A simple crib sheet for loading and plotting Arase satellite data

This notebook shows how to load and plot Arase satellite data with pySPEDAS and pyTplot.

Please refer to the following website for the details of the data.

https://ergsc.isee.nagoya-u.ac.jp/data_info/erg.shtml.en

Get started

It is assumed that you already have pySPEDAS and the latest version of ERG-SC plug-in installed on your python environment. The following commands import some necessary modules for loading and plotting the data.

In [1…

```
import pyspedas
import pytplot
from pytplot.MPLPlotter.tplot import tplot      # a Matplotli
```

You can import the ERG-SC plug-in from either the pyspedas module or the **ergpyspedas** module. The latter is kind of the bleeding-edge distribution: it always delivers the latest version of sub-modules some of which may still be in an experimental phase. The former, the main distribution of pySPEDAS, contains a stable version of the ERG-SC plug-in.

In this notebook, we use the bleeding-edge version of the ERG-SC plug-in. For example, the data-load module for the MGF data can be imported with the following command:

In [2…

```
from ergpyspedas.erg import mgf
```

Basic commands of pyTplot and pySPEDAS

With MGF data, let us introduce some basic commands of pyTplot and pySPEDAS, which are used commonly for loading and visualizing data. Also see the official document of the pyTplot module at:

https://pytplot.readthedocs.io/en/latest/index.html

Load data and plot them with "tplot"

In [3…

```
from ergpyspedas.erg import mgf
vars = mgf( trange=[ '2017-03-27', '2017-03-28' ] )  # load
tplot( 'erg_mgf_l2_mag_8sec_sm' )
```

```
10-Mar-22 15:10:24: Downloading remote index: https://ergsc.i
see.nagoya-u.ac.jp/data/ergsc/satellite/erg/mgf/l2/8sec/2017/
03/
10-Mar-22 15:10:25: File is current: /Users/horit/mnt/drobo20
20/work/data//ergsc/satellite/erg/mgf/l2/8sec/2017/03/erg_mgf
_l2_8sec_20170327_v03.04.cdf
10-Mar-22 15:10:25: /Users/horit/.pyenv/versions/3.9.6/envs/3
9_pydarn_pyspedas/lib/python3.9/site-packages/pytplot/importe
rs/cdf_to_tplot.py:250: FutureWarning: elementwise comparison
failed; returning scalar instead, but in the future will perf
orm elementwise comparison
  if ydata[ydata == var_atts["FILLVAL"]].size != 0:

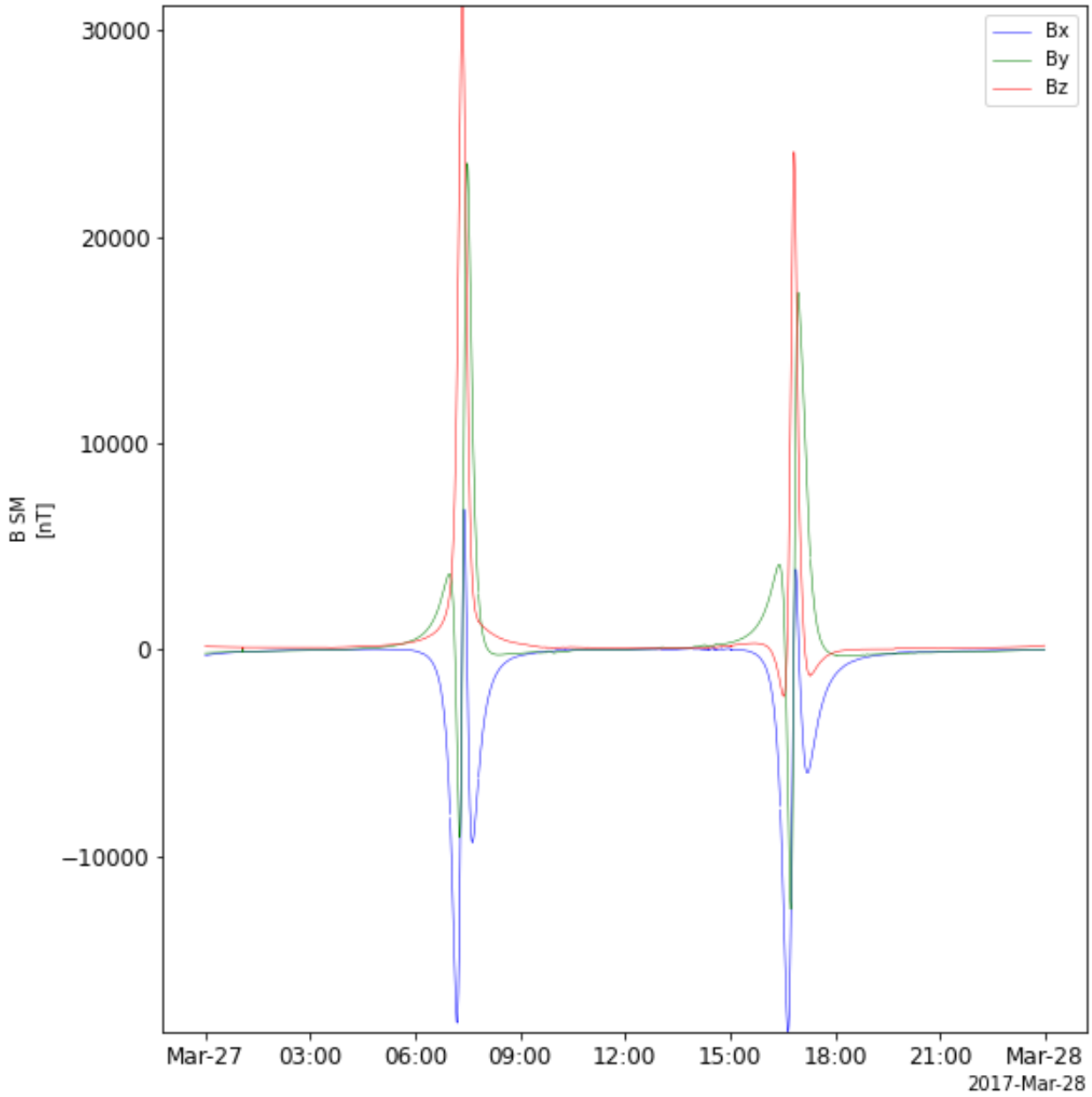
10-Mar-22 15:10:26: /Users/horit/.pyenv/versions/3.9.6/envs/3
9_pydarn_pyspedas/lib/python3.9/site-packages/pytplot/importe
rs/cdf_to_tplot.py:256: FutureWarning: elementwise comparison
failed; returning scalar instead, but in the future will perf
orm elementwise comparison
  ydata[ydata == var_atts["FILLVAL"]] = 0
```

```
**********************************************************************
*************
Exploration of Energization and Radiation in Geospace (ERG) M
agnetic Field Experiment (MGF) Level 2 spin-averaged magnetic
field data

Information about ERG MGF

PI:  Ayako Matsuoka
Affiliation: Data Analysis Center for Geomagnetism and Space
Magnetism, Graduate School of Science, Kyoto University, Kita
shirakawa-Oiwake Cho, Sakyo-ku Kyoto 606-8502, Japan

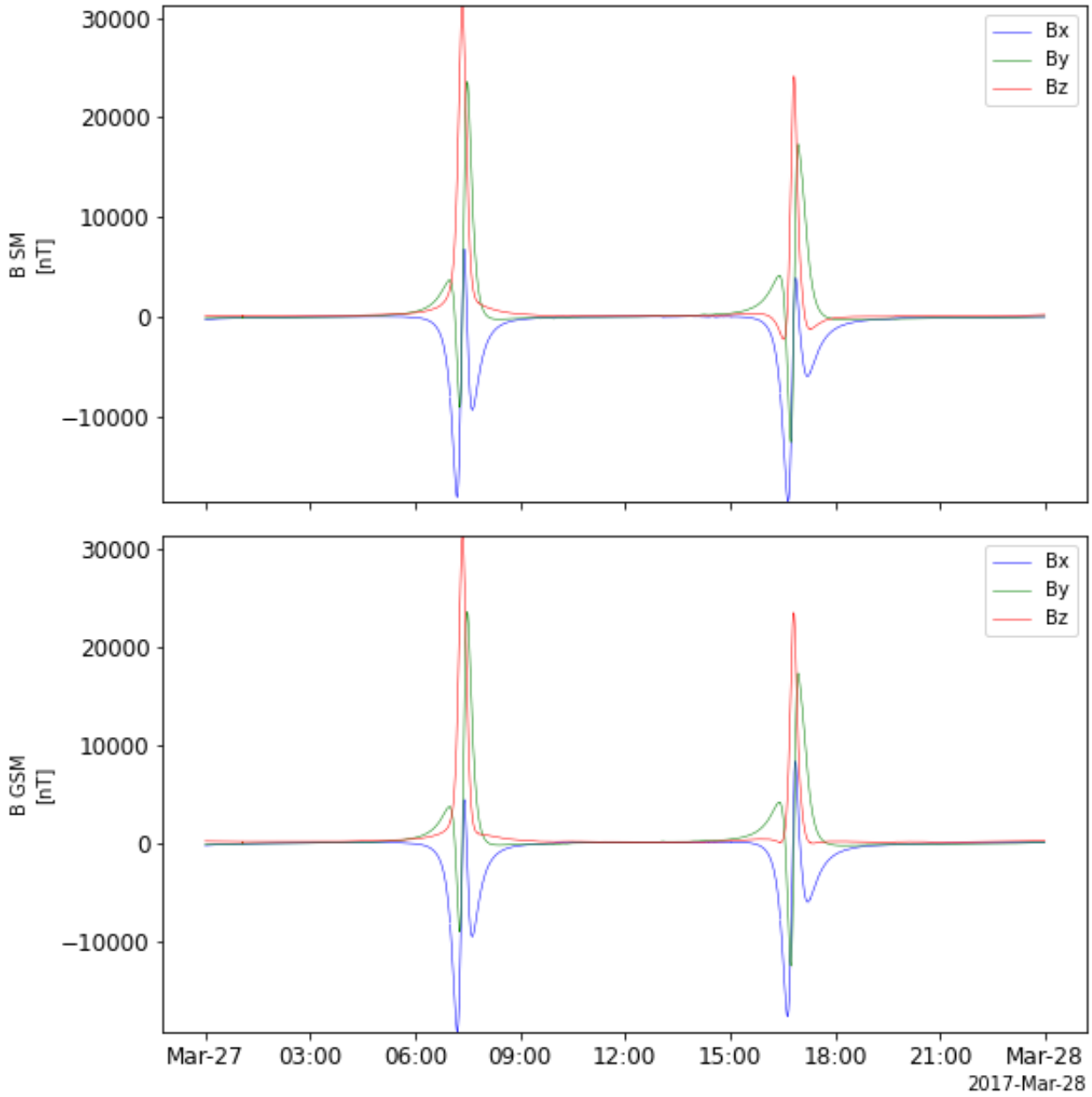
RoR of ERG project common: https://ergsc.isee.nagoya-u.ac.jp/
data_info/rules_of_the_road.shtml.en
RoR of MGF L2: https://ergsc.isee.nagoya-u.ac.jp/mw/index.php
/ErgSat/Mgf
Contact: erg_mgf_info at isee.nagoya-u.ac.jp
**********************************************************************
*************
```



