PRediction Of Geospace Radiation Environment and Solar wind parameterS

Work Package 7

Fusion of forecasting tools

Overview

- Overview
- Deliverables/Milestones
- Highlights
- 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 18-30 (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 22-33 (USFD,Skoltech/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

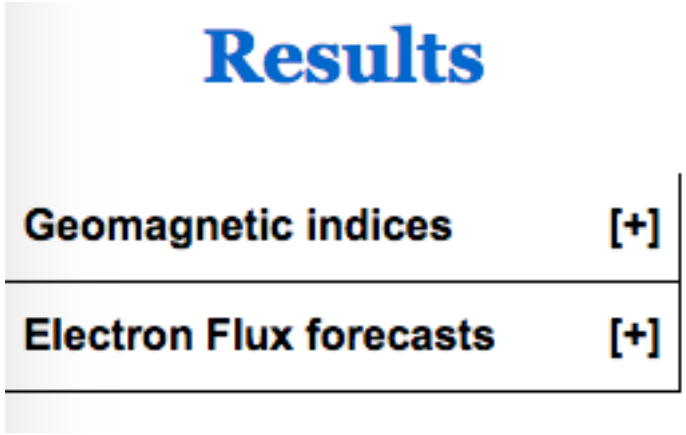
- **Task 7.3 – Orbit tool - Month 27-30 (USFD,Skoltech/GFZ,FMI)**
  The VERB-NARMAX and VERB-IMPTAM models, implemented in task 7.2, will provide forecasts of the flux of electrons. This task will use these forecasts to determine the path integrated electron fluxes in various energy ranges encountered along the orbital path of a satellite.
- **Task 7.4 – Summary - Month 30-36 (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	2017-06-30
D7.2	Forecasts of the energetic electron populations within the inner magnetosphere	2017-09-30
D7.3	On orbit forecasts of the energetic electron populations	2017-06-30
D7.4	Summary of the space weather environment	2017-12-31

Current status

Current project website has a new results menu



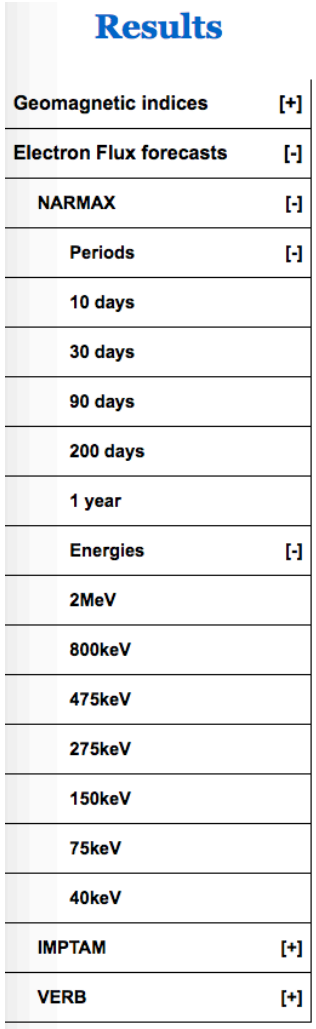
Geomagnetic indices

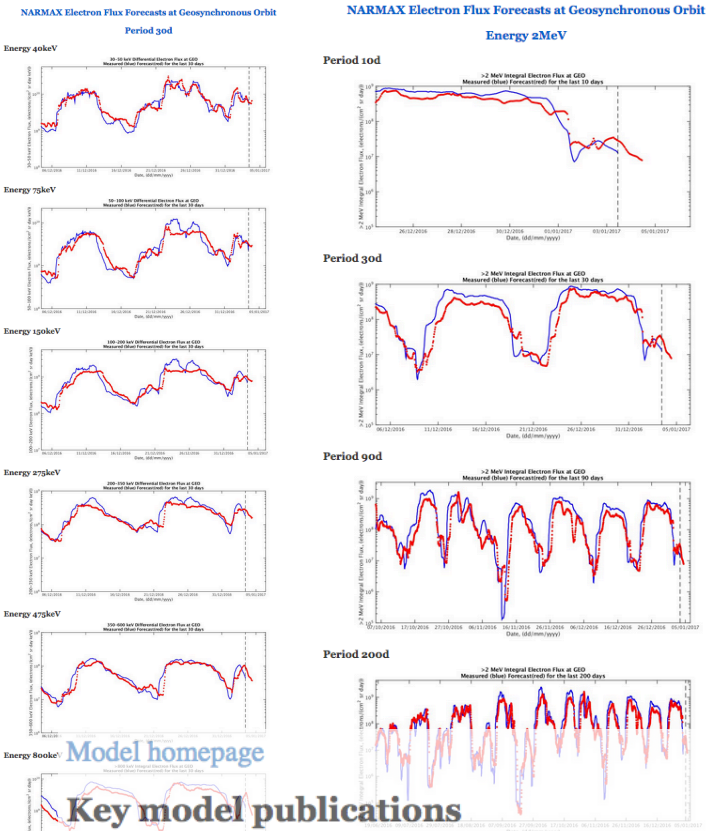
- Lund Kp (WP 3)
- Lund Dst (WP 3)

