PRediction Of Geospace Radiation Environment and Solar wind parameterS

Work Package 7

Fusion of forecasting tools

Overview

- **Overview**
- **Deliverables/Milestones**
- **Summary of current position**

Overview

Work package number	7	Title	Fusion of forecasting tools
Lead Beneficiary	USFD	Participants	UW, FMI, IRF
Start month	18	End month	36

Objectives

➢ Collect and implement models for geomagnetic index forecast at USFD and provide access to their forecasts via project web page.

➢ To provide access to the forecasts of models developed in WP 4 via the project web page.

➢ To implement the VERB-NARMAX and VERB-IMPTAM models, developed in WP 5 and 6 at USFD, and provide access to their forecasts via the project web page.

➢ Develop a tool to calculate the integrated electron fluxes along a user defined part of satellite orbit

➢ Implement a traffic light system and create an email circular summarising current and evolution of space weather conditions.

Tasks

- **Task 7.1 – Implementation of models for geomagnetic indices and electron fluxes at USFD - Month 18-34 (USFD,IRF)**
  The models for Dst and Kp, and eventually AE, developed in WP 3 will be implemented at USFD

- **Task 7.2 – Implementation of VERB-NARMAX and VERB-IMPTAM models - Month 22-40 (USFD,GFZ)**
  The VERB-NARMAX and VERB-IMPTAM models will be installed at USFD. This output of these models will provide forecasts of the particle environment throughout the radiation belt region.

Tasks

- **Task 7.3 – Orbit tool - Month 27-37 (USFD,GFZ,FMI)**
  The VERB-NARMAX and VERB-IMPTAM models, implemented in task 7.2, will provide forecasts of the flux of electrons. This task will use these forecasts to determine the path integrated electron fluxes in various energy ranges encountered along the orbital path of a satellite.

- **Task 7.4 – Summary - Month 30-41 (USFD)**
  In order to disseminate the results of the forecasts in a timely an email circular will be generated and circulated. It is envisaged that this circular will be distributed when forecasts show evidence of potentially hazardous conditions. Subscription to the email list will be performed from the project web site.

Deliverables list

	Title	Due
D7.1	The results of individual forecasts of geomagnetic indices	2017-10-31
D7.2	Forecasts of the energetic electron populations within the inner magnetosphere	2018-04-30
D7.3	On orbit forecasts of the energetic electron populations	2018-01-30
D7.4	Summary of the space weather environment	2017-07-31

Current status

Current project website has a new results menu

Results

Geomagnetic indices   [+]

Electron Flux forecasts   [+]

Geomagnetic indices
- Lund Kp (WP 3)
- Lund Dst (WP 3)
- Sheffield Kp (WP 3)

Electron fluxes
- NARMAX GEO fluxes (WP 6)
- IMPTAM low energy electrons (WP 5)
- VERB high energy electrons (WP 6)
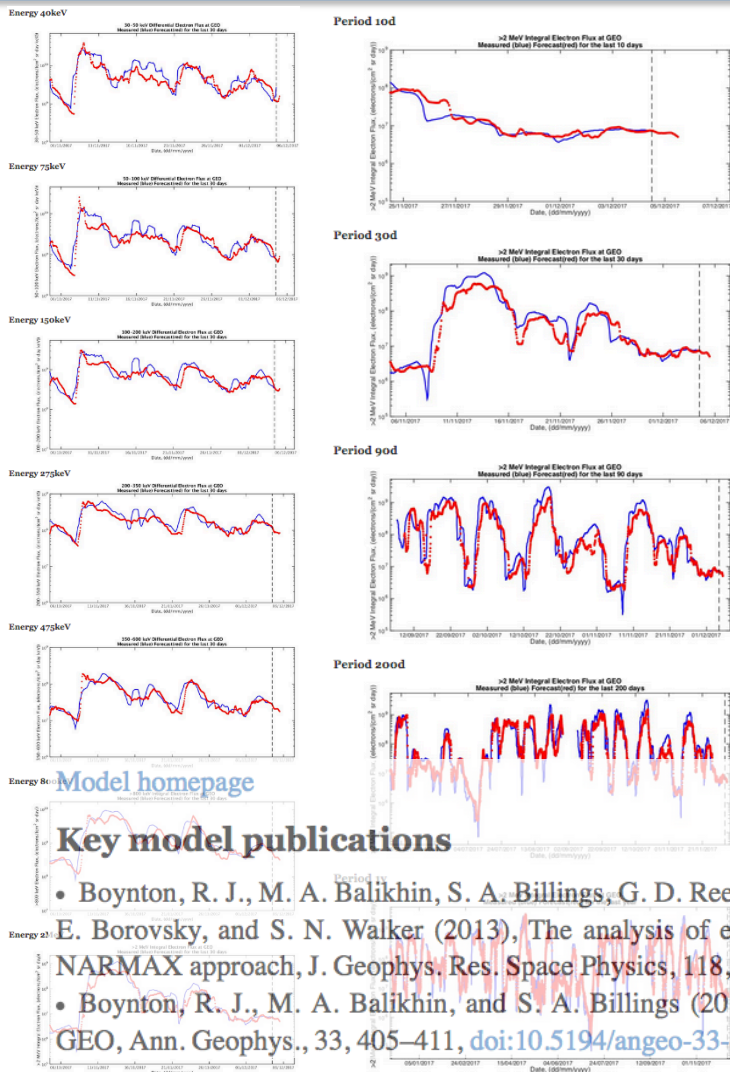
NARMAX GEO fluxes

