



# PROGRESS

## Real-time forecast of the IMPTAM-VERB coupled model

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# Outline

## 1. Inputs

- IMPTAM-forecast
- Kp-forecast

## 2. Real-time processing of IMPTAM output

## 3. VERB-3D simulations in real-time

## 4. IMPTAM-VERB forecast

## 5. Flowchart

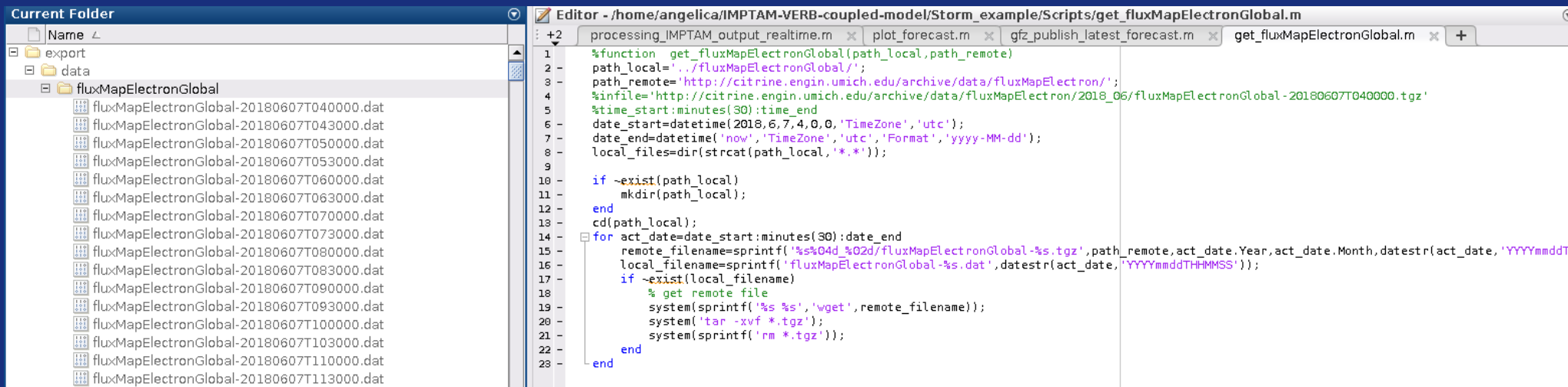
# Inputs: IMPTAM-forecast

Real-time IMPTAM nowcast

Output files were available every 30 minutes (1 hour) at:

<http://citrine.engin.umich.edu/archive/data/fluxMapElectron/>

Data is being uploaded automatically via cronjob



```
Current Folder
├── export
├── data
└── fluxMapElectronGlobal
    ├── fluxMapElectronGlobal-20180607T040000.dat
    ├── fluxMapElectronGlobal-20180607T043000.dat
    ├── fluxMapElectronGlobal-20180607T050000.dat
    ├── fluxMapElectronGlobal-20180607T053000.dat
    ├── fluxMapElectronGlobal-20180607T060000.dat
    ├── fluxMapElectronGlobal-20180607T063000.dat
    ├── fluxMapElectronGlobal-20180607T070000.dat
    ├── fluxMapElectronGlobal-20180607T073000.dat
    ├── fluxMapElectronGlobal-20180607T080000.dat
    ├── fluxMapElectronGlobal-20180607T083000.dat
    ├── fluxMapElectronGlobal-20180607T090000.dat
    ├── fluxMapElectronGlobal-20180607T093000.dat
    ├── fluxMapElectronGlobal-20180607T100000.dat
    ├── fluxMapElectronGlobal-20180607T103000.dat
    ├── fluxMapElectronGlobal-20180607T110000.dat
    └── fluxMapElectronGlobal-20180607T113000.dat

Editor - /home/angelica/IMPTAM-VERB-coupled-model/Storm_example/Scripts/get_fluxMapElectronGlobal.m
1 %function get_fluxMapElectronGlobal(path_local,path_remote)
2 path_local='../fluxMapElectronGlobal/';
3 path_remote='http://citrine.engin.umich.edu/archive/data/fluxMapElectron/';
4 %infile='http://citrine.engin.umich.edu/archive/data/fluxMapElectron/2018_06/fluxMapElectronGlobal-20180607T040000.tgz'
5 %time_start:minutes(30):time_end
6 date_start=datetime(2018,6,7,4,0,0,'TimeZone','utc');
7 date_end=datetime('now','TimeZone','utc','Format','yyyy-MM-dd');
8 local_files=dir(strcat(path_local,'*.*'));
9
10 if ~exist(path_local)
11     mkdir(path_local);
12 end
13 cd(path_local);
14 for act_date=date_start:minutes(30):date_end
15     remote_filename=sprintf('%s%04d_%02d/fluxMapElectronGlobal-%s.tgz',path_remote,act_date.Year,act_date.Month,datestr(act_date,'YYYYmddT'));
16     local_filename=sprintf('fluxMapElectronGlobal-%s.dat',datestr(act_date,'YYYYmddTHMMSS'));
17     if ~exist(local_filename)
18         % get remote file
19         system(sprintf('%s %s','wget',remote_filename));
20         system('tar -xvf *.tgz');
21         system(sprintf('rm *.tgz'));
22     end
23 end
```