Plot multiple tplot variables verticaly in a row on a window

In [4…

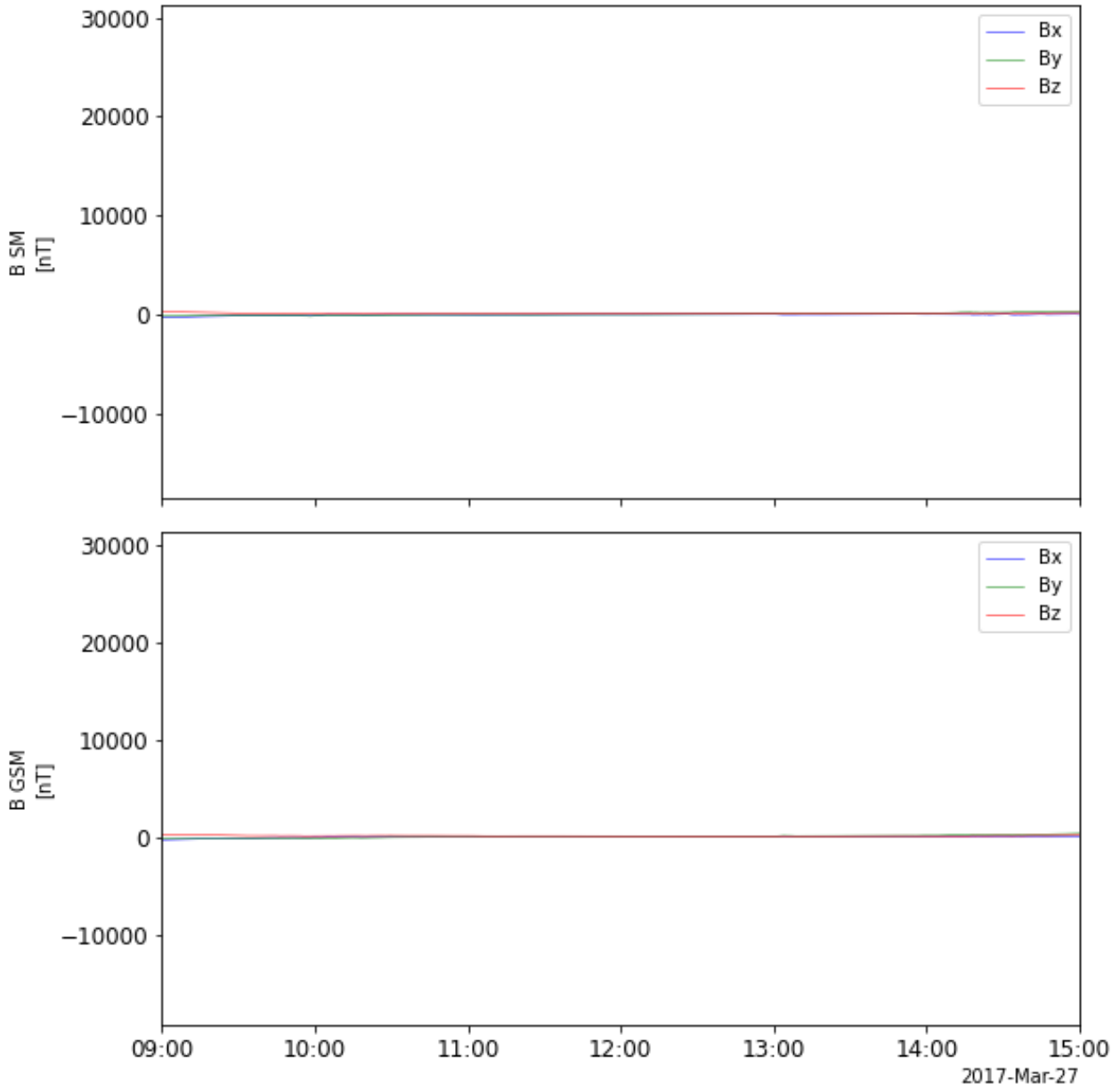
```
tplot( [ 'erg_mgf_l2_mag_8sec_sm', 'erg_mgf_l2_mag_8sec_gsm'
```



Limit the time range of a plot: `timespan()`

In [6…

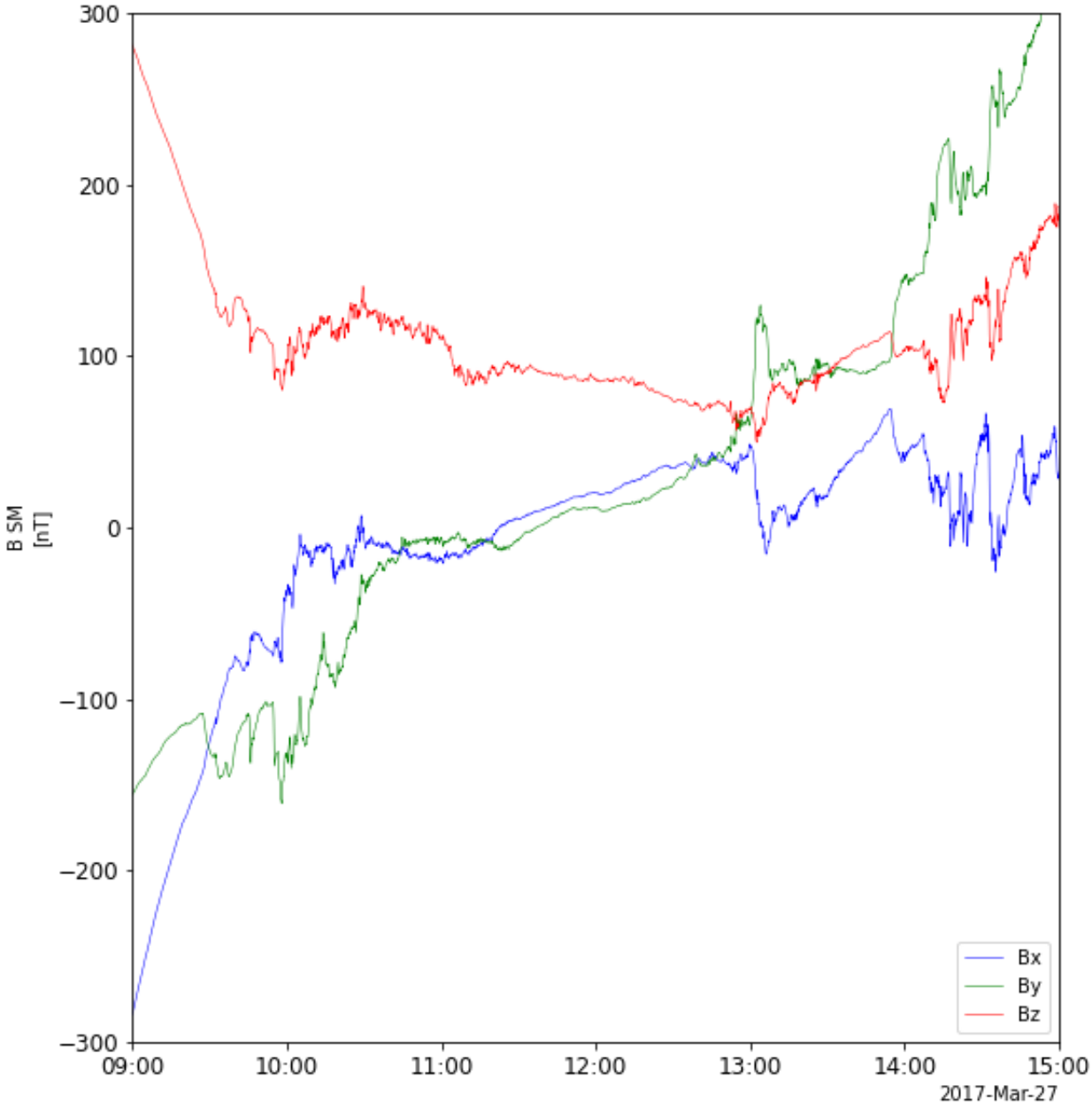
```
pytplot.timespan( '2017-03-27 09:00:00', 6, keyword='hours'
tplot( [ 'erg_mgf_l2_mag_8sec_sm', 'erg_mgf_l2_mag_8sec_gsm'
```



