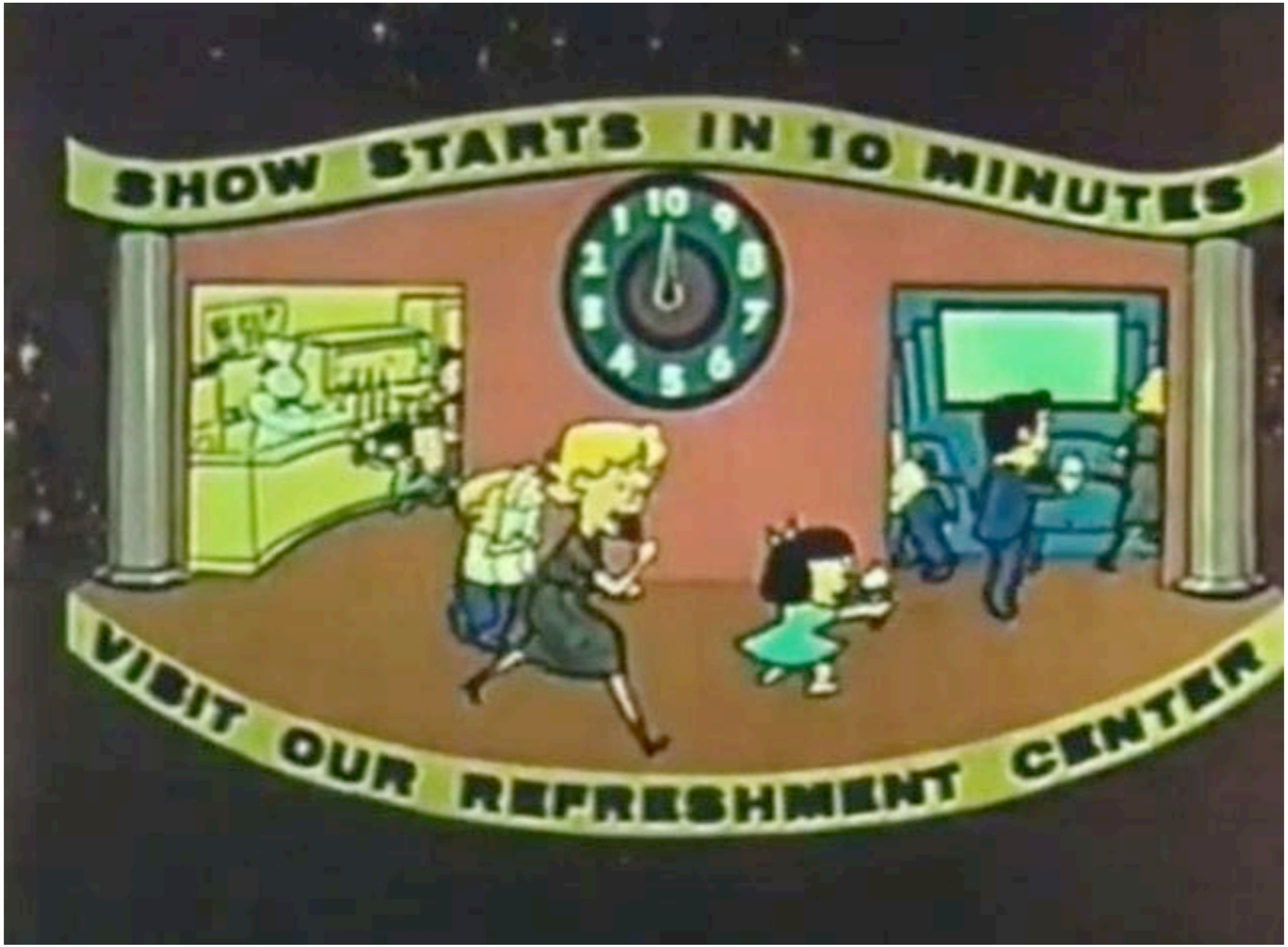
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Why Shout when you can WSPR?

K0JDD, April 2026

Definition: WSPR

WSPR (pronounced —whisper) is an acronym for — “Weak Signal Propagation Reporter.” With a computer program and a standard SSB transceiver, you can participate in a world-wide network of low-power stations exchanging beacon-like transmissions to probe potential propagation paths.

Most participating stations transmit as well as receive, although short-wave listener (SWL) activity is also common. In principle, and with the propagation gods willing, everyone can copy and be copied by everyone else who is currently active with *WSPR* on the same band.

Origins: WSPR

- Weak Signal Propagation Reporter: WSPR pronounced “Whisper”
- Invented Prof. Joe Taylor K1JT (Nobel prize in Physics) 2008
- Initially developed for sporadic E propagation and similar
- It’s not a communication mode, it’s a beacon system. A Fixed message structure is used.
- Hugely popular, really quite useful

Relative sensitivity of communication modes

Mode	Main Applications	Threshold	Bandwidth	Baud rate	Power equiv.
WSPR	**Low Power beacons, Analysis**	**-27dB**	**6Hz**	**1.4648**	**0.1W**
JT65	Weak Tropo, MoonBounce, Meteorscatter	-24dB	120Hz		0.25W
FT8	MultiHop	-20dB to -24dB	50Hz		0.4W
Olivia	Digital data transfer/Chat	-17dB	125Hz -2kHz	31.25	1W
FSK441 **	High speed meteor scatter etc.	-10db *	Various *	441*	Various*
PSK31	Data mode chat	-7dB	100Hz	32	15W
CW	Morse	-1dB	100-150Hz	Variable	40W
RTTY	PSK31 mostly replacing this.	+5dB	170Hz	45.5 / 50	160W
SSB	Voice Long distance	+10dB	3kHz	-	500W

** Cluster of options with WSJT : JTMS, FSK441, FSK315, ISCAT, JT65M, JT4

Credit: GM4EAU

The Basics: WSPR

Listening	Receivers around the world are listening on one or more bands and connected to the internet
Sending	On an exact even 2 minute boundary plus 1 second you transmit a standard coded 162 symbol message over 110 seconds at 1.4Baud with 6Hz bandwidth using 4 tone audio FSK on SSB
Decoding	The message is decoded automatically by listeners, analysed, and uploaded to a public databases - wsprnet.org. Azimuth and other location data is added from the receiving ground station
Database	The data becomes available on the internet within 1 minute
Repeat	The next 2 minute slot arrives and the above repeats

You don't transmit every slot, typically 10%-20% duty cycle

100mW is good. More than 5W not necessary (You wouldn't hear them if they called/local overloading)

Message Format: WSPR

Building the message: (The maths here is a bit tricky !)

Must introduce error correction to get -27dBm

K0JDD EN34 20

Element	Symbols	Explanation
Callsign	28	K0JDD
Locator	15	EN34
Power level	7	20 (= 100mW)
Forward error correction *	112	Redundancy for strong forward error correction *
Total	162	110 secs required to send message

* *WSPR* uses a convolutional code with constraint length K=32 and rate r=1/2. The convolution procedure extends the 50 user bits into a total of $(50 + K - 1) \times 2 = 162$ one-bit symbols. Interleaving is applied to scramble the order of these symbols, thereby minimizing the effect of short bursts of errors in reception that might be caused by QSB, QRM, or QRN.

* * There are two additional formats for 6 digit maidenhead code, and similar, and special arrangements for telemetry (balloons etc.)

Forward Error Correction: WSPR

Encoding: How does a 50 symbol payload end up being 162 symbols?

- Length = (Payload + K-1) * 2 — where P=50 K=32, r=1/2

- Convolutional FEC Code: The 50 payload symbols (P=50) are sequentially input to a string of shift 31 registers (K=32-1). Each input symbol produces **two** output symbols (r=1/2). 31 symbols of padding are used to completely flush the registers.

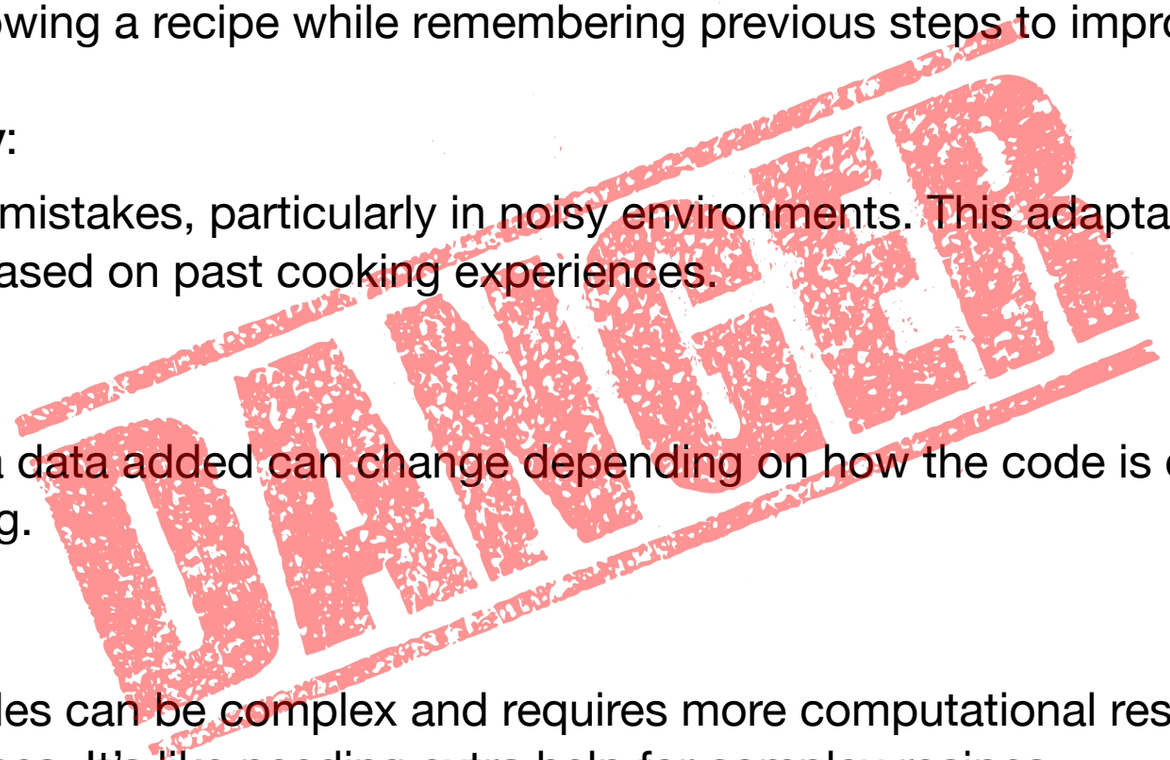
- After the 162 symbols are generated, they are scrambled using a known pattern to increase the likelihood that all errors will be detected during transmission. *(Un-scrambled upon receive)*

- The symbols are then transmitted using 4-tone frequency-shift keying at 1.46 baud.

Rabbit Hole: Convolutional Codes

- **Continuous Data Stream**:
  - Convolutional codes process data as a flowing stream, considering both the current and some previous bits. This is like following a recipe while remembering previous steps to improve the final result.

- **Error Correction Ability**:
  - They excel at fixing mistakes, particularly in noisy environments. This adaptability is akin to a chef adjusting a recipe based on past cooking experiences.



