Participants

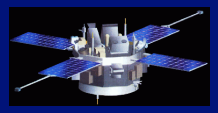
- University of Sheffield
- Finnish Meteorological Institute
- University of Warwick
- Skolkovo Institute of Science and Technology
- University of Michigan
- Space Research Institute, Ukraine
- LPC2E, France
- Swedish Institute for Space Physics

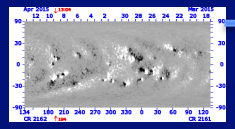
Collaborators

- Berkeley University
- UCLA

PROGRESS has received funding from the *European Union's Horizon 2020* under grant agreement No 637302.

PROGRESS

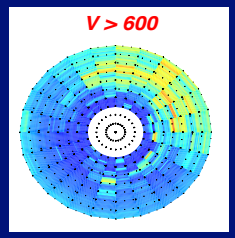




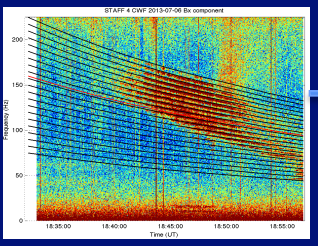
AWSoM → SWIFT

NARMAX

Geomagnetic indices Forecast
Solar Wind Parameters Forecast



ERR



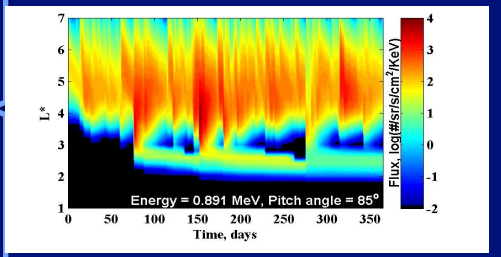
Cluster IMG

VERB

IMPTAM

NB³GEO

Forecast of Radiation Environment in Geospace



System Identification Approach

Analytical Approach

$$S = \int L(x, \dot{x}, t)\,dt$$

$$dL = \sum_i \frac{\partial L}{\partial x_i} dx_i + \sum_i \frac{\partial L}{\partial \dot{x}_i} d\dot{x}_i$$

