

# Making VLF data tractable for space weather monitoring

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Space Weather Observations

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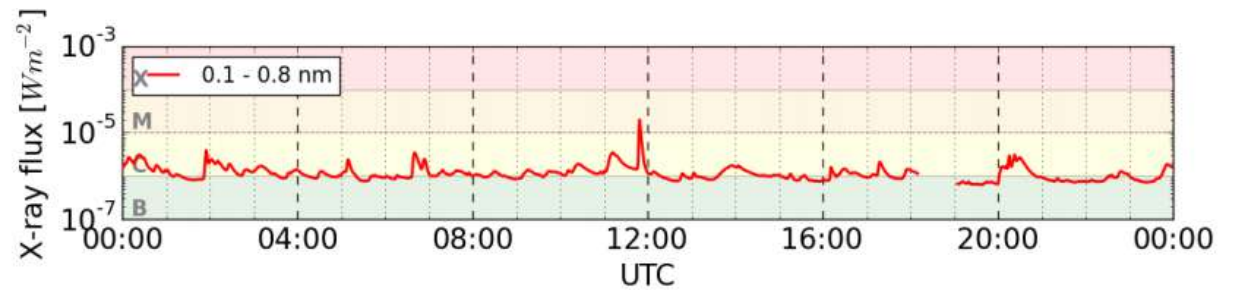
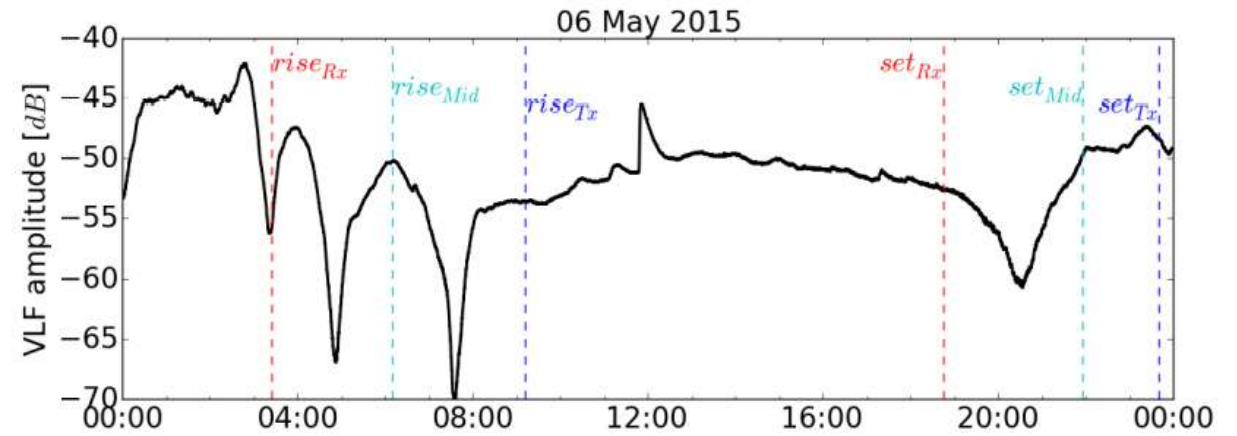
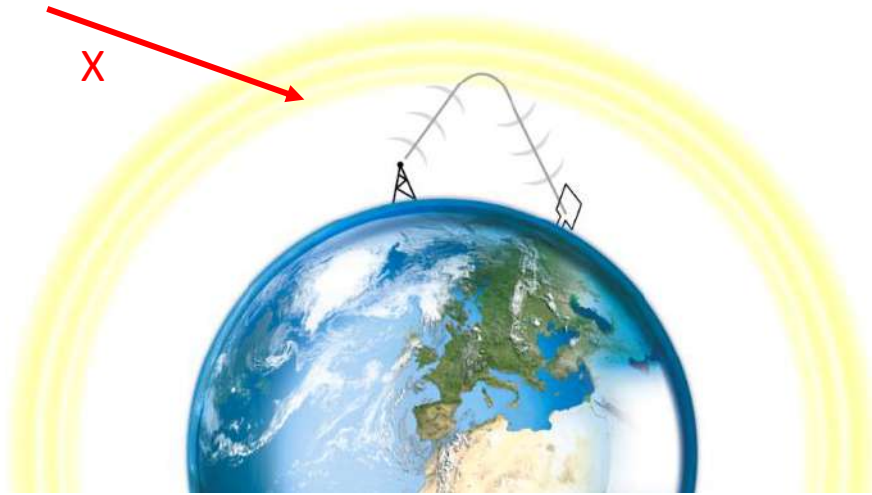