NARMAX GEO e- fluxes

- Menu

- Forecasts v measured fluxes for past #days, all energies

- Forecasts v measured fluxes for single energy over various time periods

- Model information

VERB electron Fluxes

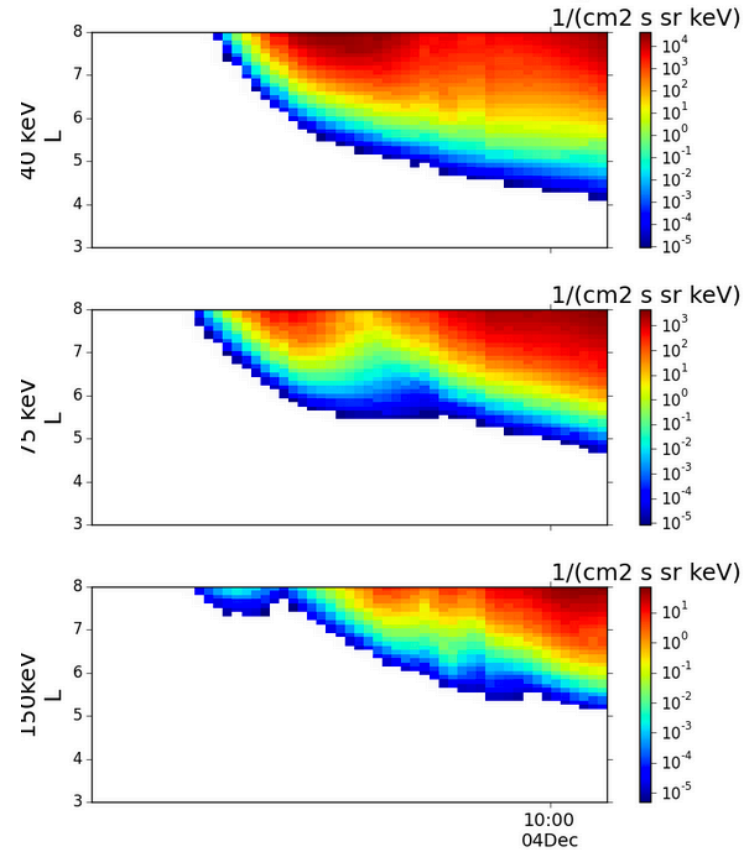VERB Radiation Belt Nowcast and Forecast

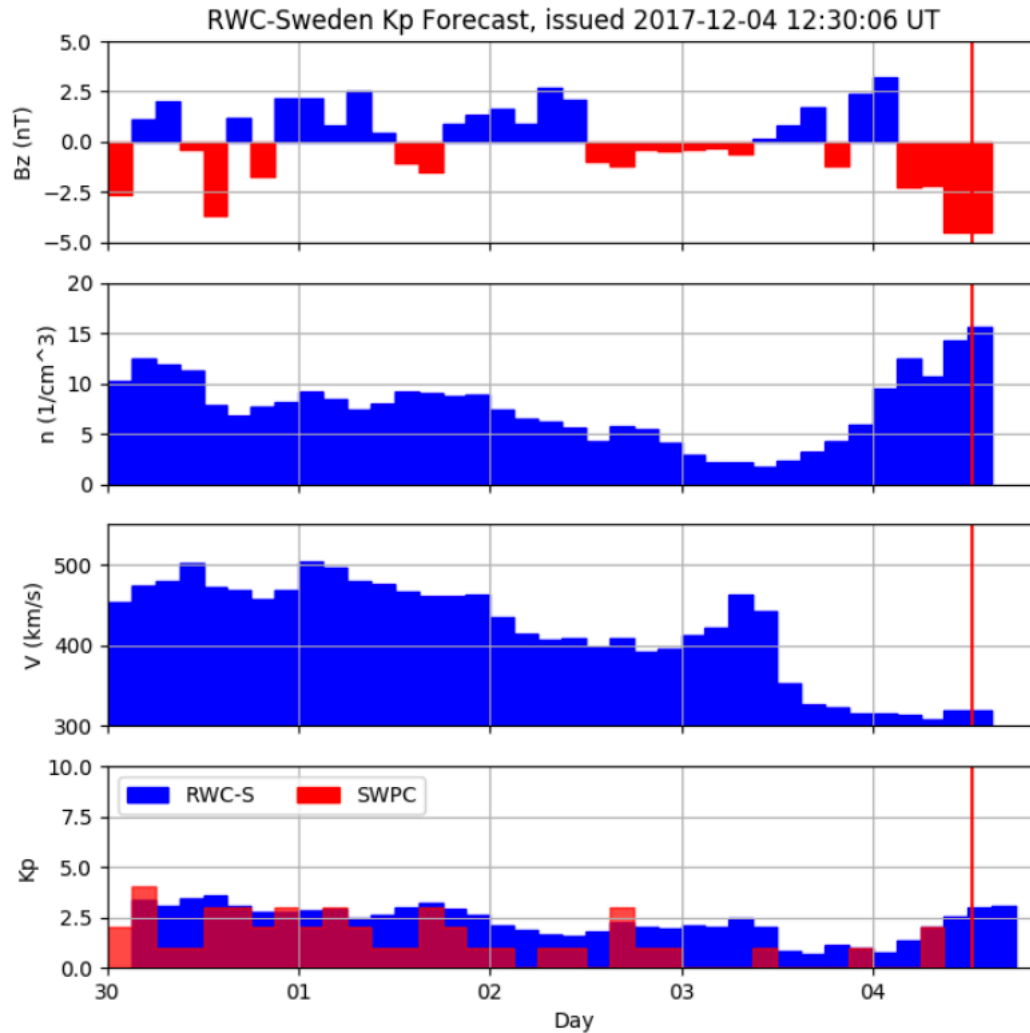# IMPTAM electron fluxes
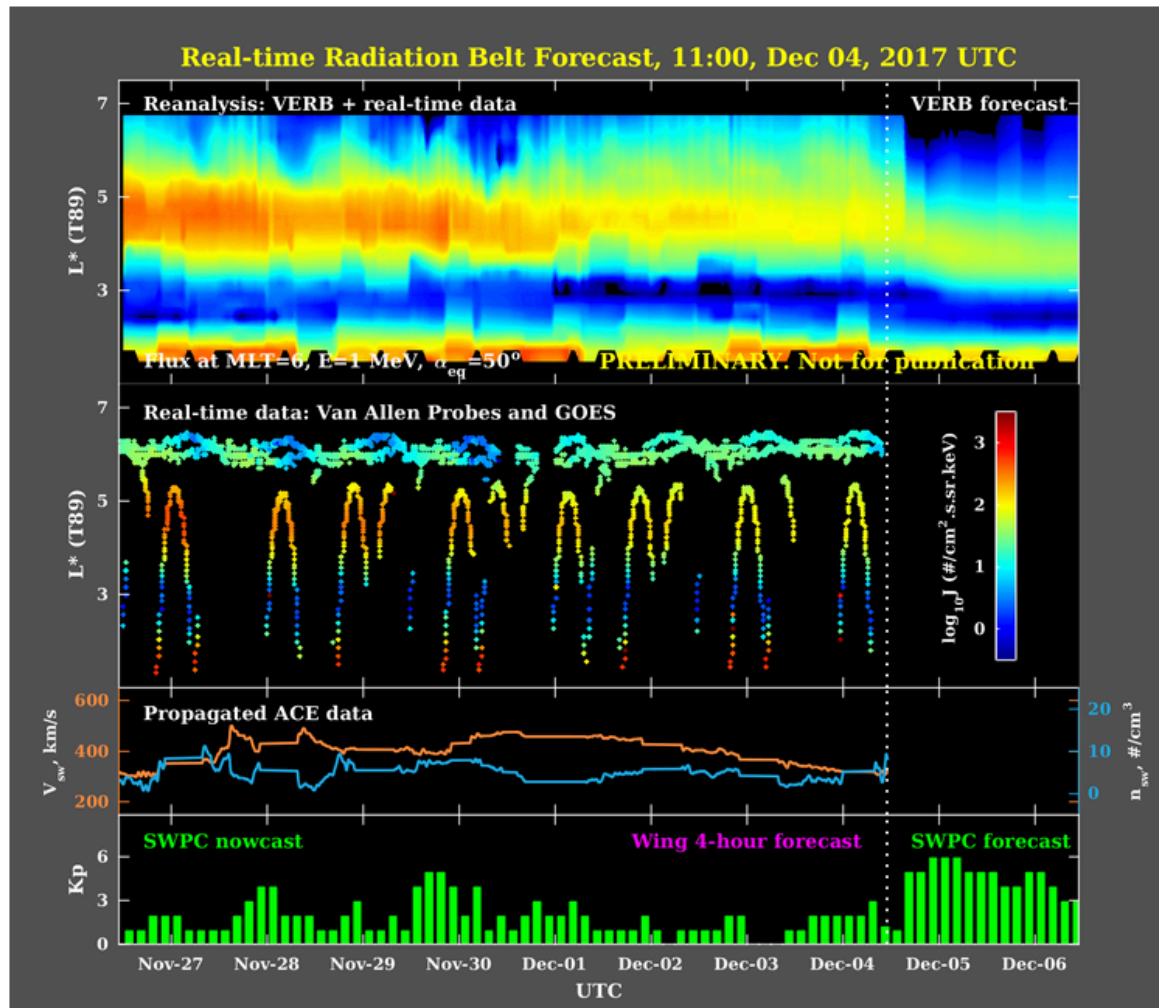
IMPTAM Electron Flux Forecasts at Geosynchronous Orbit