Change the vertical scale of a plot: `ylim`

In [7…

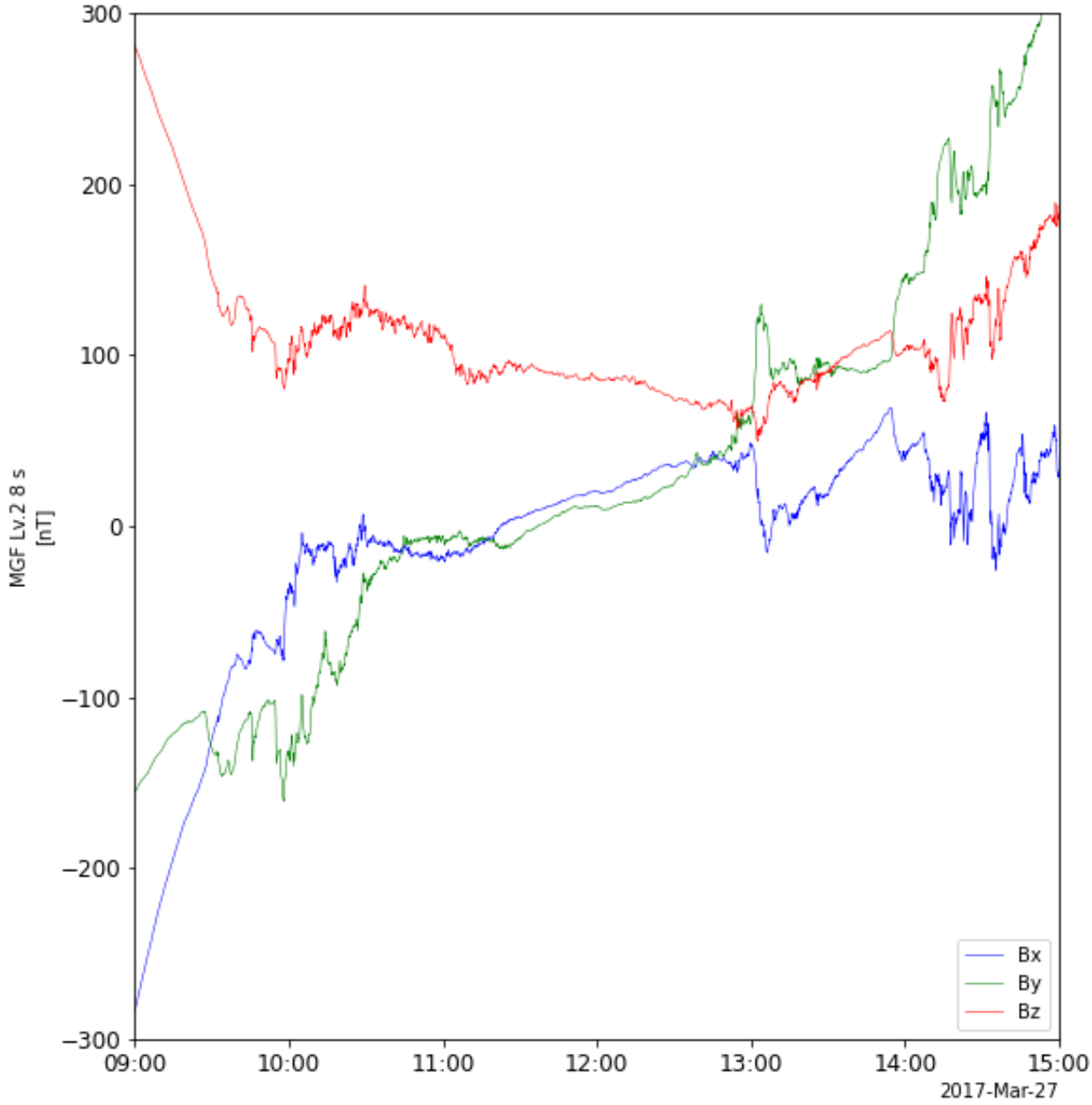
```
pytplot.ylim( 'erg_mgf_l2_mag_8sec_sm', -300., 300. )
tplot( [ 'erg_mgf_l2_mag_8sec_sm' ] )
```



Change the title of the vertical axis: `options()`

In [8…

```
pytplot.options(  'erg_mgf_l2_mag_8sec_sm', 'ytitle', 'MGF Ly
tplot( [ 'erg_mgf_l2_mag_8sec_sm' ] )
```



Change the contour scale for a spectrum-type plot: `zlim()`

In [9…

```
from ergpyspedas.erg import pwe_ofa
pwe_ofa( trange=[ '2017-03-27 09:00:00', '2017-03-27 15:00:0(
pytplot.zlim( 'erg_pwe_ofa_l2_spec_E_spectra_132', 1e-7, 1e-1
tplot( 'erg_pwe_ofa_l2_spec_E_spectra_132' )
```

```
10-Mar-22 15:21:58: Downloading remote index: https://ergsc.i
see.nagoya-u.ac.jp/data/ergsc/satellite/erg/pwe/ofa/l2/spec/2
017/03/
10-Mar-22 15:21:58: File is current: /Users/horit/mnt/drobo20
20/work/data//ergsc/satellite/erg/pwe/ofa/l2/spec/2017/03/erg
_pwe_ofa_l2_spec_20170327_v02_01.cdf
```

```
10-Mar-22 15:21:59: /Users/horit/.pyenv/versions/3.9.6/envs/3
9_pydarn_pyspedas/lib/python3.9/site-packages/pytplot/importe
rs/cdf_to_tplot.py:250: FutureWarning: elementwise comparison
failed; returning scalar instead, but in the future will perf
orm elementwise comparison
  if ydata[ydata == var_atts["FILLVAL"]].size != 0:
```

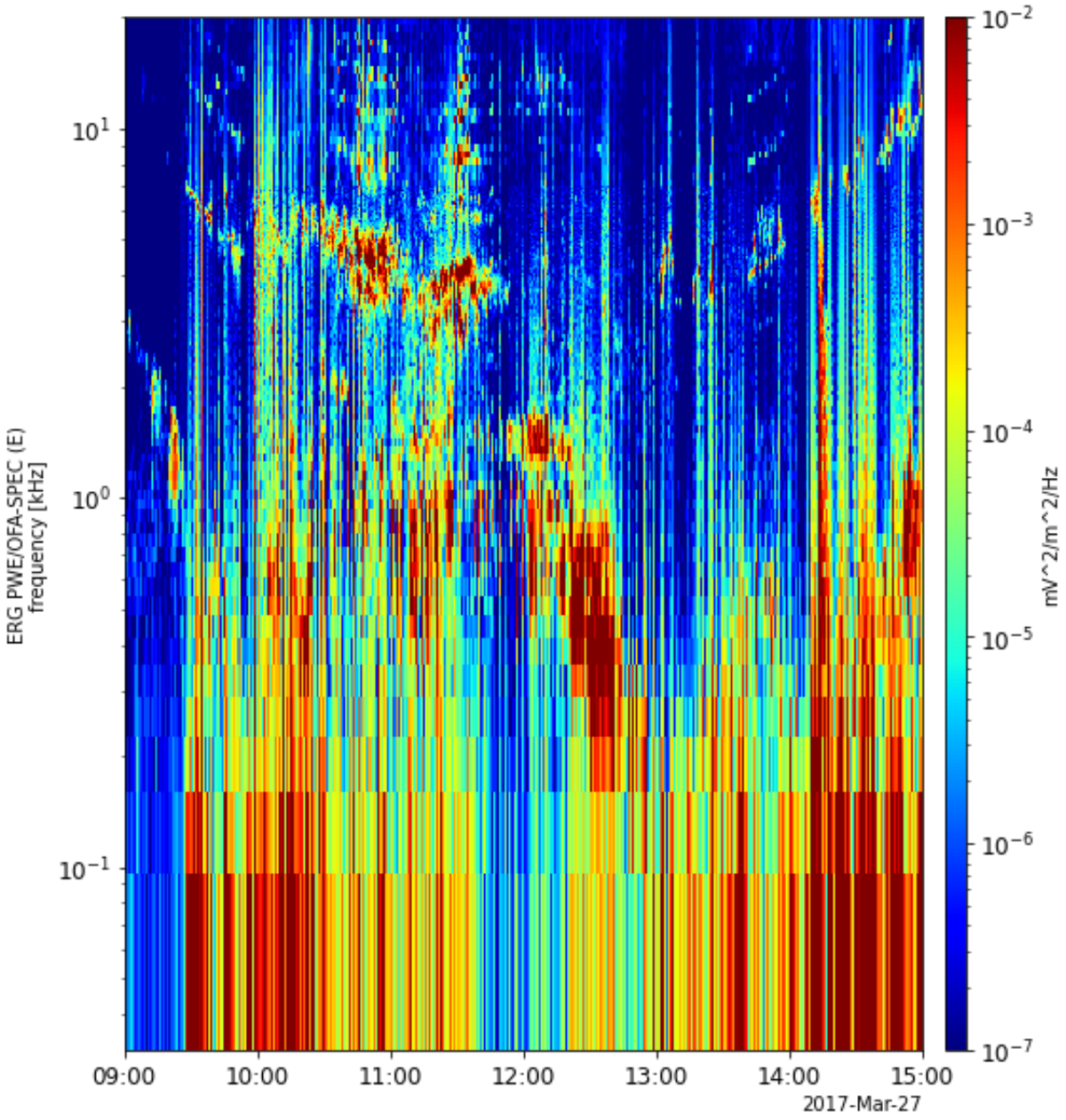
```
**************************************************************
*************
Exploration of Energization and Radiation in Geospace (ERG) P
lasma Wave Experiment (PWE) Onboard Frequency Analyzer (OFA)
Level 2 spectrum data

Information about ERG PWE OFA

PI:  Yoshiya Kasahara
Affiliation: Kanazawa University

RoR of ERG project common: https://ergsc.isee.nagoya-u.ac.jp/
data_info/rules_of_the_road.shtml.en
RoR of PWE/OFA: https://ergsc.isee.nagoya-u.ac.jp/mw/index.ph
p/ErgSat/Pwe/Ofa

Contact: erg_pwe_info at isee.nagoya-u.ac.jp
**************************************************************
*************
```



Show the list of loaded tplot variables: `tplot_names()`

In [1…

```
vars = pytplot.tplot_names()
```

```
0 : erg_mgf_l2_epoch_8sec
1 : erg_mgf_l2_mag_8sec_dsi
2 : erg_mgf_l2_mag_8sec_gse
3 : erg_mgf_l2_mag_8sec_gsm
4 : erg_mgf_l2_mag_8sec_sm
5 : erg_mgf_l2_magt_8sec
6 : erg_mgf_l2_rmsd_8sec_dsi
7 : erg_mgf_l2_rmsd_8sec_gse
8 : erg_mgf_l2_rmsd_8sec_gsm
9 : erg_mgf_l2_rmsd_8sec_sm
10 : erg_mgf_l2_rmsd_8sec
11 : erg_mgf_l2_n_rmsd_8sec
12 : erg_mgf_l2_dyn_rng_8sec
13 : erg_mgf_l2_quality_8sec
14 : erg_mgf_l2_quality_8sec_gc
15 : erg_mgf_l2_igrf_8sec_dsi
16 : erg_mgf_l2_igrf_8sec_gse
17 : erg_mgf_l2_igrf_8sec_gsm
18 : erg_mgf_l2_igrf_8sec_sm
19 : erg_pwe_ofa_l2_spec_epoch_e132
20 : erg_pwe_ofa_l2_spec_E_spectra_132
21 : erg_pwe_ofa_l2_spec_quality_flag_e132
22 : erg_pwe_ofa_l2_spec_epoch_b132
23 : erg_pwe_ofa_l2_spec_B_spectra_132
24 : erg_pwe_ofa_l2_spec_quality_flag_b132
```