Assumptions

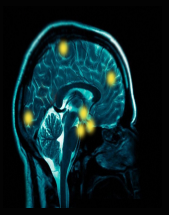
+

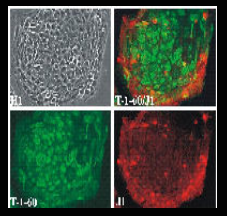
Physical Knowledge

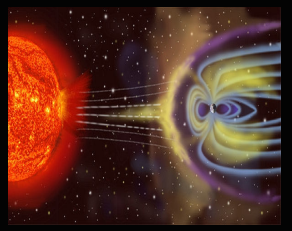
+

First Principles

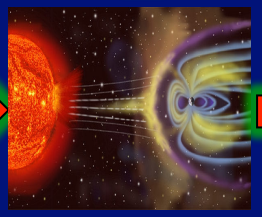
Black box System







Input Data



Output Data

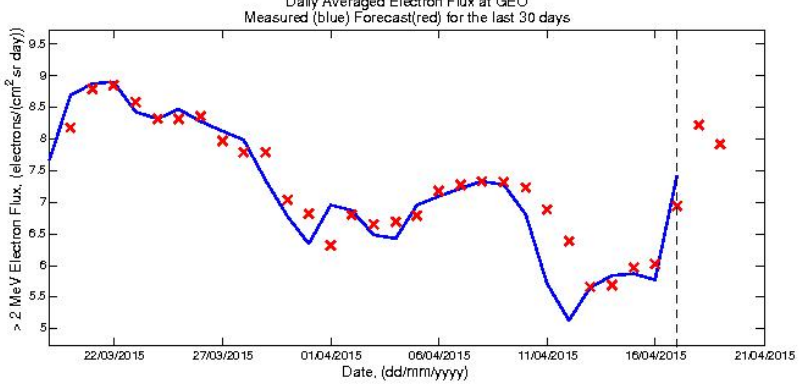
Systems Approach

Physical Knowledge of the System

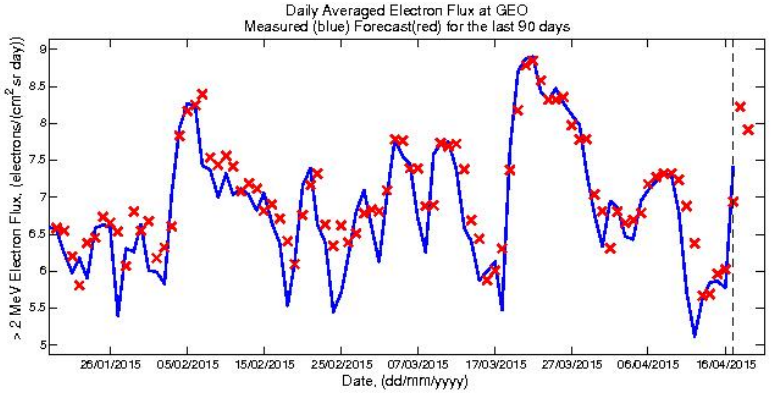
$$S = \int L(x, \dot{x}, t)\,dt$$

$$dL = \sum_i \frac{\partial L}{\partial x_i} dx_i + \sum_i \frac{\partial L}{\partial \dot{x}_i} d\dot{x}_i$$

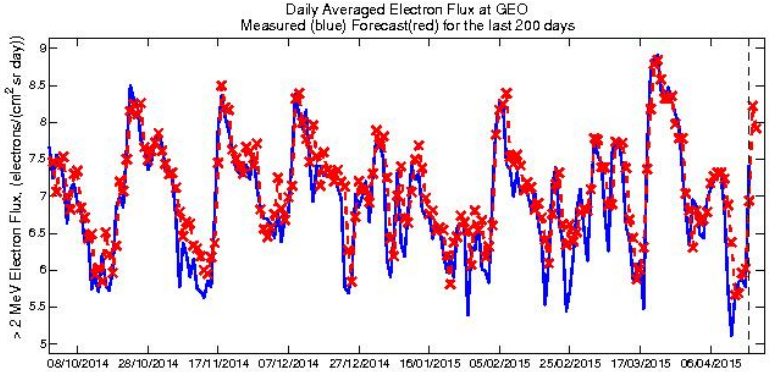
The one day ahead forecasts of the relativistic electron fluxes with energies greater than 2 MeV at GEO has been developed in Sheffield and is available in real time:
http://www.ssg.group.shef.ac.uk/USSW/2MeV_EF.html.
The PE for this model calculated for the period 14 April 2010 and 12 April 2013 is equal to 0.786