# Inputs: IMP TAM-forecast

After a downtime from July 13<sup>th</sup> the output files are now available every 30 minutes (1 hour) at:

<http://citrine.engin.umich.edu/imptam/archive/data/fluxMapElectron/>

```
~ / imptam / archive / data / fluxMapElectron /
```

📁 2018\_07

📁 2018\_08

```
~ / imptam / archive / data / fluxMapElectron / 2018_07 /
```

📁 ..

📁 fluxMapElectronGlobal-20180731T090000.tgz

📁 fluxMapElectronGlobal-20180731T103000.tgz

📁 fluxMapElectronGlobal-20180731T120000.tgz

📁 fluxMapElectronGlobal-20180731T133000.tgz

📁 fluxMapElectronGlobal-20180731T150000.tgz

📁 fluxMapElectronGlobal-20180731T163000.tgz

📁 fluxMapElectronGlobal-20180731T180000.tgz

📁 fluxMapElectronGlobal-20180731T193000.tgz

📁 fluxMapElectronGlobal-20180731T210000.tgz

📁 fluxMapElectronGlobal-20180731T223000.tgz

📁 fluxMapElectronGlobal-20180731T080000.tgz

📁 fluxMapElectronGlobal-20180731T093000.tgz

📁 fluxMapElectronGlobal-20180731T110000.tgz

📁 fluxMapElectronGlobal-20180731T123000.tgz

📁 fluxMapElectronGlobal-20180731T140000.tgz

📁 fluxMapElectronGlobal-20180731T153000.tgz

📁 fluxMapElectronGlobal-20180731T170000.tgz

📁 fluxMapElectronGlobal-20180731T183000.tgz

📁 fluxMapElectronGlobal-20180731T200000.tgz

📁 fluxMapElectronGlobal-20180731T213000.tgz

📁 fluxMapElectronGlobal-20180731T230000.tgz

📁 fluxMapElectronGlobal-20180731T083000.tgz

📁 fluxMapElectronGlobal-20180731T100000.tgz

📁 fluxMapElectronGlobal-20180731T113000.tgz

📁 fluxMapElectronGlobal-20180731T130000.tgz

📁 fluxMapElectronGlobal-20180731T143000.tgz

📁 fluxMapElectronGlobal-20180731T160000.tgz

📁 fluxMapElectronGlobal-20180731T173000.tgz

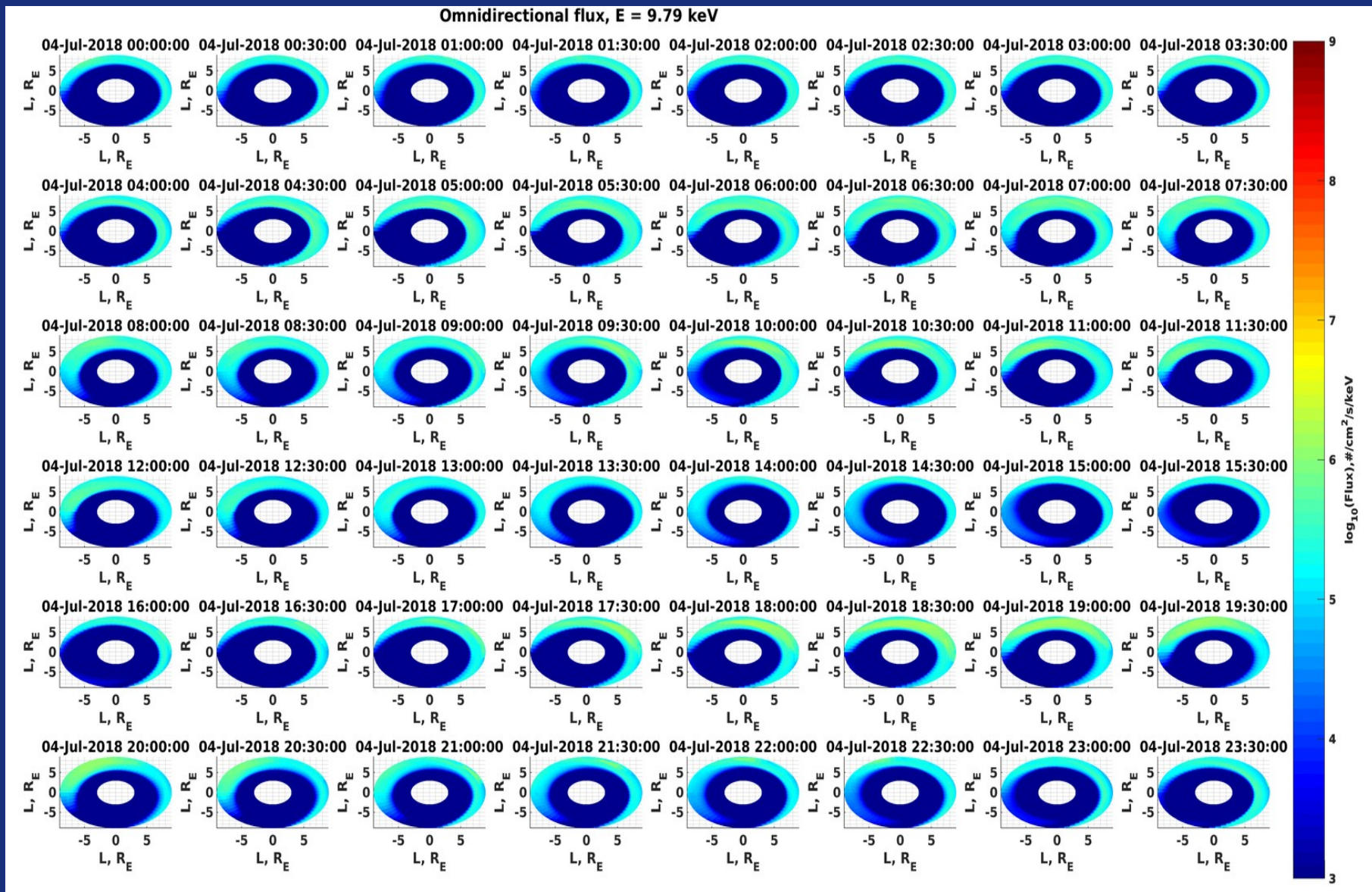
📁 fluxMapElectronGlobal-20180731T190000.tgz