Remove tplot variables that have been loaded

In [1…

```
pytplot.del_data( 'erg_*' )
vars = pytplot.tplot_names()
```

Load Arase satellite data

In [1…

```
from ergpyspedas.erg import pwe_hfa, pwe_ofa, pwe_efd, mgf, 
pwe_hfa( trange=['2017-04-05 00:00:00', '2017-04-06 00:00:00
pwe_ofa( trange=['2017-04-05 00:00:00', '2017-04-06 00:00:00
pwe_efd( trange=['2017-04-05 00:00:00', '2017-04-06 00:00:00
mgf( trange=['2017-04-05 00:00:00', '2017-04-06 00:00:00'] )
xep( trange=['2017-04-05 00:00:00', '2017-04-06 00:00:00'], 
hep( trange=['2017-04-05 00:00:00', '2017-04-06 00:00:00'], 
mepe( trange=['2017-04-05 00:00:00', '2017-04-06 00:00:00'],
lepe( trange=['2017-04-05 00:00:00', '2017-04-06 00:00:00'],
mepi_nml( trange=['2017-04-05 00:00:00', '2017-04-06 00:00:0
lepi( trange=['2017-04-05 00:00:00', '2017-04-06 00:00:00'],
```

```
10-Mar-22 16:13:47: Downloading remote index: https://ergsc.i
see.nagoya-u.ac.jp/data/ergsc/satellite/erg/pwe/hfa/l2/spec/l
ow/2017/04/
10-Mar-22 16:13:47: File is current: /Users/horit/mnt/drobo20
20/work/data//ergsc/satellite/erg/pwe/hfa/l2/spec/low/2017/04
/erg_pwe_hfa_l2_spec_low_20170405_v01_02.cdf
```

```
Conflicting size for at least one dimension
Could not create coordinate v1_dim for variable erg_pwe_hfa_l
2_low_spectra_eu_ev
Could not create coordinate v2_dim for variable erg_pwe_hfa_l
2_low_spectra_eu_ev
Conflicting size for at least one dimension
Could not create coordinate v1_dim for variable erg_pwe_hfa_l
2_low_spectra_eu_bg
Could not create coordinate v2_dim for variable erg_pwe_hfa_l
2_low_spectra_eu_bg
Conflicting size for at least one dimension
Could not create coordinate v1_dim for variable erg_pwe_hfa_l
2_low_spectra_ev_bg
Could not create coordinate v2_dim for variable erg_pwe_hfa_l
2_low_spectra_ev_bg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Exploration of Energization and Radiation in Geospace (ERG) P
lasma Wave Experiment (PWE) Electric Field Data (HFA) Level 2
spectrum data

Information about ERG PWE HFA

PI:  Yoshiya Kasahara
Affiliation: Kanazawa University

RoR of ERG project common: https://ergsc.isee.nagoya-u.ac.jp/
data_info/rules_of_the_road.shtml.en
RoR of PWE/HFA: https://ergsc.isee.nagoya-u.ac.jp/mw/index.ph
p/ErgSat/Pwe/Hfa

Contact: erg_pwe_info at isee.nagoya-u.ac.jp
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*************
```

```
10-Mar-22 16:13:50: Downloading remote index: https://ergsc.isee.nagoya-u.ac.jp/data/ergsc/satellite/erg/pwe/ofa/l2/spec/2017/04/
10-Mar-22 16:13:50: File is current: /Users/horit/mnt/drobo2020/work/data//ergsc/satellite/erg/pwe/ofa/l2/spec/2017/04/erg_pwe_ofa_l2_spec_20170405_v02_01.cdf
10-Mar-22 16:13:52: Downloading remote index: https://ergsc.isee.nagoya-u.ac.jp/data/ergsc/satellite/erg/pwe/efd/l2/spec/2017/04/
10-Mar-22 16:13:52: File is current: /Users/horit/mnt/drobo2020/work/data//ergsc/satellite/erg/pwe/efd/l2/spec/2017/04/erg_pwe_efd_l2_spec_20170405_v02_02.cdf


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Exploration of Energization and Radiation in Geospace (ERG) Plasma Wave Experiment (PWE) Onboard Frequency Analyzer (OFA) Level 2 spectrum data

Information about ERG PWE OFA

PI:  Yoshiya Kasahara
Affiliation: Kanazawa University

RoR of ERG project common: https://ergsc.isee.nagoya-u.ac.jp/data_info/rules_of_the_road.shtml.en
RoR of PWE/OFA: https://ergsc.isee.nagoya-u.ac.jp/mw/index.php/ErgSat/Pwe/Ofa

Contact: erg_pwe_info at isee.nagoya-u.ac.jp
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10-Mar-22 16:13:53: Downloading remote index: https://ergsc.isee.nagoya-u.ac.jp/data/ergsc/satellite/erg/mgf/l2/8sec/2017/04/
10-Mar-22 16:13:53: File is current: /Users/horit/mnt/drobo2020/work/data//ergsc/satellite/erg/mgf/l2/8sec/2017/04/erg_mgf_l2_8sec_20170405_v03.04.cdf
```

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Exploration of Energization and Radiation in Geospace (ERG) P
lasma Wave Experiment (PWE) Electric Field Data (EFD) Level 2
spectrum data

Information about ERG PWE EFD

PI:  Yoshiya Kasahara
Affiliation: Kanazawa University

RoR of ERG project common: https://ergsc.isee.nagoya-u.ac.jp/
data_info/rules_of_the_road.shtml.en
RoR of PWE/EFD: https://ergsc.isee.nagoya-u.ac.jp/mw/index.ph
p/ErgSat/Pwe/Efd

Contact: erg_pwe_info at isee.nagoya-u.ac.jp
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10-Mar-22 16:13:55: Downloading remote index: https://ergsc.i
see.nagoya-u.ac.jp/data/ergsc/satellite/erg/xep/l2/omniflux/2
017/04/
10-Mar-22 16:13:55: File is current: /Users/horit/mnt/drobo20
20/work/data//ergsc/satellite/erg/xep/l2/omniflux/2017/04/erg
_xep_l2_omniflux_20170405_v01_00.cdf
```

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Exploration of Energization and Radiation in Geospace (ERG) M
agnetic Field Experiment (MGF) Level 2 spin-averaged magnetic
field data

Information about ERG MGF

PI:  Ayako Matsuoka
Affiliation: Data Analysis Center for Geomagnetism and Space
Magnetism, Graduate School of Science, Kyoto University, Kita
shirakawa-Oiwake Cho, Sakyo-ku Kyoto 606-8502, Japan

RoR of ERG project common: https://ergsc.isee.nagoya-u.ac.jp/
data_info/rules_of_the_road.shtml.en
RoR of MGF L2: https://ergsc.isee.nagoya-u.ac.jp/mw/index.php
/ErgSat/Mgf
Contact: erg_mgf_info at isee.nagoya-u.ac.jp
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10-Mar-22 16:13:55: /Users/horit/.pyenv/versions/3.9.6/envs/3
9_pydarn_pyspedas/lib/python3.9/site-packages/pytplot/importe
rs/cdf_to_tplot.py:250: FutureWarning: elementwise comparison
failed; returning scalar instead, but in the future will perf
orm elementwise comparison
  if ydata[ydata == var_atts["FILLVAL"]].size != 0:

10-Mar-22 16:13:55: Downloading remote index: https://ergsc.i
see.nagoya-u.ac.jp/data/ergsc/satellite/erg/hep/l2/omniflux/2
017/04/
10-Mar-22 16:13:55: Downloading https://ergsc.isee.nagoya-u.a
c.jp/data/ergsc/satellite/erg/hep/l2/omniflux/2017/04/erg_hep
_l2_omniflux_20170405_v03_01.cdf to /Users/horit/mnt/drobo202
0/work/data//ergsc/satellite/erg/hep/l2/omniflux/2017/04/erg_
hep_l2_omniflux_20170405_v03_01.cdf
10-Mar-22 16:13:55: Download complete: /Users/horit/mnt/drobo
2020/work/data//ergsc/satellite/erg/hep/l2/omniflux/2017/04/e
rg_hep_l2_omniflux_20170405_v03_01.cdf
```

```
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Exploration of Energization and Radiation in Geospace (ERG) E
xtremely High-Energy Electron Experiment (XEP) Level 2 extrem
ely high energy electron data

Information about ERG XEP

PI:  Nana Higashio
Affiliation: Space Environment Group, Aerospace Research and
Development Directorate, Tsukuba Space Center, Japan Aerospac
e Exploration Agency, 2-1-1 Sengen, Tsukuba, Ibaraki 305-8505
, Japan

RoR of ERG project common: https://ergsc.isee.nagoya-u.ac.jp/
data_info/rules_of_the_road.shtml.en
RoR of XEP: https://ergsc.isee.nagoya-u.ac.jp/mw/index.php/Er
gSat/Xep

Contact: erg_xep_info at isee.nagoya-u.ac.jp
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10-Mar-22 16:13:56: Downloading remote index: https://ergsc.i
see.nagoya-u.ac.jp/data/ergsc/satellite/erg/mepe/l2/omniflux/
2017/04/
10-Mar-22 16:13:56: File is current: /Users/horit/mnt/drobo20
20/work/data//ergsc/satellite/erg/mepe/l2/omniflux/2017/04/er
g_mepe_l2_omniflux_20170405_v01_02.cdf
```

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Exploration of Energization and Radiation in Geospace (ERG) H
igh-energy electron experiments (HEP) Level-2 omni flux data

PI:  Takefumi Mitani
Affiliation: ISAS, JAXA

- The rules of the road (RoR) common to the ERG project:
       https://ergsc.isee.nagoya-u.ac.jp/data_info/rules_of_t
he_road.shtml.en
- RoR for HEP data: https://ergsc.isee.nagoya-u.ac.jp/mw/inde
x.php/ErgSat/Hep

Contact: erg_hep_info at isee.nagoya-u.ac.jp
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*************
10-Mar-22 16:13:56: Downloading remote index: https://ergsc.i
see.nagoya-u.ac.jp/data/ergsc/satellite/erg/lepe/l2/omniflux/
2017/04/
10-Mar-22 16:13:56: File is current: /Users/horit/mnt/drobo20
20/work/data//ergsc/satellite/erg/lepe/l2/omniflux/2017/04/er
g_lepe_l2_omniflux_20170405_v03_01.cdf

