2nd Space Weather Workshop
WiSEE 2021, Cleveland

Making VLF data tractable for space weather monitoring

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Space Weather Observations

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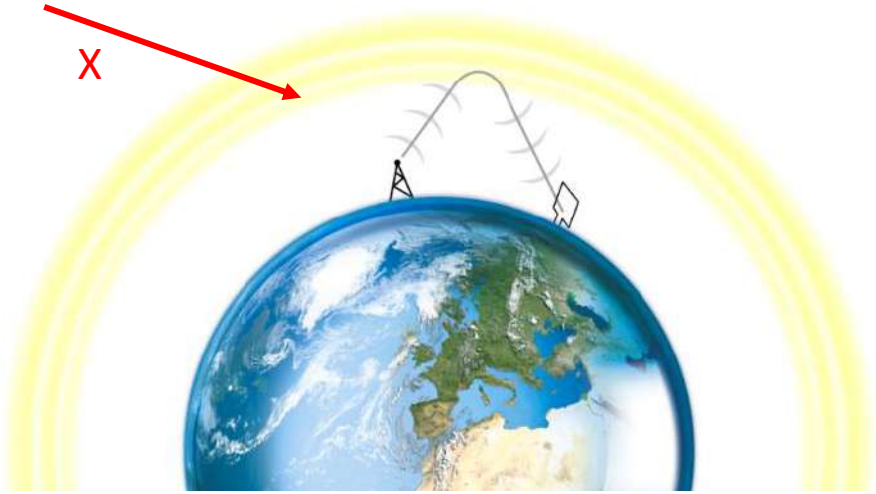
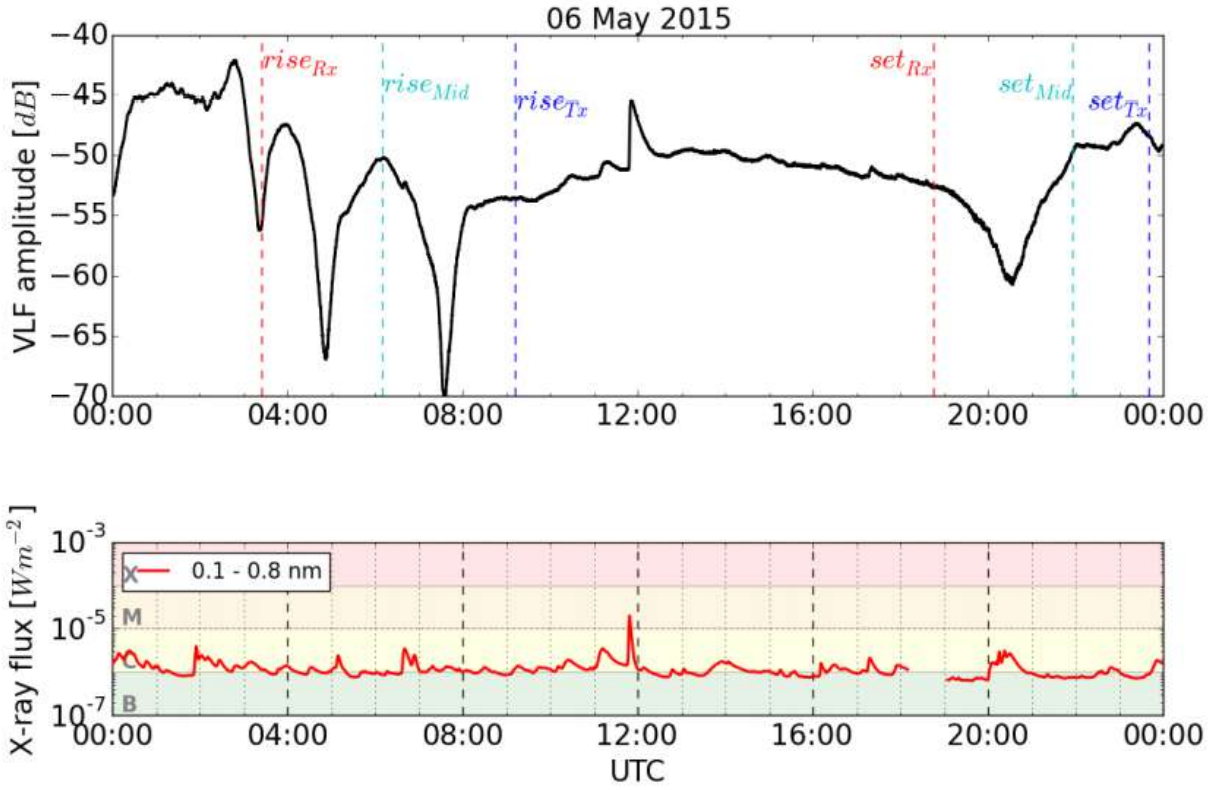
Introduction

- solar radiation alters ionosphere
- disturbances observable in radio signals
- natural variations are a challenge
- ! turn scientific monitoring into technical alerting ?