Electron fluxes

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

NARMAX GEO fluxes





Model homepage

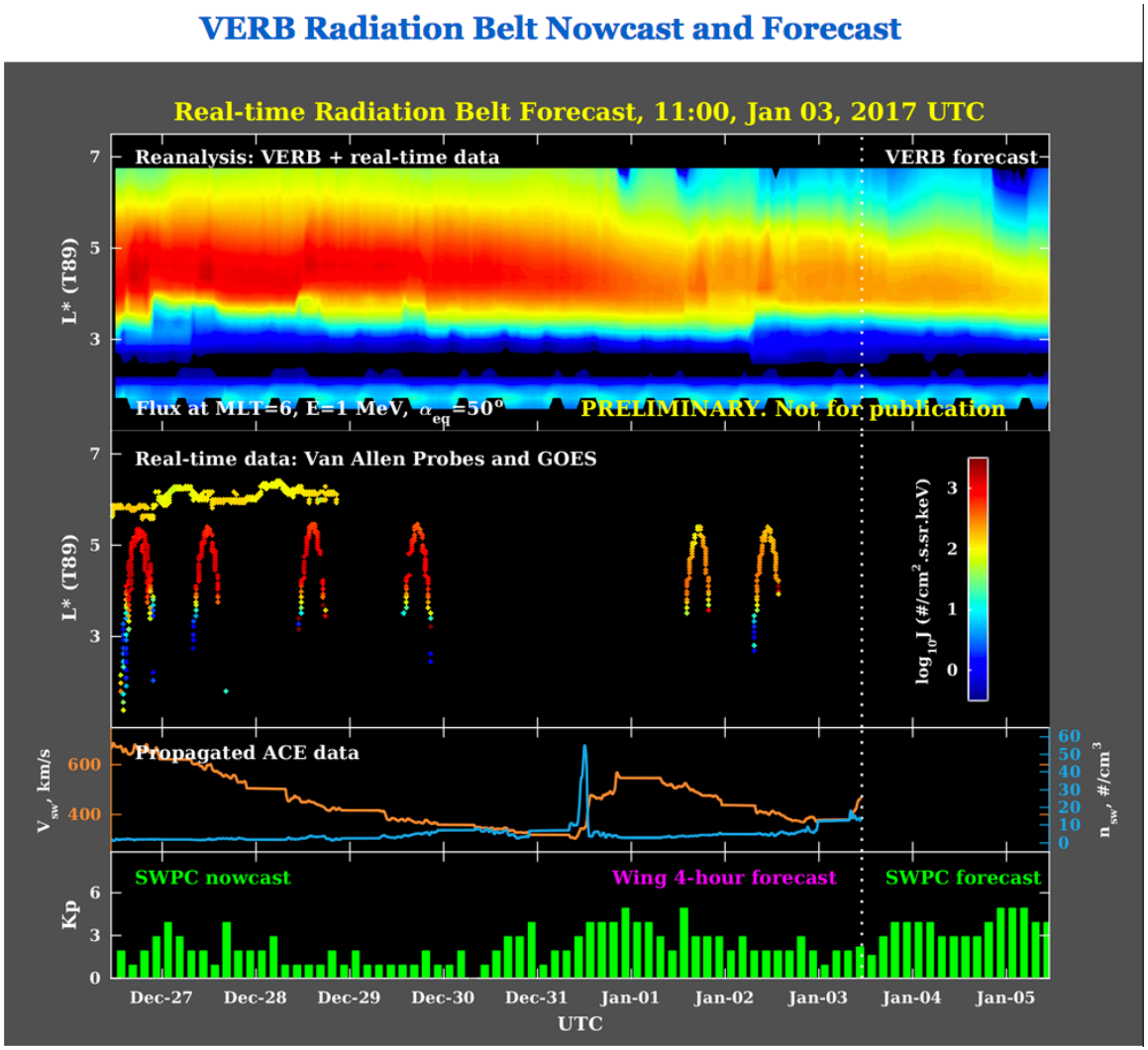
Key model publications

- Boynton, R. J., M. A. Balikhin, S. A. Billings, G. D. Reeves, N. Ganushkina, M. Gedalin, O. A. Amariutei, J. E. Borovsky, and S. N. Walker (2013), The analysis of electron fluxes at geosynchronous orbit employing a NARMAX approach, J. Geophys. Res. Space Physics, 118, 1500–1513, doi:10.1002/jgra.50192
- Boynton, R. J., M. A. Balikhin, and S. A. Billings (2015), Online NARMAX model for electron fluxes at GEO, Ann. Geophys., 33, 405–411, doi:10.5194/angeo-33-405-2015