📁 fluxMapElectronGlobal-20180731T203000.tgz

📁 fluxMapElectronGlobal-20180731T220000.tgz

📁 fluxMapElectronGlobal-20180731T233000.tgz

# Inputs: IMPTAM-forecast



# Inputs: Kp-forecast

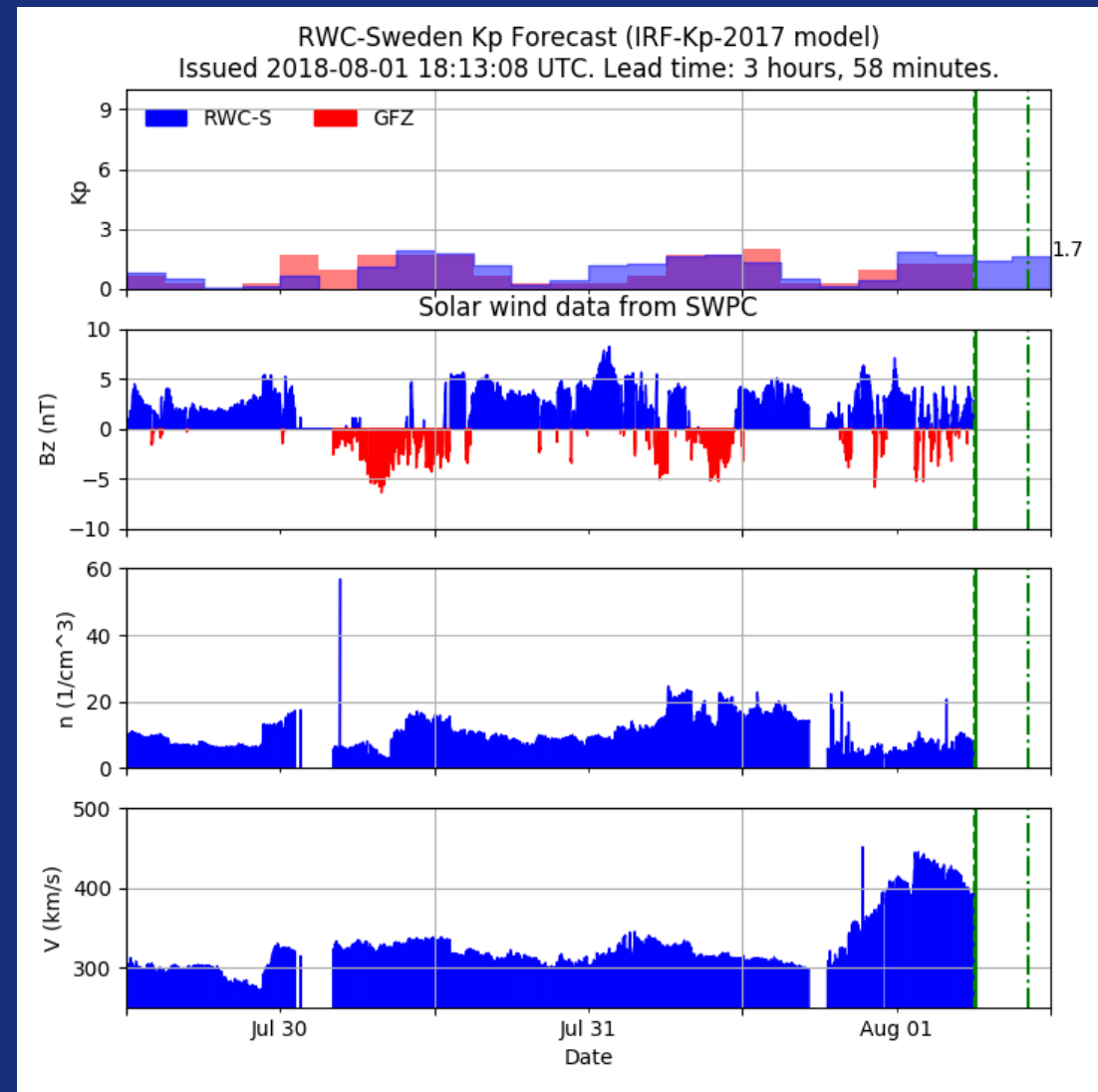
IRF-Kp-2017 model from Lund

Kp-prediction using solar wind parameters

Needed in VERB for the calculation of the plasmopause location and for the scaling of the diffusion coefficients.

