

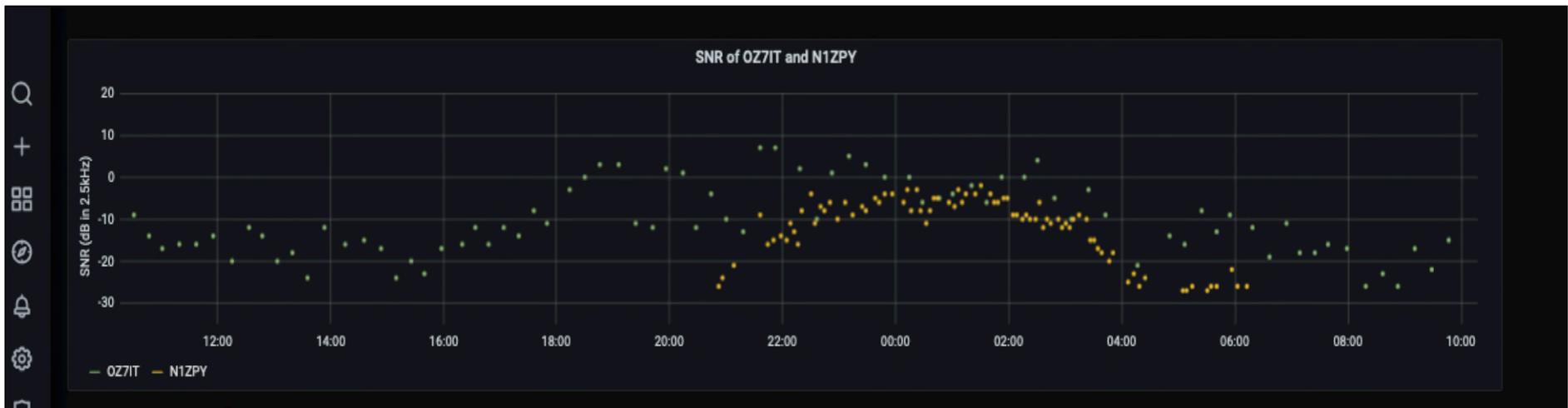


Aids to the Presentation and Analysis of WSPR Spots: TimescaleDB database and Grafana

Gwyn Griffiths, G3ZIL and Rob Robinett, AI6VN

For more information visit wsprdaemon.org
or email gwyn@autonomousanalytics.com

With enormous thanks to Gary, Corrie and the team providing wsprnet.org



Synopsis

- ❑ Motivation – Original, leading to a growing ambition
- ❑ Steps from DCC 2019 to reach today's WsprDaemon
- ❑ Today's Timescale database and Hardware
- ❑ Exploiting the TimescaleDB
 - Real-time data service to Third Parties
 - Grafana data visualisation of WSPR data
 - Access to additional data from WsprDaemon users
 - Noise estimates
 - Complete wsprd parameter set
- ❑ Next Steps

Motivation

□ Initial

- Rob Robinett, AI6VN's concept: A robust and reliable WSPR reporting tool for users of the KiwiSDR multi-channel rx.
- With Glenn Elmore, N6GN, sees potential for KiwiSDRs to estimate noise at the same time as WSJT-X estimates SNR.
- Bench investigations (Griffiths, DCC 2019) lead to simple Influx database & Grafana graphs by Tommy Nourse, KI6NKO.