Past 90 days



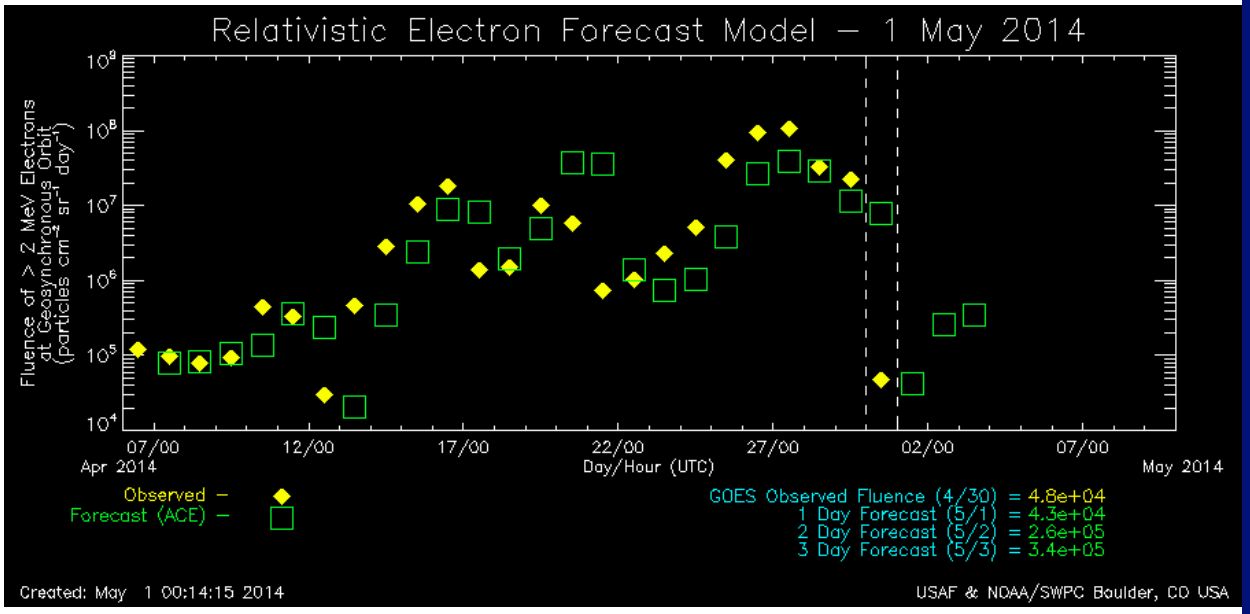
Past 200 days



NOAA / Space Weather Prediction Center

Relativistic Electron Forecast Model

Presented by the USAF and NOAA/ Space Weather Prediction Center



The impact of high-energy (relativistic) electrons on orbiting satellites can cause electric discharges across internal satellite components, which in turn leads to spacecraft upsets and/or complete satellite failures. The Relativistic Electron Forecast Model predicts the occurrence of these electrons in geosynchronous orbit.
Plots and data are updated daily at 0010 UT. Dashed vertical lines indicate the last vertical value.
When the input parameters are not available, the forecast is not shown.

REFM Verification Plot and Model Documentation

1 to 3 Day Predictions (text file) and corresponding Performance Statistics.
Predictions created using data from the ACE spacecraft.

Historical electron particle data is archived at the
National Geophysical Data Center for Solar-Terrestrial Physics.

Visually impaired users may contact SWPC for assistance.
Please credit SWPC when using these images.

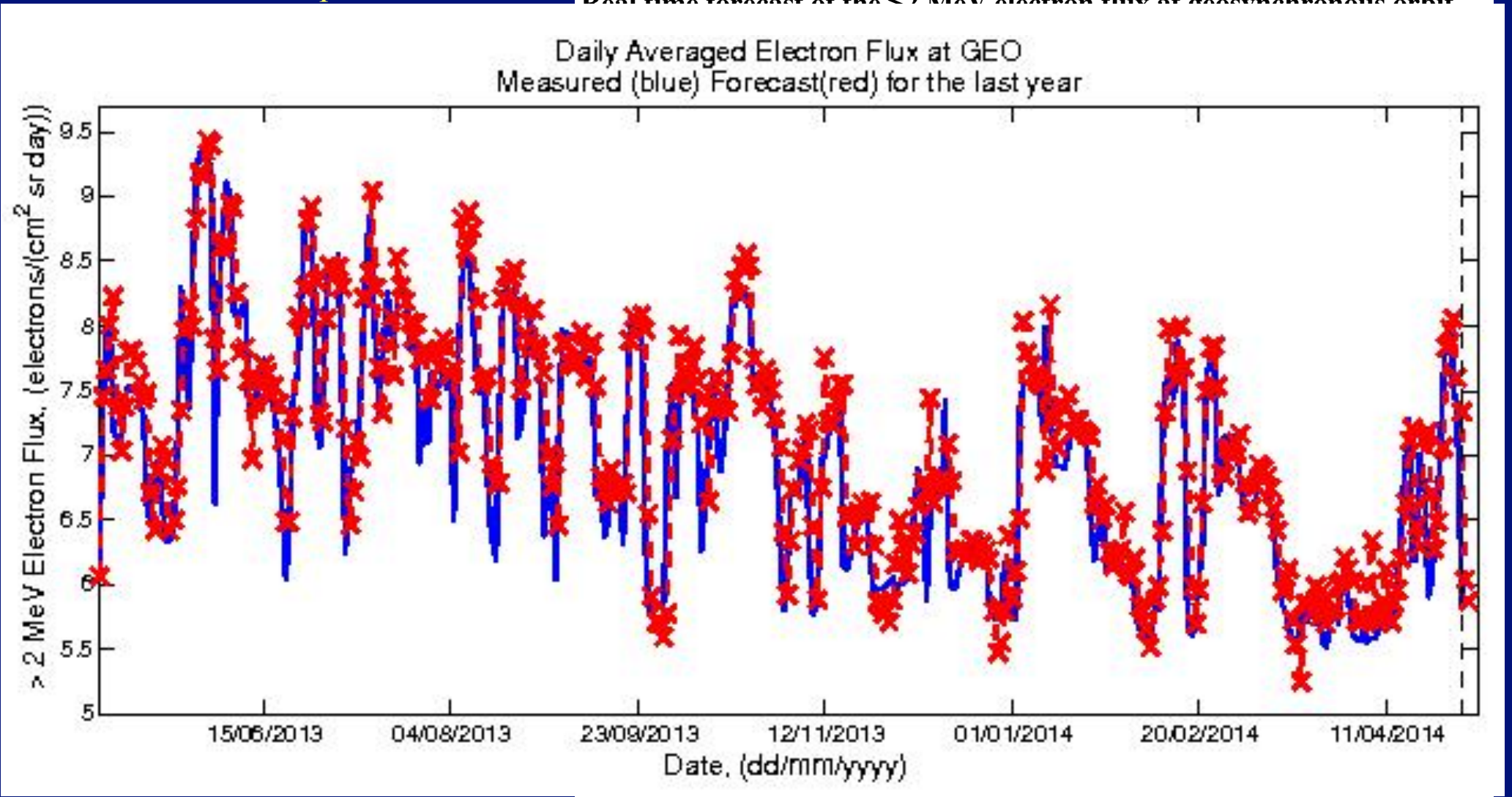
The one day ahead forecasts of the relativistic electron fluxes with energies greater than 2 MeV at GEO has been developed in