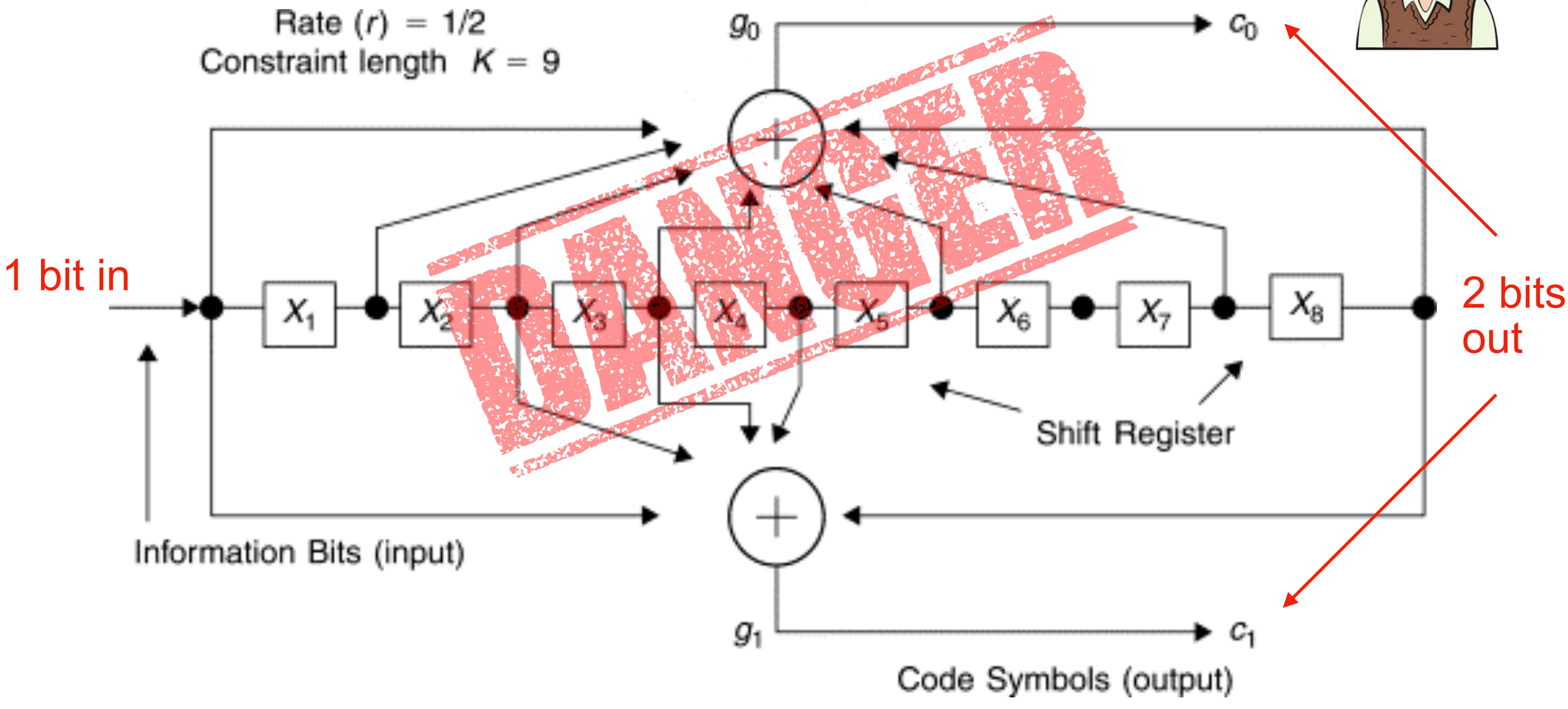
- **Variable Code Rate**:
  - The amount of extra data added can change depending on how the code is designed, which allows for flexibility in encoding.

- **Decoding Complexity**:
  - Decoding these codes can be complex and requires more computational resources, especially with longer data sequences. It’s like needing extra help for complex recipes.

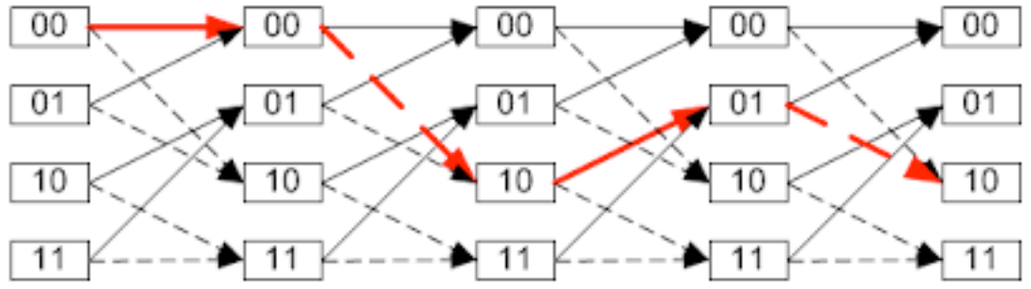
- **Real-Time Applications**:
  - Commonly used in live systems, such as cell phones and satellites, where data is transmitted continuously and must be corrected in real time.

- **Noise Resilience**:
  - Convolutional codes are better at handling varying levels of noise since they leverage information from past data, enhancing their error-correction capabilities.

Example: Convolutional Codes



Output affected by the prior 8 bits



Decoding

Trellis Decoding using the Sequential Method

1. **Trellis as a Map:**
   Think of the trellis as a map of all possible routes you might take. Each intersection on the map represents a point in time where decisions are made about the data being sent.

2. **States and Decisions:**
   Each point (or state) on this map corresponds to a different possible state of the data. As you plot the data points over time, you make decisions about which path to take based on what you receive.

3. As the data is received, the decoder looks at all the possible paths through the trellis. It's like trying to find the best route through the city by considering all the streets you can take.

4. **Finding the Best Path:**
   The goal is to find the path that matches the received data most closely. This is determined by calculating how many "mistakes" would have been made on each path. The decoder tries to find the path with the least errors, just like selecting the best route that avoids detours and traffic.

5. **Backtracking:**
   Once the best path is determined, the decoder can trace back through the map to figure out the original data.

-...-.-

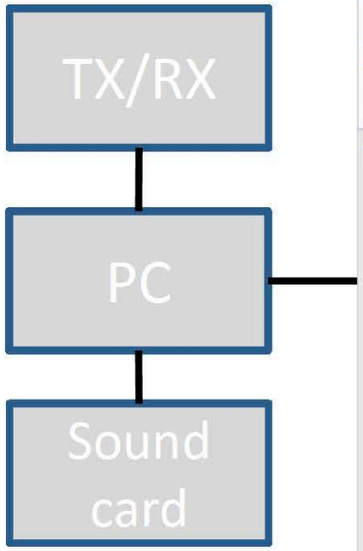
Mandatory Cognitive Rest Break

(30 Seconds)

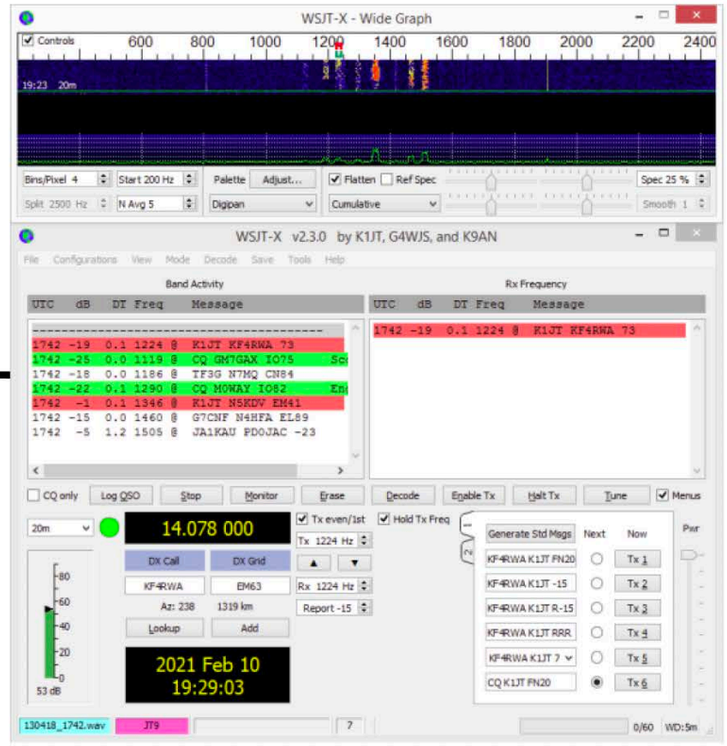
How do I WSPR?

Use existing SSB rig with a PC/Sound card and optional CAT control of TX/RX. WSJT software running

Ties up your RIG, good for one-off experimental approach. Many support notes on how to do this.

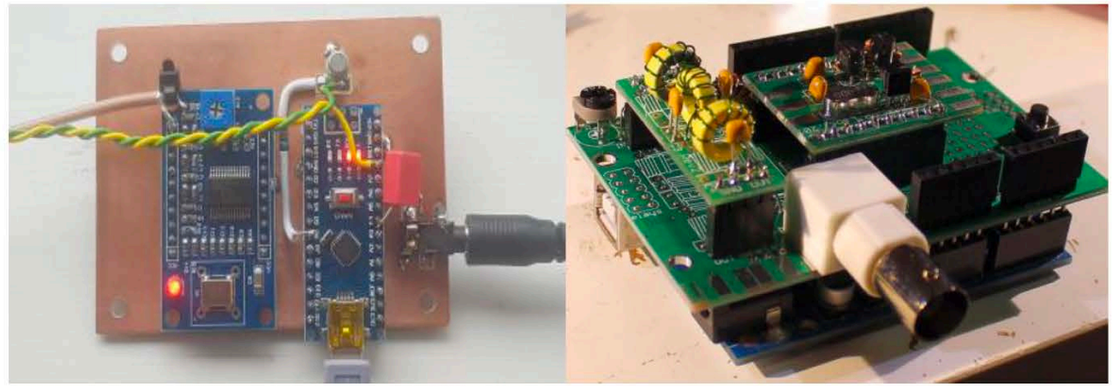


WSJT software



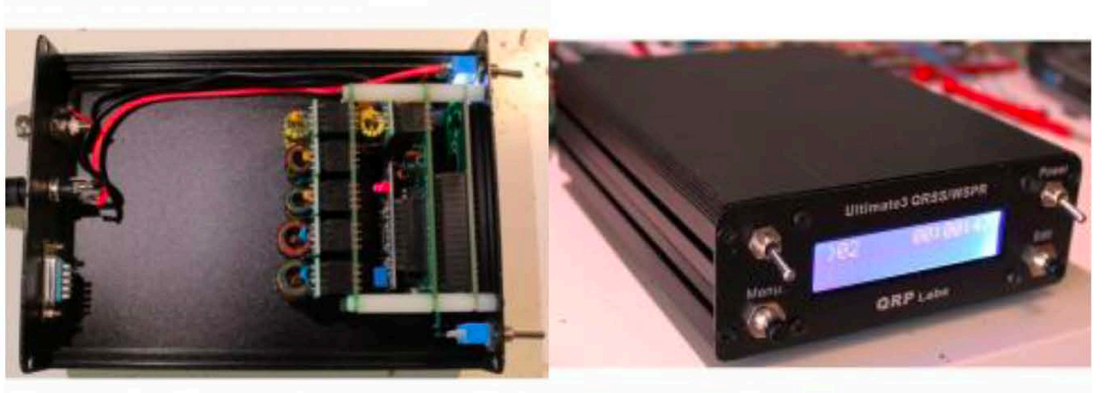
Design/copy and build solution with Arduino or Raspberry or many other similar boards/options to consider

Can get complex, lots of research to get started. Will almost certainly need computing software skills.



Build a standalone dedicated beacon system.

Modular design, minimal PC skills required . No impact of rest of the shack equipment. Can leave it running. High chance of success. Looks good in the shack too!



Credit: GM4EAU

Definition: WSPRnet.org

Most stations using WSPR are configured to automatically upload their reception reports to a central database at WSPRnet.org, in real time.

By pointing your browser to WSPRnet.org you can get nearly instantaneous reports of where and at what signal strength you're being received, and view the results plotted on a world map.