Electron fluxes at geostationary orbit
IMPTAM vs Goes13
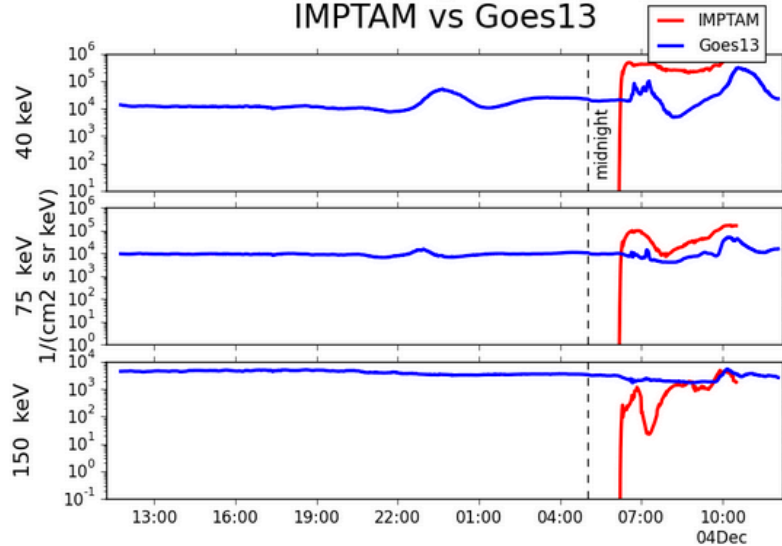
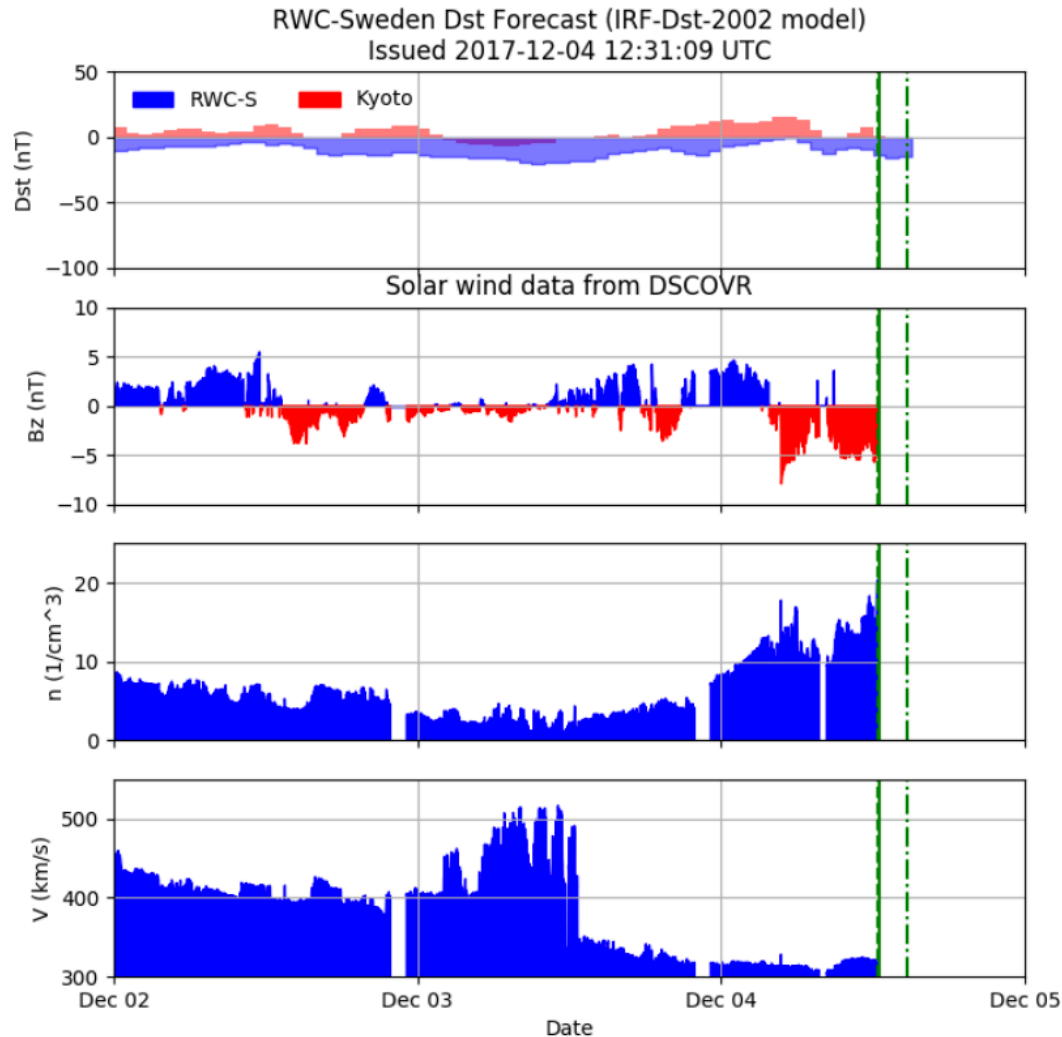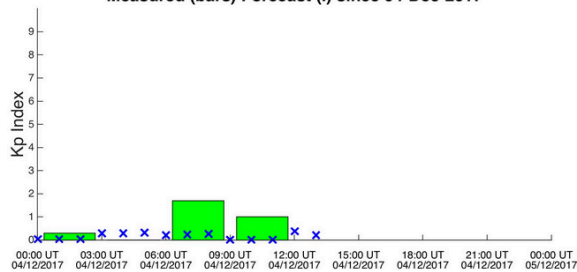IMPTAM electron fluxes at midnight