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*************
Exploration of Energization and Radiation in Geospace (ERG) M
edium Energy Particle experiments - electron analyzer (MEP-e)
electron omni flux data

PI:  Satoshi Kasahara
Affiliation: The University of Tokyo

- The rules of the road (RoR) common to the ERG project:
      https://ergsc.isee.nagoya-u.ac.jp/data_info/rules_of_th
e_road.shtml.en
- RoR for MEP-e data:  https://ergsc.isee.nagoya-u.ac.jp/mw/i
ndex.php/ErgSat/Mepe

Contact: erg_mep_info at isee.nagoya-u.ac.jp
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```

```
10-Mar-22 16:13:56: Downloading remote index: https://ergsc.isee.nagoya-u.ac.jp/data/ergsc/satellite/erg/mepi/l2/omniflux/2017/04/
10-Mar-22 16:13:56: File is current: /Users/horit/mnt/drobo2020/work/data//ergsc/satellite/erg/mepi/l2/omniflux/2017/04/erg_mepi_l2_omniflux_20170405_v02_01.cdf

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Exploration of Energization and Radiation in Geospace (ERG) Low-Energy Particle experiments - electron analyzer (LEP-e) Level 2 omni electron flux data

Information about ERG LEPe

PI:  Shiang-Yu Wang
Affiliation: Academia Sinica, Taiwan

RoR of ERG project common: https://ergsc.isee.nagoya-u.ac.jp/data_info/rules_of_the_road.shtml.en
RoR of LEPe L2: https://ergsc.isee.nagoya-u.ac.jp/mw/index.php/ErgSat/Lepe

Contact: erg_lepe_info at isee.nagoya-u.ac.jp
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*************
10-Mar-22 16:13:58: Downloading remote index: https://ergsc.isee.nagoya-u.ac.jp/data/ergsc/satellite/erg/lepi/l2/omniflux/2017/04/
10-Mar-22 16:13:58: File is current: /Users/horit/mnt/drobo2020/work/data//ergsc/satellite/erg/lepi/l2/omniflux/2017/04/erg_lepi_l2_omniflux_20170405_v03_00.cdf
```

```
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*************
Exploration of Energization and Radiation in Geospace (ERG) M
edium Energy Particle experiments - ion mass analyzer (MEP-i)
3D ion omni flux data

PI:  Shoichiro Yokota
Affiliation: Osaka University

- The rules of the road (RoR) common to the ERG project:
      https://ergsc.isee.nagoya-u.ac.jp/data_info/rules_of_th
e_road.shtml.en
- RoR for MEP-i data: https://ergsc.isee.nagoya-u.ac.jp/mw/in
dex.php/ErgSat/Mepi

Contact: erg_mep_info at isee.nagoya-u.ac.jp
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Exploration of Energization and Radiation in Geospace (ERG) L
ow Energy Particle Ion (LEPi) Experiment 3D ion flux data

Information about ERG LEPi

PI:  Kazushi Asamura
Affiliation: ISAS, Jaxa

RoR of ERG project common: https://ergsc.isee.nagoya-u.ac.jp/
data_info/rules_of_the_road.shtml.en
RoR of LEPi L2: https://ergsc.isee.nagoya-u.ac.jp/mw/index.ph
p/ErgSat/Lepi
RoR of ERG/LEPi: https://ergsc.isee.nagoya-u.ac.jp/mw/index.p
hp/ErgSat/Lepi#Rules_of_the_Road

Contact: erg_lepi_info at isee.nagoya-u.ac.jp
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```

Out[1…
```
['erg_lepi_l2_omniflux_Epoch',
 'erg_lepi_l2_omniflux_FPDO',
 'erg_lepi_l2_omniflux_FHEDO',
 'erg_lepi_l2_omniflux_FODO',
 'erg_lepi_l2_omniflux_FPDO_raw',
 'erg_lepi_l2_omniflux_FHEDO_raw',
 'erg_lepi_l2_omniflux_FODO_raw']
```

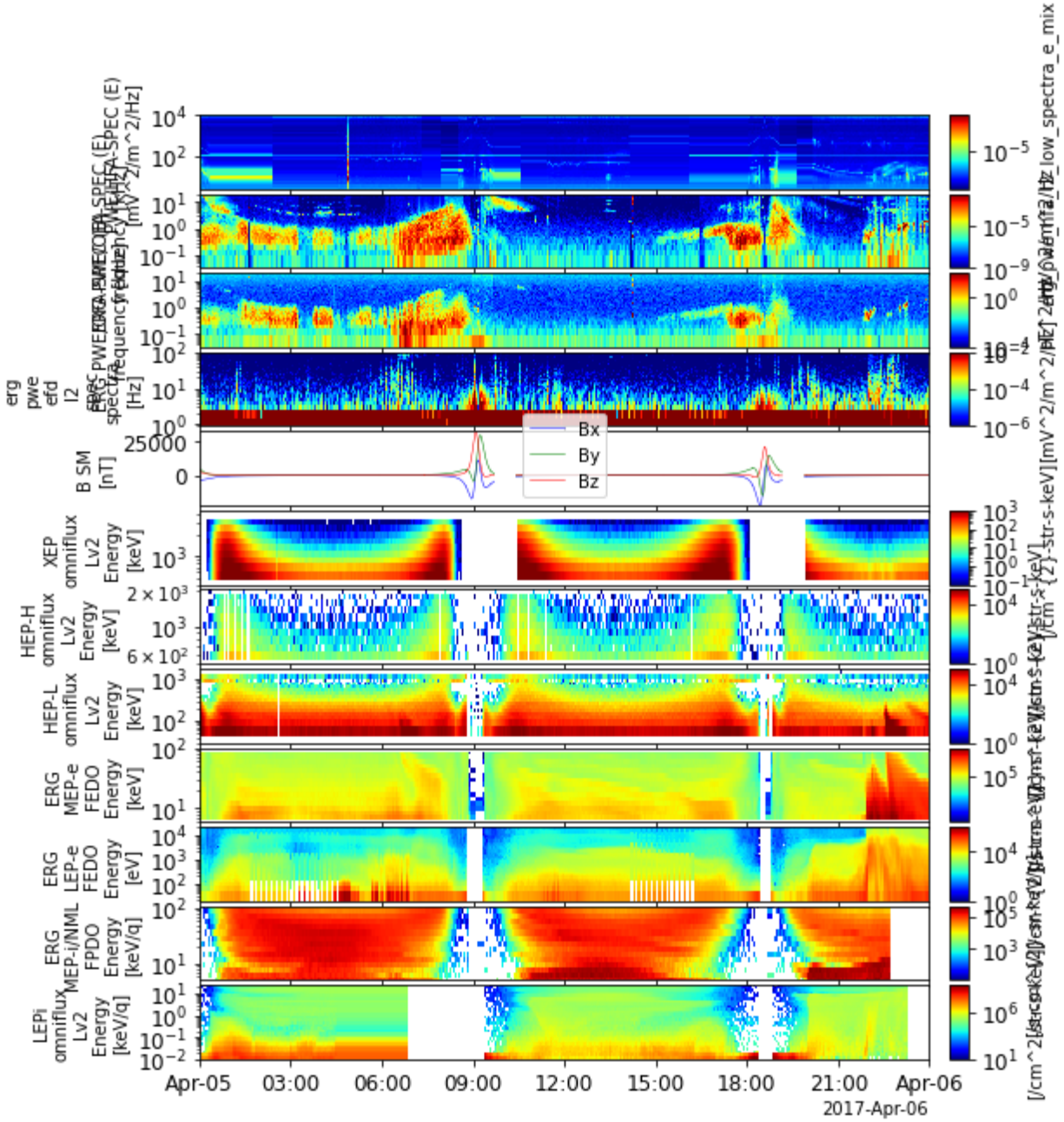
In [2…
```
vars = pytplot.tplot_names()
```

```
0 : erg_pwe_hfa_l2_low_Epoch
1 : erg_pwe_hfa_l2_low_spectra_eu
2 : erg_pwe_hfa_l2_low_spectra_ev
3 : erg_pwe_hfa_l2_low_spectra_bgamma
4 : erg_pwe_hfa_l2_low_spectra_esum
5 : erg_pwe_hfa_l2_low_spectra_er
6 : erg_pwe_hfa_l2_low_spectra_el
7 : erg_pwe_hfa_l2_low_spectra_e_mix
8 : erg_pwe_hfa_l2_low_spectra_e_ar
9 : erg_pwe_hfa_l2_low_spectra_eu_ev
10 : erg_pwe_hfa_l2_low_spectra_eu_bg
11 : erg_pwe_hfa_l2_low_spectra_ev_bg
12 : erg_pwe_hfa_l2_low_quality_flag
13 : erg_pwe_ofa_l2_spec_epoch_e132
14 : erg_pwe_ofa_l2_spec_E_spectra_132
15 : erg_pwe_ofa_l2_spec_quality_flag_e132
16 : erg_pwe_ofa_l2_spec_epoch_b132
17 : erg_pwe_ofa_l2_spec_B_spectra_132
18 : erg_pwe_ofa_l2_spec_quality_flag_b132
19 : erg_pwe_efd_l2_spec_spectra
20 : erg_pwe_efd_l2_spec_quality_flag
21 : erg_mgf_l2_epoch_8sec
22 : erg_mgf_l2_mag_8sec_dsi
23 : erg_mgf_l2_mag_8sec_gse
24 : erg_mgf_l2_mag_8sec_gsm
25 : erg_mgf_l2_mag_8sec_sm
26 : erg_mgf_l2_magt_8sec
27 : erg_mgf_l2_rmsd_8sec_dsi
28 : erg_mgf_l2_rmsd_8sec_gse
29 : erg_mgf_l2_rmsd_8sec_gsm
30 : erg_mgf_l2_rmsd_8sec_sm
31 : erg_mgf_l2_rmsd_8sec
32 : erg_mgf_l2_n_rmsd_8sec
33 : erg_mgf_l2_dyn_rng_8sec
34 : erg_mgf_l2_quality_8sec
```