Example: Stations currently hearing N0STP

WSPRnet

Welcome to the Weak Signal Propagation Reporter Network

Activity | Map | Database

User login

Username *

Password *

Create new account
Request new password

Log in

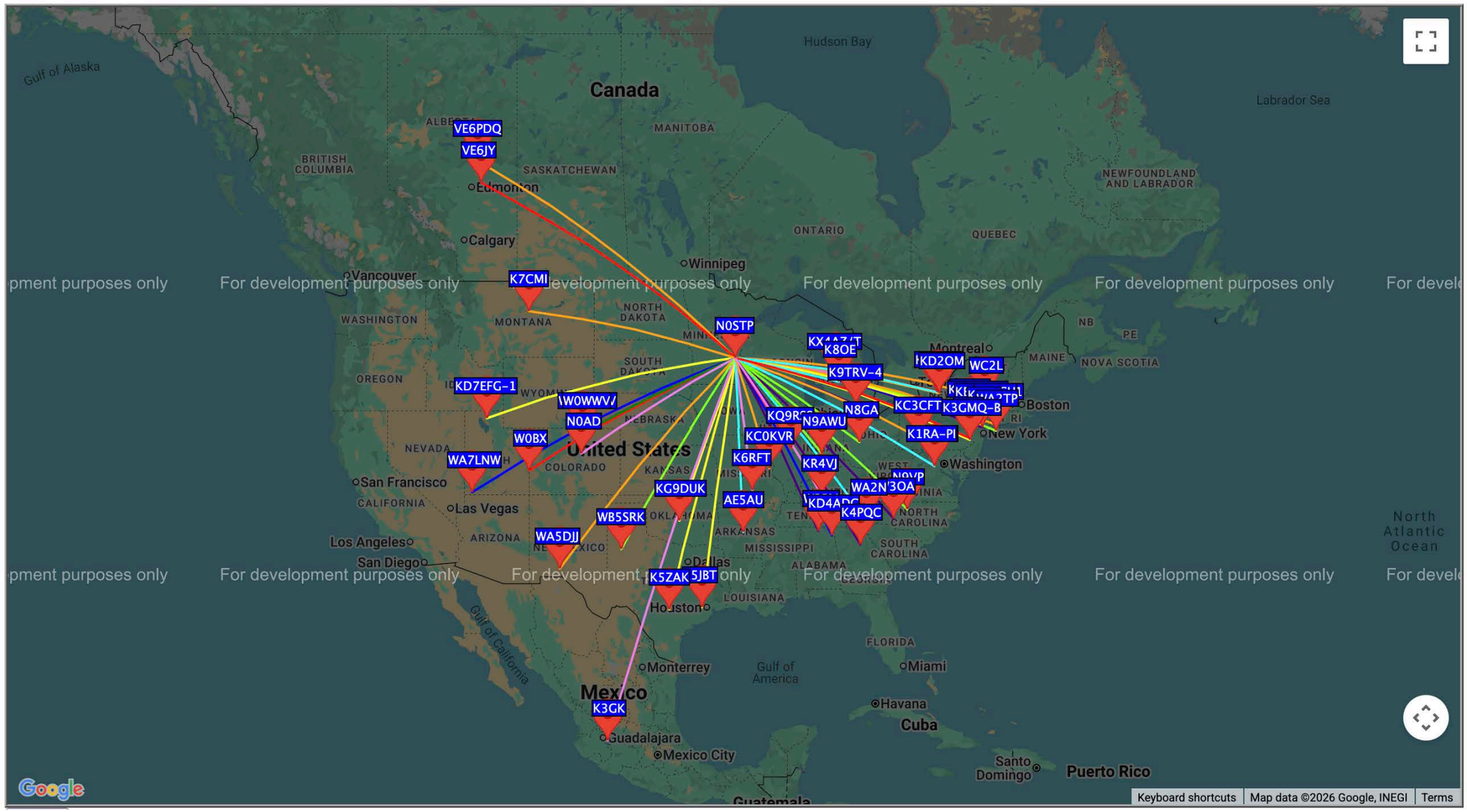
Frequencies

USB dial (MHz): 0.136, 0.4742, 1.8366, 3.5686, 5.2872, 5.3647, 7.0386, 10.1387, 13.5539, 14.0956, 18.1046, 21.0946, 24.9246, 28.1246, 50.293, 70.091, 144.489, 432.300, 1296.500

3rd Party Maps and Data

WSPR Rocks!
M0XDK Map
KB9AMG Monthly Stats
WA2ZKD Spot Analysis
DJ2LS WSPR Spot Heat Map
LU7AA/LU7ABF Maps/Graphs

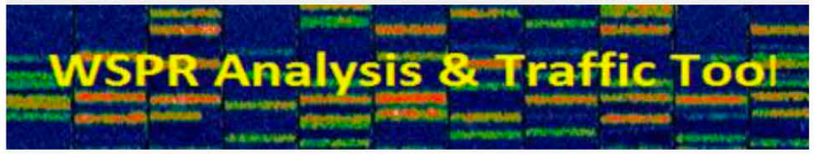
Map



What else might I do with WSPR?

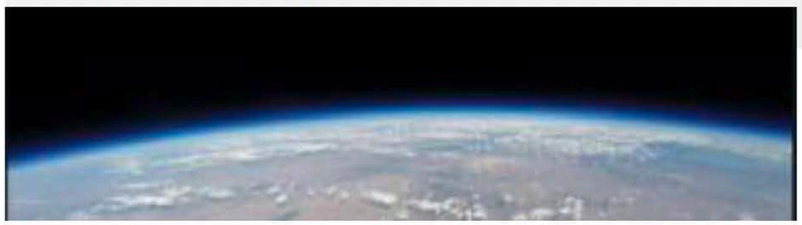
Looking at propagation

Development of a Reporting tool – WATT for radio amateur use



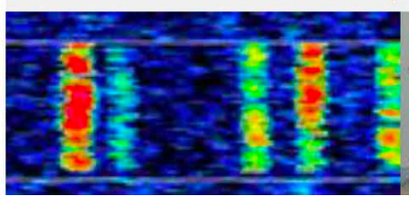
Balloon tracking

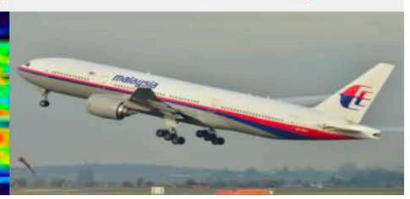
Tracking the circumnavigation of very small high altitude balloons



Data Science

Using historic WSPR data to plot the flight paths for commercial aircraft, including analysis of the lost MH370 Malaysian Airbus flight





WSPR : Can be more than simple reporting ….

WSPR can be deployed for activities beyond its fundamental use for propagation reporting.

There are nearly 3 Billion data points held going back to 2009 in the database. 60M spots added monthly

5000 or more WSPR stations are listening

2 Million amateurs on the planet

WSPR data can be REPURPOSED for other (possibly unforeseen) uses. This is exciting and open-ended


OUR FEATURE
PRESENTATION

SEMARC WSPR Week 2026

Participants

- K0DTM, Dale Mathisen
- K0JDD, John Dean
- K0OOI, Darreck Lisle
- KA8VHF, David Finley
- KD0IRF, David Bloom
- KF0NOK, Bruce MacDonald
- KF0TUA, Richard Renfroe
- KF9CP, Paul Kanikula
- N0BM, Brian McInerney
- N0UC, Richard Roberts
- N0WUE, Dwayne Lovelady
- NA0L, Charles Hanson
- W7EEC, Paul Nelson
- WB0VBG, Mark Christensen

SEMARC WSPR Week

Extremely High Level Analysis

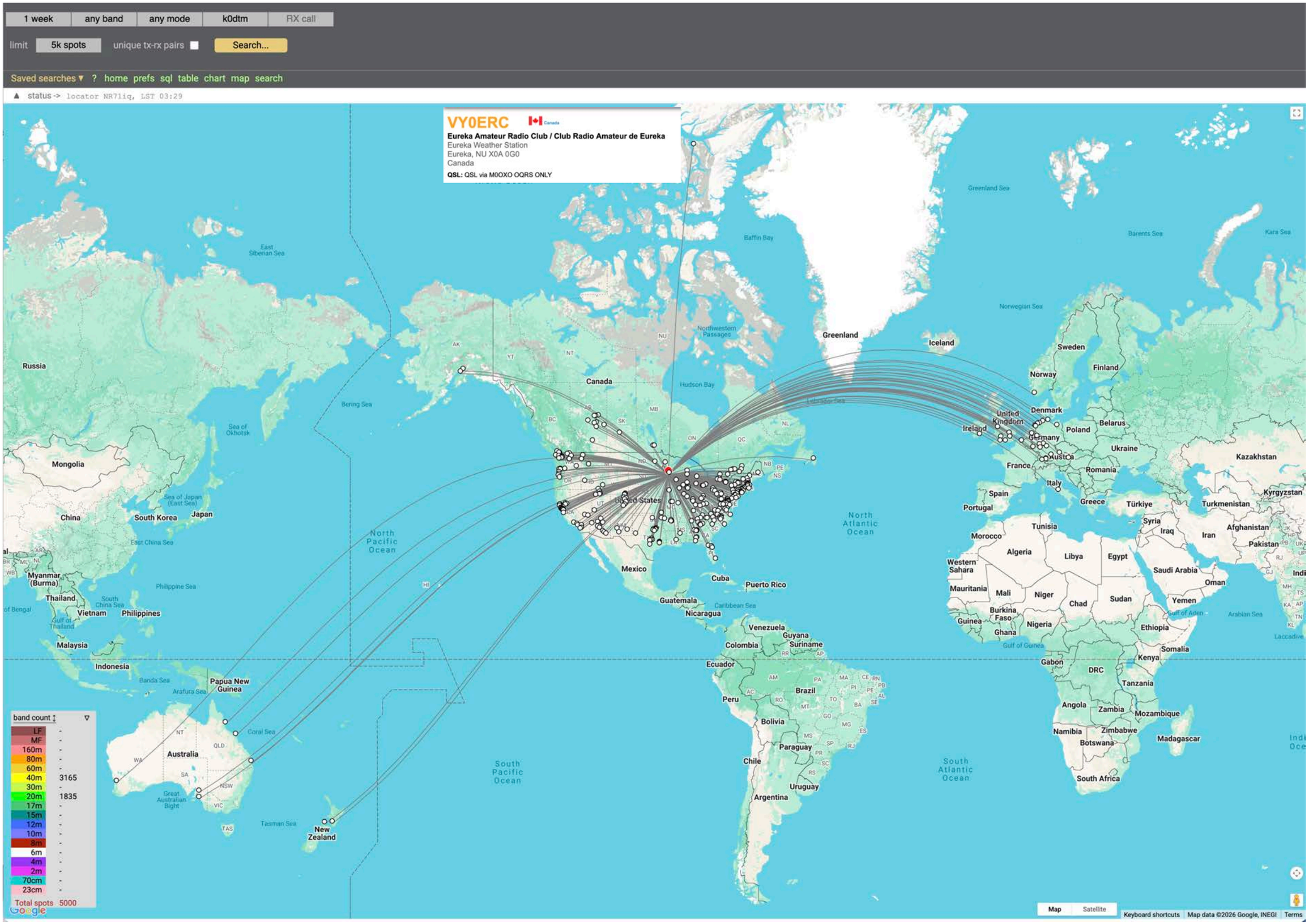
- What patterns do you see, if any?
- What seems to stand out?
- What seems to be ‘missing’?