Knowledge for Tomorrow



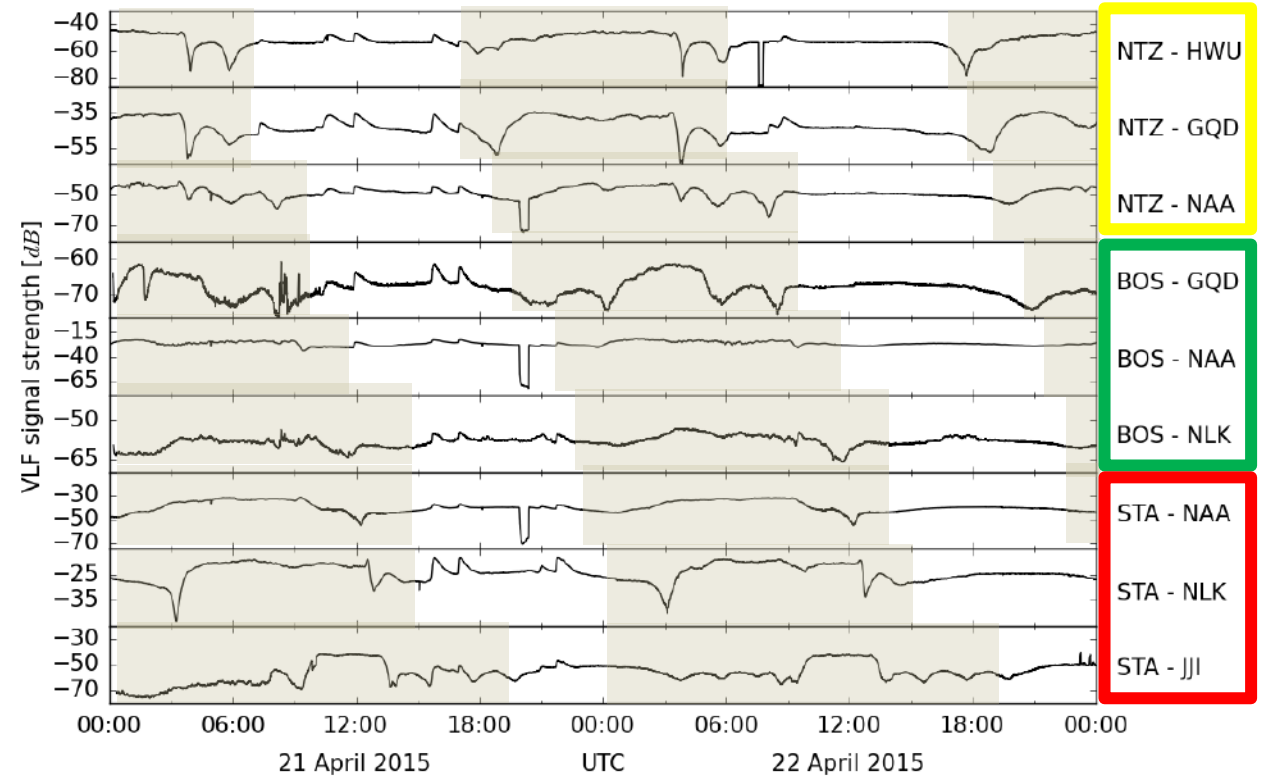
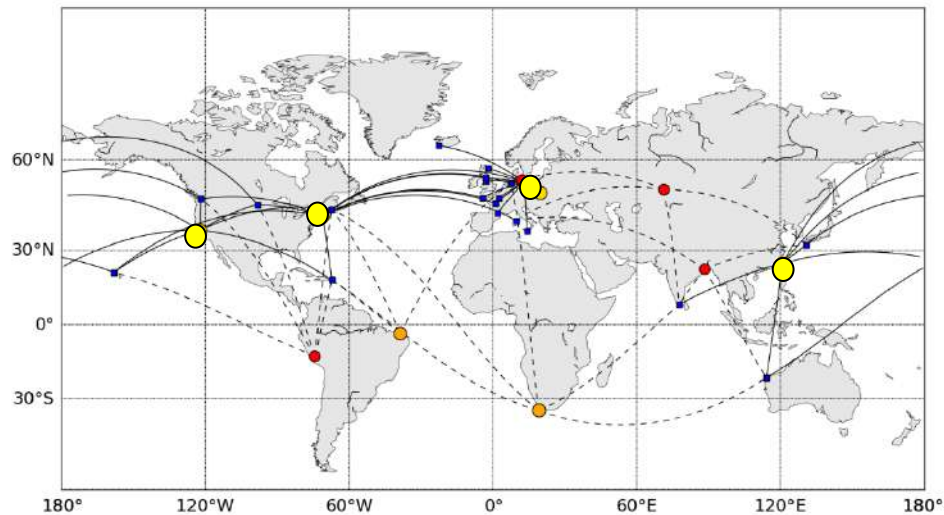
# Introduction