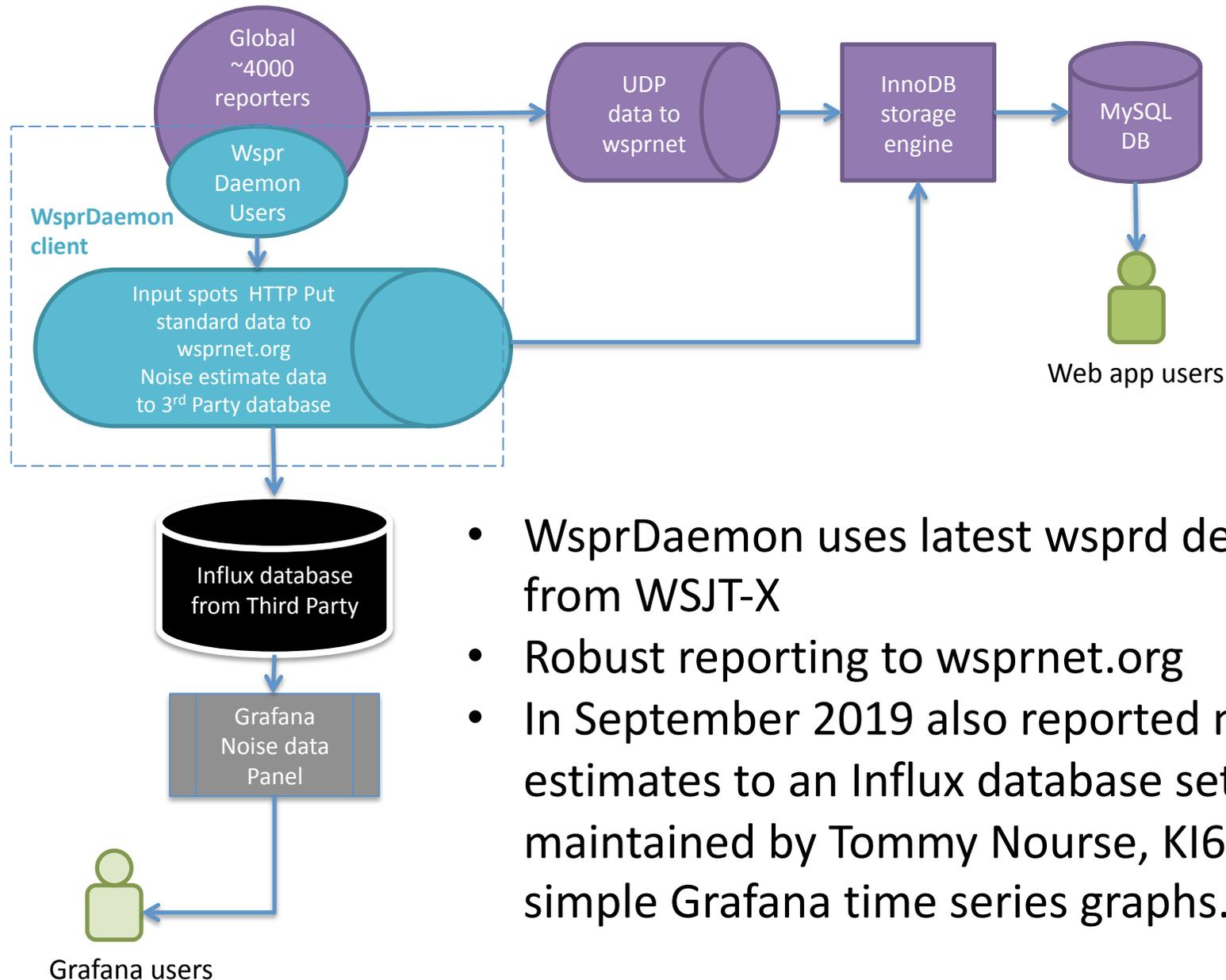
□ Early evolution

- Recognise benefits of database with noise and spot data, and derived variables, e.g. azimuth at the receiver; lats and lons.