- > 200,000 - Total Observations (Data Points)

- Map tool limited to 5,000 spots. Newest data first.
  Note: Maps don’t depict time of day or day of week - more of a general picture


ONE WEEK
LATER...
imgflip.com

K0DTM - TX all bands - Last 1 weeks



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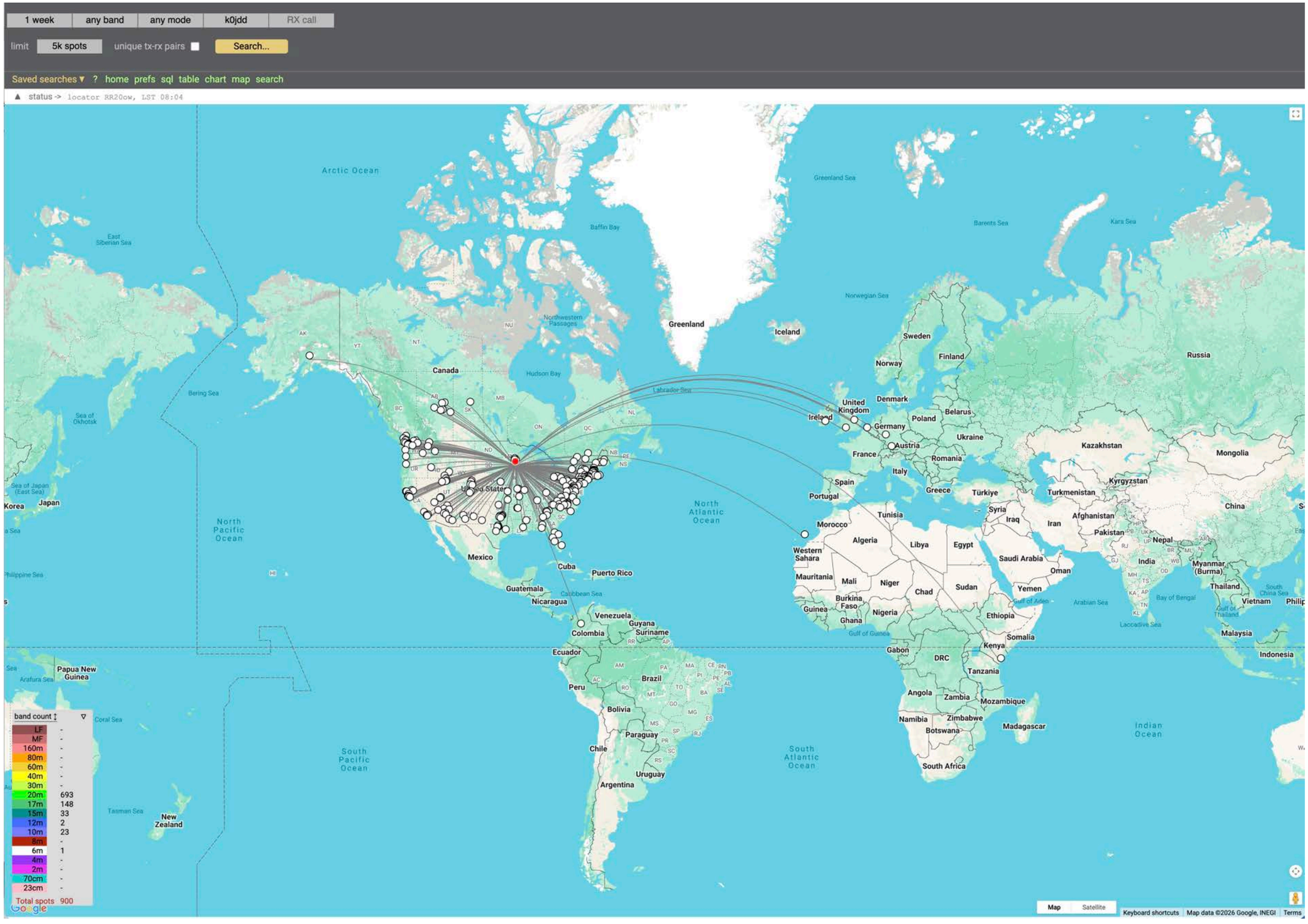
K0JDD - TX all bands - Last 1 week



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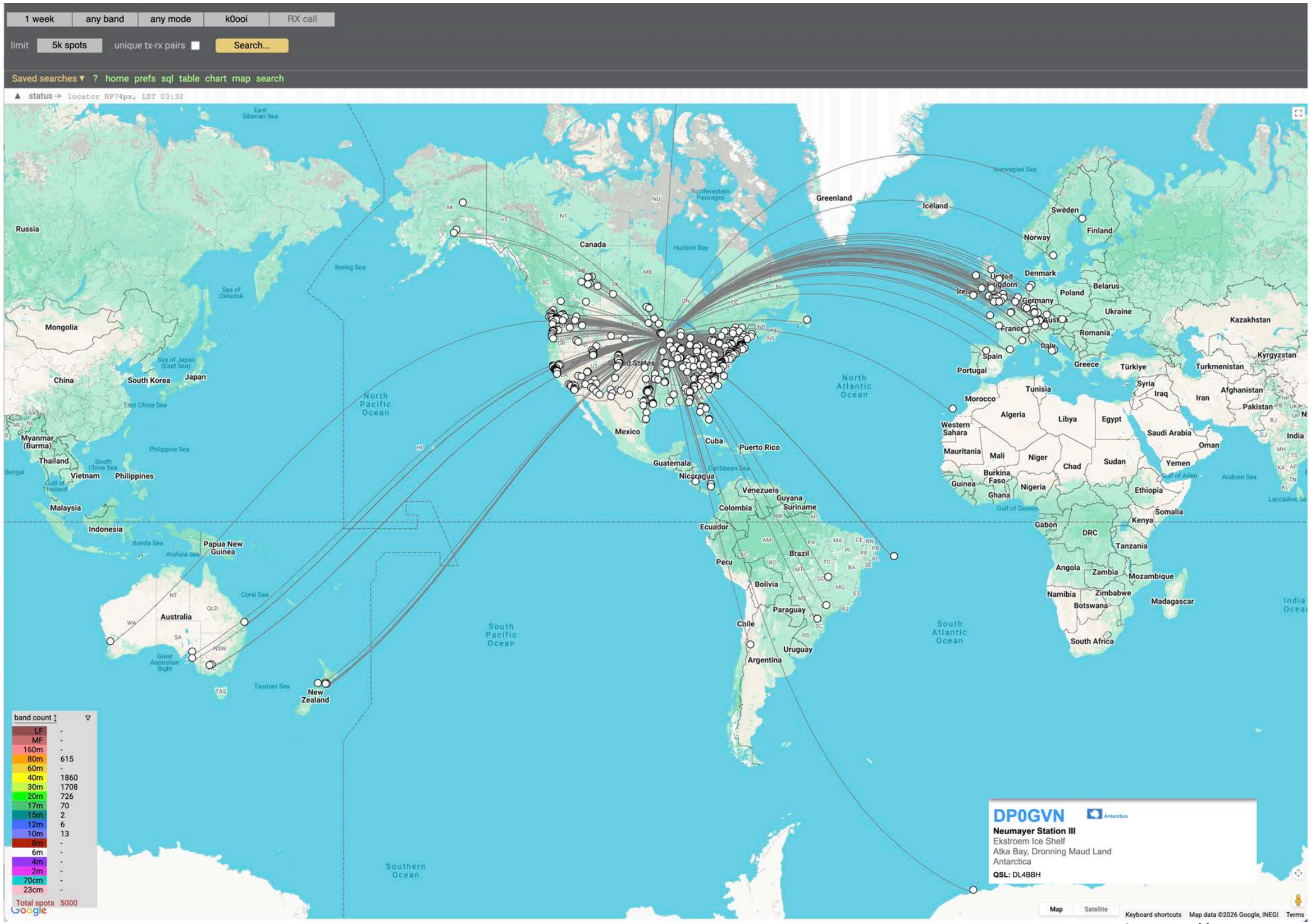
K0OOI - TX all bands - Last 1 week



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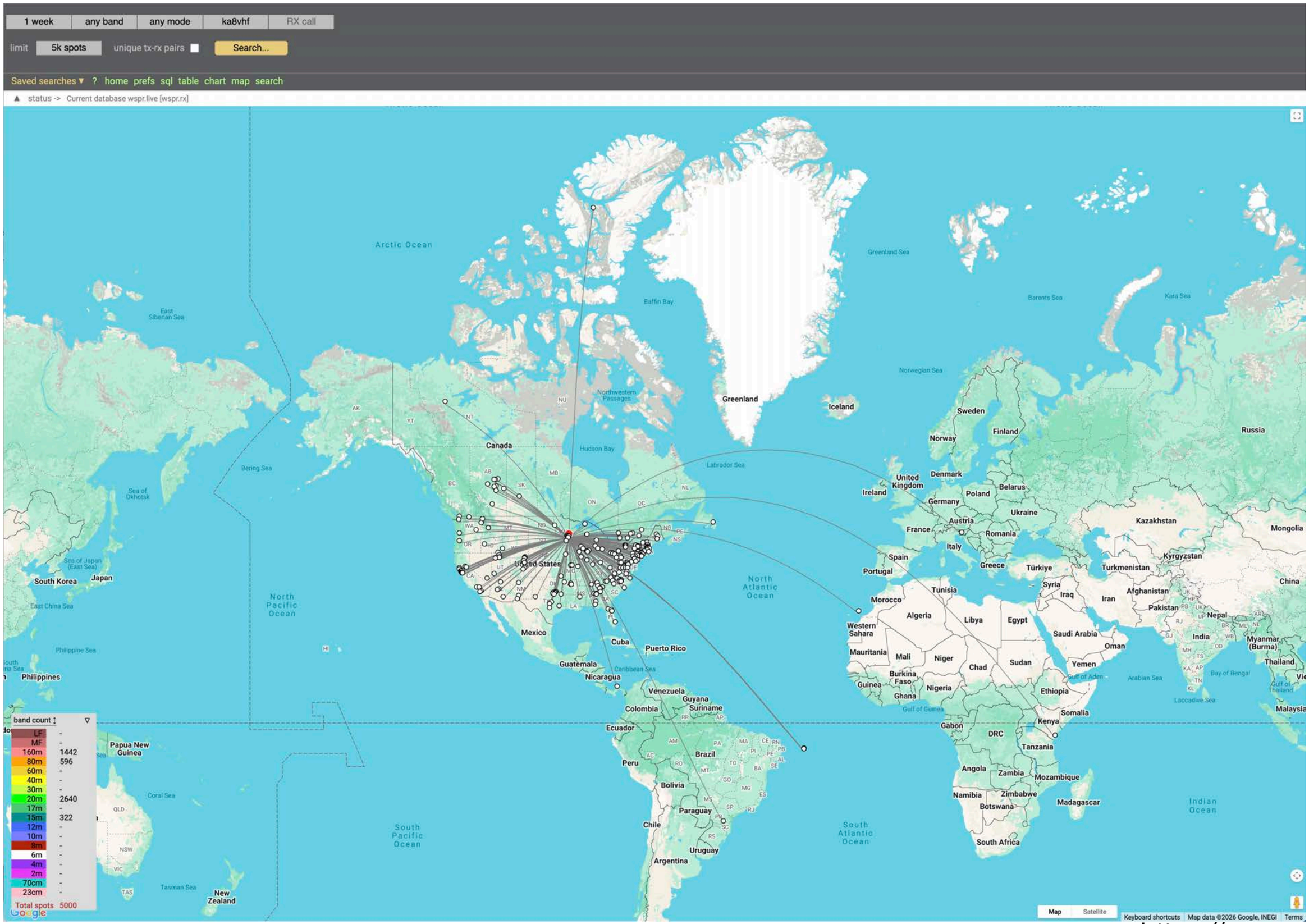
KA8VHF - TX all bands - Last 1 week



