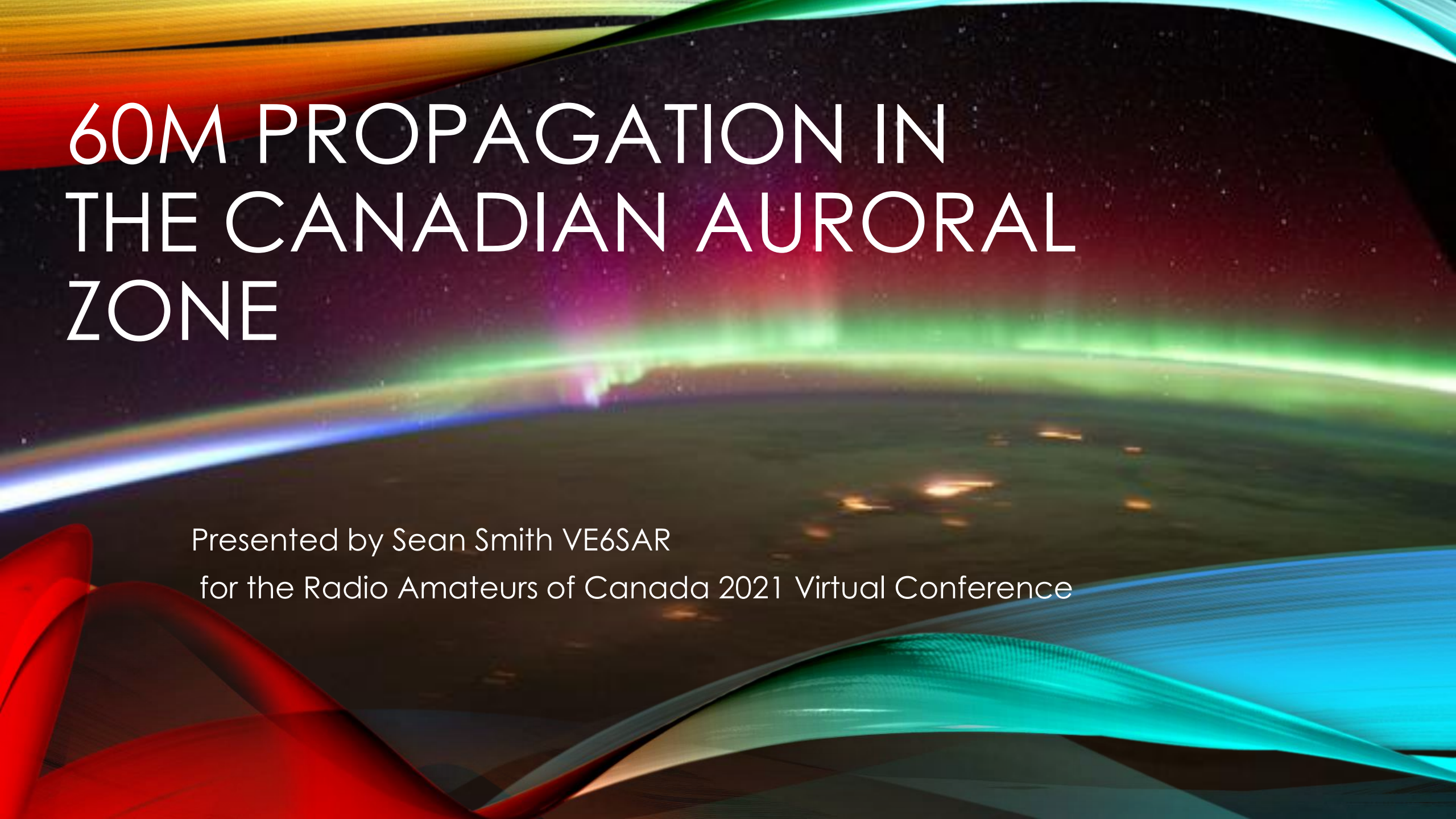
60M PROPAGATION IN THE CANADIAN AURORAL ZONE



Presented by Sean Smith VE6SAR
for the Radio Amateurs of Canada 2021 Virtual Conference

60M BAND BACK GROUND

- January, 2014 RAC Announced Industry Canada's Approval of 5 channels in the 60m (5 Mhz) Band
- Primary use was for Emergency Communications
- Power limited to 100 Watts ERP
- South of the 49th parallel, in Military and Commercial services know as the Rock band because due to its characteristics of seemingly being open to somewhere any hour of the day or night.
- Very little publicly available propagation data