Download of value every 3 hours into a dynamic array of 6\*8-hour values

Available at:  
<http://lund.irf.se/progress/rest/data/sets/irfkp2017>

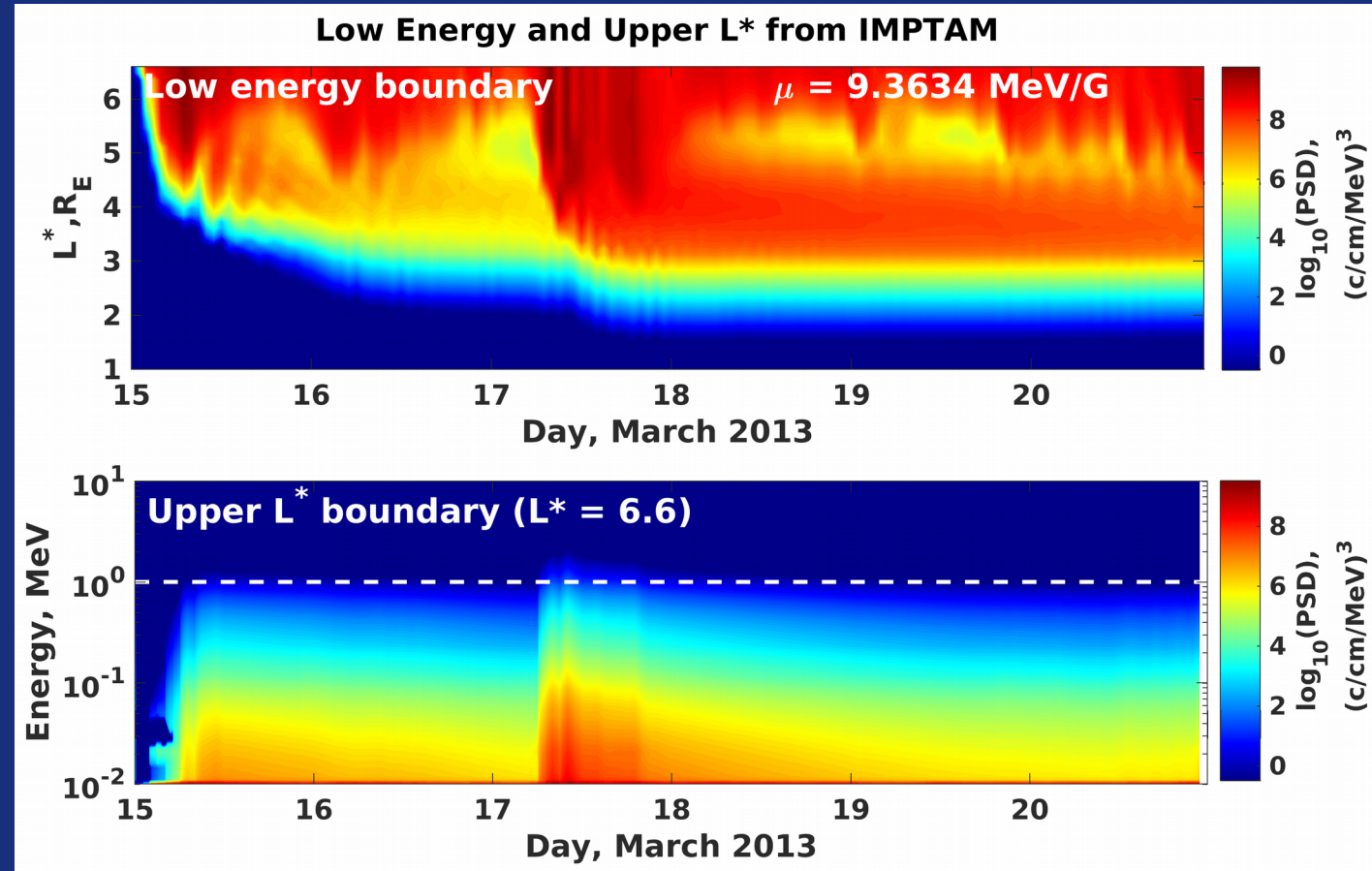


# Processing of the IMPTAM output

Check if IMPTAM files have correct format