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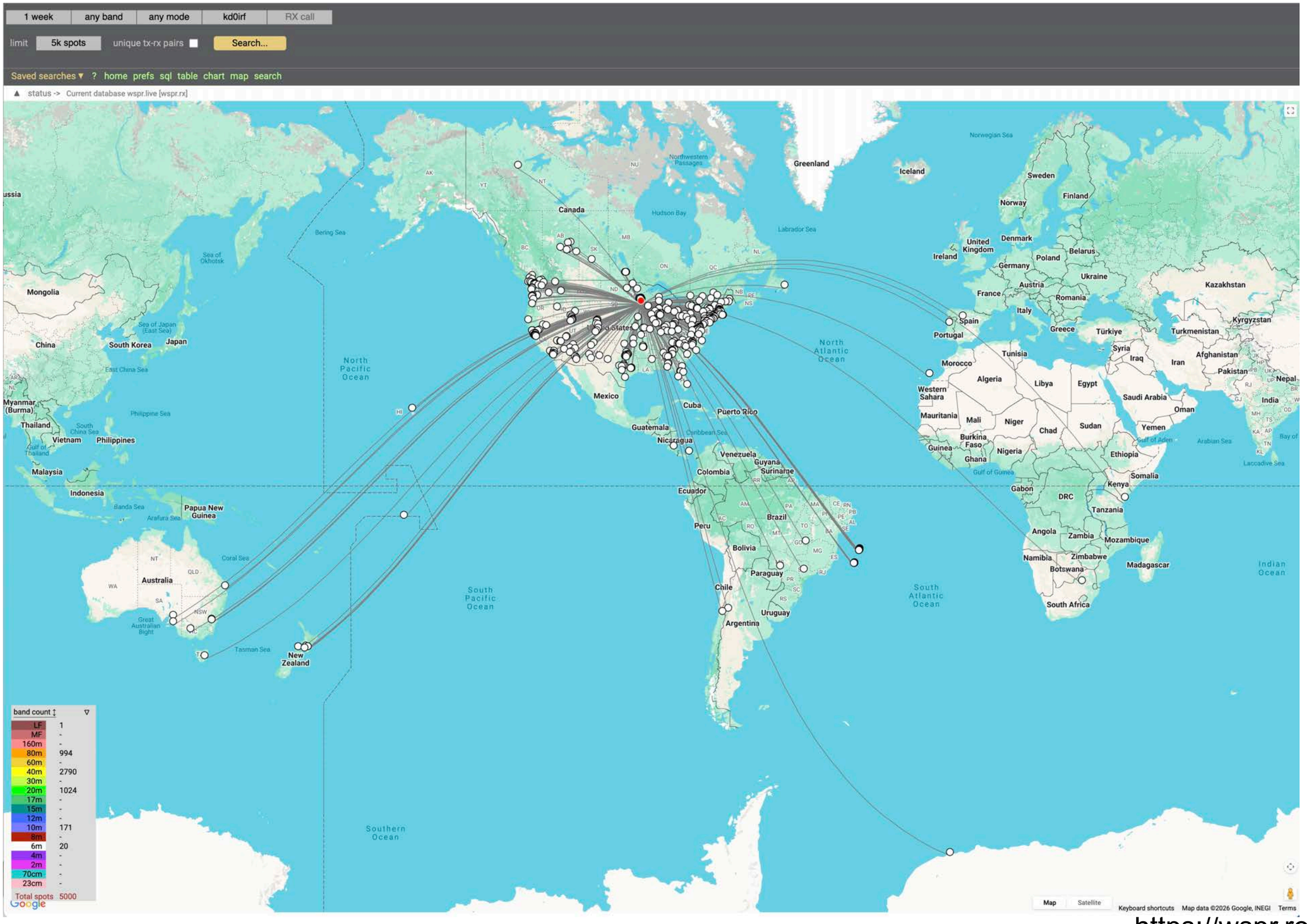
KD0IRF - TX all bands - Last 1 week



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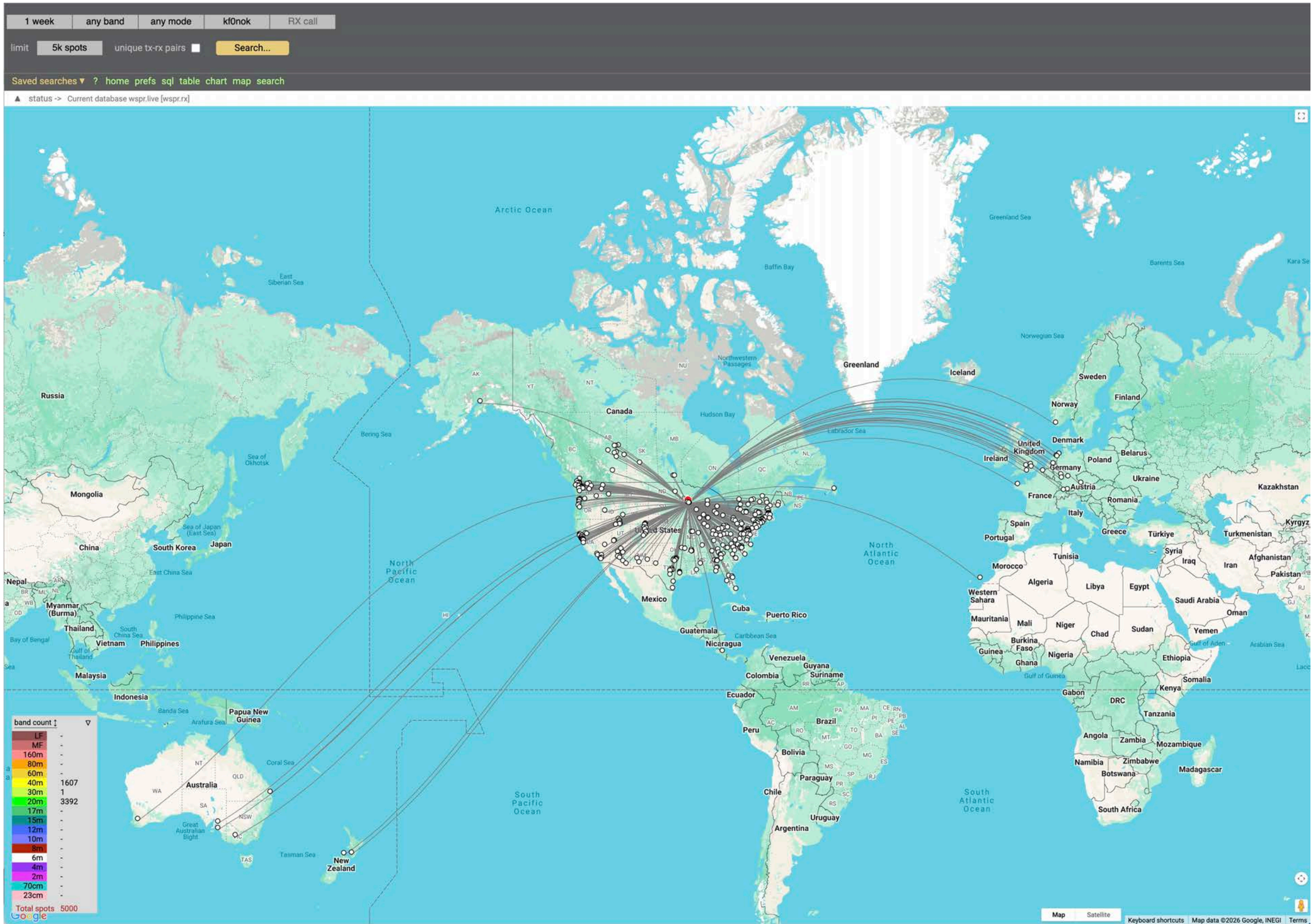
KF0NOK - TX all bands - Last 1 week



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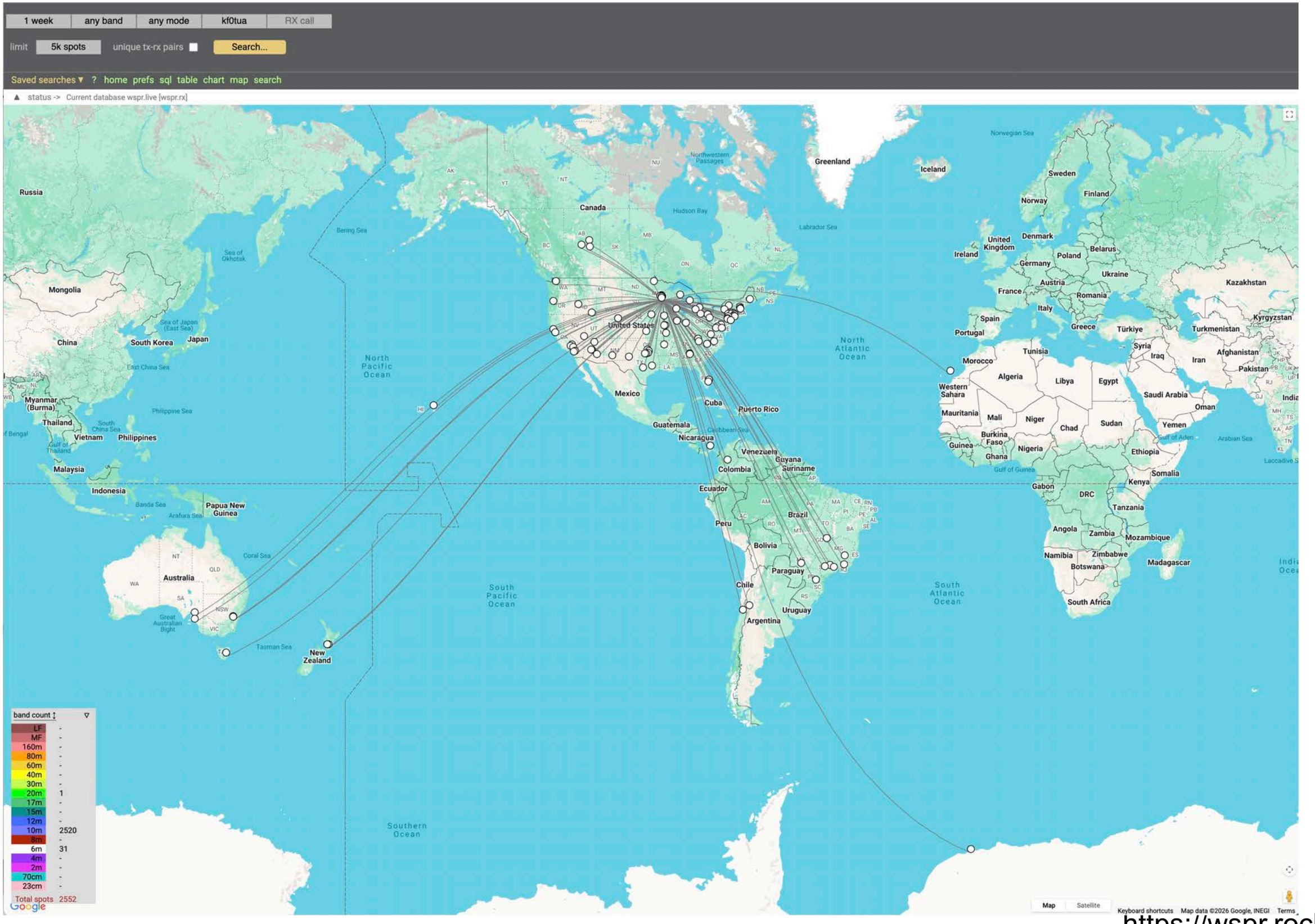
KF0TUA - TX all bands - Last 1 week