WERE IT STARTED

- After Slave Lake (2011) and Fort McMurray (2016) fire the need for reliable HF communications between Northern Communities and Southern Centres becomes apparent
- Al Parsons VE6RFM, Sean Smith VE6SAR, and Matthew Lewis VE6JI began researching the possibility of using 60m
- Any data that was located was from lower latitudes that don't experience aurora issues
- In the absence of data, and in the spirt of Amateur Radio we decided to do our own experiment

OBJECTIVES

- To evaluate the viability of the 60m band with real world conditions
  - Max 100 watts ERP
  - S6 -> S9+ noise in urban areas
  - Basic NVIS antennas Inverted V, or dipole mounted 2m – 5m above the ground
- Communications needed to use a mode that facilitates the passage of traffic, and potential emergency traffic
- Need to be able to quantify results

MODE SELECTION

- Initial contact attempt between VE6RFM (Ft. McMurray, AB) and VE6SAR (Grimshaw, AB) 384km
- Started with SSB local QRM on both ends made for a very bad copy.
- Switched to PSK31 at 50w no copy
- Switched to Olivia 4-250 at 50w perfect copy reduced power to 5w and still a perfect copy.
- Olivia is not as fast as other modes, provides a way to communicate when conditions are less then ideal.
- In 2020 we switched to JS8Call, better S/N ratio, and report receive signal strength

EXPERIMENT SETUP

- Developed script the would cause FLDIGI to send a beacon every 30 minutes at specific times so as not to double on other beacons
- With the help of Philip Gladstone N1DQ we were able to access a filtered real time feed from pskreporter.info
- Solar data collection scripts
- All the data saved to a Database

HIGH LEVEL OVERVIEW

- 175,740 beacon reports saved in the database
- 200,988 beacon transmissions
- Olivia beacon receive rate of 65.7% over 4 years
- 4.8 GB of Solar Data