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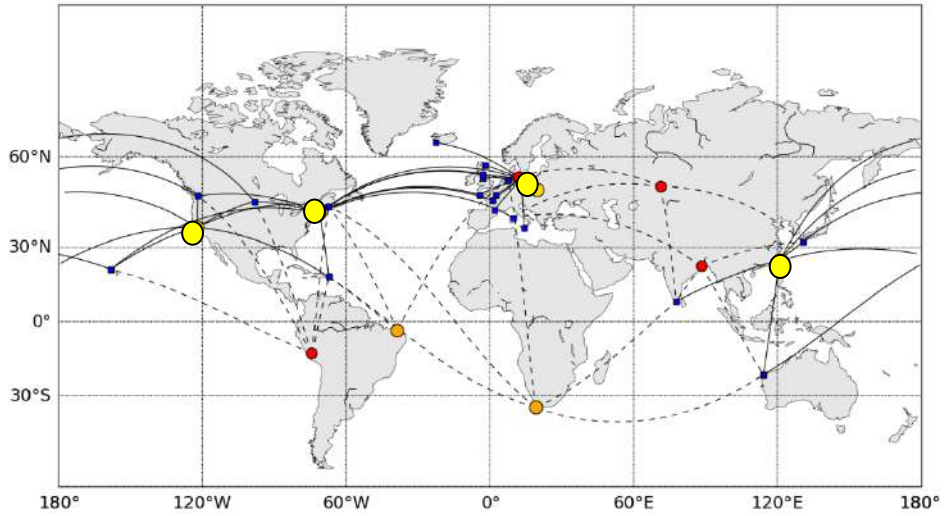
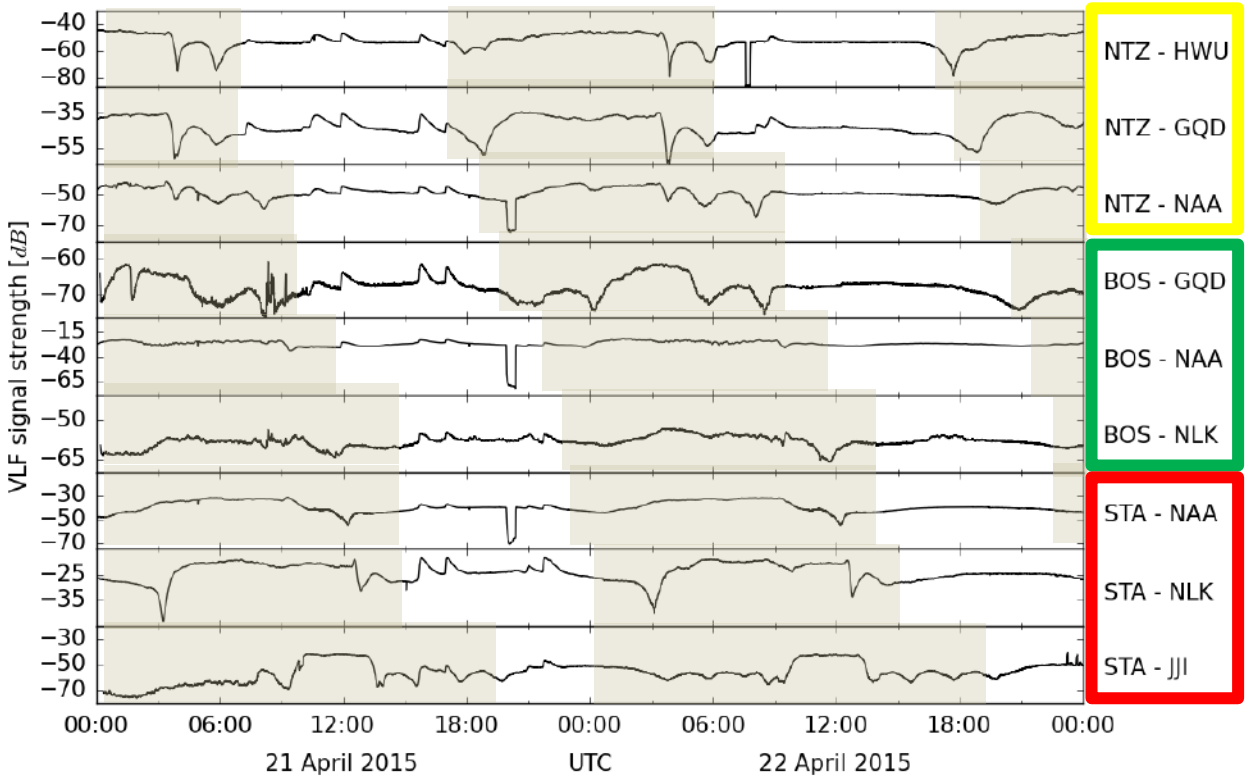
Global Ionospheric Flare Detection System – GIFDS