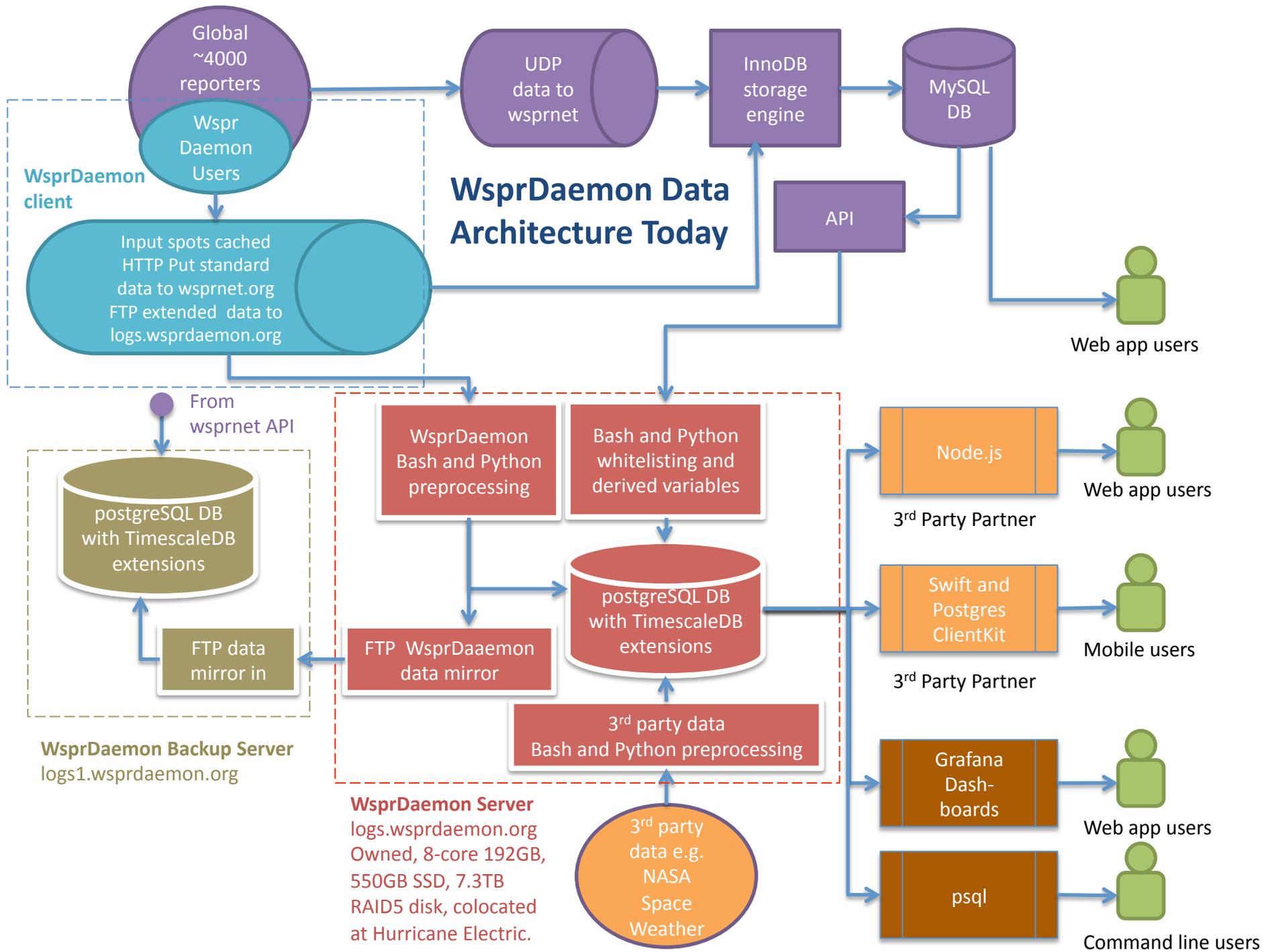
□ Developing ambition

- Add spots from wsprnet.org to our database, help reduce load on wsprnet.org by serving data to popular third-party Apps as secondary source.
- Serve data on-line for longer period than wsprnet.org to interested researchers and citizen scientists, e.g. HamSci community.

WsprDaemon: From DCC 2019 ...



- WsprDaemon uses latest wsprd decoder from WSJT-X
- Robust reporting to wsprnet.org
- In September 2019 also reported noise estimates to an Influx database set up and maintained by Tommy Nourse, KI6NKO, with simple Grafana time series graphs.



Timescale Database & Data Retention



Packaged as an extension to PostgreSQL –

benefiting from its 20+ years as a widely used Open Source database.



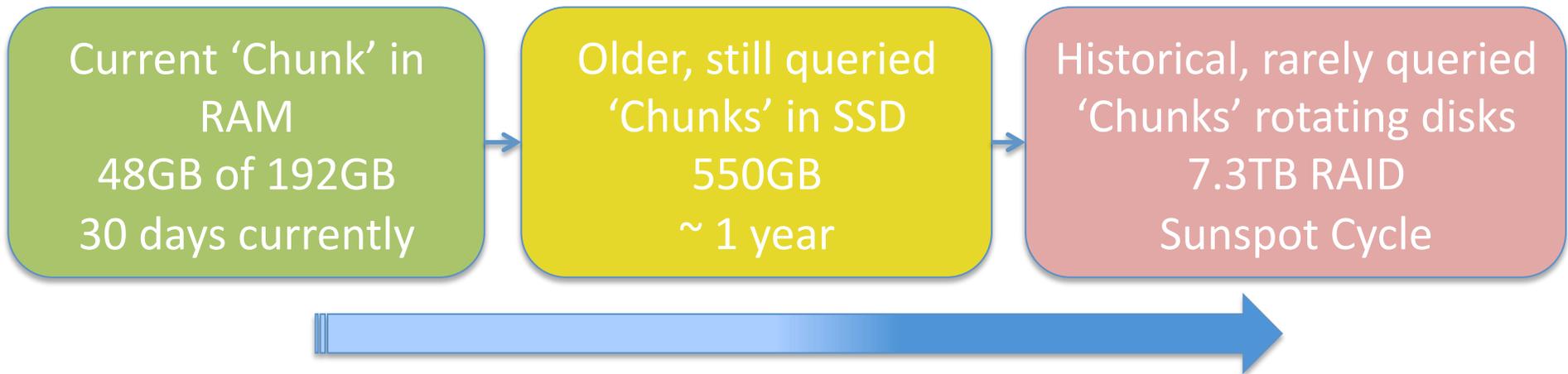
Brings concept of time 'chunks' to PostgreSQL to

handle time series efficiently. Fast data insertion. Fast retrieval of recent data.



B-tree indexing better suited to high cardinality

WSPR data than Influx – which we tried first.