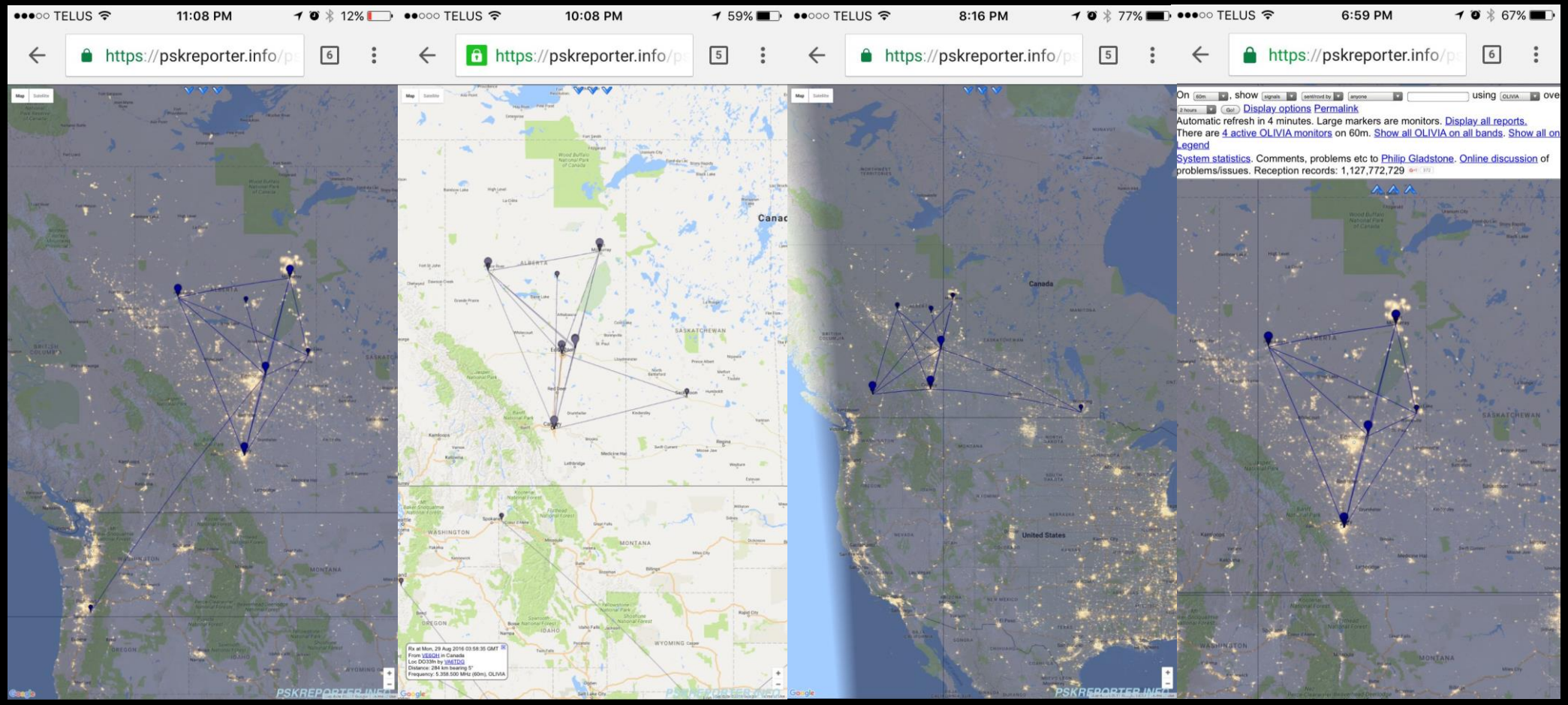
DATA ANALYSIS

- Originally started using Grafana https://grafana.com/ to produce graphs to show data points of viable time periods
  - Easy to use
  - Web based