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



# 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?

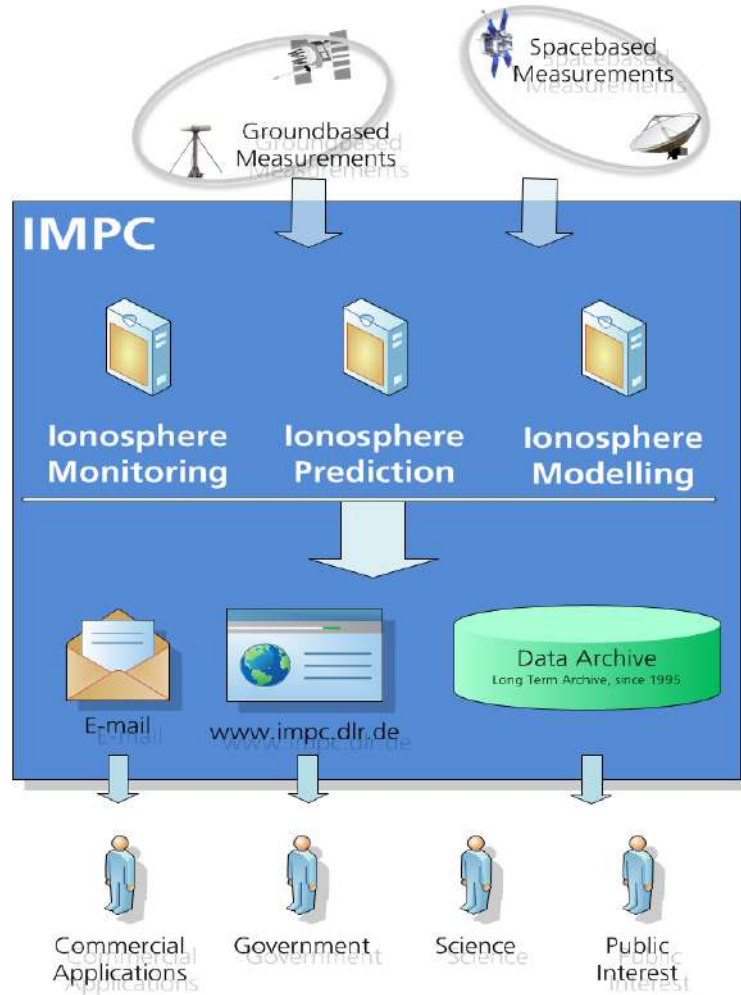


→ D. Banyś



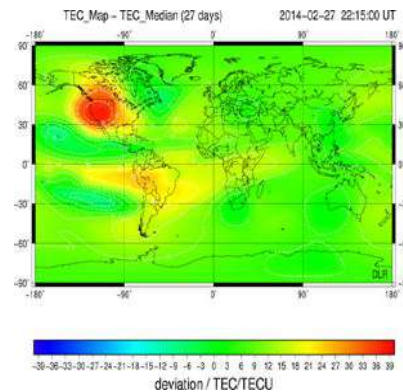


# Ionosphere Monitoring and Prediction Center – IMPC

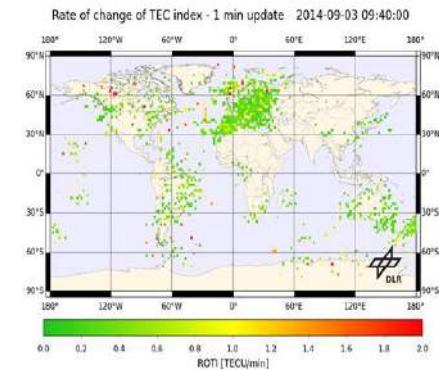


