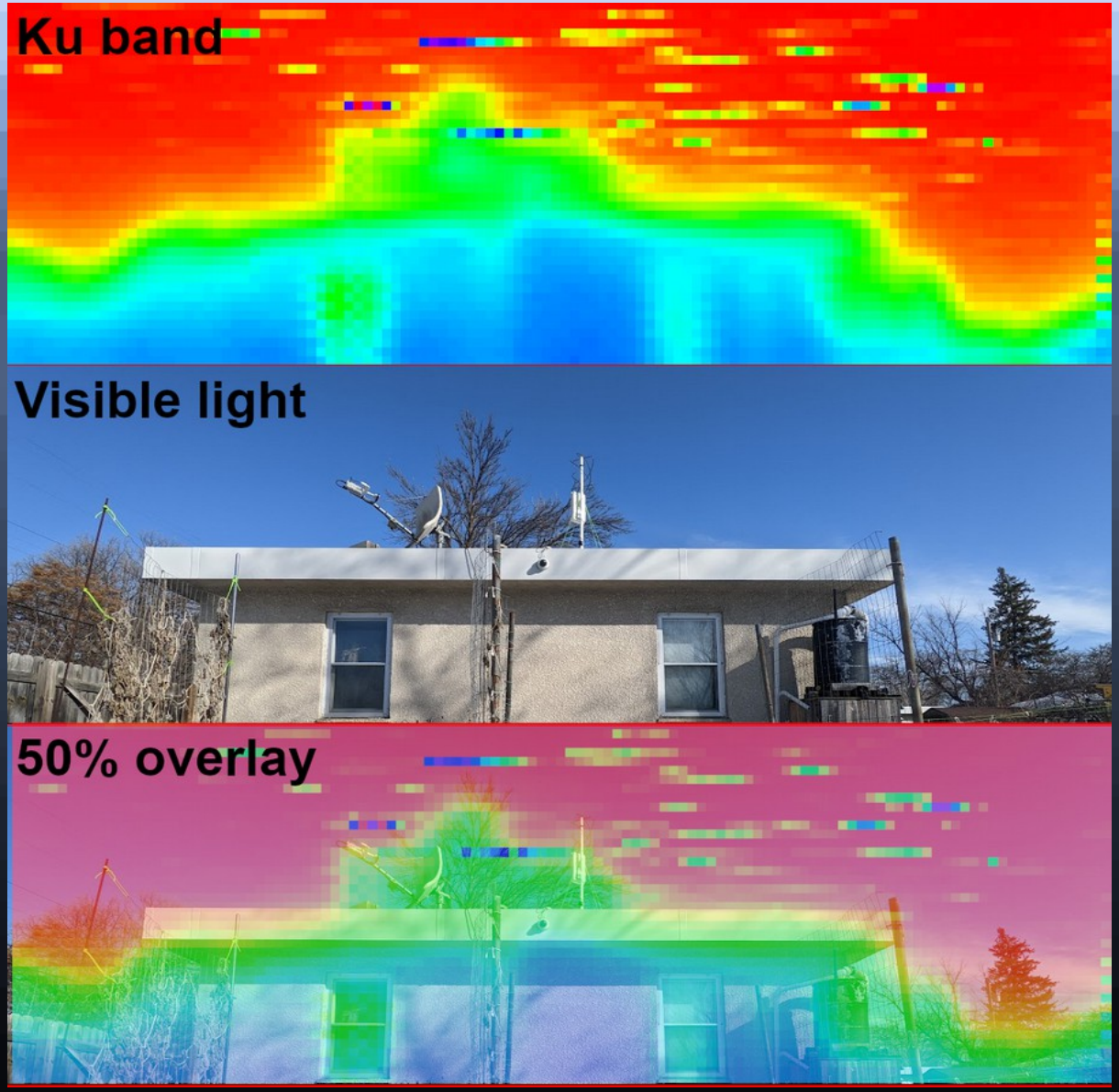
# Seeing Radio Waves (on a budget)