  - Can directly access data in database

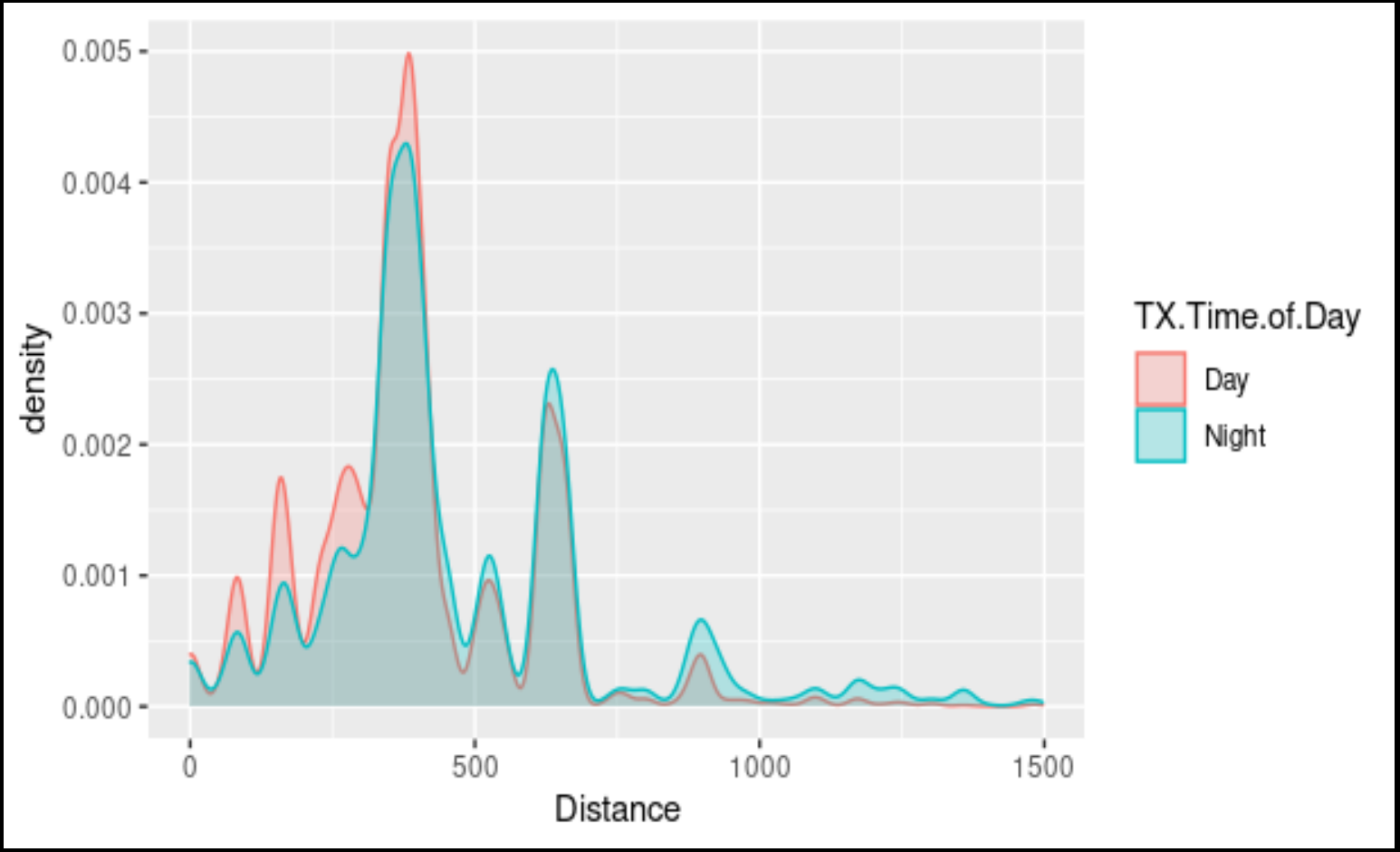
- Recently started us R / R-Studio to do statistical analysis.
  - Very power tool,
  - Steep Learning Curve