- near real-time information and data service on the current state of the ionosphere, related forecasts and warnings

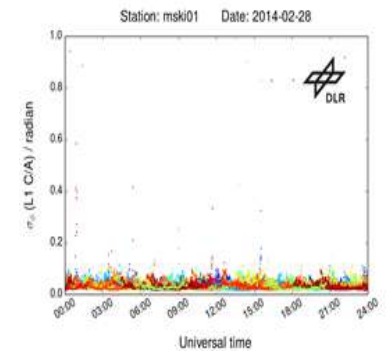
TEC deviation



ROTI



Scintillations



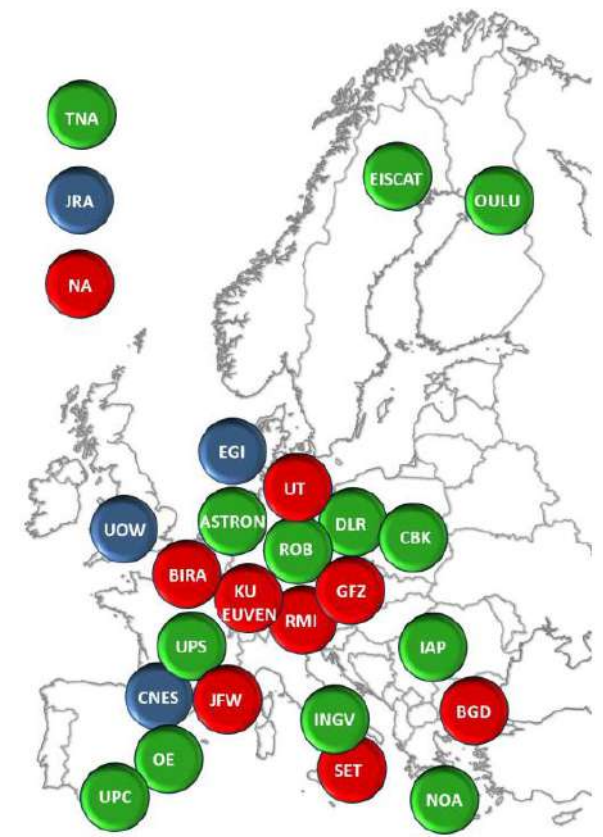
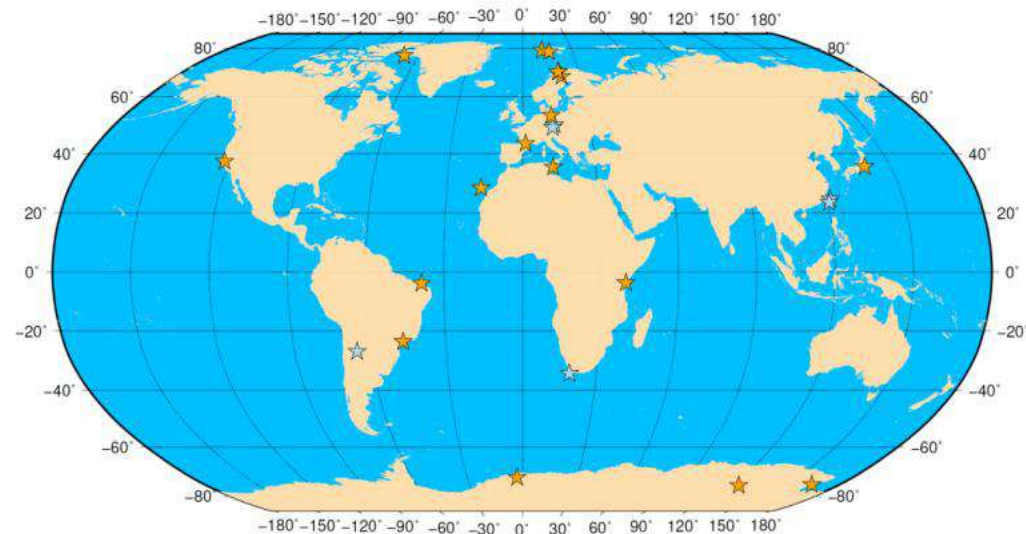
→ M. Kriegel