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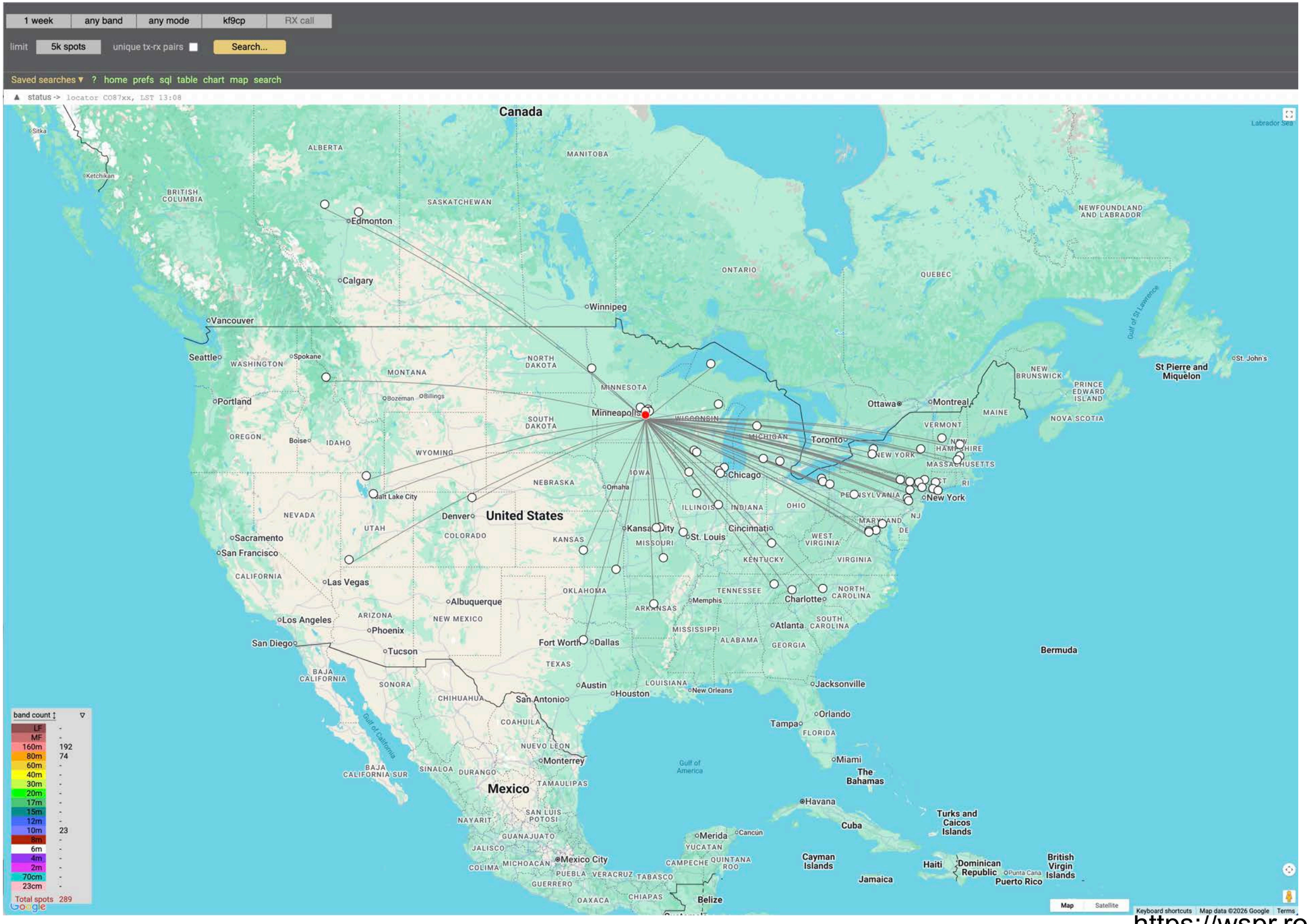
KF9CP - TX all bands - Last 1 week



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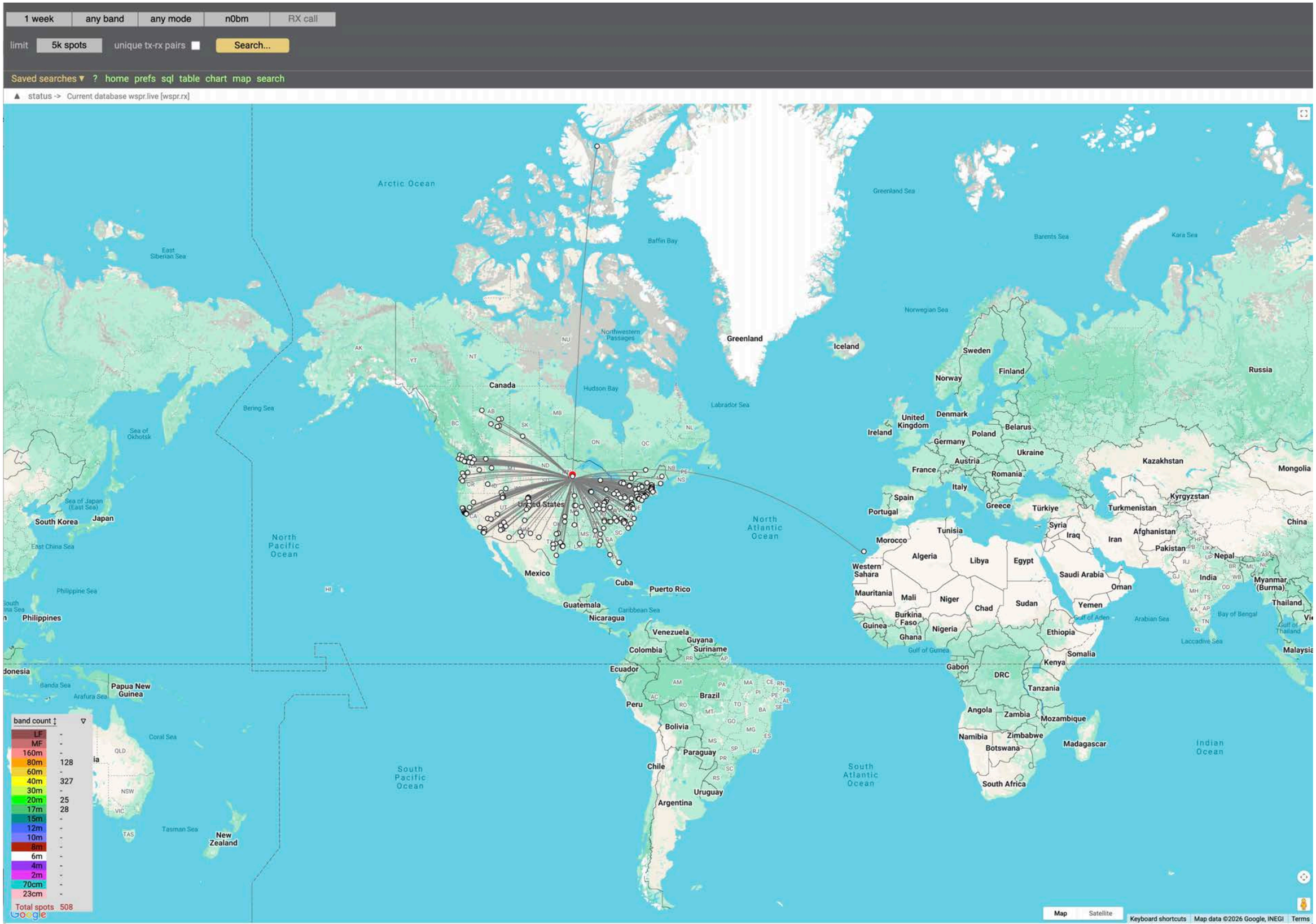
N0BM - TX all bands - Last 1 week



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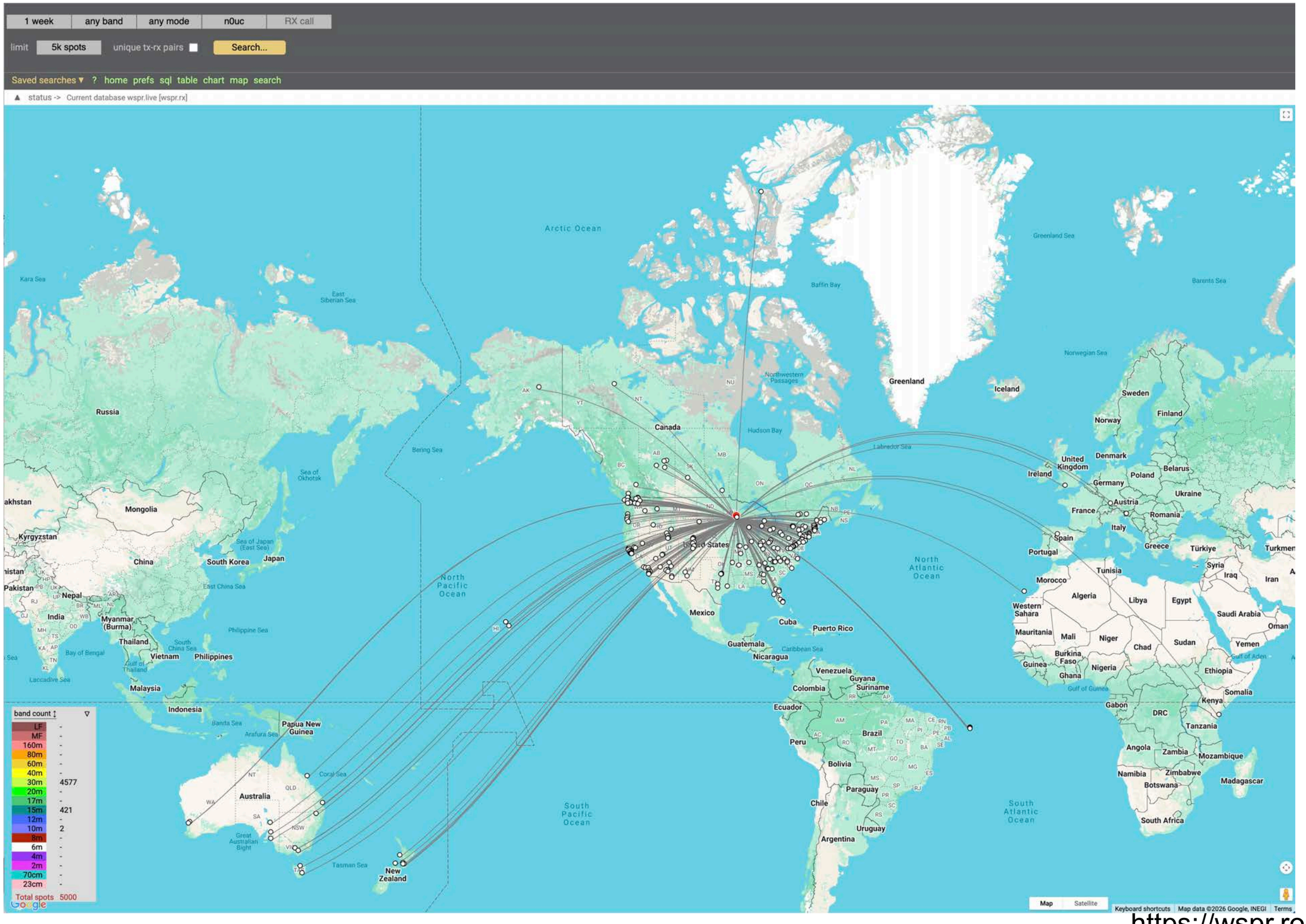
N0UC - TX all bands - Last 1 week