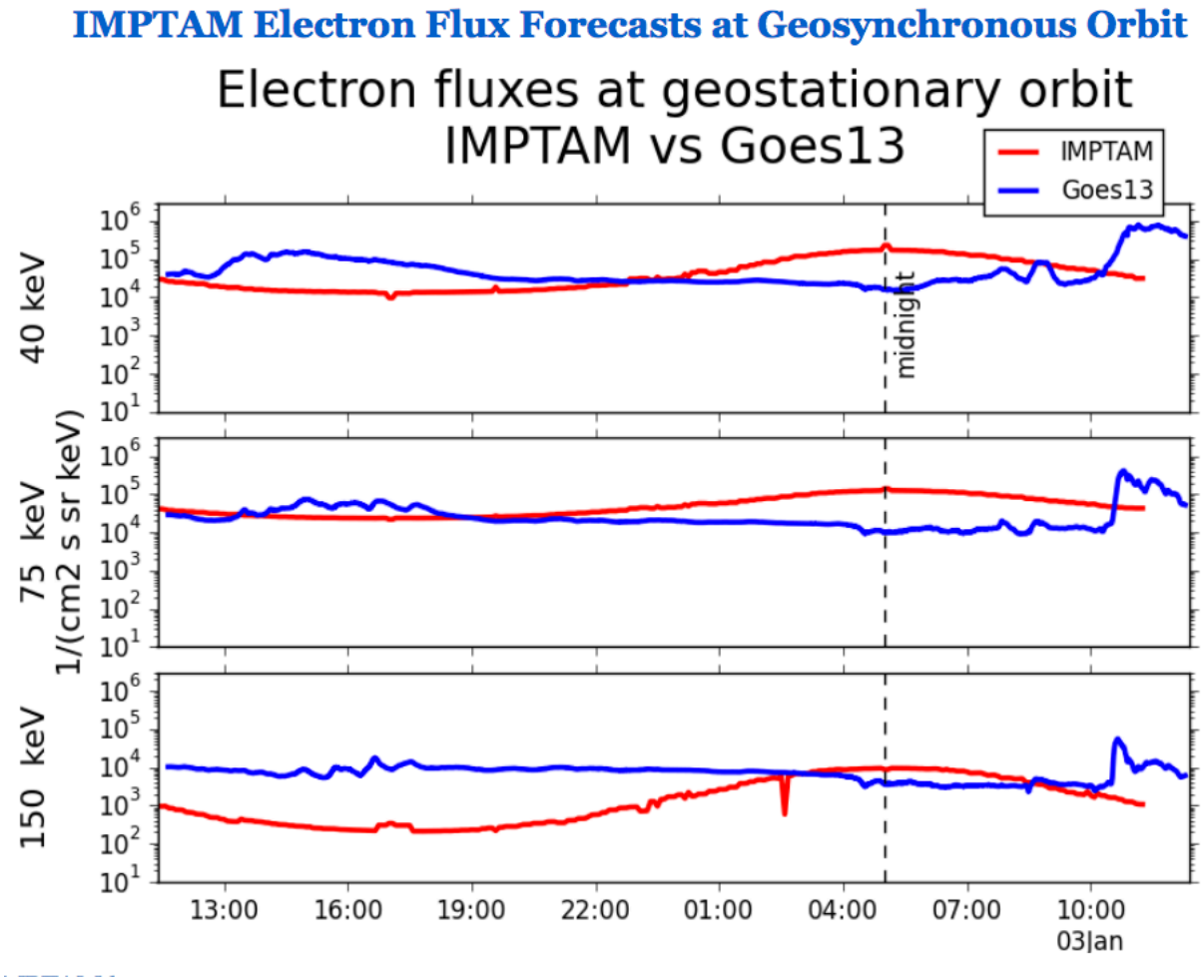
NARMAX GEO e- fluxes

- 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

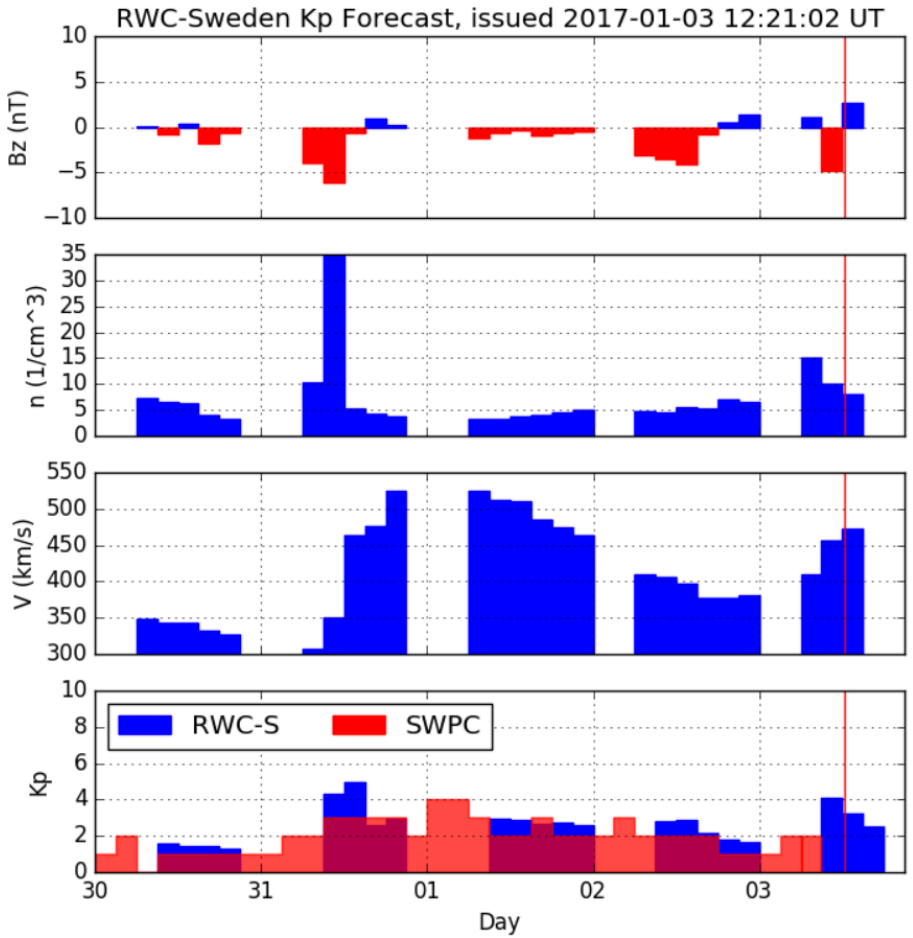


IMPTAM electron fluxes

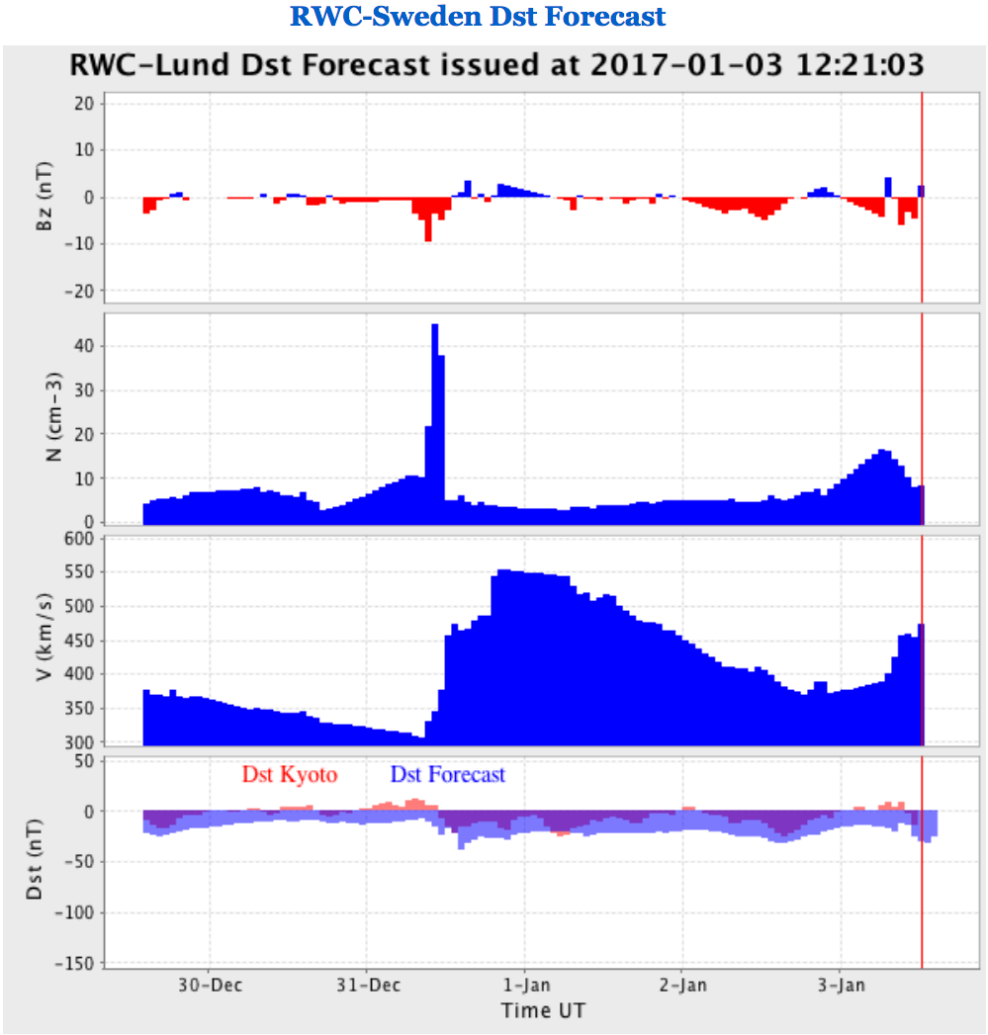


Lund Kp

RWC-Sweden Kp Forecast



Lund Dst


RWC-Sweden Dst Forecast
RWC-Lund Dst Forecast issued at 2017-01-03 12:21:03
Bz (nT)
N (cm-3)
V (km/s)
Dst (nT)
Dst Kyoto
Dst Forecast
30-Dec
31-Dec
1-Jan
2-Jan
3-Jan
Time UT

New developments

New developments, currently on the test web site

Statistical wave models (WP 4)

- Provides access to the statistical wave model data for lower band chorus, hiss, and magnetosonic waves

Current space weather conditions (WP 7)

Shows current (and forecast) values for

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

Statistical wave models