Data movement over time to higher capacity, less expensive storage

Real-time data service to Third Parties

← → ↻ ⓘ Not Secure | wsprd.vk7jj.com

Apps ★ Bookmarks 📁 Imported From Fir... 🚩 MARS Gliders 🌐 NOC ↻

Auto-search: Search WSPR Daemon ->

FAQ | Stats | Charts | Map | Table | Home ☰

Spot date-time UTC local

Band colours WSPRnet classic

Map paths (see FAQ) balloon WSPR spots

SSB comparison SSB WSPR

Open Advanced search panel

Save current map view & zoom

Save current search settings

Restore saved search settings on startup restore

Save current spots table

Load saved spots table

Auto-search time period (2-60 minutes) minutes

Check the speed of WSPRdaemon.org

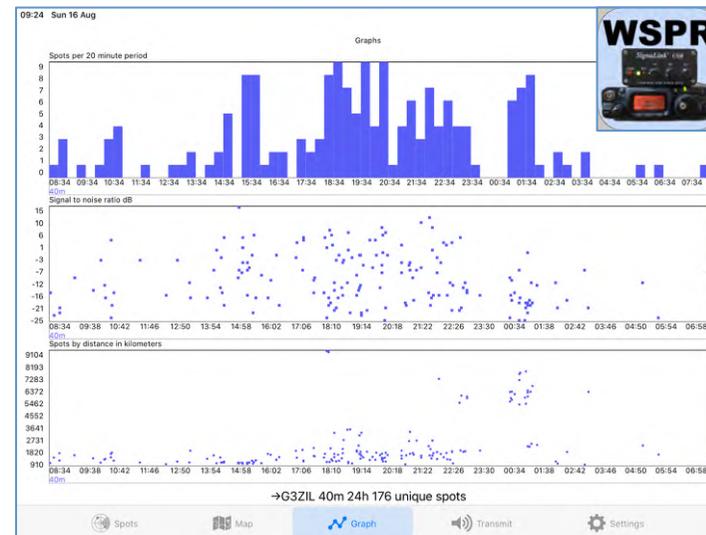
Export the current spots into Google Earth

CSV file import, choose a file...
 No file chosen

⚠ Hold down Alt/Option key to export RML Balloon Tracks. See FAQ for Details.

Spot data courtesy of WSPR Daemon

WSPR Daemon.org's shiny new WSPR spot database is faster than ever.
 New search options, better wild cards, no WSPRnet lockups.



wsprd.vk7jj.com Phil Barnard VK7JJ

WsprWatch iOS app Peter Marks VK2TPM

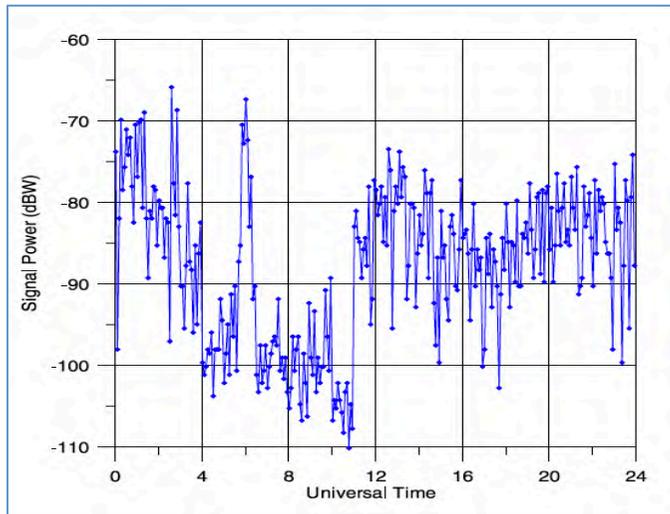
Grafana data visualisation of WSPR data

The image shows a Grafana dashboard interface with several annotations:

- Dashboard name:** Points to the breadcrumb "New dashboard / Edit Panel".
- Dashboard Settings:** Points to the gear icon in the top right.
- Dashboard Save:** Points to the "Save" button in the top right.
- Panel Title:** Points to the text "Panel Title" above the chart.
- Set time window:** Points to the "Last 6 hours UTC" dropdown menu.
- Zoom in/out:** Points to the zoom controls on the chart.
- Reload:** Points to the refresh icon on the chart.
- Database to use:** Points to the "default" dropdown in the Query Builder.
- First query 'A':** Points to the query editor for the first query.
- Query Builder:** Points to the query editor interface.
- Toggle Query Editor and Text Entry:** Points to the "Edit SQL" button.
- Visualisation:** Points to the "Visualization" section in the right-hand settings panel.
- Display:** Points to the "Display" section in the right-hand settings panel.
- Axes:** Points to the "Axes" section in the right-hand settings panel.