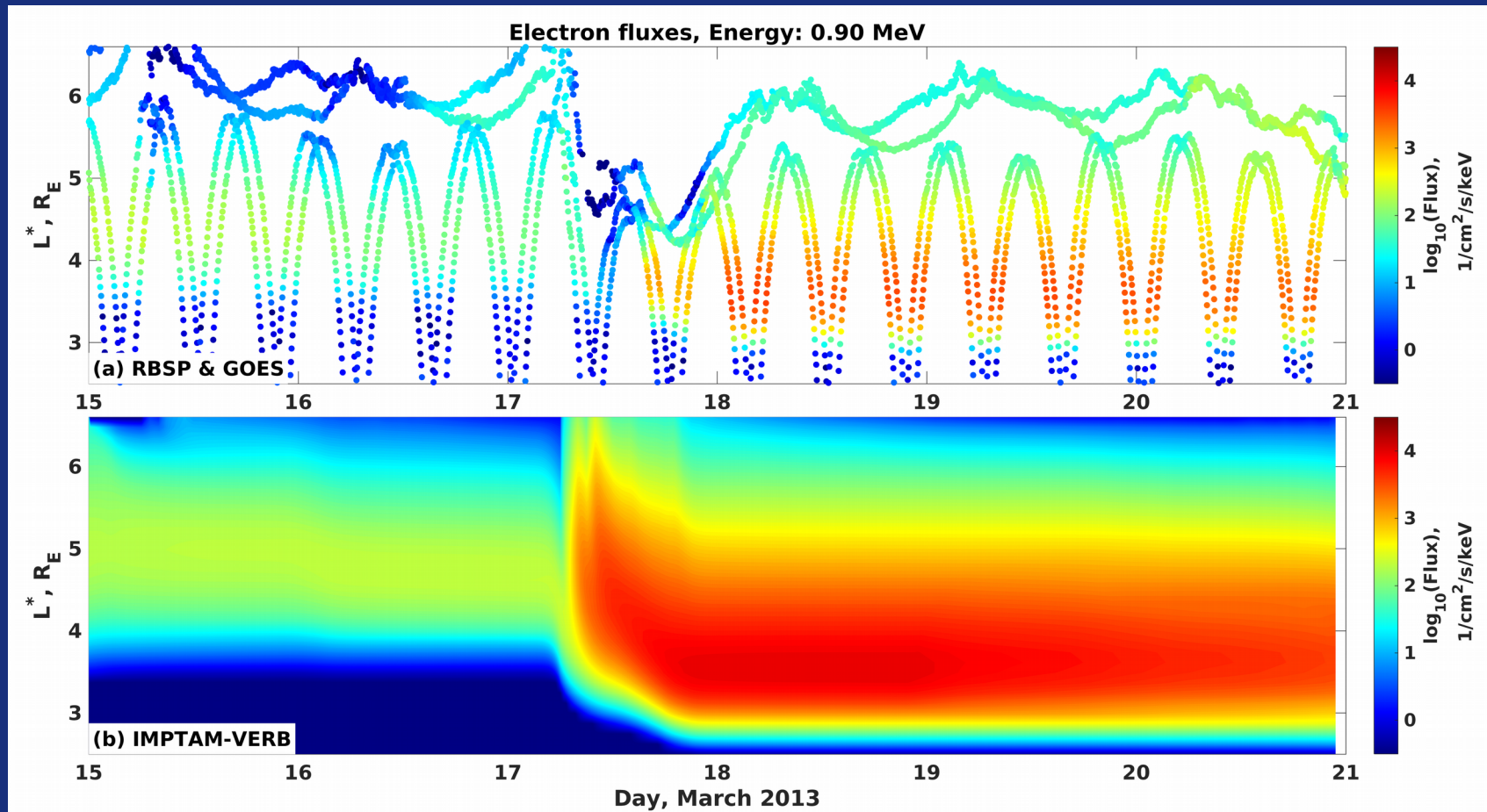
MLT-averaging, grid adaptation

Calculation of the low energy boundary and the outer boundary necessary to run the VERB 3D code every 30 minutes. Using IMPTAM output