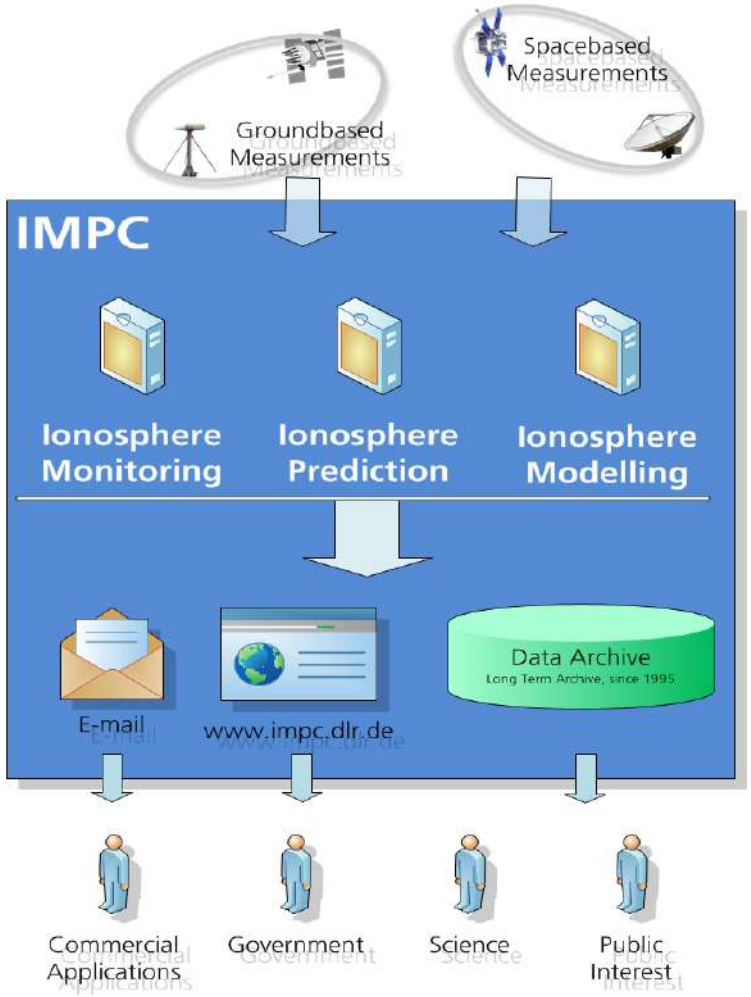
- amplitude and phase measurements of various VLF transmitters
- now cast detection of SIDs caused by solar flares using a ground-based VLF system
- cut, adjust, and combine information, but how?