```
35 : erg_mgf_l2_quality_8sec_gc
36 : erg_mgf_l2_igrf_8sec_dsi
37 : erg_mgf_l2_igrf_8sec_gse
38 : erg_mgf_l2_igrf_8sec_gsm
39 : erg_mgf_l2_igrf_8sec_sm
40 : erg_xep_l2_FEDO_SSD
41 : erg_hep_l2_FEDO_L
42 : erg_hep_l2_FEDO_H
43 : erg_mepe_l2_omniflux_epoch
44 : erg_mepe_l2_omniflux_FEDO
45 : erg_lepe_l2_omniflux_FEDO
46 : erg_mepi_l2_omniflux_epoch
47 : erg_mepi_l2_omniflux_epoch_tof
48 : erg_mepi_l2_omniflux_FIDO_Energy
49 : erg_mepi_l2_omniflux_FPDO
50 : erg_mepi_l2_omniflux_FHE2DO
51 : erg_mepi_l2_omniflux_FHEDO
52 : erg_mepi_l2_omniflux_FOPPDO
53 : erg_mepi_l2_omniflux_FODO
54 : erg_mepi_l2_omniflux_FO2PDO
55 : erg_mepi_l2_omniflux_FPDO_tof
56 : erg_mepi_l2_omniflux_FHE2DO_tof
57 : erg_mepi_l2_omniflux_FHEDO_tof
58 : erg_mepi_l2_omniflux_FOPPDO_tof
59 : erg_mepi_l2_omniflux_FODO_tof
60 : erg_mepi_l2_omniflux_FO2PDO_tof
61 : erg_lepi_l2_omniflux_Epoch
62 : erg_lepi_l2_omniflux_FPDO_raw
63 : erg_lepi_l2_omniflux_FHEDO_raw
64 : erg_lepi_l2_omniflux_FODO_raw
65 : erg_lepi_l2_omniflux_FPDO
66 : erg_lepi_l2_omniflux_FHEDO
67 : erg_lepi_l2_omniflux_FODO
```

In [2…

```
pytplot.timespan( '2017-04-05 00:00:00', 24, keyword='hours'
tplot( [ 'erg_pwe_hfa_l2_low_spectra_e_mix', 'erg_pwe_ofa_l2_
```



Add some extra Xaxes to the bottom of the plot

In [2…

```
orb( trange=['2017-04-05 00:00:00', '2017-04-06 00:00:00'])
labels = pytplot.split_vec( 'erg_orb_l2_pos_rmlatmlt' )
pytplot.options( 'erg_orb_l2_pos_rmlatmlt_x', 'ytitle', 'R [
pytplot.options( 'erg_orb_l2_pos_rmlatmlt_y', 'ytitle', 'MLa
pytplot.options( 'erg_orb_l2_pos_rmlatmlt_z', 'ytitle', 'MLT
tplot( [ 'erg_pwe_hfa_l2_low_spectra_e_mix', 'erg_pwe_ofa_l2_
```

```
10-Mar-22 18:38:47: Downloading remote index: https://ergsc.i
see.nagoya-u.ac.jp/data/ergsc/satellite/erg/orb/def/2017/
10-Mar-22 18:38:47: File is current: /Users/horit/mnt/drobo20
20/work/data//ergsc/satellite/erg/orb/def/2017/erg_orb_l2_201
```

```
70405_v03.cdf
10-Mar-22 18:38:48: /Users/horit/.pyenv/versions/3.9.6/envs/3
9_pydarn_pyspedas/lib/python3.9/site-packages/pytplot/importe
rs/cdf_to_tplot.py:250: FutureWarning: elementwise comparison
failed; returning scalar instead, but in the future will perf
orm elementwise comparison
  if ydata[ydata == var_atts["FILLVAL"]].size != 0:

10-Mar-22 18:38:49: /Users/horit/.pyenv/versions/3.9.6/envs/3
9_pydarn_pyspedas/lib/python3.9/site-packages/pytplot/importe
rs/cdf_to_tplot.py:256: FutureWarning: elementwise comparison
failed; returning scalar instead, but in the future will perf
orm elementwise comparison
  ydata[ydata == var_atts["FILLVAL"]] = 0
```

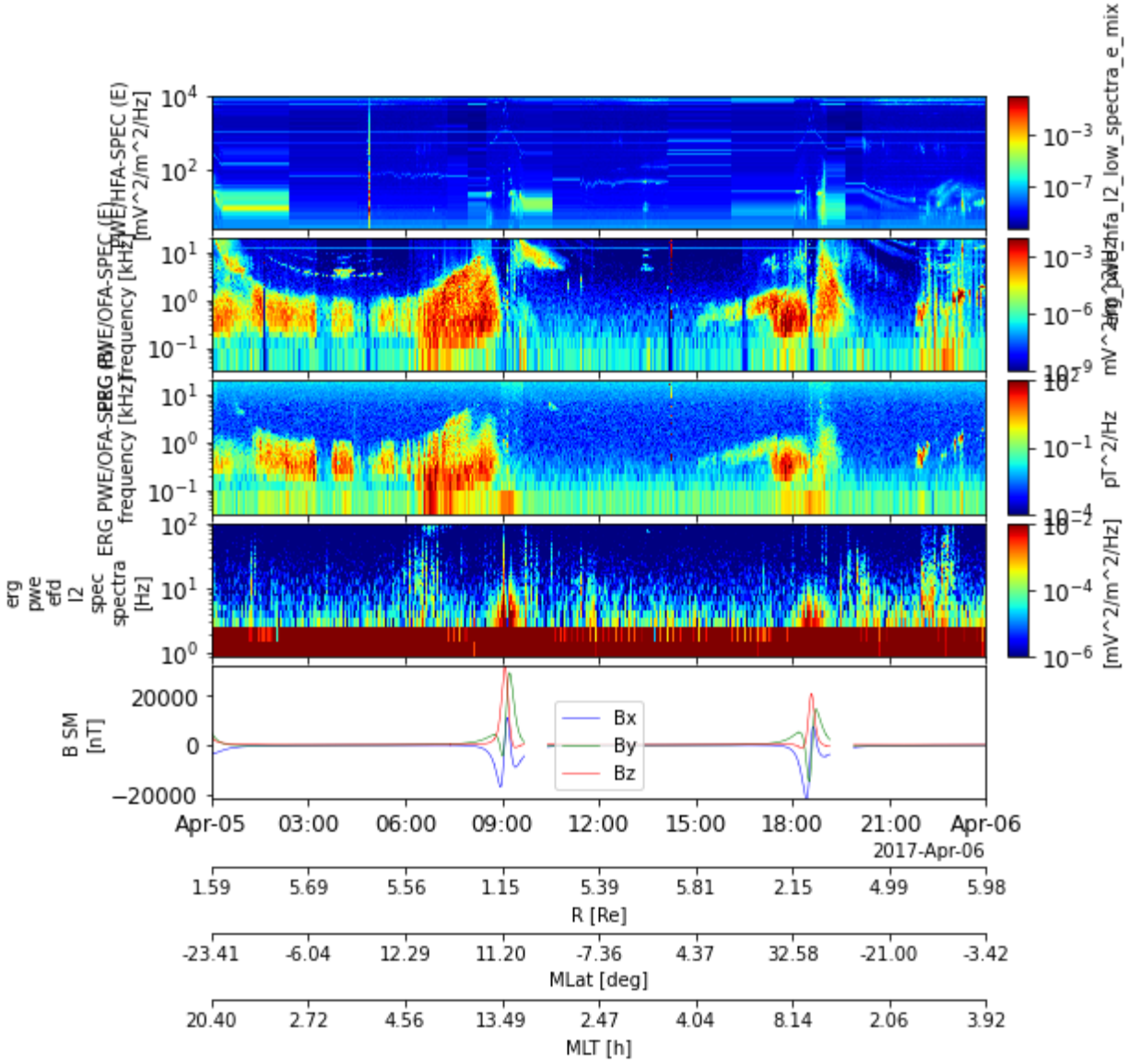
```
**************************************************************
*************
Exploration of Energization and Radiation in Geospace (ERG) L
evel-2 orbit data

Information about ERG orbit


RoR of ERG project common: https://ergsc.isee.nagoya-u.ac.jp/
data_info/rules_of_the_road.shtml.en

Contact: erg-sc-core at isee.nagoya-u.ac.jp
**************************************************************
*************
```

```
10-Mar-22 18:38:53: /Users/horit/.pyenv/versions/3.9.6/envs/3
9_pydarn_pyspedas/lib/python3.9/site-packages/pytplot/MPLPlot
ter/tplot.py:230: UserWarning: Attempted to set non-positive
bottom ylim on a log-scaled axis.
Invalid limit will be ignored.
  this_axis.set_ylim(yrange)
```


erg pwe efd l2 spec spectra [Hz]
ERG PWE/OFA-SPEC (E) frequency [kHz]
PWE/HFA-SPEC (E) [mV^2/m^2/Hz]
B SM [nT]
Bx
By
Bz
Apr-05
03:00
06:00
09:00
12:00
15:00
18:00
21:00
Apr-06
2017-Apr-06
R [Re]
MLat [deg]
MLT [h]
pT^2/Hz
[mV^2/m^2/Hz]

Use the part_products library to obtain particle spectra

An experimental version of the part_products library has just been implemented to the ERG-SC plug-in. So far only the bleeding-edge distribution of the plug-in contains the part_products. In near future, after fully tested, the ERG part_products will be merged to the main distribution of pySPEDAS.

As of Mar., 2022, the following modules are released experimentally:

- `erg_xep_part_products()`
- `erg_hep_part_products()`
- `erg_mep_part_products()` for MEP-e and MEP-i Normal mode data
- `erg_lep_part_products()` for LEP-e and LEP-i Normal mode data

They can be used with common arguments and options, similar to those of the (original) IDL version. Several spectrum plots using part_products are demonstrated below to show how to use the library for Arase's particle data.

Generate a tplot variable containing energy-time spectra

In [3…

```
# Load MEP-e Lv.2 3-D flux data
pytplot.timespan( '2017-04-05 21:45:00', 2.25, keyword='hours
mepe( trange=[ '2017-04-05 21:45:00', '2017-04-05 23:59:59']
```