The University Of Sheffield.

UNIVERSITY OF SHEFFIELD SPACE WEATHER

Home | Electron Flux | Dst Index | Archive | Contact

Real time forecast of the >2 MeV electron flux at geosynchronous orbit



Comparison of NOAA and SNB^{3}GEO Forecasts (01.03.2012-03.07.2014)

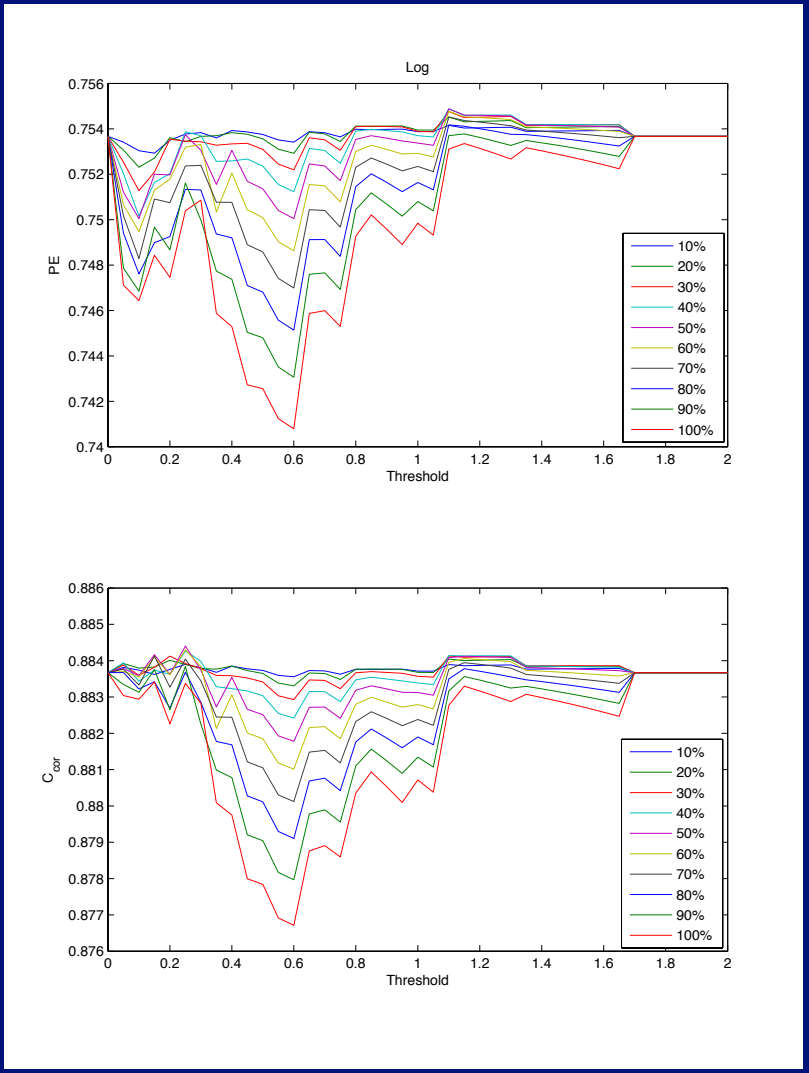
$$PE = 1 - \frac{1}{N}\sum \frac{(Y(t) - Ym(t))^2}{\mathrm{var}(Y)}$$

$$C_{cor} = \frac{1}{N}\sum \frac{(Y(t) - \langle Y(t)\rangle)(Ym(t) - \langle Ym(t)\rangle)}{\sqrt{\mathrm{var}(Ym)\mathrm{var}(Y)}}$$