Lund Kp

RWC-Sweden Kp Forecast, issued 2017-12-04 12:30:06 UT

Lund Dst

RWC-Sweden Dst Forecast (IRF-Dst-2002 model)
Issued 2017-12-04 12:31:09 UTC

Sheffield Kp

University of Sheffield Kp Forecast
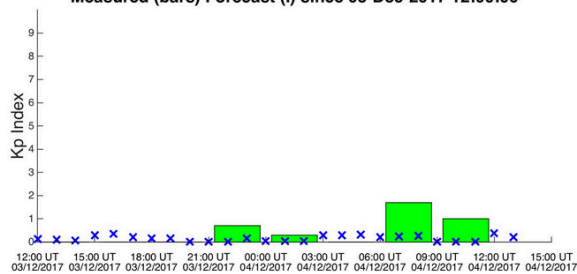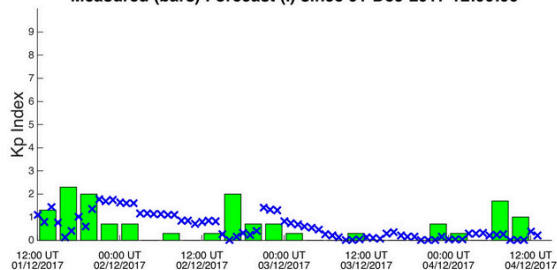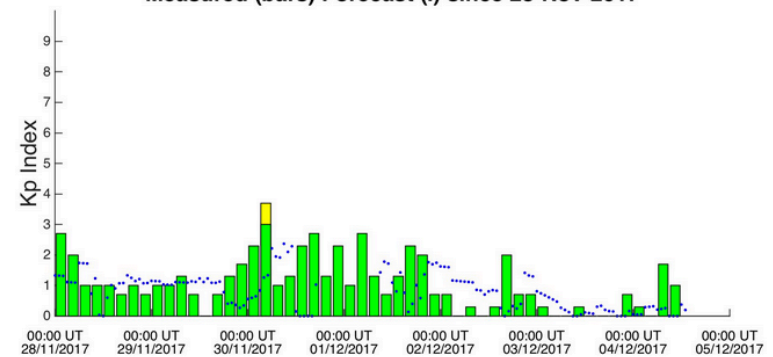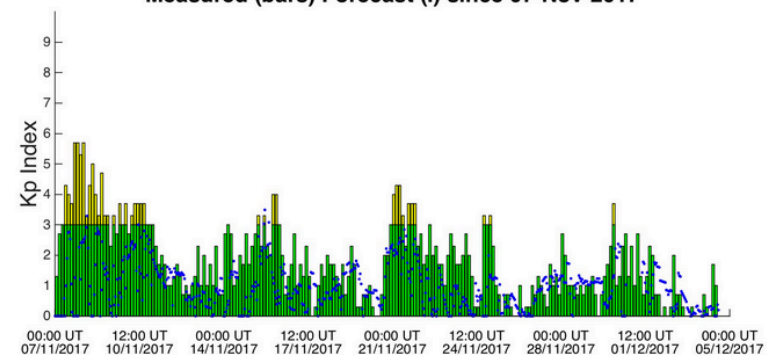
Lower band chorus

Download the set of LBC wave models
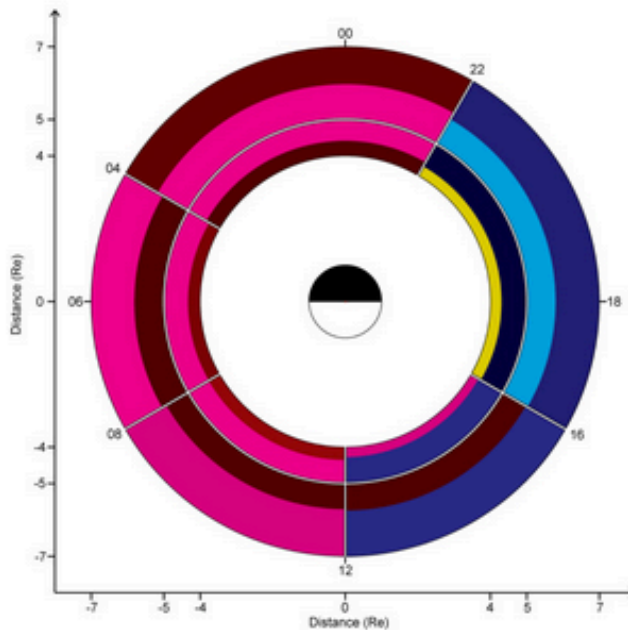
Time lag (hours) Input	1	2	3	4	5	6	7	8	9	10
Velocity										
Density										
Pressure										
IMF Factor										
Dst Index										
AE Index										

Notes:

None

Statistical wave model

The coefficients a_{ij} for the model of RMS magnetic wave amplitudes B_w

L-shell range: 5 < L < 7

MLT range: 16:00-22:00

Parameters are V and DST with time lags of 1 and 4 hours respectively.

The parameters for the equation

$$log_{10}(B_w) = \sum_{i=0}^{3} \sum_{j=0}^{3} a_{ij} cp_1^i cp_2^j$$