Gabe Emerson - Secretcon 2026

# Introduction / Abstract

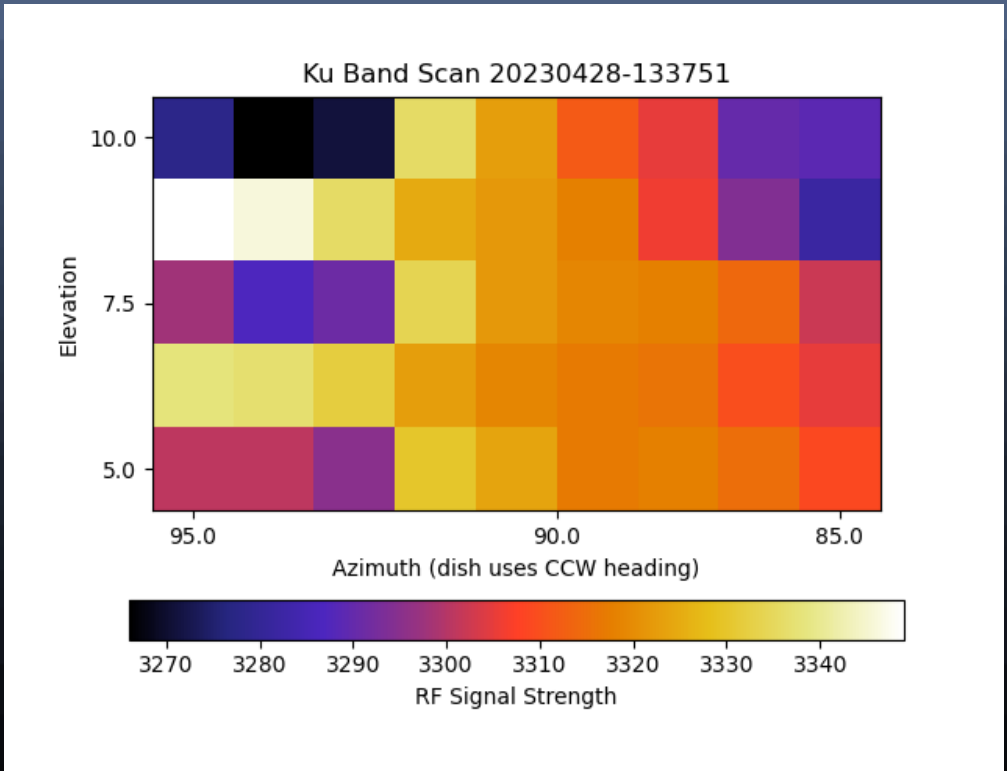
- Radio imaging isn't new, but usually expensive / not very portable
- Ongoing project – I've been doing since 2023
- Great way to visualize radio signals
- More intuitive than “Fox Hunting”
- Not as expensive as you might think
- I showed some of this at Secretcon 2025
- Also demo'd at Open Sauce in SF
- Several videos at youtube.com/saveitforparts

# Background / Bio

- I grew up on an island in Alaska
- Long-time interest in radios & computers
- Lots of hobbies, not an “expert” at any one thing
- Started YouTube channel ~2020, now fulltime

# Radio Imaging – Basic Theory

- “See” radio waves by graphing signal strength to x,y coordinates.