Comparison of NOAA and SNB^{3}GEO Forecasts (01.03.2012-03.07.2014)

Model	Prediction Efficiency	Correlation
NOAA	68.39%	84.73%
SNB^{3}GEO	78.88%	89.75%

Comparison of NOAA and SNB^{3}GEO Forecasts (01.03.2012-03.07.2014)

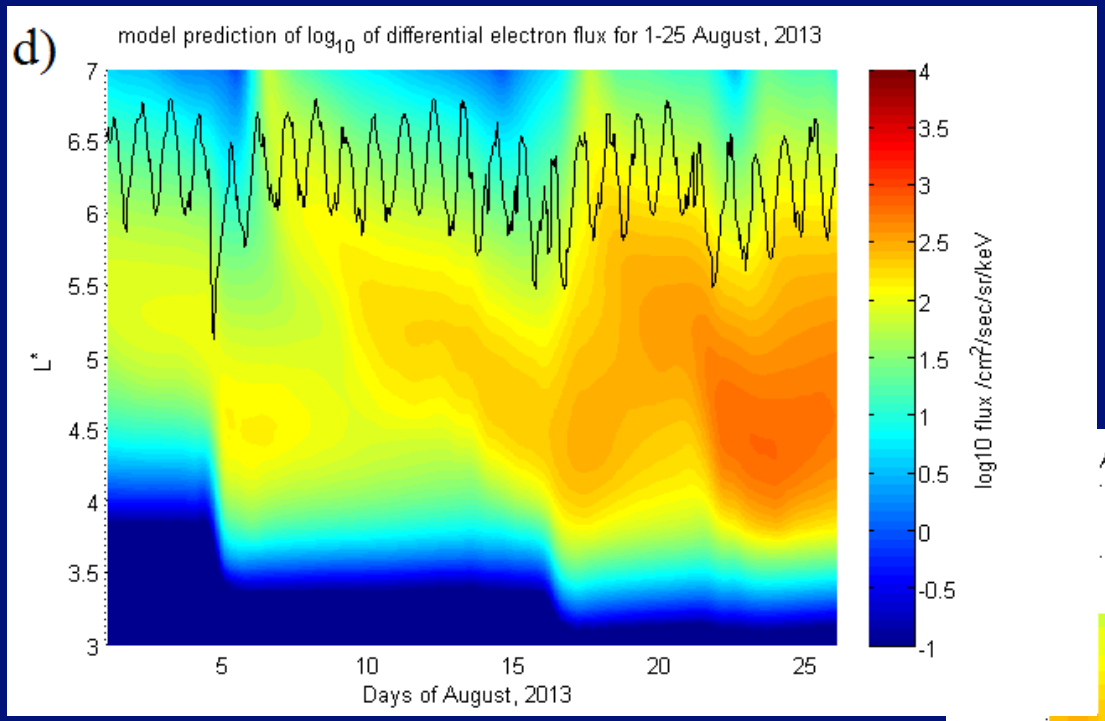


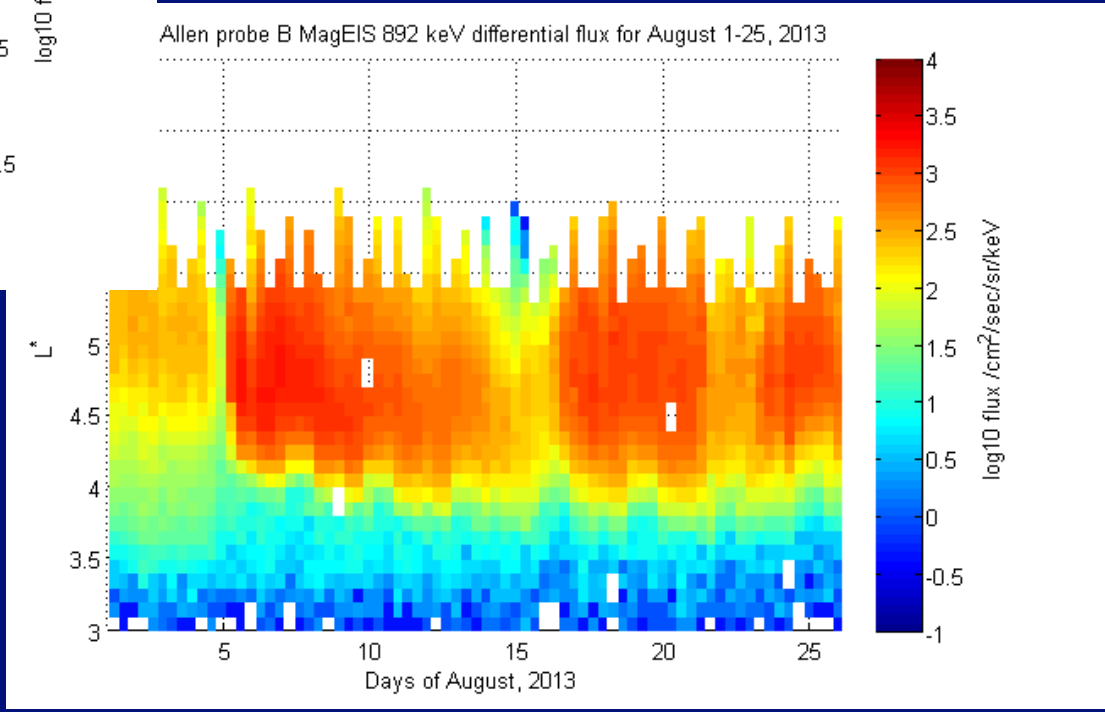
Problems of the “first principles” forecast