where B_w is the RMS wave amplitude, cp_1 and cp_2 are the pair of control parameters that have greatest influence of wave acrivity, and a_{ij} are the model coefficients.

i/j	0	1	2	3
0	-3.5348	0.0722681	0.0066522	9.4716E-5
1	0.00498868	-0.000398039	-3.4394E-5	-4.96633E-7
2	-6.1357E-6	7.05331E-7	5.73804E-8	8.43005E-10
3	2.05188E-9	-3.99662E-10	-3.08718E-11	-4.6397E-13

Links to
- ERR analysis description
- Development of models
- Download all models or specific mode

New developments

New developments, currently on the test web site

Current space weather conditions (WP 7)

Shows current (and forecast) values for

- geomagnetic indices
- various solar wind parameters
- GEO electron fluxes

New developments

Current Conditions

Time: 2017-12-04 12:15:10 UTC		
Magnetosphere	**Current**	**Forecast**
Dst (nT)	6	
Kp	1	0.1
Solar wind	**Current**	**Forecast**
IBI (nT)	3.4	
Bz (nT gsm)	-2.9	
Density (cm^{-3})	7.1	
Velocity (kms^{-1})	305.2	
GEO e⁻ flux	**Current**	**Forecast**
F>2MeV	6.8763	6.5764
F>800keV	8.8802	8.4528