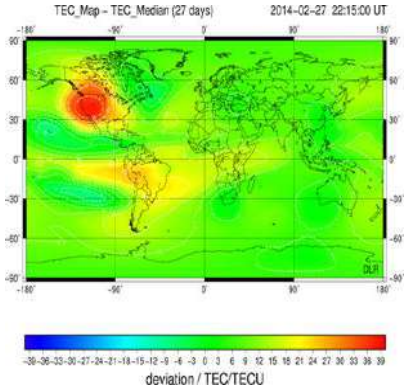
→ D. Banyś

Ionosphere Monitoring and Prediction Center – IMPC

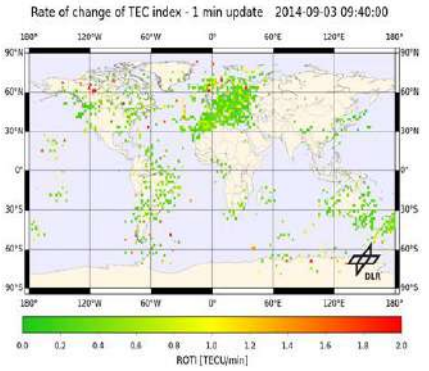


- near real-time information and data service on the current state of the ionosphere, related forecasts and warnings

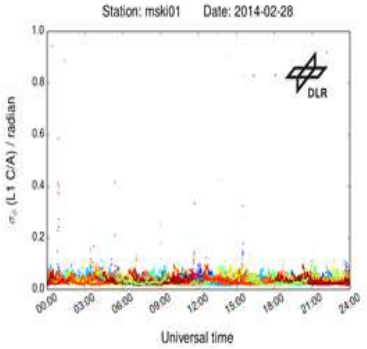
TEC deviation



ROTI



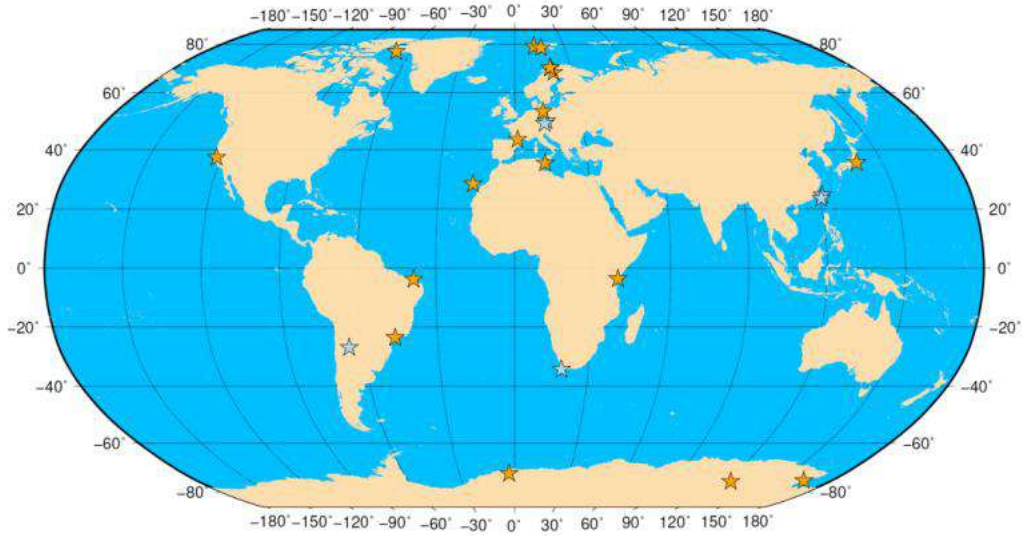
Scintillations

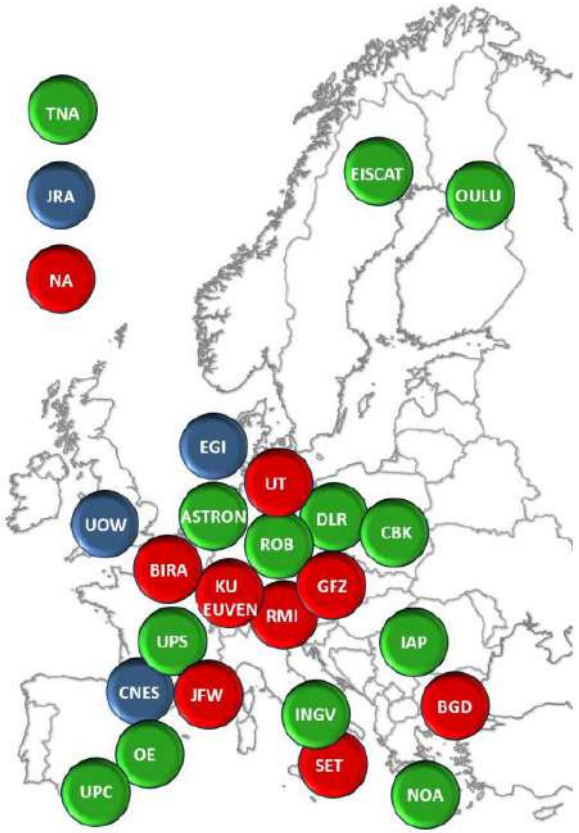


→ M. Kriegel

Plasmasphere Ionosphere Thermosphere Integrated Research Environment and Access services: a Network of Research Facilities