- Still On Going

BEACON NETWORK



DAY VS. NIGHT

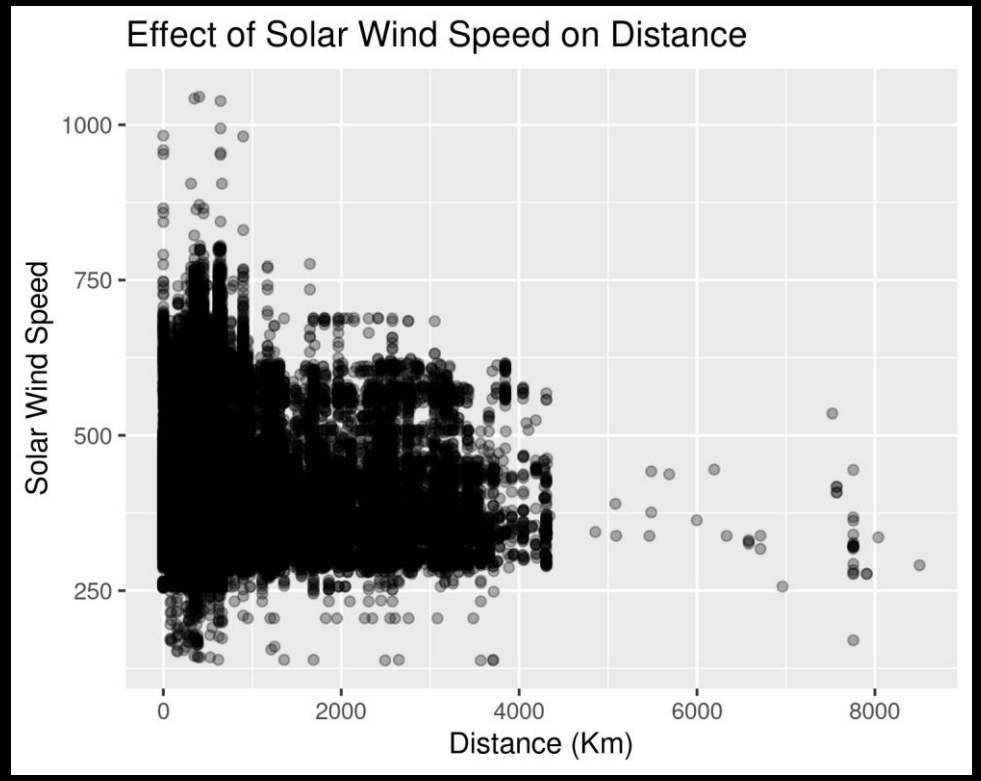


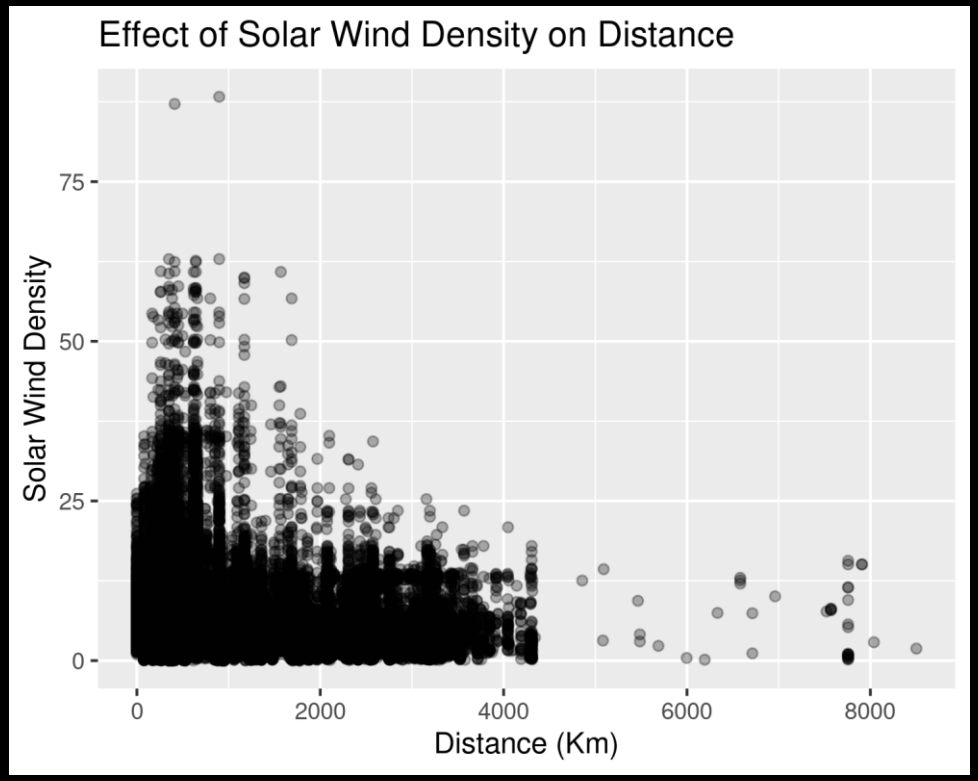
- Band goes long at night
- Demonstrates the combining of the F2 and F1 layers and changing the angle of incidence of the reflected signals
- NVIS range appears to favours 0 – 450 KM during the day

HOW FAR IS 450KM?

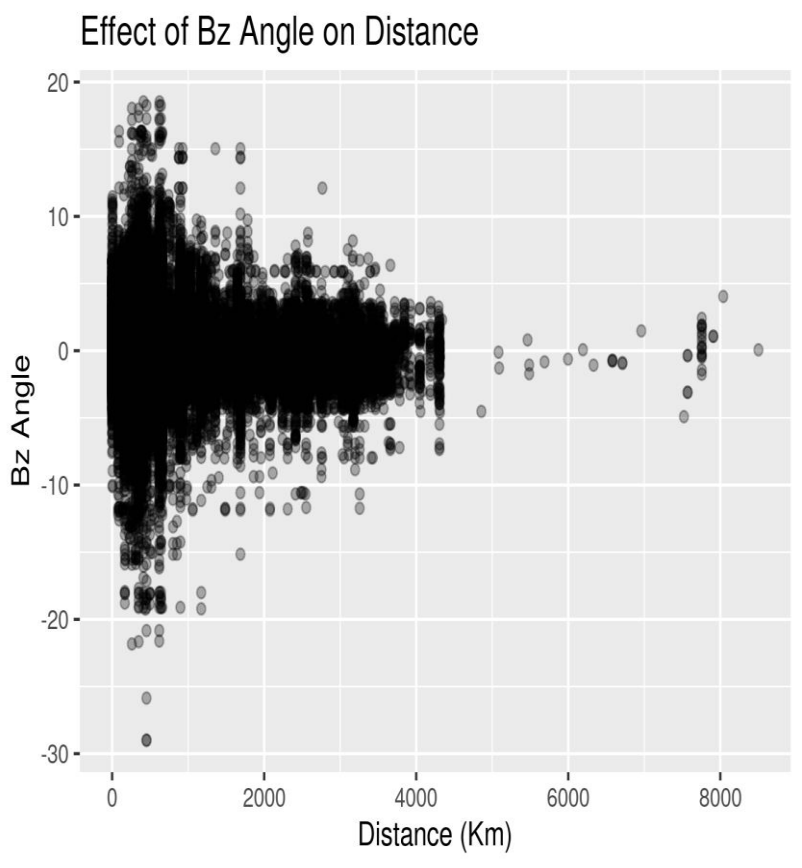
Map Source: https://www.mapdevelopers.com/draw-circle-tool.php