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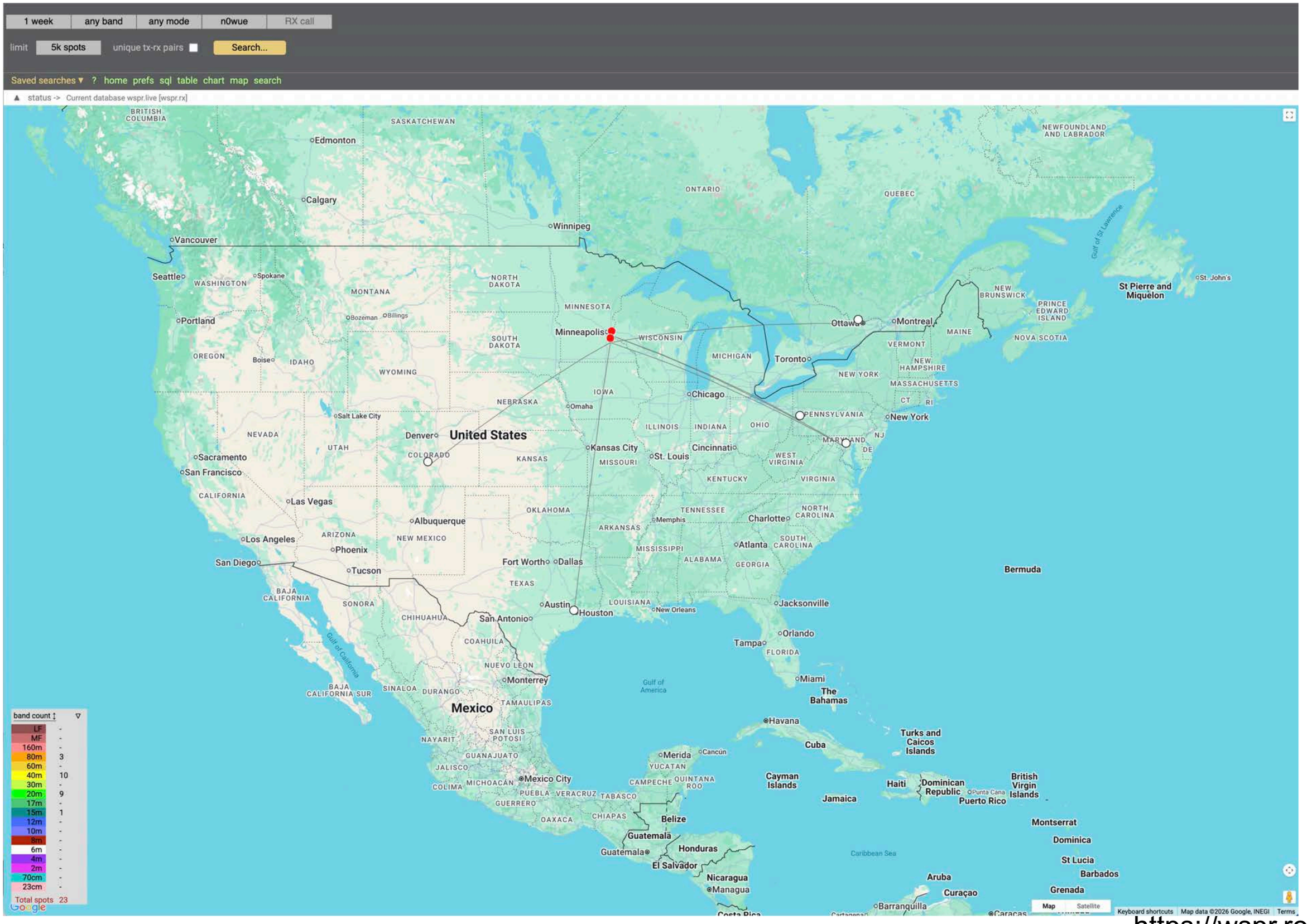
N0WUE - TX all bands - Last 1 week



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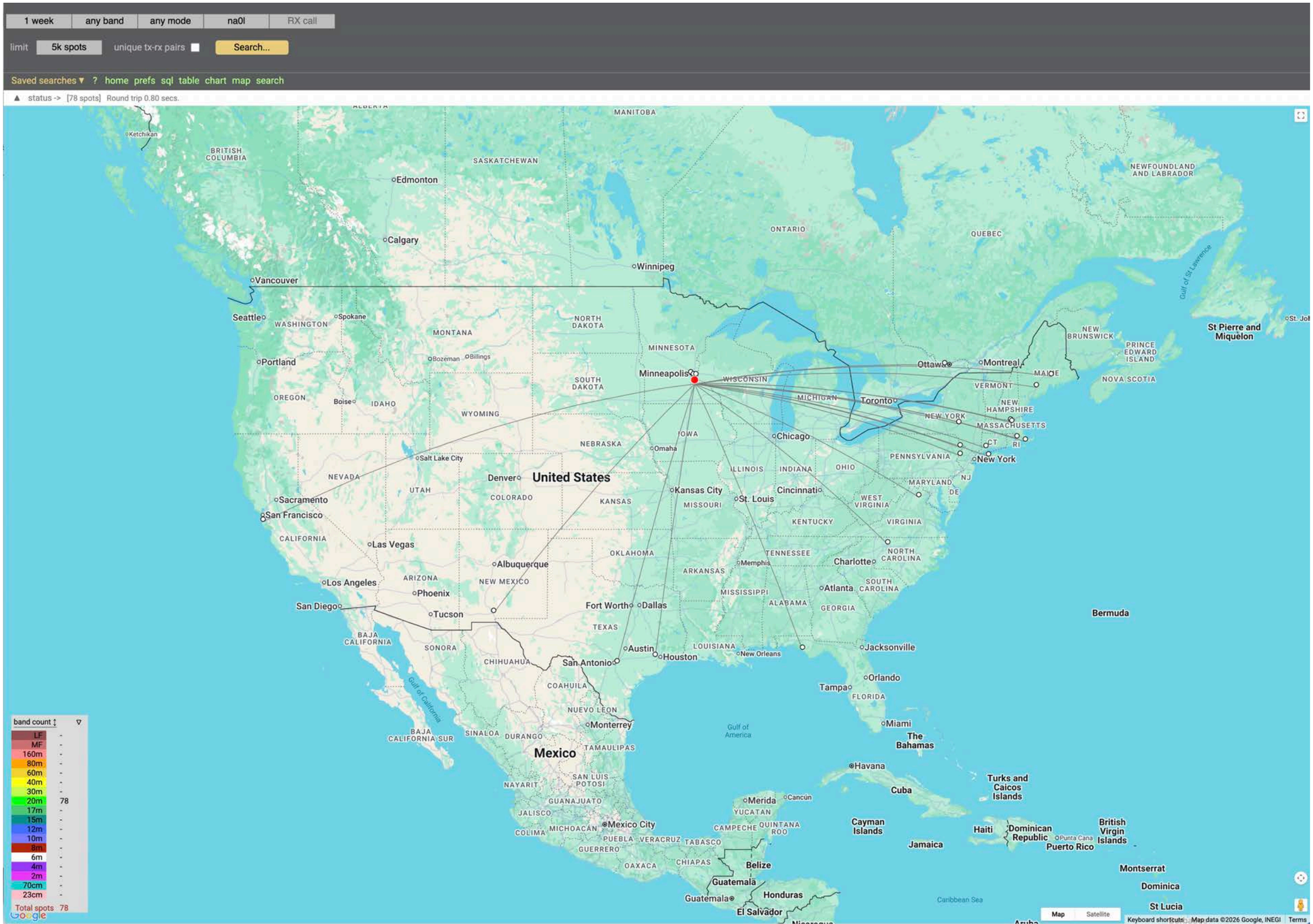
NA0L - TX all bands - Last 1 week



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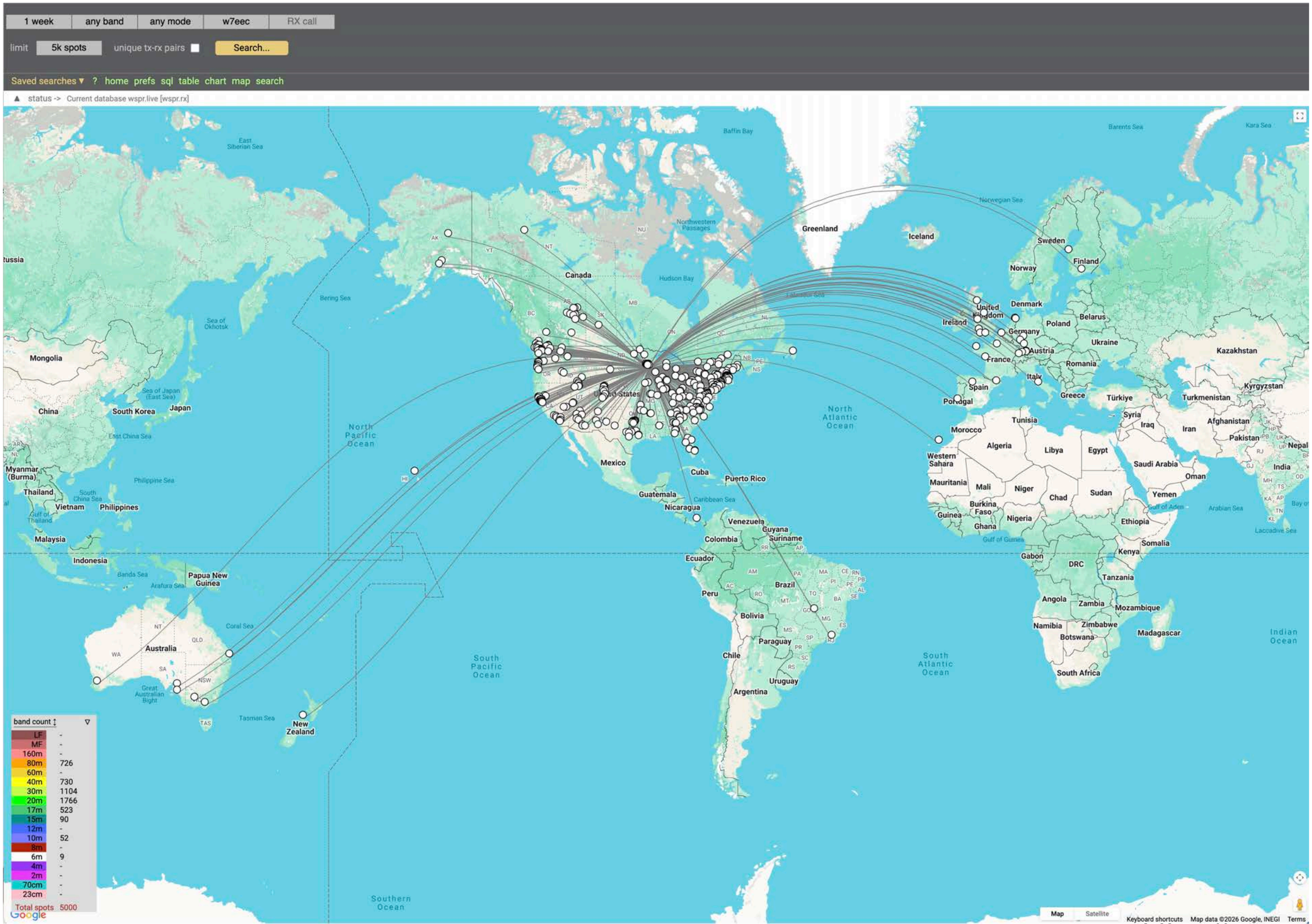
W7EEC - TX all bands - Last 1 week