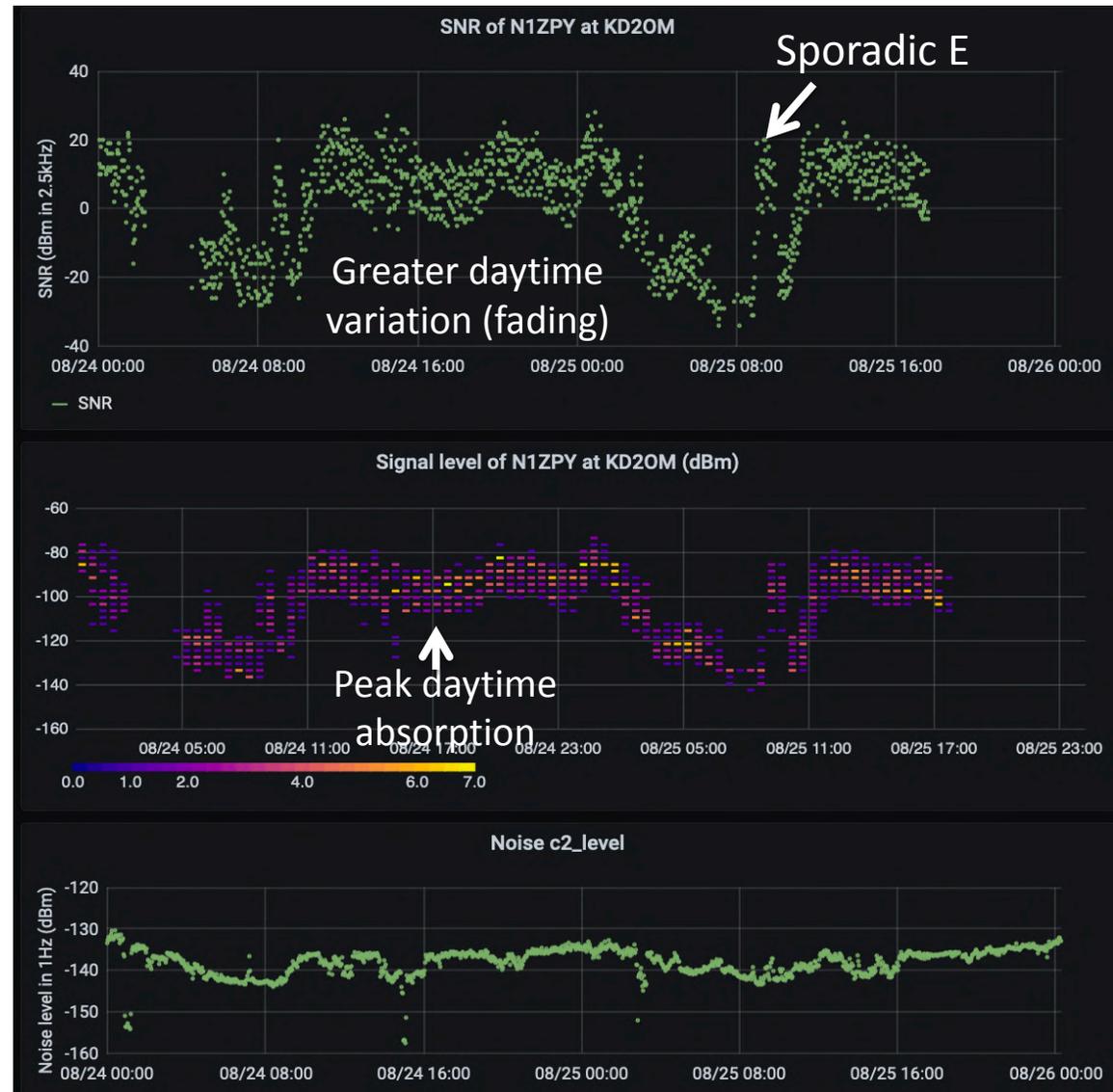
At the bottom of the dashboard, there is a text box containing the URL: [A guide is available at wsprdaemon.org/grafana.html](https://wsprdaemon.org/grafana.html)

Derive signal levels: Data akin to that in research publications



Above: Signal power received at nr. Boston from CHU time signal station nr. Ottawa, 1 Sept. 2003 on 7.335MHz. From McNamara et al., 2008. *Radio Science*, 43(2).

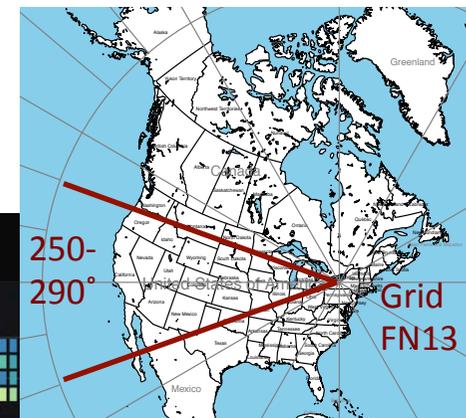
- ❑ **TimescaleDB:** Join SNR and noise tables
- ❑ **Grafana:** Time series plots, with Signal Level as Heatmap.



N1ZPY, Maine received at KD2OM, nr Rochester, NY on 7.04MHz

Heatmaps: Number of WSPR spots in 200km range rings every 20 min

- ❑ **TimescaleDB:** Select all receivers in grid FN13% where azimuth between 250–290°
- ❑ **Grafana:** Standard Heatmap in 200km and 20 min