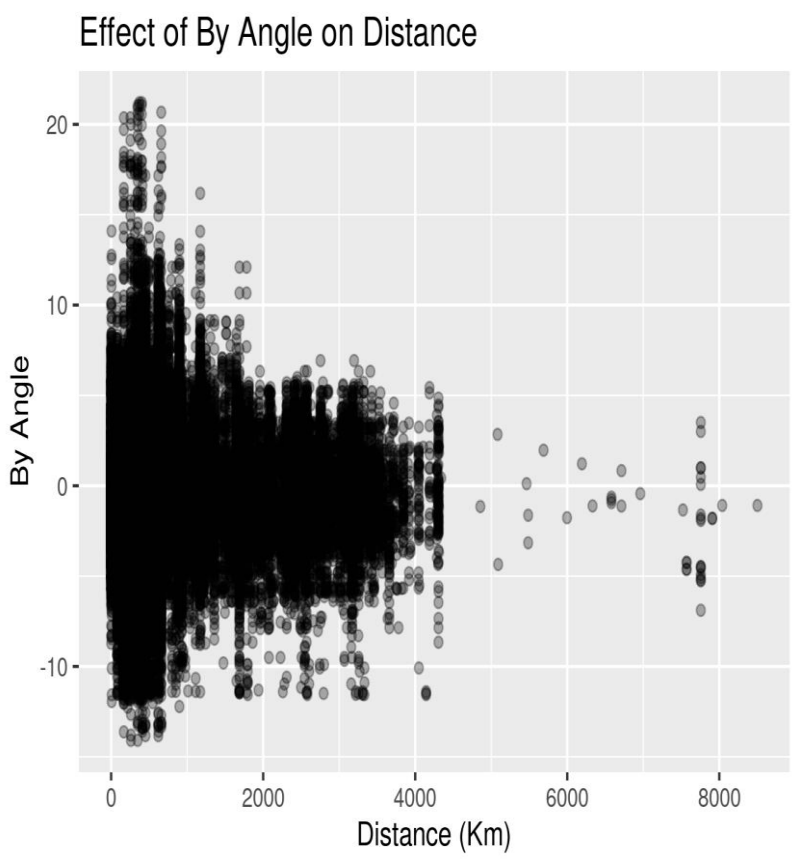
SOLAR WIND

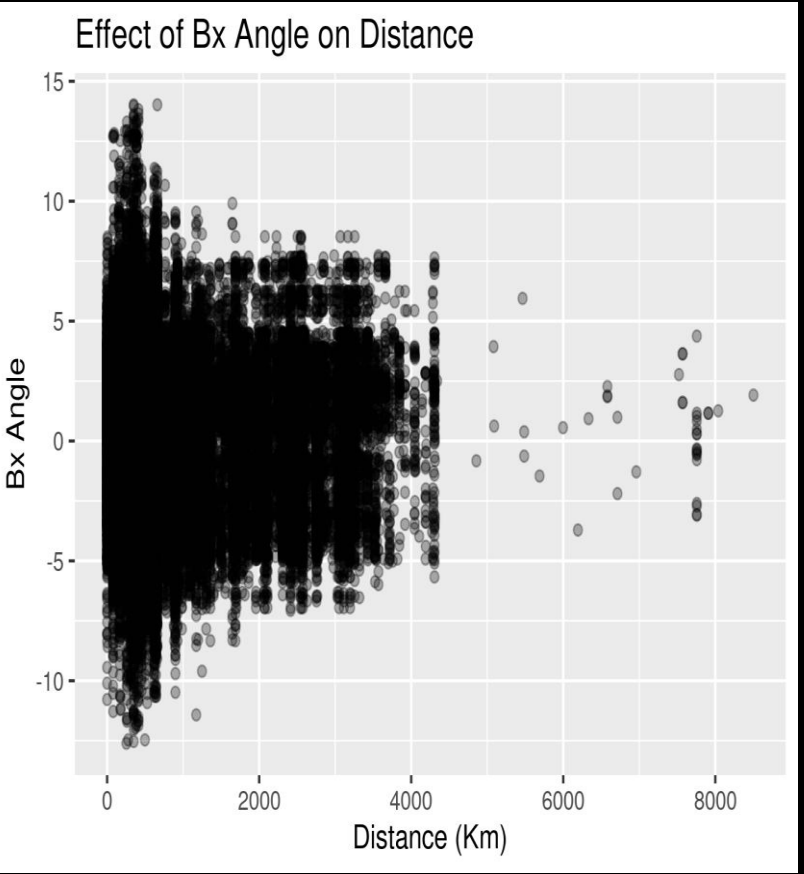

Effect of Solar Wind Speed on Distance
Solar Wind Speed
1000
750
500
250
0
2000
4000
6000
8000
Distance (Km)


Effect of Solar Wind Density on Distance
Solar Wind Density
75
50
25
0
0
2000
4000
6000
8000
Distance (Km)