# PITHIA-NRF

## 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



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

→ M. Hansen

Project tasks:

- Get/plot the data!
- ...

British Antarctic Survey  
NATURAL ENVIRONMENT RESEARCH COUNCIL

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### Download Eskdalemuir ULTRA Data - 2016

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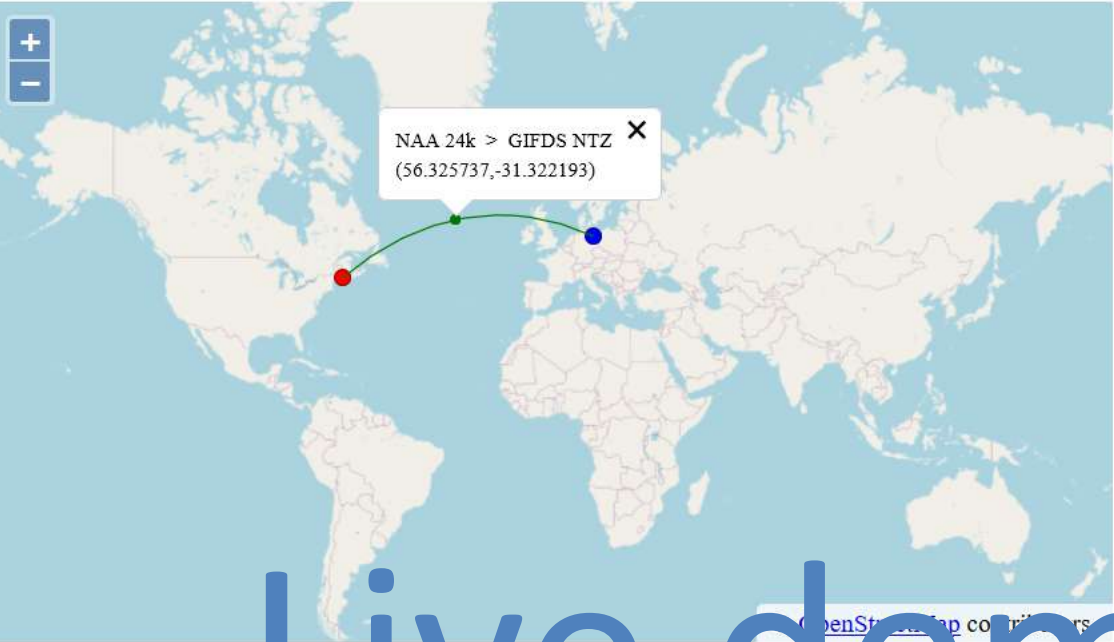
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<input type="checkbox"/> File Name	File Size (bytes)	Last Modified	Quality	Access
<input type="checkbox"/> JXN20160101.txt	22464212	2016-01-02 00:00		
<input checked="" type="checkbox"/> NAA20160101.txt	22464212	2016-01-02 00:00		
<input type="checkbox"/> NRK20160101.txt	22464212	2016-01-02 00:00		
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<input type="checkbox"/> BAC20160102.txt	22464212	2016-01-03 00:00		

```
% 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
```