- combining different data (e.g. GNSS and VLF) for access and modelling





→ J. Berdermann

International Space Weather Camp

- almost three weeks for students from 3 countries hosted by

Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

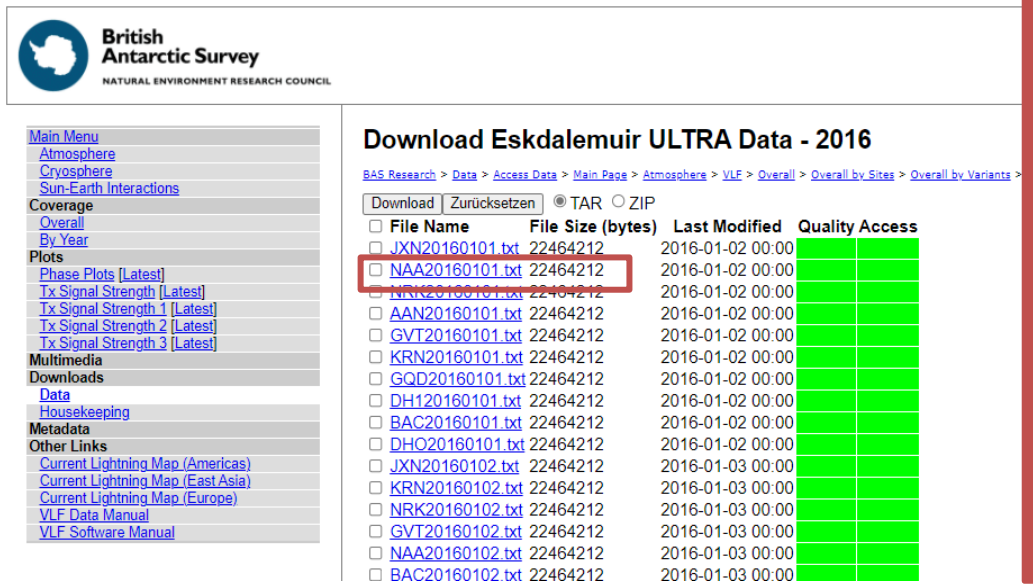
sansa SOUTH AFRICAN NATIONAL SPACE AGENCY

How to turn measurements into an analytical model – at the example of VLF data

→ M. Hansen

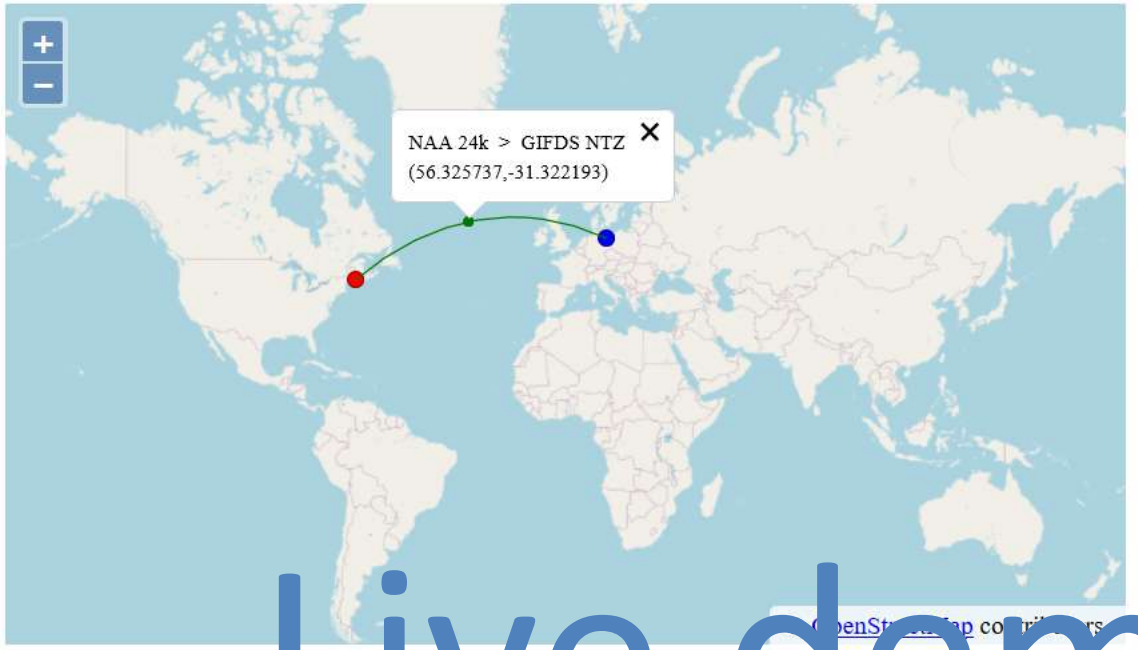
Project tasks:

- Get/plot the data!
- …




```
% UltraMSK: version 1.0 beta 14
% Site: Eskdalemuir
% Date: 2016-01-01
% Frequency: 24000.000000 Hz
% Baud Rate: 200 Hz
% VLF Channel: 3
% PPS Channel: 4
% Jack Server: default
% Output Format: Polar
% End
00000.000  -59.76 -113.14
00000.100  -59.85 -112.81
00000.200  -59.99 -110.87
00000.300  -60.04 -113.06
00000.400  -59.94 -113.03
00000.500  -59.85 -111.36
00000.600  -59.69 -111.68
00000.700  -59.82 -111.98
00000.800  -59.51 -111.99
```

DLR



▸ Map

▸ Daytime

Live demonstration

▸ Receivers

▸ Transmitters

▾ Links

Search

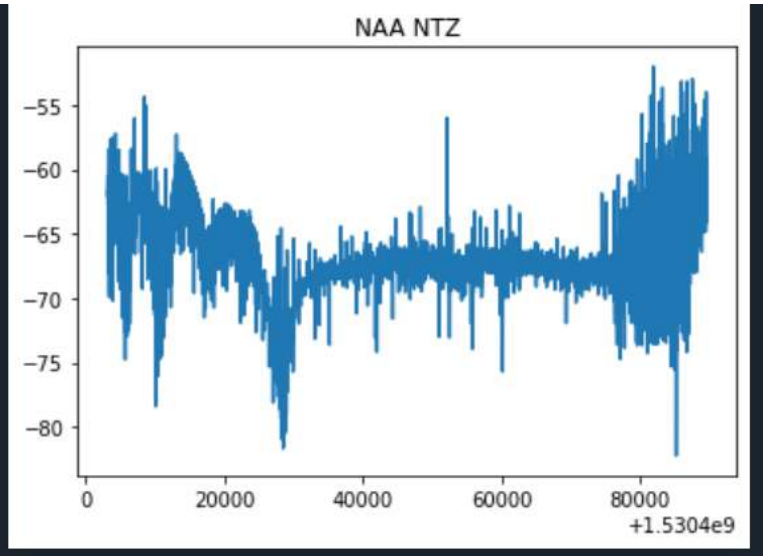
	ends ▸		position ▸		properties ▸			depot ▸	notes	!!!
	Transmitter	Receiver	lat [°]	lon [°]	distance [km]	azimuth [°]	rotation time [s]	label		
☐	NAA	NTZ	56.325737	-31.322193	5625.15	49.64	-19280	1		edit

→ P. David

▸ Series

DLR

```python
import urllib.parse

import pandas
import pyarrow.fs

import matplotlib.pyplot as plt
import datetime
import requests

def loaddb(link,start,end=None):


if __name__ == '__main__':
    ressource = 'http://impc-k8s-testing-worker-04.np.kn.nz.dlr.de:80/gifds/vlf/series/label=
    start = '20180701'
    end = '20180701'

    d, s, l, t, r = loaddb(ressource,start,end)

    plt.pl(d['time'],d['strength'])
    plt.gca().set_title(t['label_str']+' '+r['profile'])

```



Variable explorer Help Files Plots

```
Python 3.8.3 (tags/v3.8.3:6f8c832, May 13 2020, 22:37:02) [MSC v.
1927 64 bit (AMD64)]
Type "copyright", "credits" or "license" for more information.

IPython 7.14.0 -- An enhanced Interactive Python.

Restarting kernel...



In [1]: runfile('C:/Users/wenz_dv/Documents/dox200617/db_plot.py',
wdir='C:/Users/wenz_dv/Documents/dox200617')

In [2]:
```