Map courtesy
Tom NS6T

14MHz

7MHz

0000 UTC

28 Aug –

0000 UTC

29 Aug

Y axis: Range

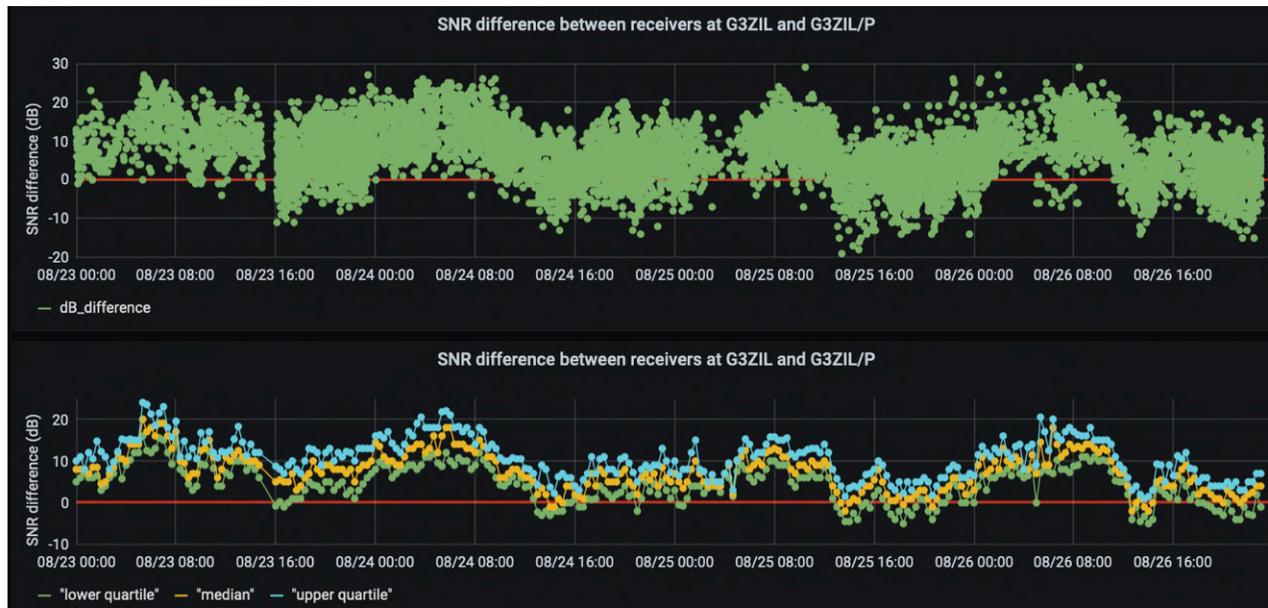
0 – 4000km



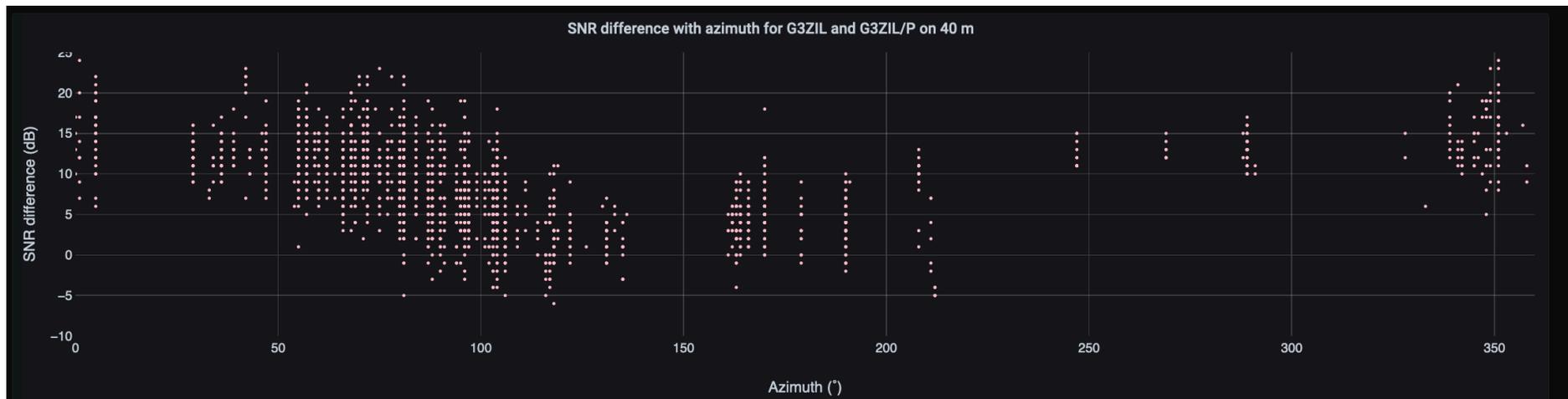
SNR differences: 2 antennas 1 location

G3ZIL: 40m inverted V dipole pair with adaptive noise reduction