- ▶ Map
- ▶ Daytime

# Live demonstration

- ▶ Receivers
- ▶ Transmitters

▼ Links

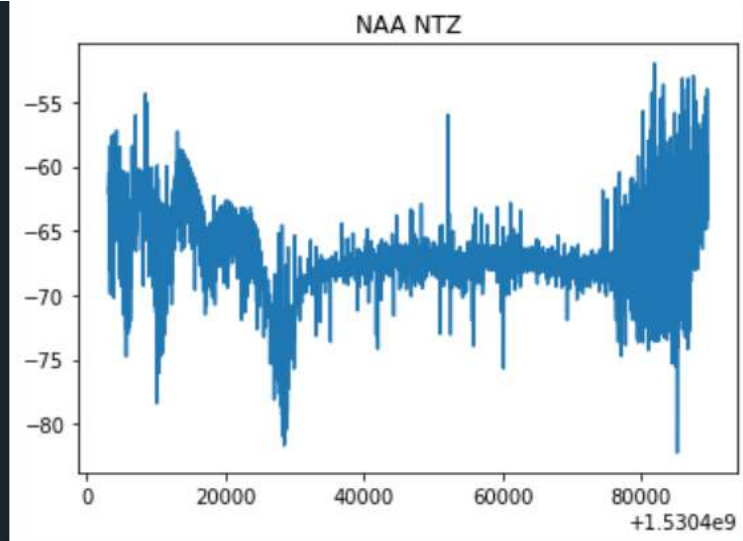
	ends ▶		position ▶		properties ▶			depot ▶	notes	!!!
	Transmitter	Receiver	lat [°]	lon [°]	distance [km]	azimuth [°]	rotation time [s]	label		
<input type="checkbox"/>	<a href="#">NAA</a>	<a href="#">NTZ</a>	56.325737	-31.322193	5625.15	49.64	-19280	1		<a href="#">edit</a>

→ P. David

▶ Series



```
1 import urllib.parse
2
3 import pandas
4 import pyarrow.fs
5
6 import matplotlib.pyplot as plt
7 import datetime
8 import requests
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10 def loaddb(link, start, end=None):
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92 if __name__ == '__main__':
93     ressource = 'http://impc-k8s-testing-worker-04.np.kn.nz.dlr.de:80/gifds/vLf/series/Label='
94     start = '20180701'
95     end = '20180701'
96
97     d, s, l, t, r = loaddb(ressource, start, end)
98
99     plt.plot(d['time'], d['strength'])
100     plt.gca().set_title(t['cal_start'] + ' ' + t['file_name'])
101
```



# Live demonstration

Variable explorer Help Files Plots

Python 3.8.3 (tags/v3.8.3:6f0c83f, May 13 2020, 22:37:02) [MSC v.192, 64 bit (AMD64)]