Geomagnetic indices
- Dst – WDC Kyoto
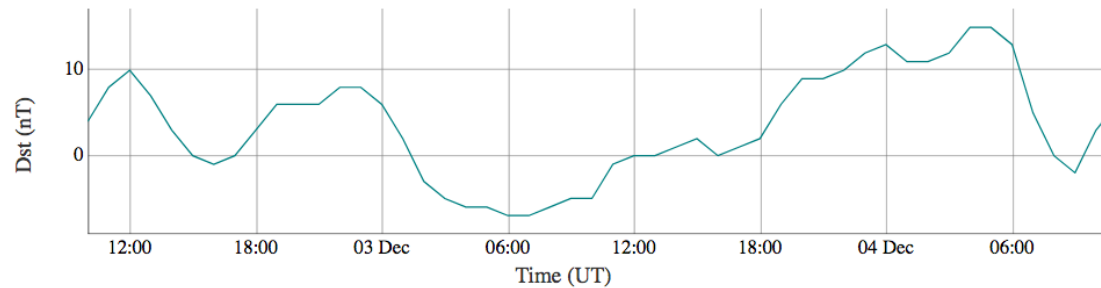- Kp – GFZ Potsdam
- Sheffield Kp model

Solar wind
- All data from ACE real time
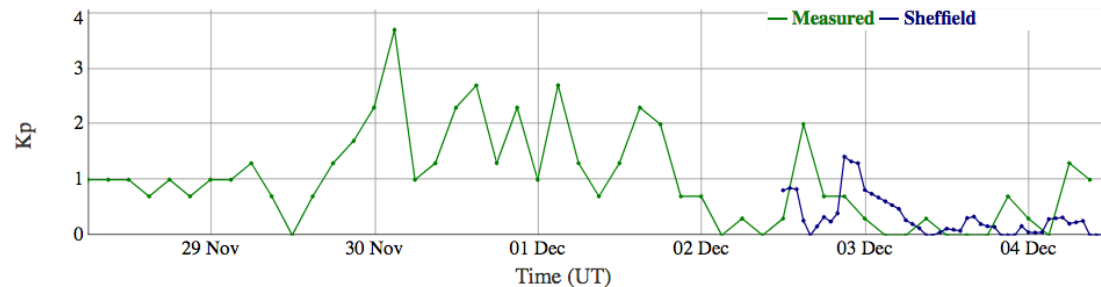- SWIFT solar wind forecasts now available

GEO electron flux
- GOES observations
- Sheffield NARMAX models

New developments

Current solar wind/geomagnetic conditions
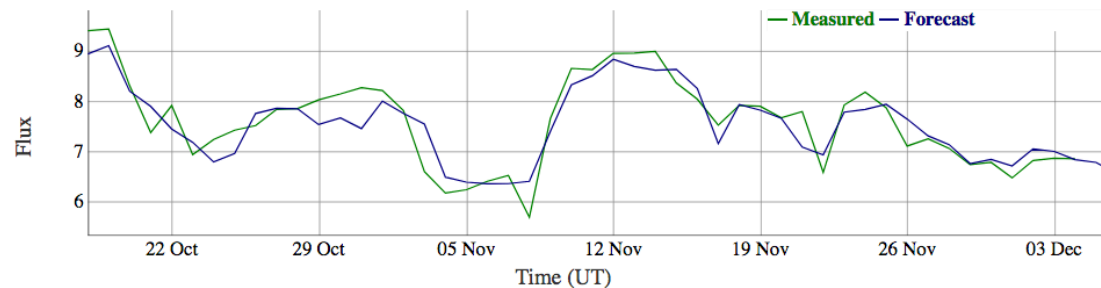
New developments

Orbit tool (WP 7) , currently under development
Shows electron flux from VERB along a selected orbit

Orbit tool

The PROGRESS Orbit Tool allows the user to select a satellite and view the flux of electrons around trajectory of the satellite.