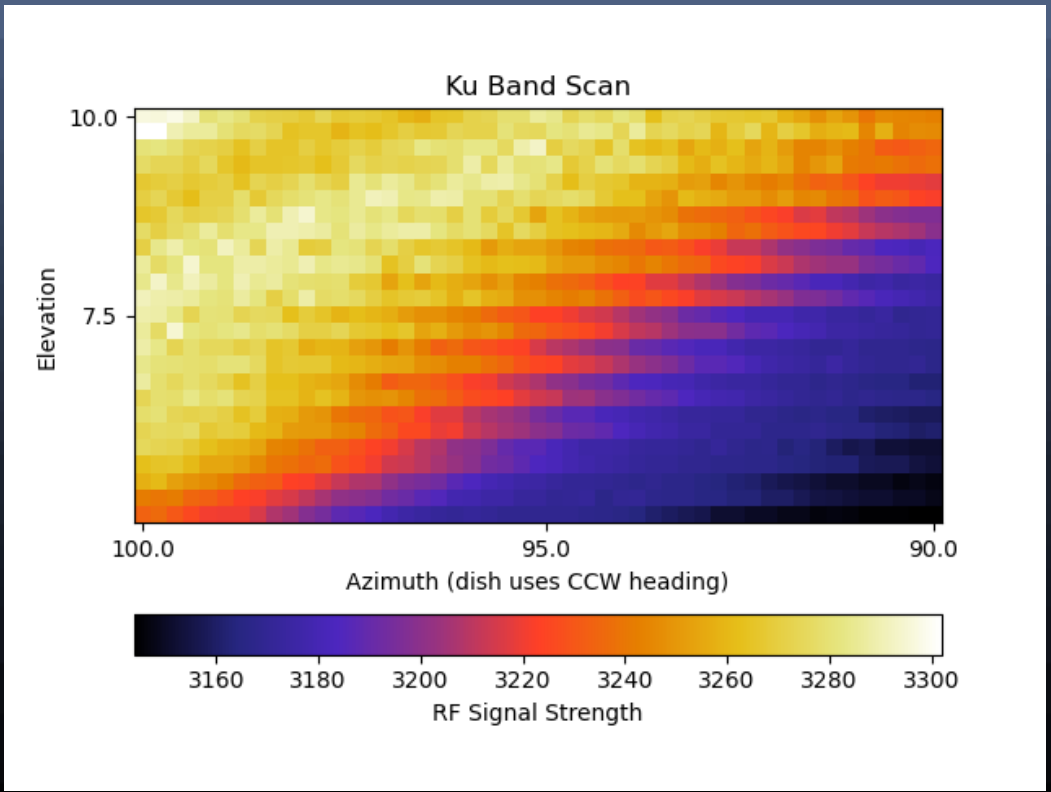


# Radio Imaging – Basic Theory

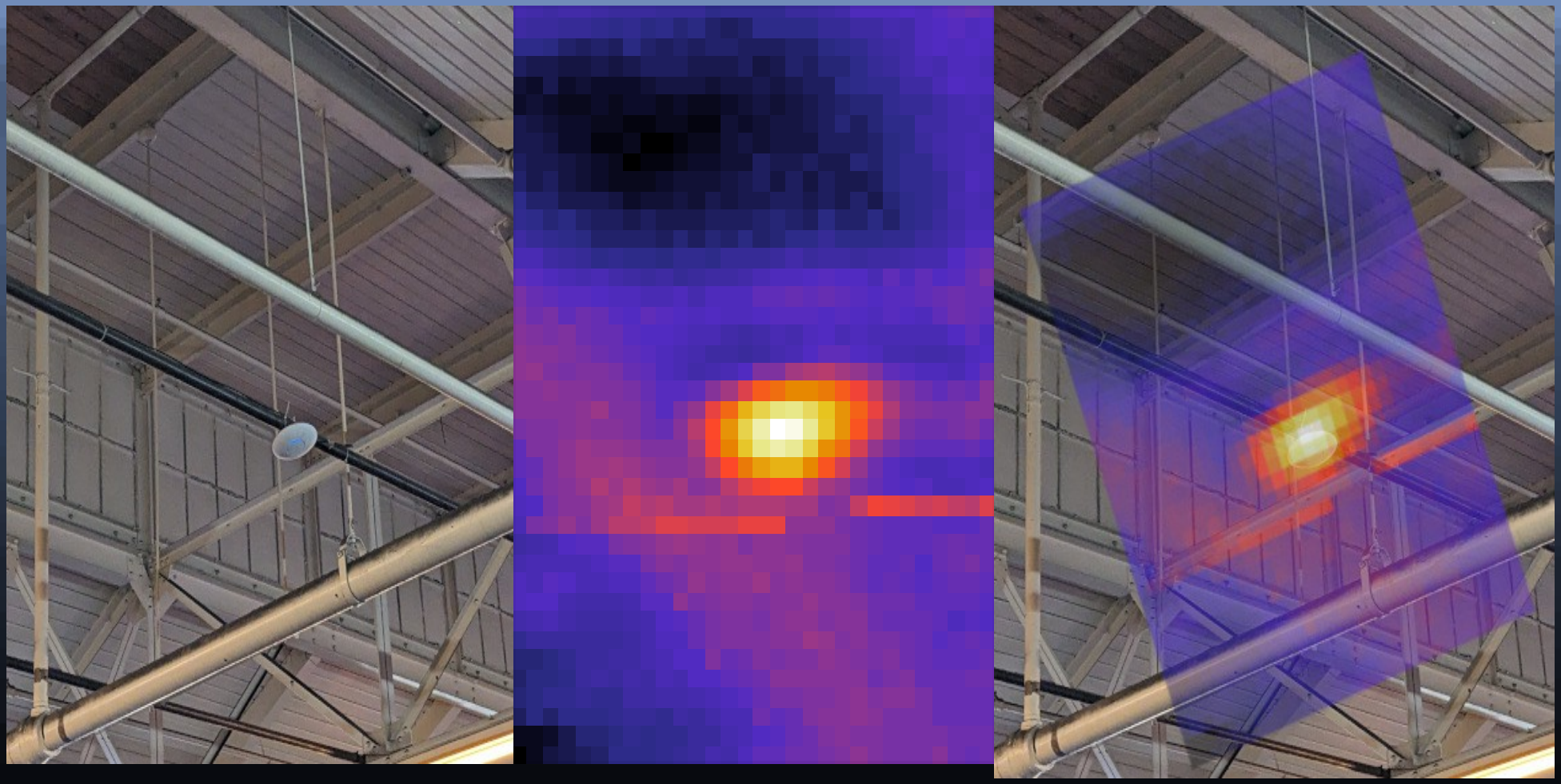
- Point antenna at coordinates
- Record signal
- Repeat