Type "copyright" or "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





# International Space Weather Camp

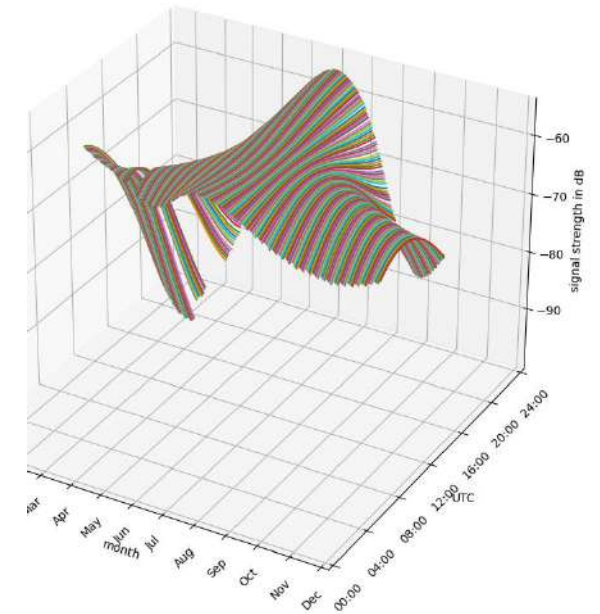
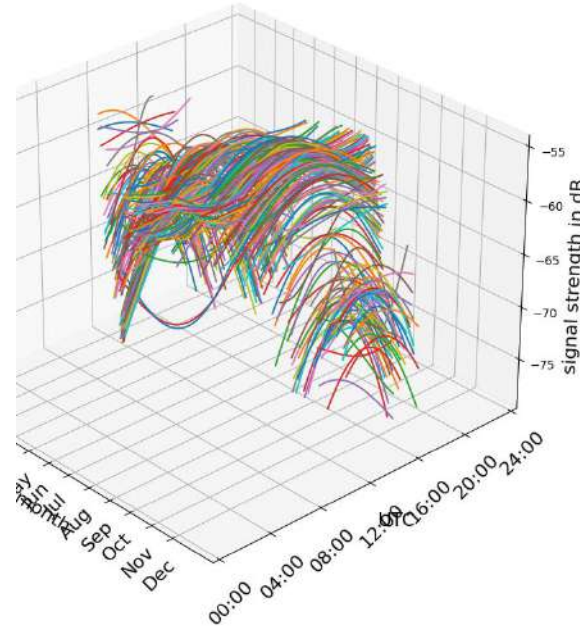
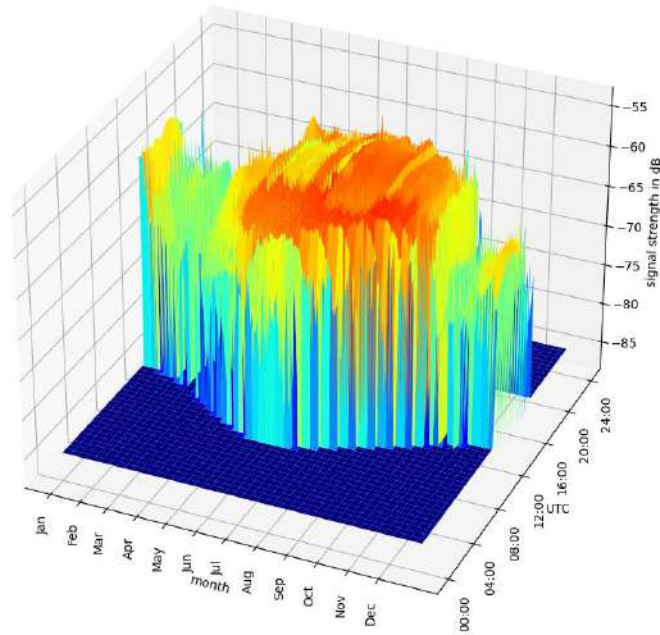
- almost three weeks for students from 3 countries hosted by DLR, UAH, SANSA

## 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!



Mecklenburgische Seenplatte