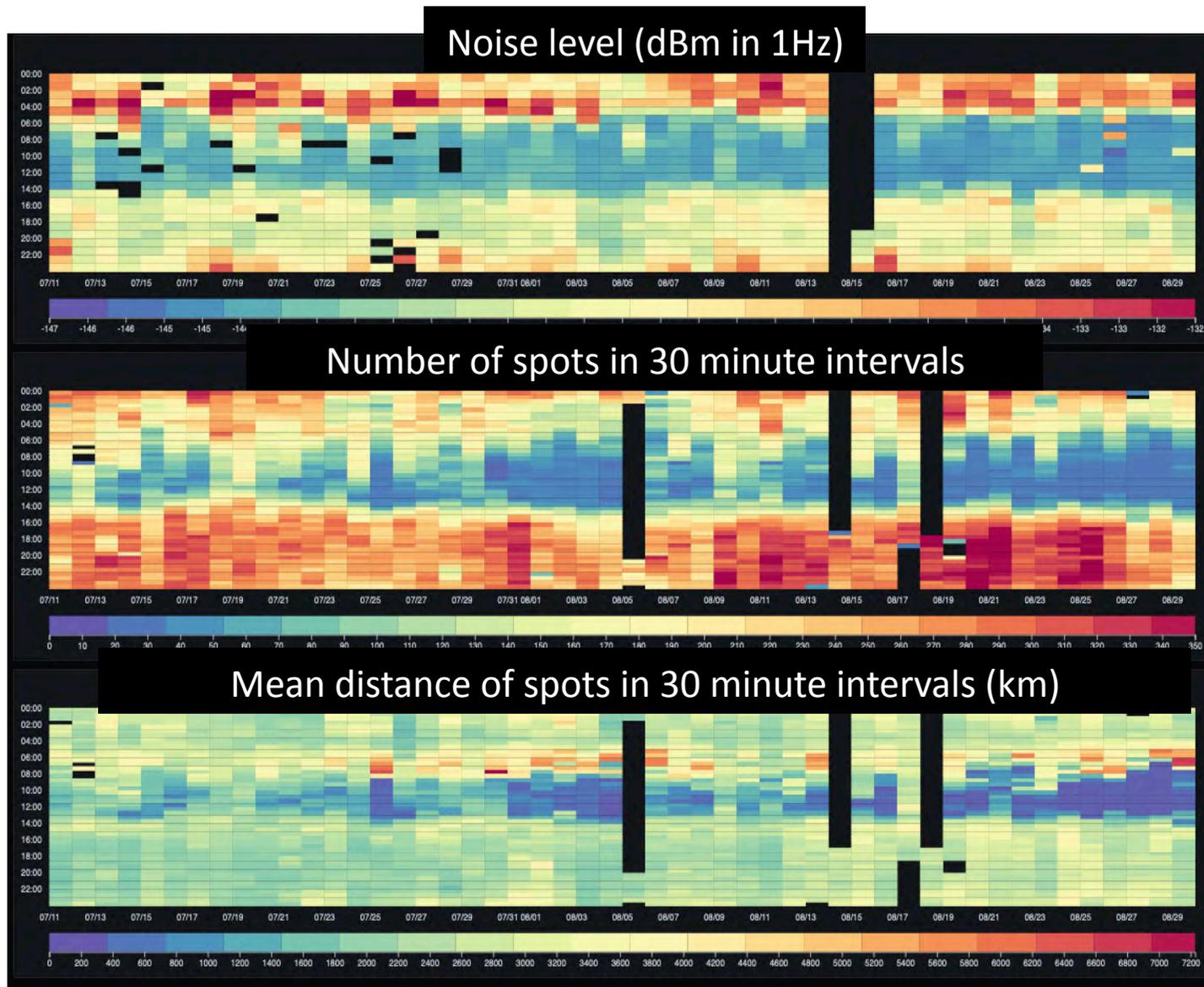
G3ZIL/P: Active short vertical dipole (2m tip to tip) N6GN design.



- TimescaleDB:** Calculate median and quartiles in 20 minute intervals.
- Grafana:** Plotly plug-in for X-axis other than time – here Azimuth at rx.



