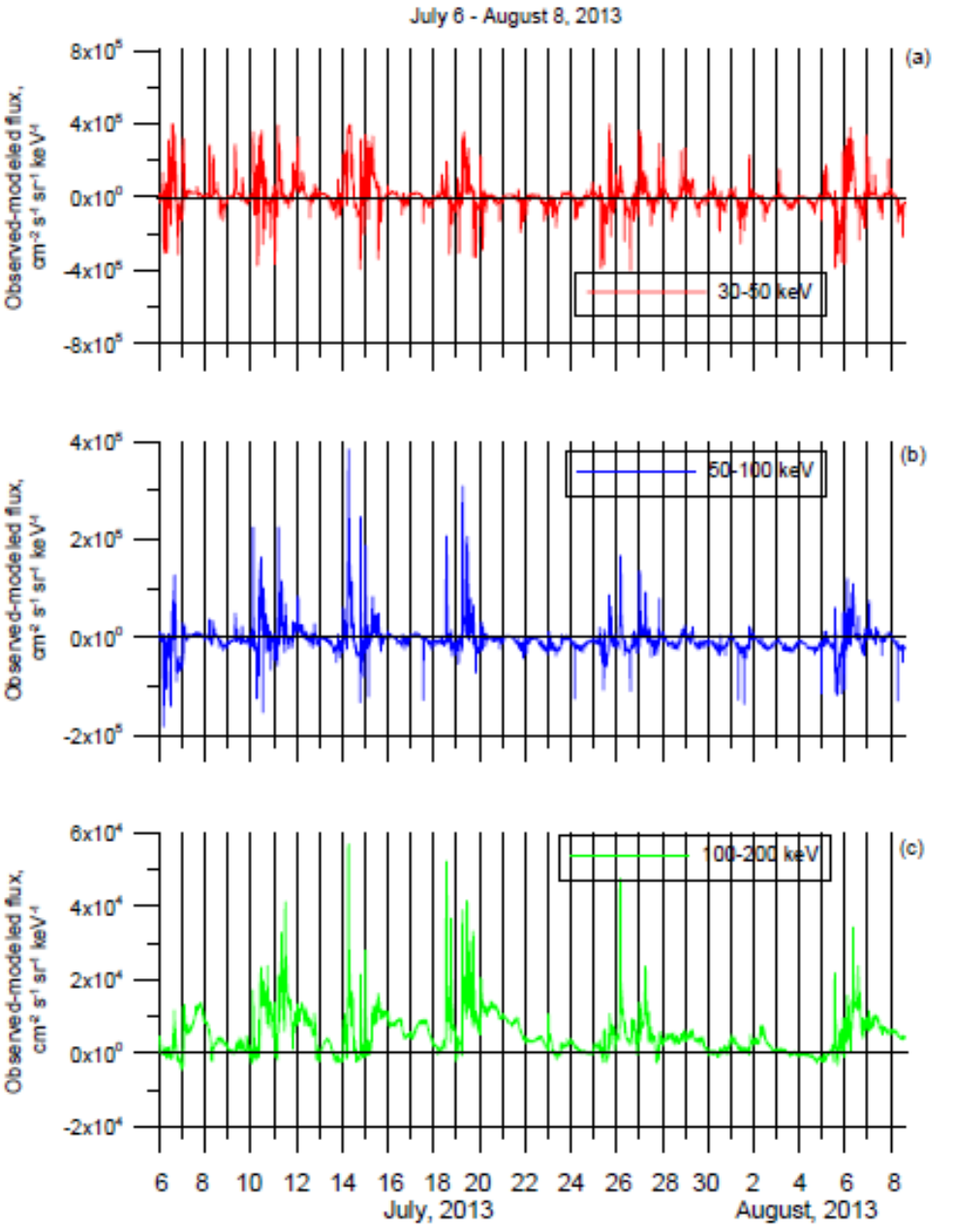






4. IMPTAM performance





♦ <100 keV electron fluxes are in very good agreement with the observed fluxes.
♦ Significant flux dropouts were not present in the model fluxes.
♦ 100-200 keV electron flux is constantly smaller than the observed one (1 order max).

♦ For 30-50 keV electrons the difference between the observed and modeled fluxes come close to zero. All the oscillations of the difference were around zero.
♦For 50-100 keV electrons the pattern is similar, the difference oscillates around zero. General trend being below zero which means that, on average, the modeled fluxes were higher than the observed ones over one month period.
♦The periodic variations with a period of about one day are present for both 30-50 keV and 50-100 keV energy ranges.
♦ For 100-200 keV electrons the difference is almost always positive meaning that modeled fluxes are smaller than the observed ones. The difference does not oscillate around zero, and the daily variation determined by the model is not clearly seen.