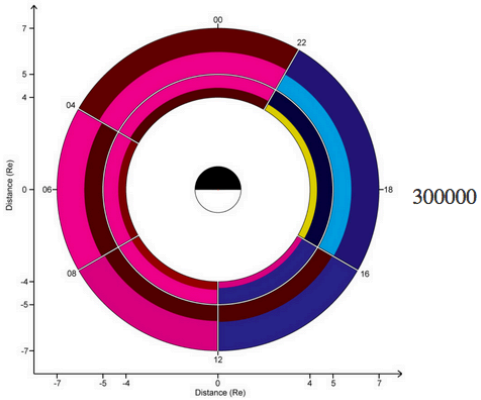
Statistical Wave Models

Magnetic field wave data from the Cluster and THEMIS missions has been used as the basis to compute new statistical wave models for the amplitudes of lower band chorus, hiss, and equatorial magnetosonic waves. The models are based on the results of an Error Reduction Ratio analysis of solar wind parameters, location, and geomagnetic indices in order to determine which of the input set of parameters are in most influential of the evolution of the magnetic field amplitudes of the wave modes under consideration.

- Description of the Error Reduction Analysis and it application
- Description of the calculation of the Statistical Wave Models
- Download the set of Statistical Wave Models

Lower band chorus

Download the set of LBC wave models



Hiss

Download the set of hiss wave models

Equatorial magnetosonic waves

Download the set of Equatorial Magnetosonic wave models

Current conditions

Current Conditions

Magnetosphere	Current	Forecast
Dst (nT)	0	
Kp	7	
Solar wind	**Current**	**Forecast**
|B| (nT)	3.8	
Bz (nT gsm)	-1.5	
Density (cm^{-3})	4.7	
Velocity (kms^{-1})	334.2	
GEO e^- flux	**Current**	**Forecast**
F>2MeV	8.829	8.553
F>800keV	9.7006	9.3311

Geomagnetic indices

Dst – WDC Kyoto

KP – GFZ Potsdam

Solar wind

All data from ACE real time

GEO electron flux

GOES observations

Sheffield NARMAX models

Summary

Progress has been made on all 4 tasks of WP 7

T7.1 - Results of Lund Kp and Dst models added to web site.

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

T7.3 - VERB component of VERB-NARMAX model currently being installed at USFD

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