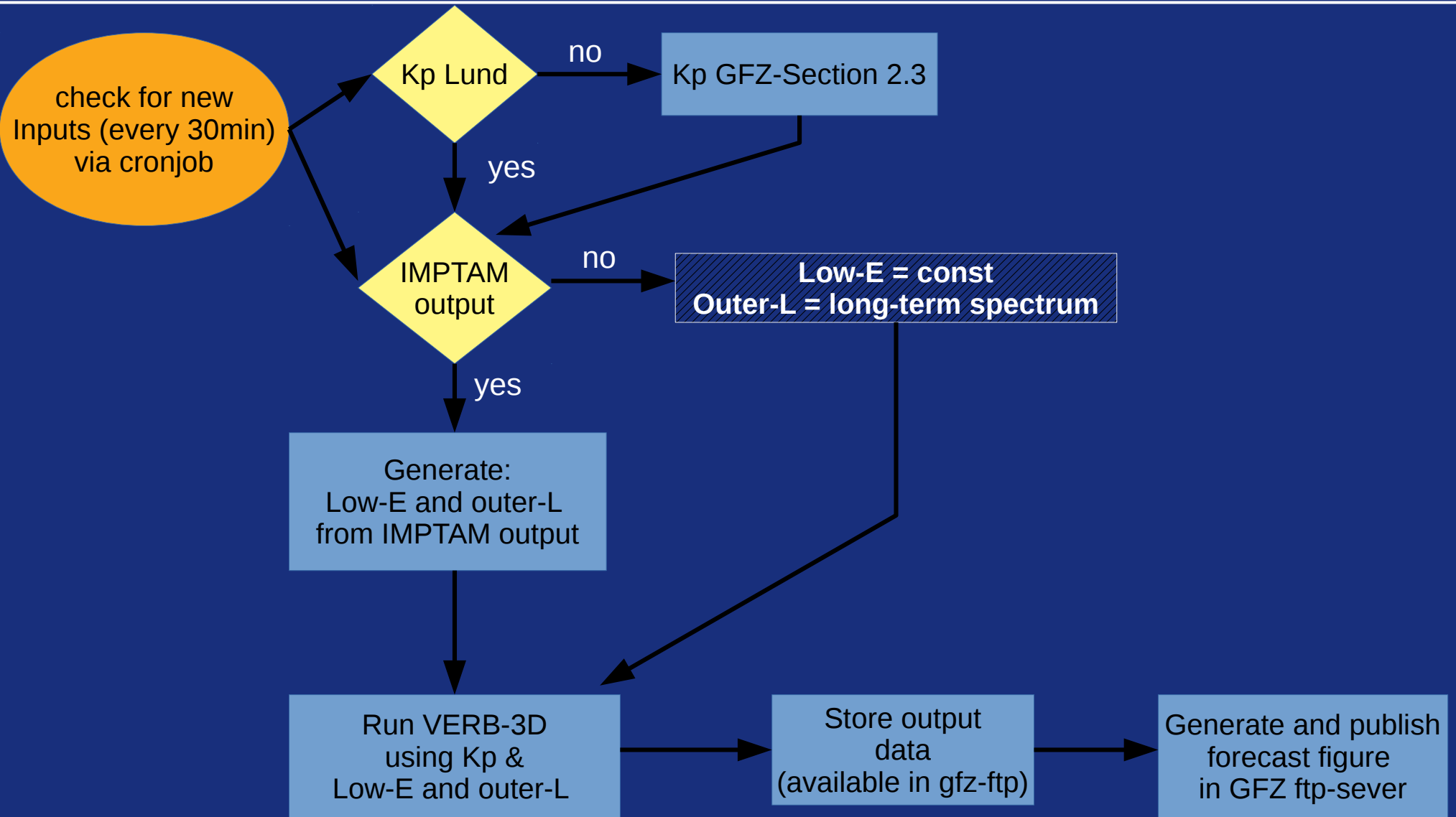
# VERB simulations

- Run VERB simulation
- Store electron flux data in the gfz-ftp server
- Update flux figure and publish it on the gfz-website