IPython console History

Live demonstration

Run file

LSP Python: ready Line 94, Col 22 ASCII CRLF RW Mem 39%

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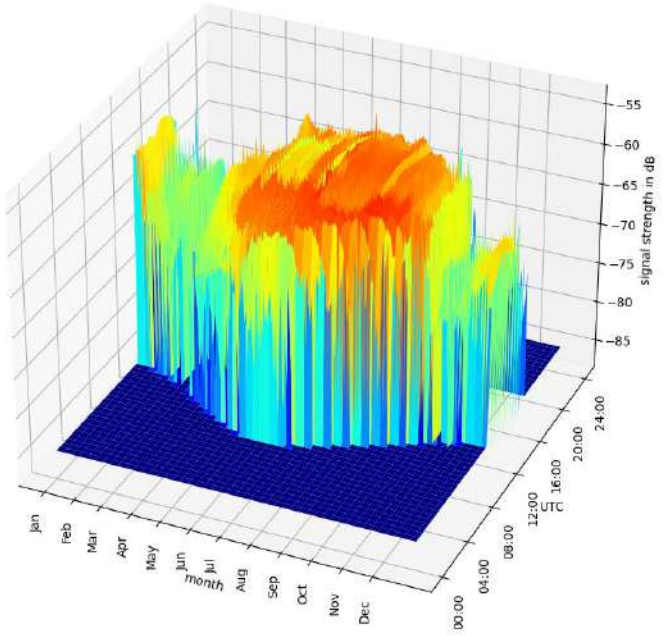
International Space Weather Camp

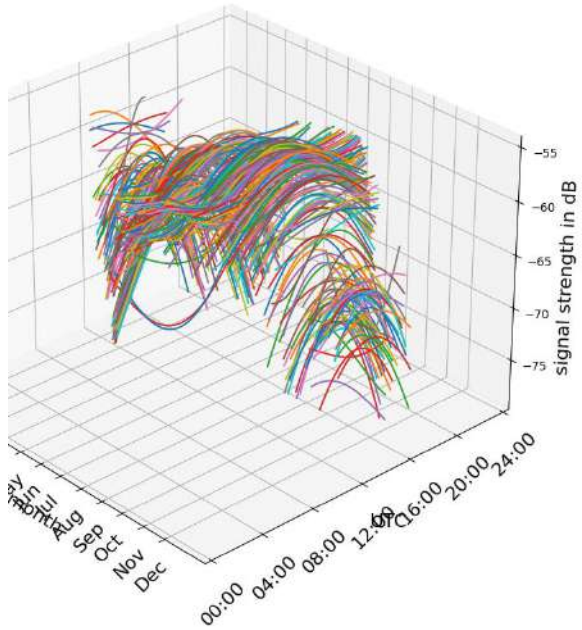
- almost three weeks for students from 3 countries hosted by DLR, UAH, SANSA

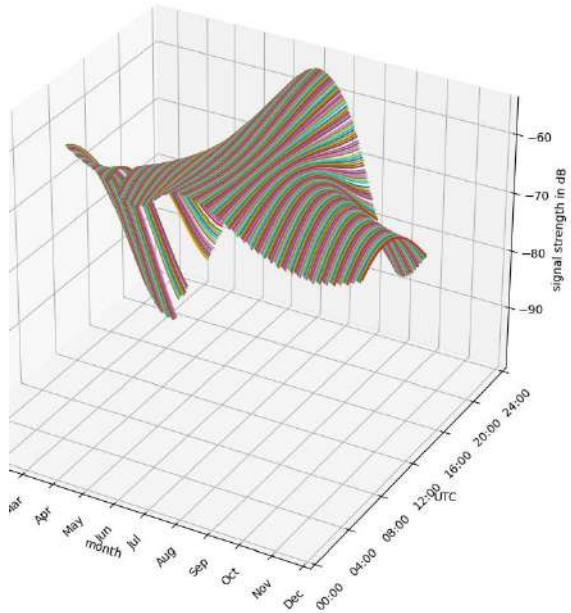
How to turn measurements into an analytical model – at the example of VLF data

→ M. Hansen

Project tasks:
- Get/plot the data!
- Dump the night.
- Fit a(ny) day.
- Match a year.







Thank you!