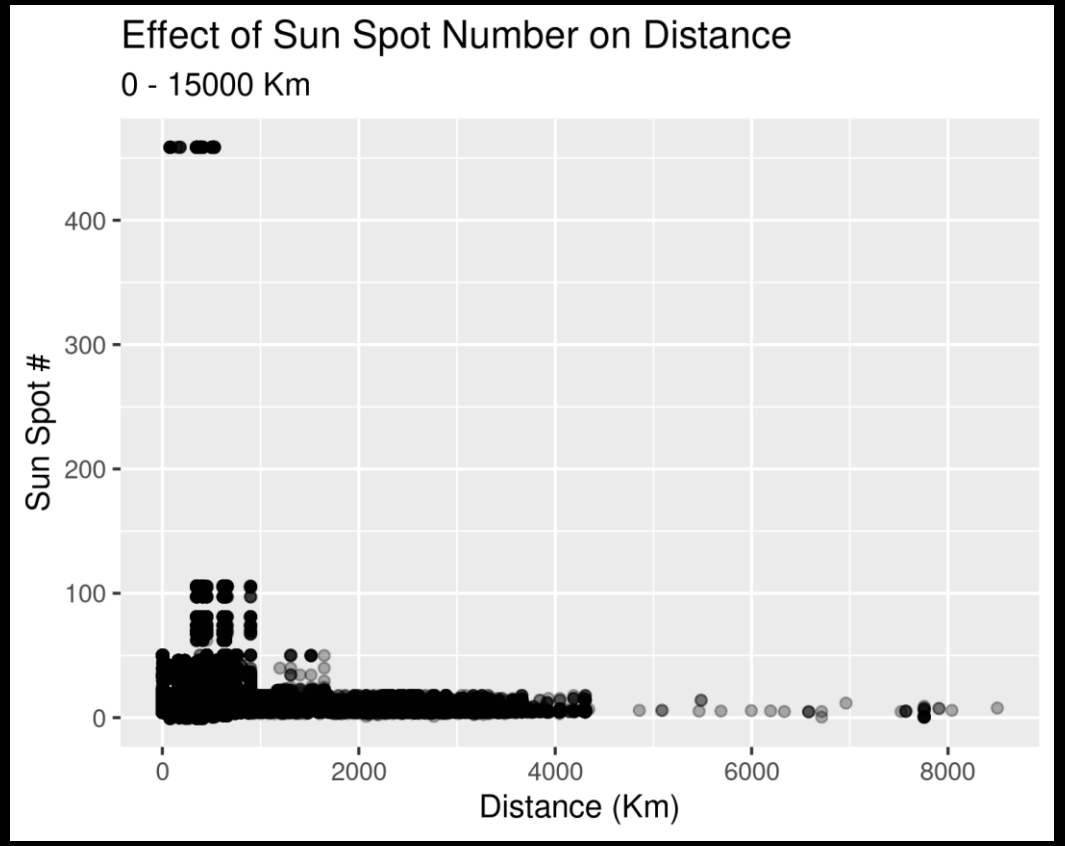
INTERPLANETARY MAGNETIC FIELD ANGLES





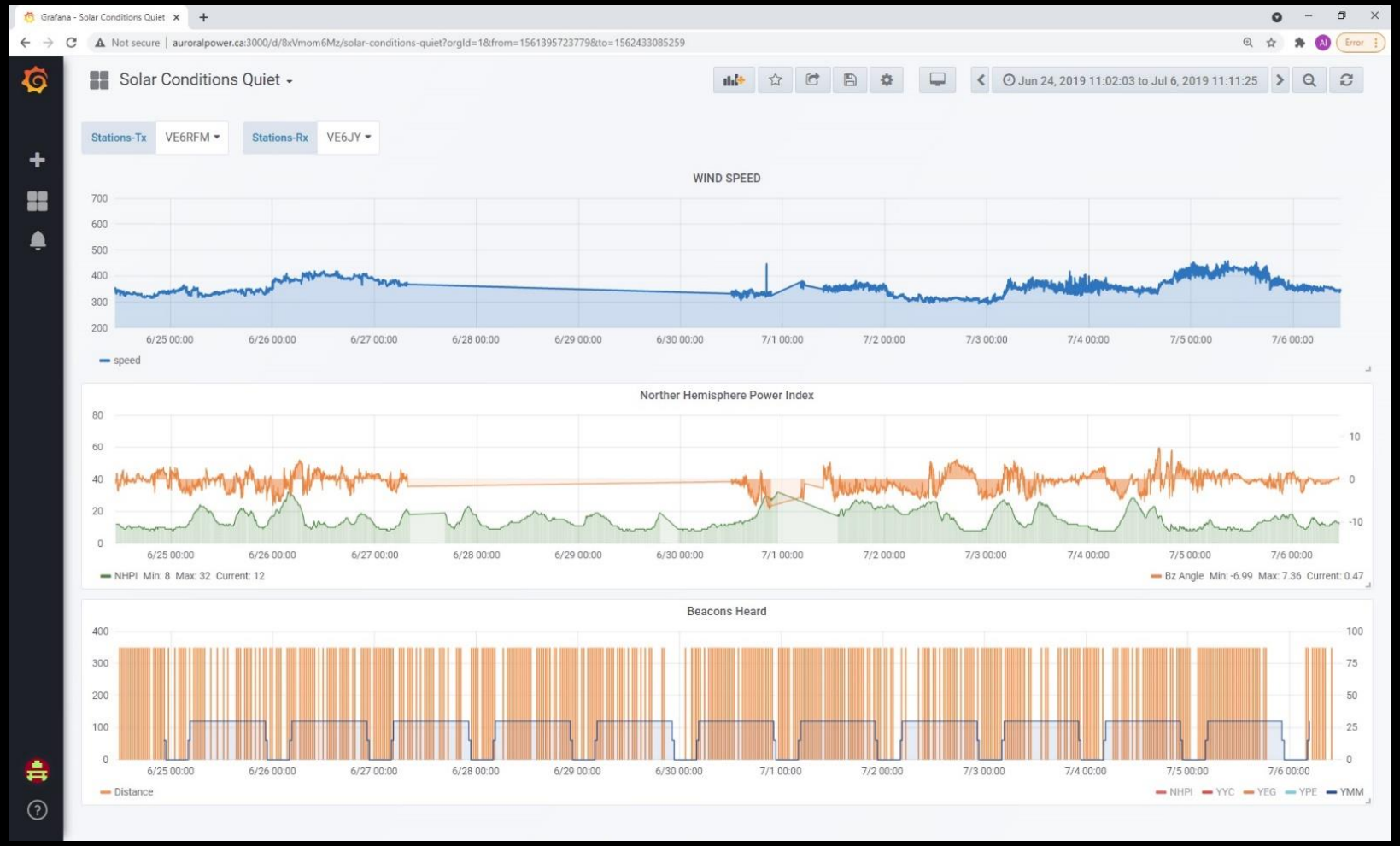


SUN SPOTS



Sun Spot numbers calculated by author using data and formula from Natural Resources Canada – Space Weather Center

QUIET CONDITIONS



SOLAR STORM


Grafana - Solar Storm
Not secure | auroralpower.ca:3000/d/f-zuhieGz/solar-storm?orgId=1
Solar Storm
Oct 23, 2019 00:03:40 to Nov 4, 2019 17:22:59
Stations-Tx
VE6RFM
Stations-Rx
VE6JY
WIND SPEED
700
600
500
400
300
200
10/24 00:00
10/25 00:00
10/26 00:00
10/27 00:00
10/28 00:00
10/29 00:00
10/30 00:00
10/31 00:00
11/1 00:00
11/2 00:00
11/3 00:00
11/3 23:00
speed
Norther Hemisphere Power Index
80
60
40
20
0
10
0
-10
NHPI Min: 8 Max: 65 Current: 11
Bz Angle Min: -11.59 Max: 16.45 Current: -1.44
Beacons Heard
400
300
200
100
0
100
75
50
25
0
Distance
NHPI
YYC
YEG
YPE
YMM

PROBLEMS ENCOUNTERED

- Solar Data source location periodically changed
- Small number of beacon stations not well distributed
- Volunteer beacon stations weren't able to consistently beacon

ACKNOWLEDGEMENTS

We'd like to acknowledge the following operators for their assistance.

VA6DBC
VA6MIS
VA6OK
VA6TDG
VE6ZZZ
VE4BOZ
VE4GLS
VE4PER
VE6JY (MONITOR)
VE6CIA
VE6EC
VE6FT
VE6JI
VE6RFM
VE6SAR
VE7FSR
VE7KAZ

DATA SOURCES

- PSK Reporter, Phil Gladstone N1DQ - https://pskreporter.info/
- Space Weather Prediction Center – NOAA https://www.swpc.noaa.gov/
- Space Weather Canada – Natural Resources Canada https://spaceweather.gc.ca/index-en.php
- NASA - https://data.nasa.gov/dataset/Space-Weather-in-Operation/usry-vycb

CONTACT INFORMATION

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  - Twitter: @alparsons10

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  - Email: ve6sar at gmail
  - Twitter: @ve6sar