This application

- Allows the user to select the satellite and time period.
- Computes the orbit of the satellite from the Two Line Element orbital descrption using SGP4
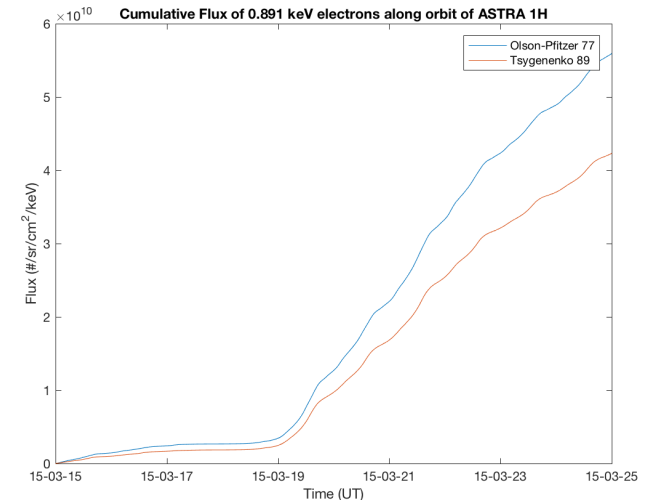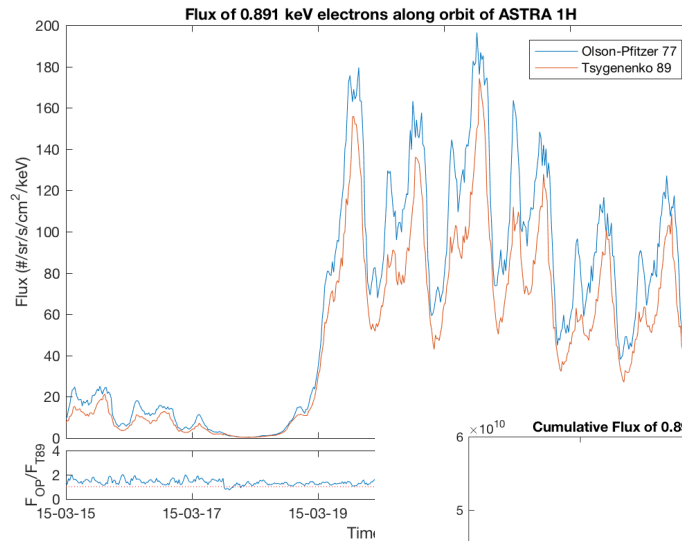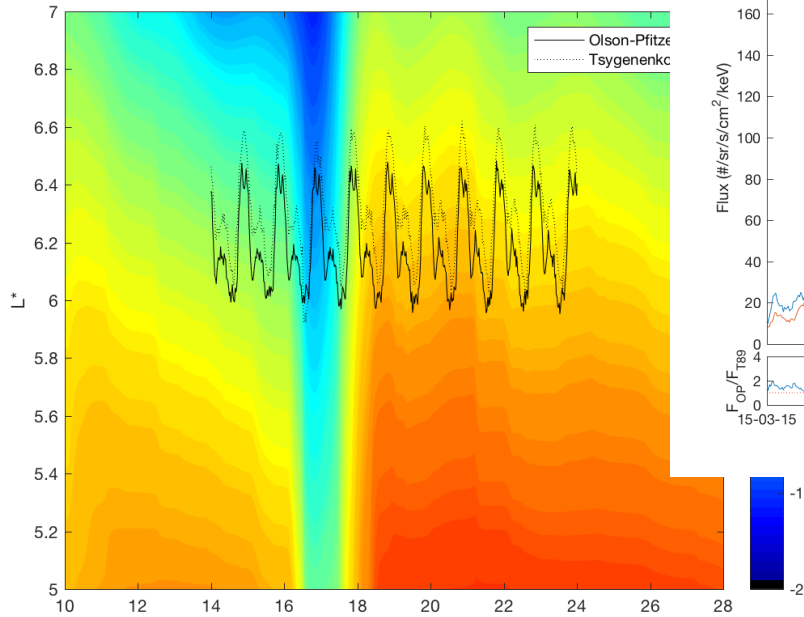- Determines the electron flux at these locations

Satellite:
ABS-2
Start date:
01 / 01 / 2017
End date:
01 / 03 / 2017
Submit

- Orbit defined by TLE

- Propagated using SGP4

- Location converted to L*

- Fluxes extracted from VERB-NARMAX results

New developments

Orbit tool (WP 7) , currently under development

Summary

T7.1

Plots for Lund Kp and Dst models, Sheffield Kp model added.

D7.1

Submitted 2017-10-31

T7.2 - VERB-NARMAX model currently under development at USFD (WP 6)

T7.3 – Orbit tool currently under development

T7.4 - A panel showing the current space weather conditions has been added to the web site.