```
10-Mar-22 19:08:19: Downloading remote index: https://ergsc.isee.nagoya-u.ac.jp/data/ergsc/satellite/erg/mepe/l2/3dflux/2017/04/
10-Mar-22 19:08:19: Downloading https://ergsc.isee.nagoya-u.ac.jp/data/ergsc/satellite/erg/mepe/l2/3dflux/2017/04/erg_mepe_l2_3dflux_20170405_v01_01.cdf to /Users/horit/mnt/drobo2020/work/data//ergsc/satellite/erg/mepe/l2/3dflux/2017/04/erg_mepe_l2_3dflux_20170405_v01_01.cdf
10-Mar-22 19:08:30: Download complete: /Users/horit/mnt/drobo2020/work/data//ergsc/satellite/erg/mepe/l2/3dflux/2017/04/erg_mepe_l2_3dflux_20170405_v01_01.cdf
10-Mar-22 19:08:39: /Users/horit/.pyenv/versions/3.9.6/envs/39_pydarn_pyspedas/lib/python3.9/site-packages/pytplot/importers/cdf_to_tplot.py:250: FutureWarning: elementwise comparison failed; returning scalar instead, but in the future will perform elementwise comparison
  if ydata[ydata == var_atts["FILLVAL"]].size != 0:
```

```
**************************************************************
*************
Exploration of Energization and Radiation in Geospace (ERG) Medium-Energy Particle experiments - electron analyzer (MEP-e) Level 2 3D electron flux data

PI:  Satoshi Kasahara
Affiliation: The University of Tokyo

- The rules of the road (RoR) common to the ERG project:
      https://ergsc.isee.nagoya-u.ac.jp/data_info/rules_of_the_road.shtml.en
- RoR for MEP-e data:  https://ergsc.isee.nagoya-u.ac.jp/mw/index.php/ErgSat/Mepe

Contact: erg_mep_info at isee.nagoya-u.ac.jp
**************************************************************
*************
```

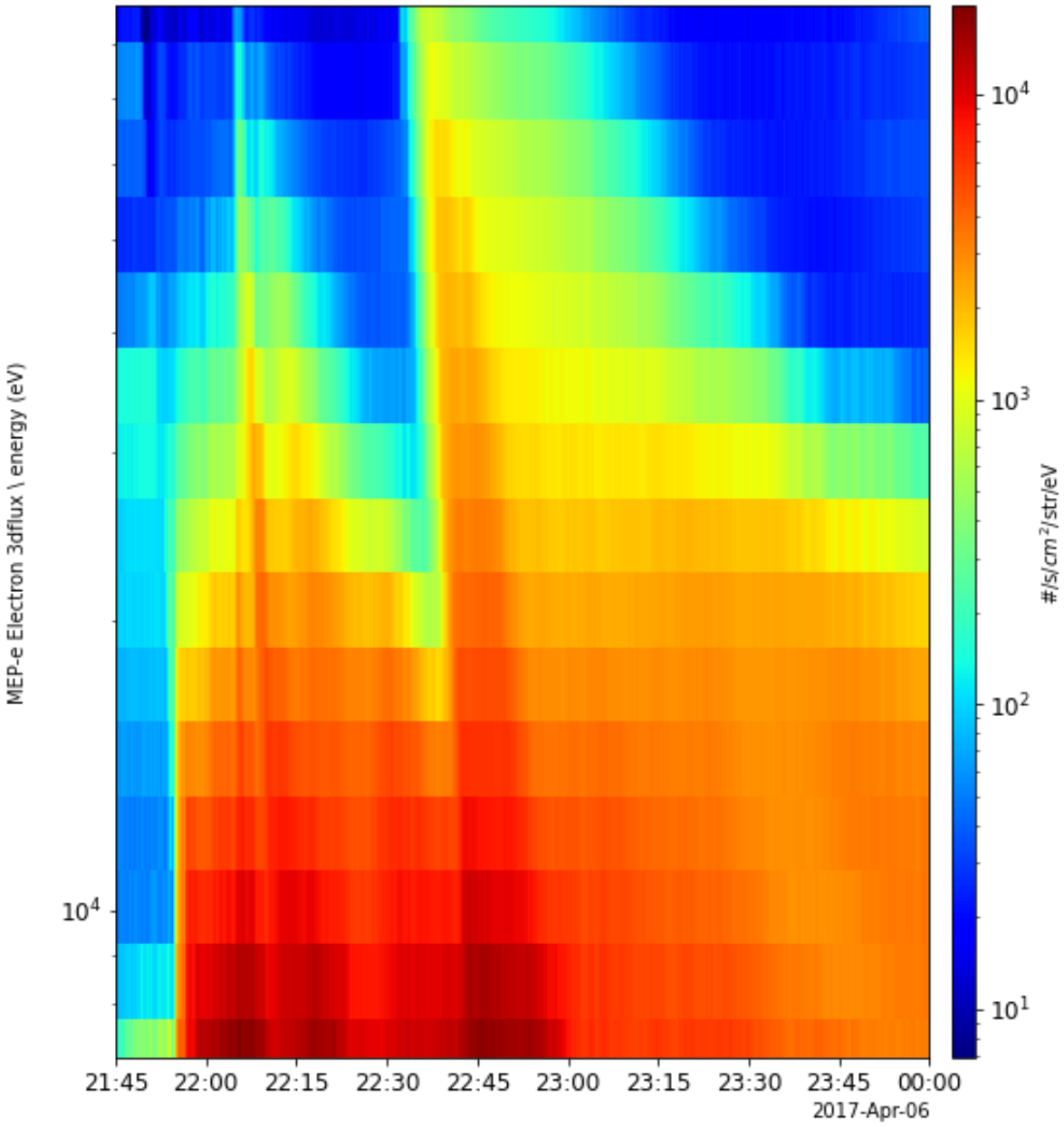
Out[3…

```
['erg_mepe_l2_3dflux_FEDU',
 'erg_mepe_l2_3dflux_FEDU_n',
 'erg_mepe_l2_3dflux_FEEDU',
 'erg_mepe_l2_3dflux_count_raw',
 'erg_mepe_l2_3dflux_spin_phase']
```

In [3…

```
# Calculate energy-time spectra of the omni-dir. electron fl
from ergpyspedas.erg import erg_mep_part_products
vars = erg_mep_part_products( 'erg_mepe_l2_3dflux_FEDU', outp

tplot( 'erg_mepe_l2_3dflux_FEDU_energy' )
```



In [4…

```
# Calculate pitch-angle-time spectra of electron flux based
vars = mgf( trange=[ '2017-04-05 21:45:00', '2017-04-05 23:5
vars = orb( trange=[ '2017-04-05 21:45:00', '2017-04-05 23:5
mag_vn = 'erg_mgf_l2_mag_8sec_dsi'
pos_vn = 'erg_orb_l2_pos_gse'

vars = erg_mep_part_products( 'erg_mepe_l2_3dflux_FEDU', outp

tplot( 'erg_mepe_l2_3dflux_FEDU_pa' )
```

```
10-Mar-22 19:34:42: Downloading remote index: https://ergsc.i
see.nagoya-u.ac.jp/data/ergsc/satellite/erg/mgf/l2/8sec/2017/
04/
10-Mar-22 19:34:42: File is current: /Users/horit/mnt/drobo20
20/work/data//ergsc/satellite/erg/mgf/l2/8sec/2017/04/erg_mgf
_l2_8sec_20170405_v03.04.cdf
10-Mar-22 19:34:44: Downloading remote index: https://ergsc.i
see.nagoya-u.ac.jp/data/ergsc/satellite/erg/orb/def/2017/

**************************************************************
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Exploration of Energization and Radiation in Geospace (ERG) M
agnetic Field Experiment (MGF) Level 2 spin-averaged magnetic
field data

Information about ERG MGF

PI:  Ayako Matsuoka
Affiliation: Data Analysis Center for Geomagnetism and Space
Magnetism, Graduate School of Science, Kyoto University, Kita
shirakawa-Oiwake Cho, Sakyo-ku Kyoto 606-8502, Japan

RoR of ERG project common: https://ergsc.isee.nagoya-u.ac.jp/
data_info/rules_of_the_road.shtml.en
RoR of MGF L2: https://ergsc.isee.nagoya-u.ac.jp/mw/index.php
/ErgSat/Mgf
Contact: erg_mgf_info at isee.nagoya-u.ac.jp
**************************************************************
*************
```

```
10-Mar-22 19:34:44: File is current: /Users/horit/mnt/drobo20
20/work/data//ergsc/satellite/erg/orb/def/2017/erg_orb_l2_201
70405_v03.cdf
10-Mar-22 19:34:44: /Users/horit/.pyenv/versions/3.9.6/envs/3
9_pydarn_pyspedas/lib/python3.9/site-packages/pytplot/importe
rs/cdf_to_tplot.py:250: FutureWarning: elementwise comparison
failed; returning scalar instead, but in the future will perf
orm elementwise comparison
  if ydata[ydata == var_atts["FILLVAL"]].size != 0:

10-Mar-22 19:34:46: /Users/horit/.pyenv/versions/3.9.6/envs/3
9_pydarn_pyspedas/lib/python3.9/site-packages/pytplot/importe
rs/cdf_to_tplot.py:256: FutureWarning: elementwise comparison
failed; returning scalar instead, but in the future will perf
orm elementwise comparison
  ydata[ydata == var_atts["FILLVAL"]] = 0
```

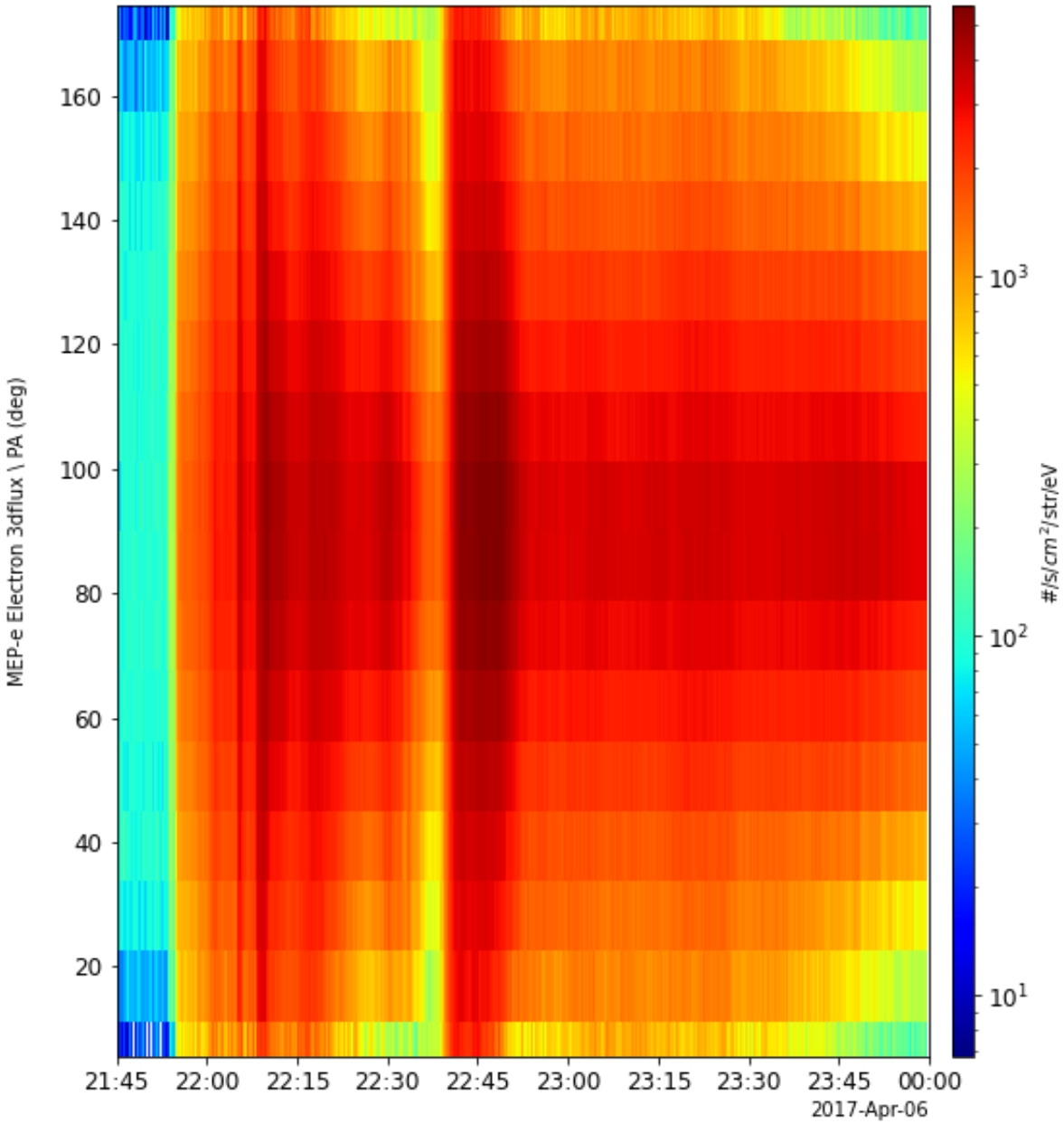
```
**************************************************************
*************
Exploration of Energization and Radiation in Geospace (ERG) L
evel-2 orbit data

Information about ERG orbit


RoR of ERG project common: https://ergsc.isee.nagoya-u.ac.jp/
data_info/rules_of_the_road.shtml.en

Contact: erg-sc-core at isee.nagoya-u.ac.jp
**************************************************************
*************
erg_mgf_l2_mag_8sec_dsi_shifted copied to erg_mgf_l2_mag_8sec
_dsi_shifted_pgs_temp
tinterpol (linear) was applied to: erg_mgf_l2_mag_8sec_dsi_sh
ifted_pgs_temp
erg_orb_l2_pos_gse copied to erg_orb_l2_pos_gse_pgs_temp
tinterpol (linear) was applied to: erg_orb_l2_pos_gse_pgs_tem
p
```

```
10-Mar-22 19:34:51: erg_mepe_l2_3dflux_FEDU is 77% done.
10-Mar-22 19:34:53: /Users/horit/work/python/work/devel/pyspe
das_plugin/ergpyspedas/erg/satellite/erg/particle/erg_pgs_lim
it_range.py:42: RuntimeWarning: invalid value encountered in
fmod
  phi_max = np.fmod(data_in['phi'] + 0., 360.)
```



In [4…

```
# Calculate energy-time spectra of electron flux for limited

## Here we calculate energy-time spectra for PA = 0-10 deg a
vars = erg_mep_part_products( 'erg_mepe_l2_3dflux_FEDU', outp
vars = erg_mep_part_products( 'erg_mepe_l2_3dflux_FEDU', outp

## Decorate the obtained spectrum variables
pytplot.options( 'erg_mepe_l2_3dflux_FEDU_energy_mag_pa80-10(
pytplot.options( 'erg_mepe_l2_3dflux_FEDU_energy_mag_pa0-10'

tplot( ['erg_mepe_l2_3dflux_FEDU_energy_mag_pa80-100', 'erg_m
```

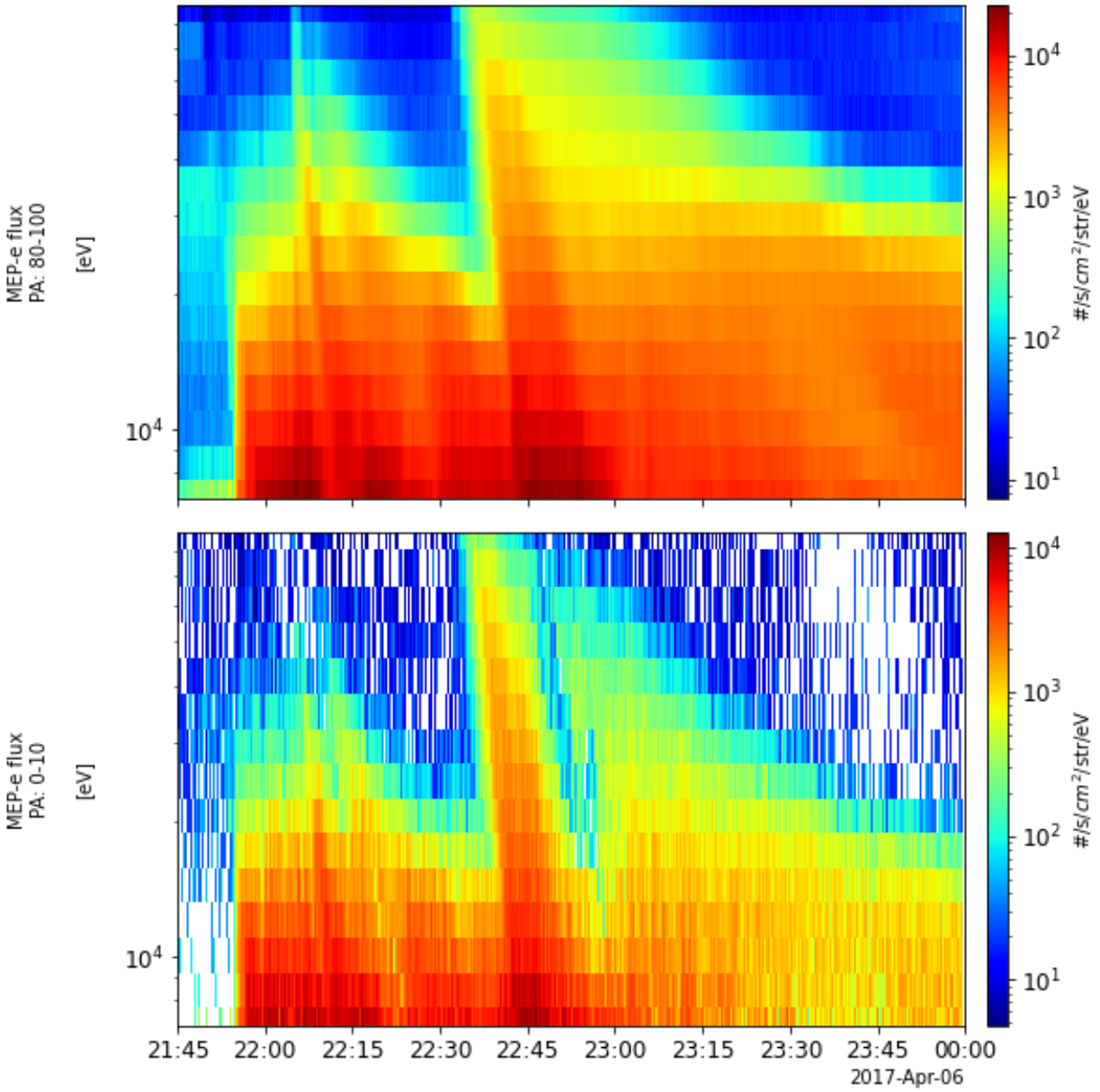
```
10-Mar-22 19:50:07: /Users/horit/work/python/work/devel/pyspe
das_plugin/ergpyspedas/erg/satellite/erg/particle/erg_pgs_mak
e_e_spec.py:30: RuntimeWarning: invalid value encountered in
true_divide
  ave = data_array.sum(axis=1) / data['bins'].sum(axis=1)

erg_mgf_l2_mag_8sec_dsi_shifted copied to erg_mgf_l2_mag_8sec
_dsi_shifted_pgs_temp
tinterpol (linear) was applied to: erg_mgf_l2_mag_8sec_dsi_sh
ifted_pgs_temp
erg_orb_l2_pos_gse copied to erg_orb_l2_pos_gse_pgs_temp
tinterpol (linear) was applied to: erg_orb_l2_pos_gse_pgs_tem
p
10-Mar-22 19:50:12: /Users/horit/work/python/work/devel/pyspe
das_plugin/ergpyspedas/erg/satellite/erg/particle/erg_pgs_lim
it_range.py:42: RuntimeWarning: invalid value encountered in
fmod
  phi_max = np.fmod(data_in['phi'] + 0., 360.)

10-Mar-22 19:50:12: /Users/horit/work/python/work/devel/pyspe
das_plugin/ergpyspedas/erg/satellite/erg/particle/erg_pgs_mak
e_e_spec.py:30: RuntimeWarning: invalid value encountered in
true_divide
  ave = data_array.sum(axis=1) / data['bins'].sum(axis=1)

erg_mgf_l2_mag_8sec_dsi_shifted copied to erg_mgf_l2_mag_8sec
_dsi_shifted_pgs_temp
tinterpol (linear) was applied to: erg_mgf_l2_mag_8sec_dsi_sh
ifted_pgs_temp
erg_orb_l2_pos_gse copied to erg_orb_l2_pos_gse_pgs_temp
tinterpol (linear) was applied to: erg_orb_l2_pos_gse_pgs_tem
p
```

```
10-Mar-22 19:50:17: /Users/horit/work/python/work/devel/pyspedas_plugin/ergpyspedas/erg/satellite/erg/particle/erg_pgs_limit_range.py:42: RuntimeWarning: invalid value encountered in fmod
  phi_max = np.fmod(data_in['phi'] + 0., 360.)
```



In […