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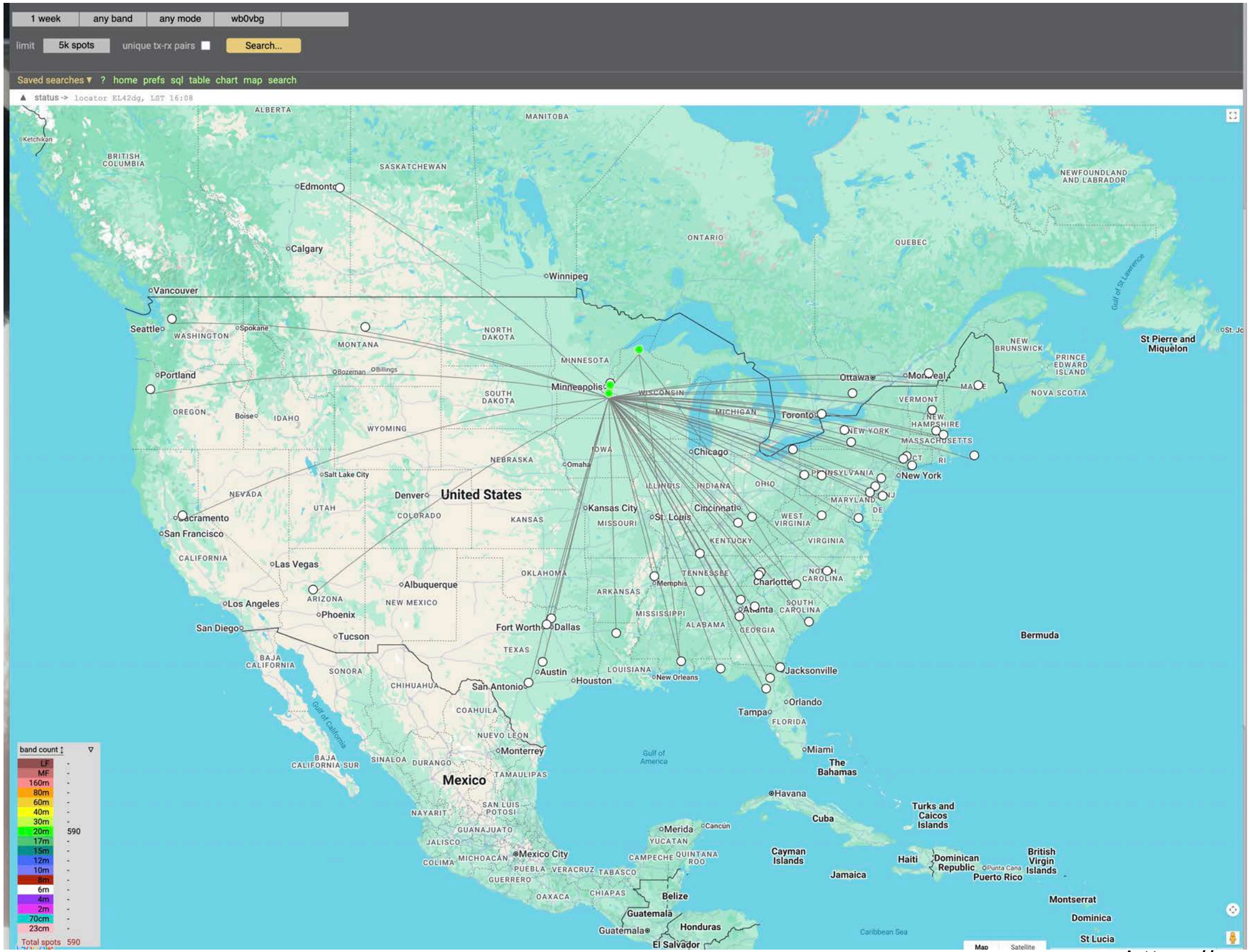
WB0VBG - RX all bands - Last 1 week



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SEMARC WSPR Week

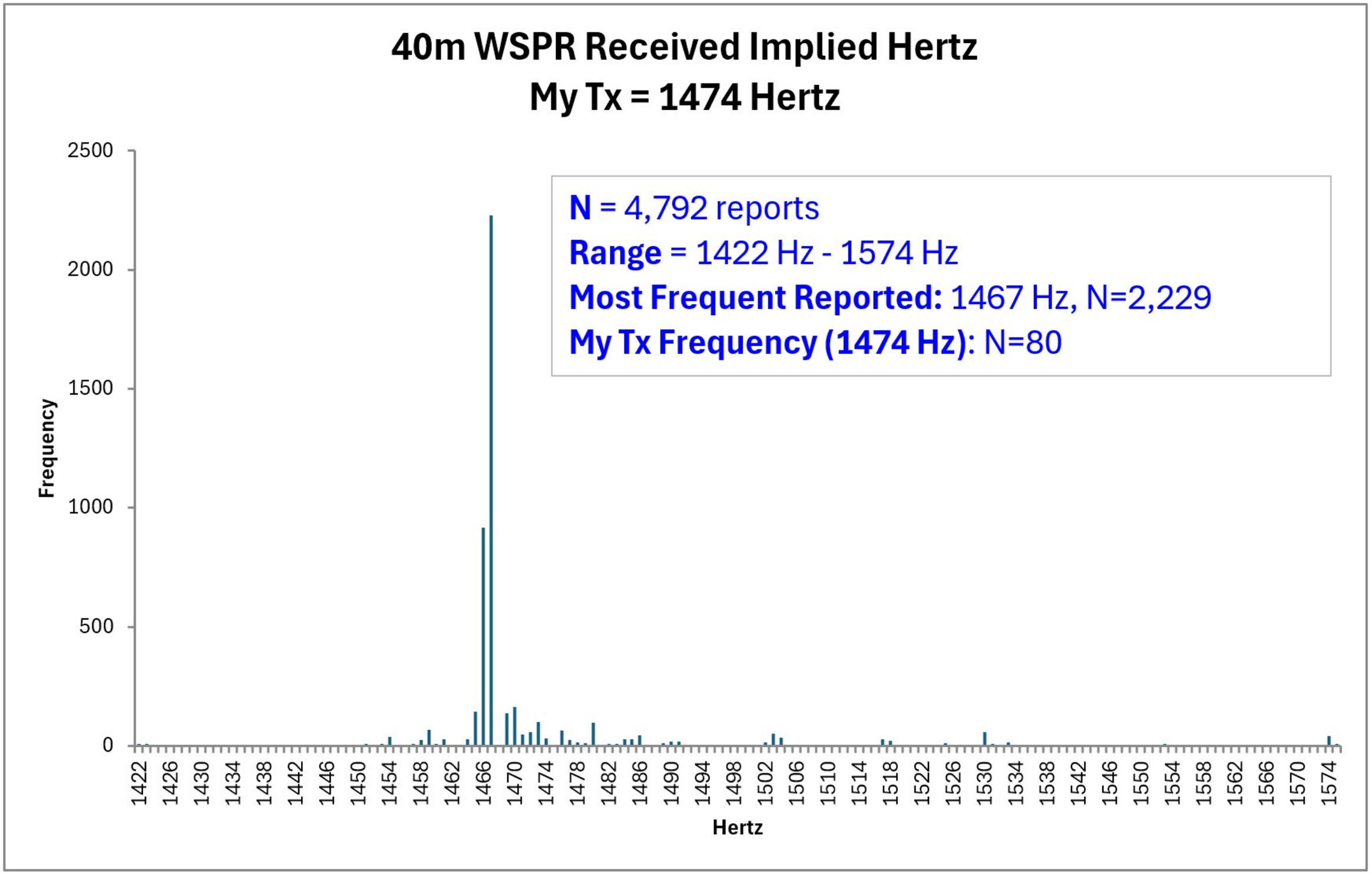
Extremely High Level Analysis

- What patterns do you see, if any?
- What seems to stand out?
- What seems to be ‘missing’?

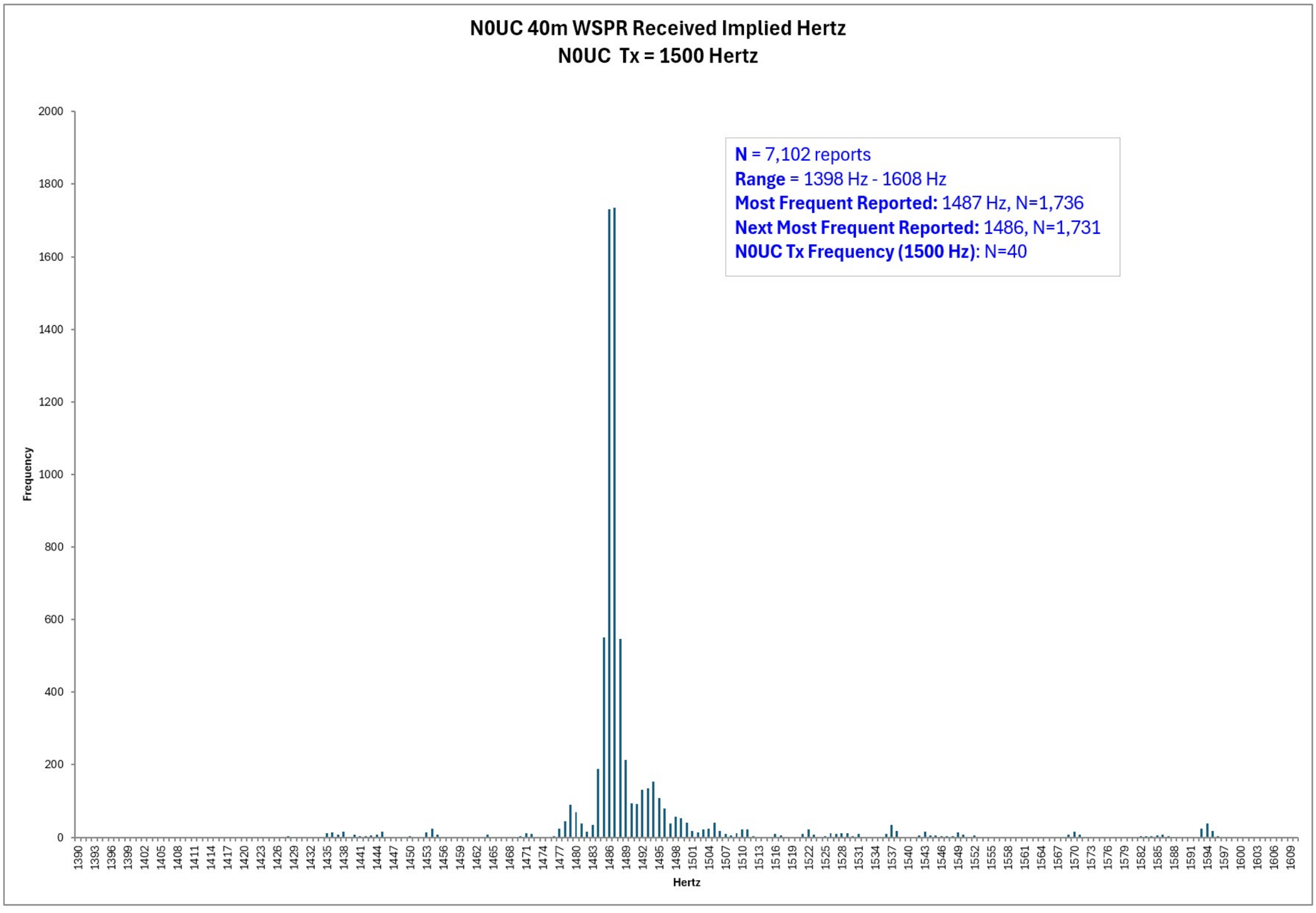
Oak Clusters Awarded

For WSPR Week Efforts Above and Beyond

KA8VHF Frequency Analysis 40m



N0UC Frequency Analysis 40m



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- Taylor, J., & Walker, B. (2010, November). *Whispering around the world.* QST Magazine.

- Murray, C. (2021, November). *WSPR near real-time propagation analysis.* www.gm4eau.com.

Q&A / Discussion