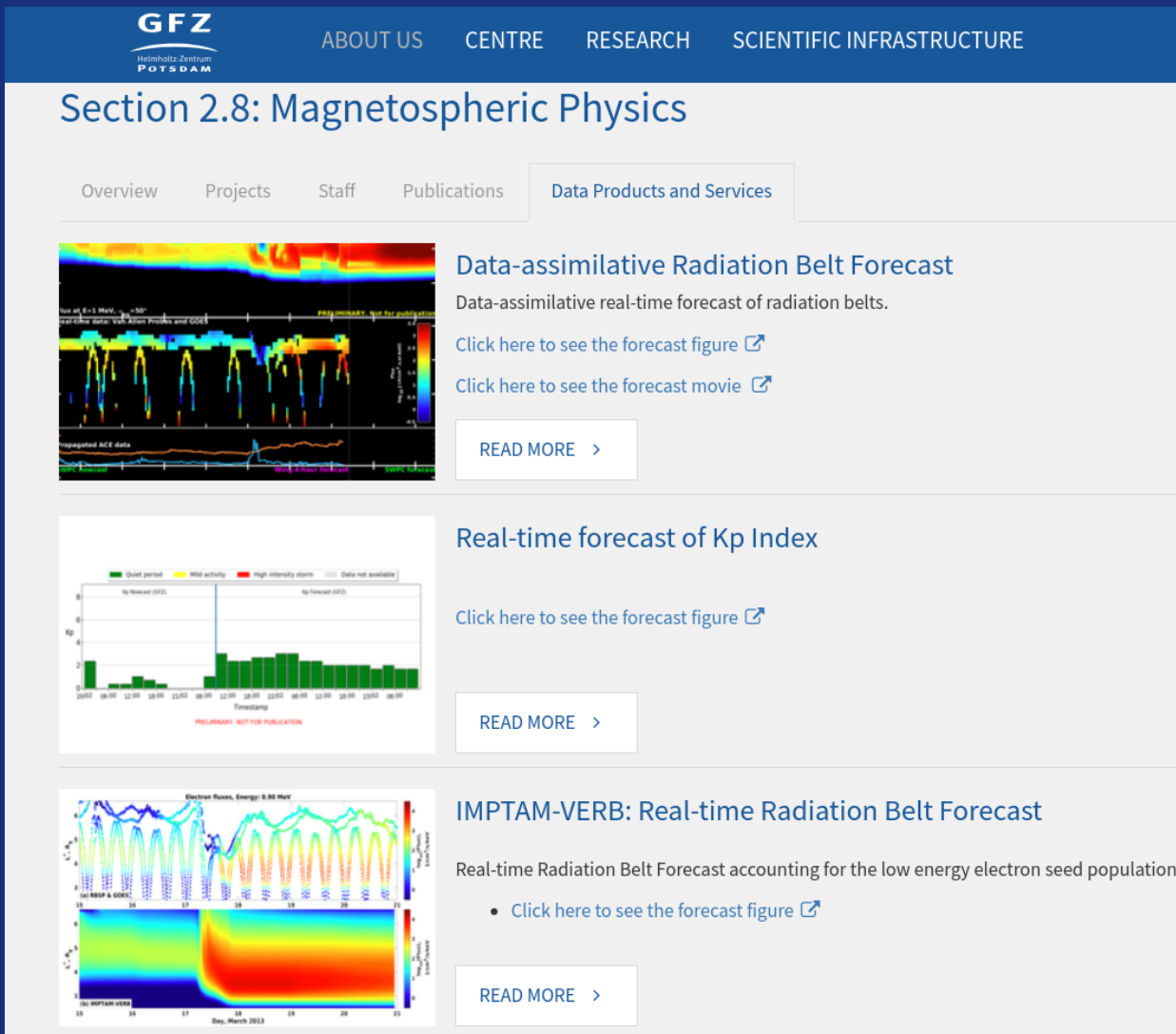




# Flow diagram



# Forecast publicly available



The screenshot shows the GFZ website interface. At the top, there is a navigation bar with the GFZ logo and menu items: ABOUT US, CENTRE, RESEARCH, and SCIENTIFIC INFRASTRUCTURE. Below this is the section title "Section 2.8: Magnetospheric Physics". A secondary navigation bar includes "Overview", "Projects", "Staff", "Publications", and "Data Products and Services". Three data product cards are visible:

- Data-assimilative Radiation Belt Forecast:** Includes a heatmap plot of radiation belt intensity. Description: "Data-assimilative real-time forecast of radiation belts." Links: "Click here to see the forecast figure" and "Click here to see the forecast movie".
- Real-time forecast of Kp Index:** Includes a bar chart showing Kp index values over time. Description: "Real-time forecast of Kp Index." Link: "Click here to see the forecast figure".
- IMPTAM-VERB: Real-time Radiation Belt Forecast:** Includes a plot of electron fluxes at 0.9 MeV. Description: "Real-time Radiation Belt Forecast accounting for the low energy electron seed population." Link: "Click here to see the forecast figure".

Hourly electron fluxes for particles at 0.9 MeV energy

Time window of 6 days

Available at:  
<https://www.gfz-potsdam.de/en/section/magnetospheric-physics/data-products-and-services/>



Thank you !!

# Inputs: Real-time Kp-forecast

Kp-prediction using neuronal networks, developed by Ruggero Vassile at the Magnetospheric Physics Section of the GFZ

Available at: <https://www.gfz-potsdam.de/en/section/magnetospheric-physics/data-products-and-services/>