- Boundary conditions
- Statistical Wave models and physics of wave particle interaction
- Magnetopause Shadowing

VNC=VERB-NARMAX Coupling

I. Pakhotin, A. Drozdov, Yu. Shprits, M. Balikhin





Problems of the “first principles” forecast

- Statistical Wave models and physics of wave particle interaction

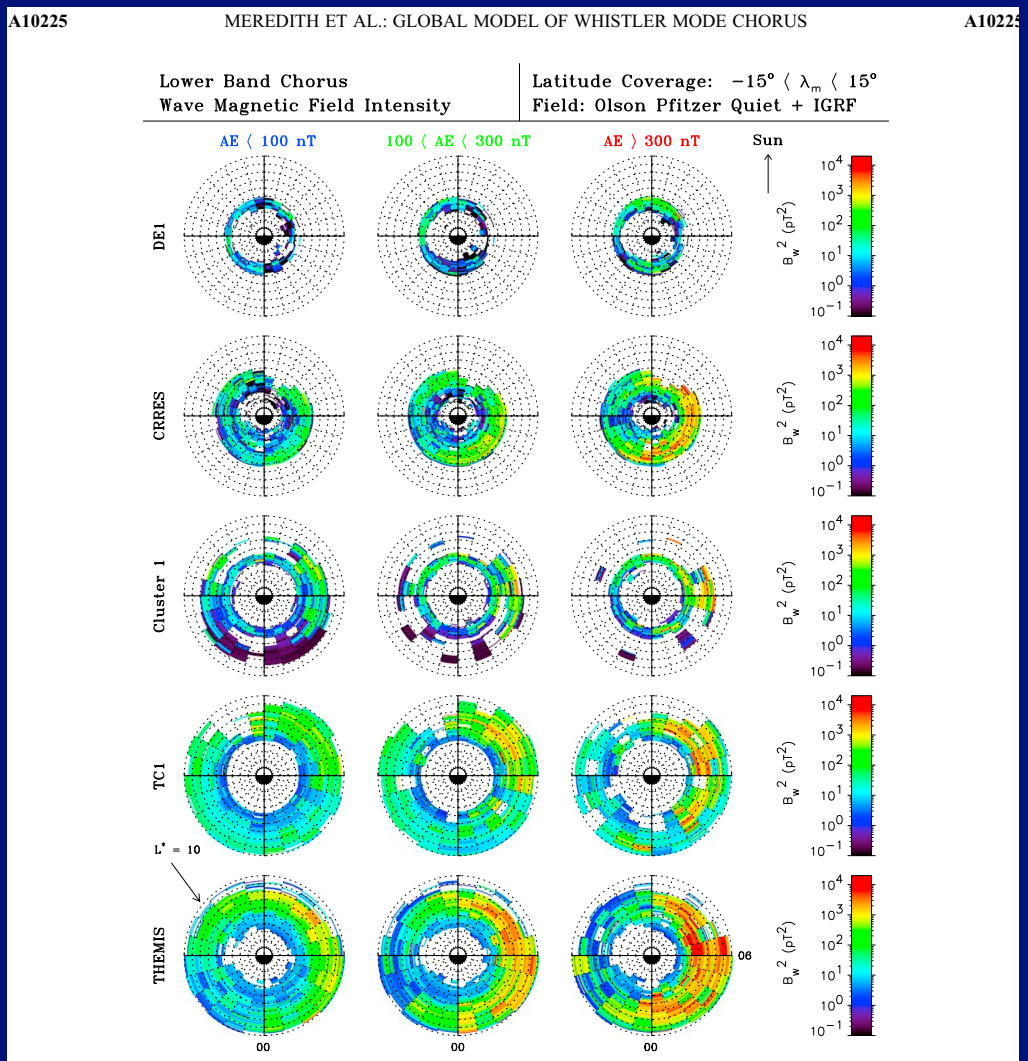
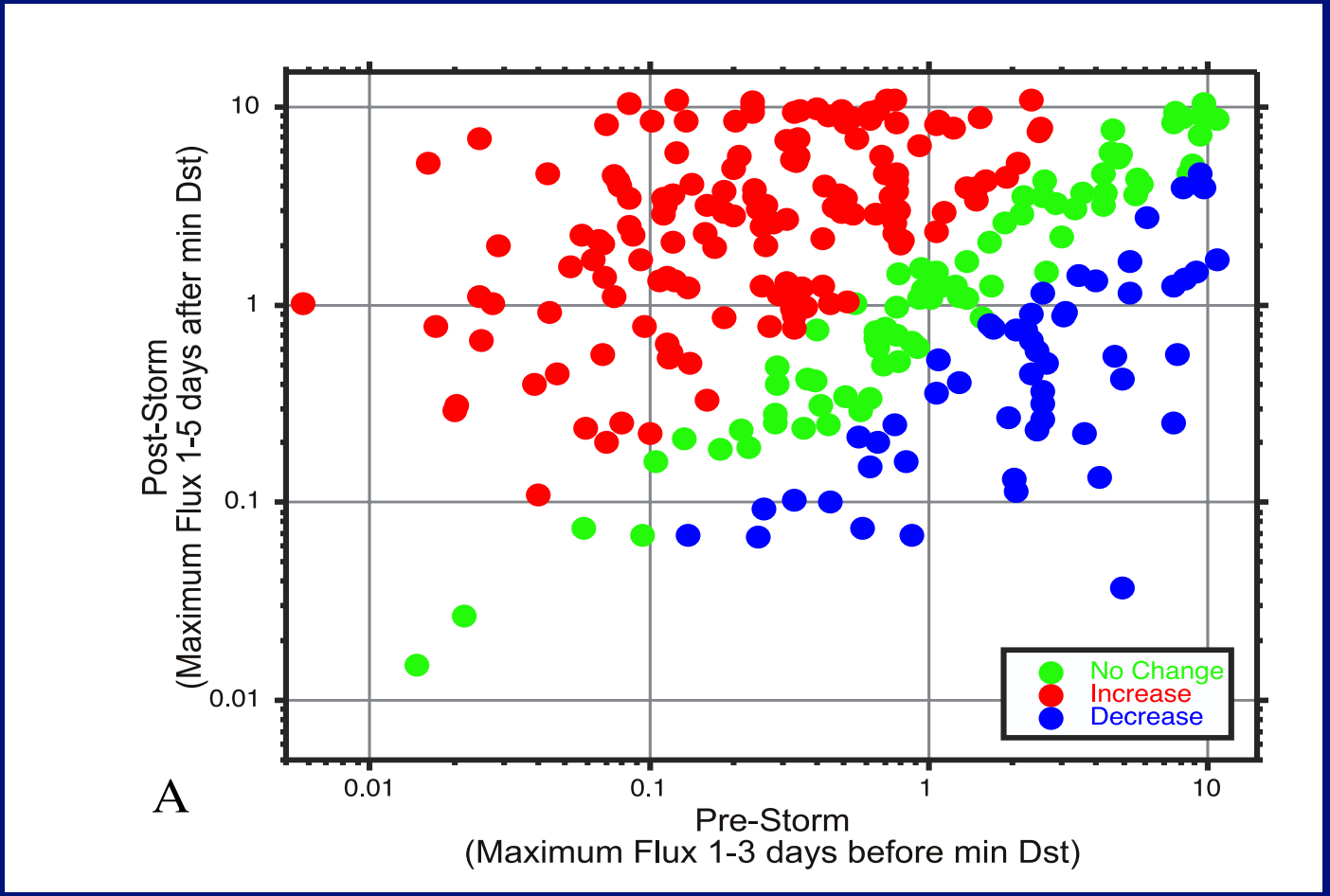


Figure 2. Equatorial wave intensity of lower band chorus as a function of L^*, MLT and geomagnetic activity for each of the five satellites.