Long view: Heatmaps by hour of day



Data from
Northern Utah
SDR KA7OEI-1

On 14MHz

11 July – 29 Aug

▣ **TimescaleDB:**
Simple SQL

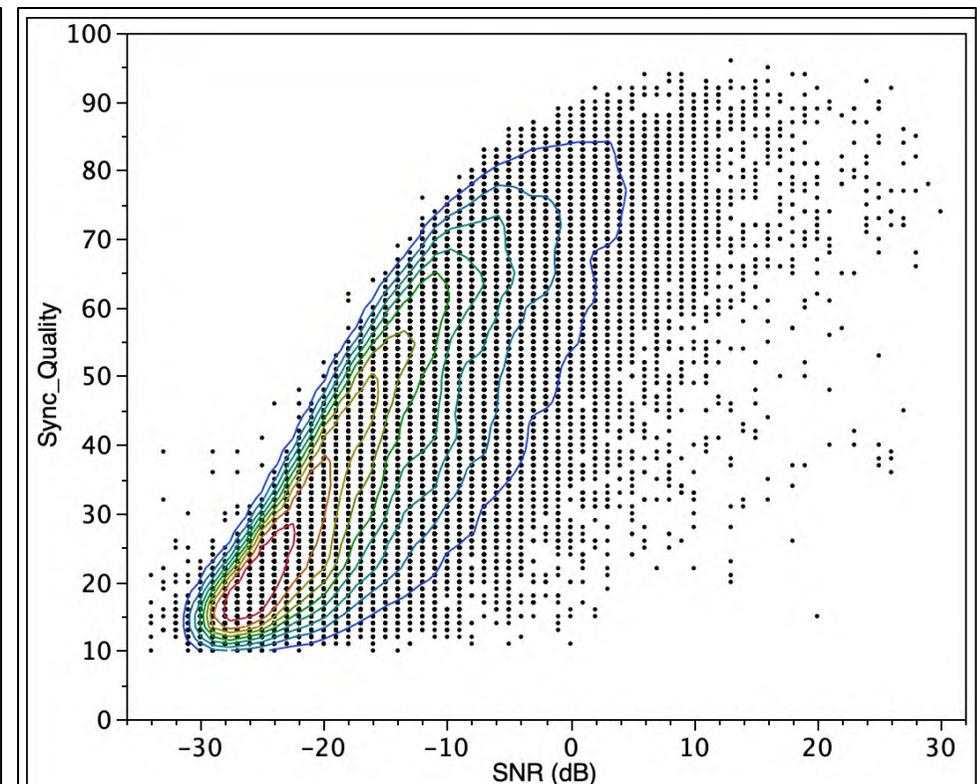
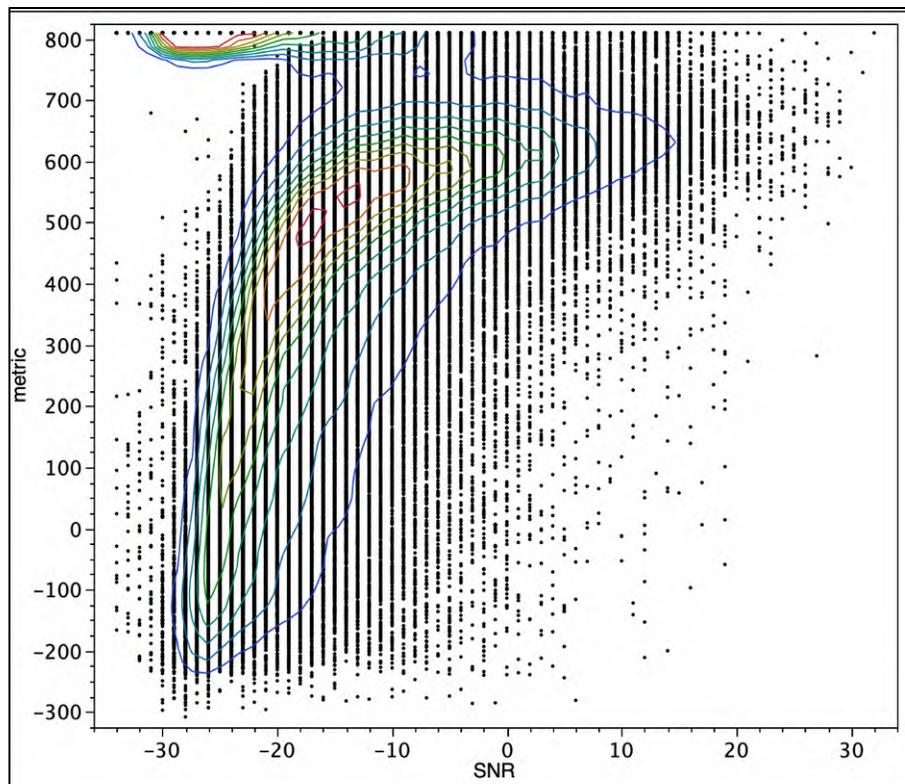
▣ **Grafana:**
Hourly Heat-
map plug-in

Y axis is hour of the day (UTC) 0000 at top, 2359 at bottom, each block on **X axis** is one day

WsprDaemon logs all wsprd parameters

Needs non-parametric density contours – not in Grafana

- ❑ **Blocksize:** number of symbols over which decode attempted
- ❑ **Time Offset:** resolution of 10ms
- ❑ **Decode Cycles:** Iterations of the Fano decoder per bit
- ❑ **ipass, nhardmin, decode type**
- ❑ **Jitter:** fine time offset
- ❑ **Metric (left):** “closeness of a path to the received sequence”
- ❑ **Sync Quality (right):** how well received sync symbol sequence matches local



Next Steps

- ❑ **WsprDaemon:** Extend robust reporting (and noise) to receivers with a Soapy interface.
- ❑ **TimescaleDB:** App developers welcome to evaluate our database; look to ease load on wsprnet.org.
- ❑ **Grafana:** Improve front page layout and help, find plugins (or learn to code json) for unavailable graph types

Welcome most heartedly contact with anyone interested in the types of analysis and data presentation in this talk to study propagation or their own station performance or ...

With enormous thanks to Gary, Corrie and the team providing wsprnet.org and to Tommy Nourse, Steve Sykes, Clint Turner, Phil Barnard, Peter Marks, Glenn Elmore