Statistical independence of B_z

Reeves, 2003

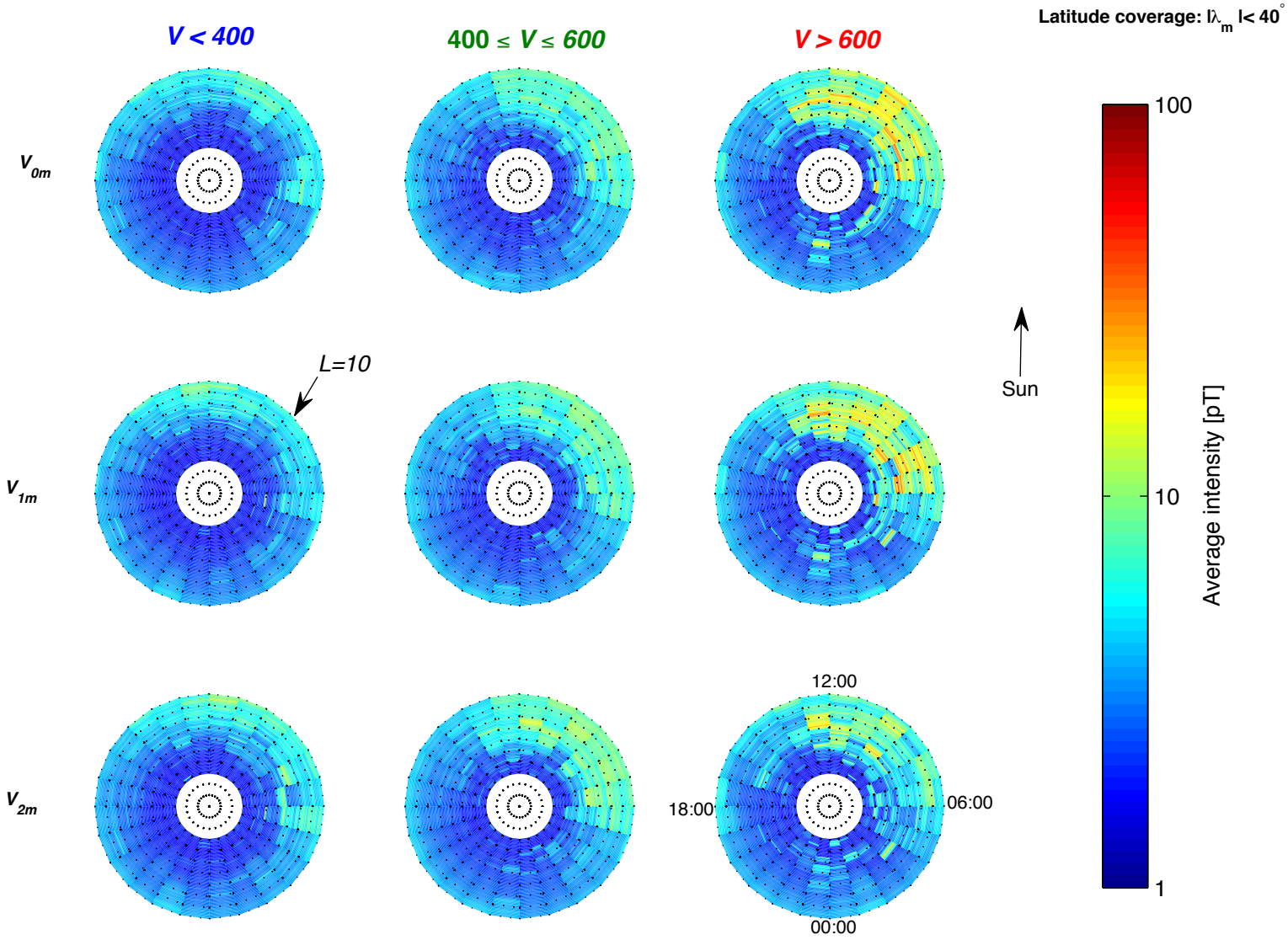


Increase
in 50% of storms

Decrease
In 25% of storms

No change
In 25% of storms

Aryan, et al., 2013



Forecast of the effects of magnetopause shadowing is the weakest point. We hope it will be rectified as the result of UMICH, Warwick and Sheffield effort.