# Radio Imaging – Basic Theory

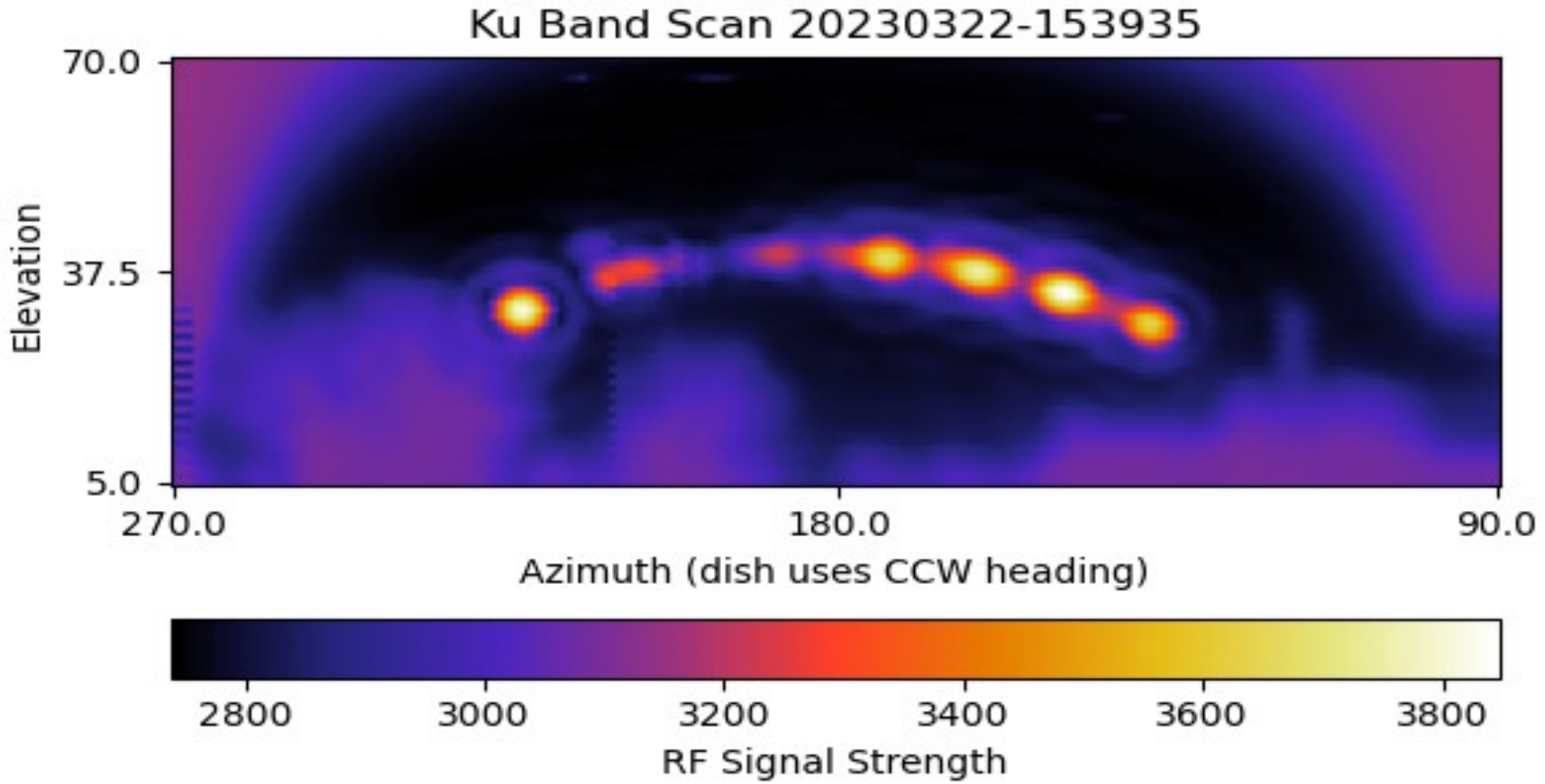
- Essentially a “single pixel camera”
- Iterates through x/y range, creates heatmap.



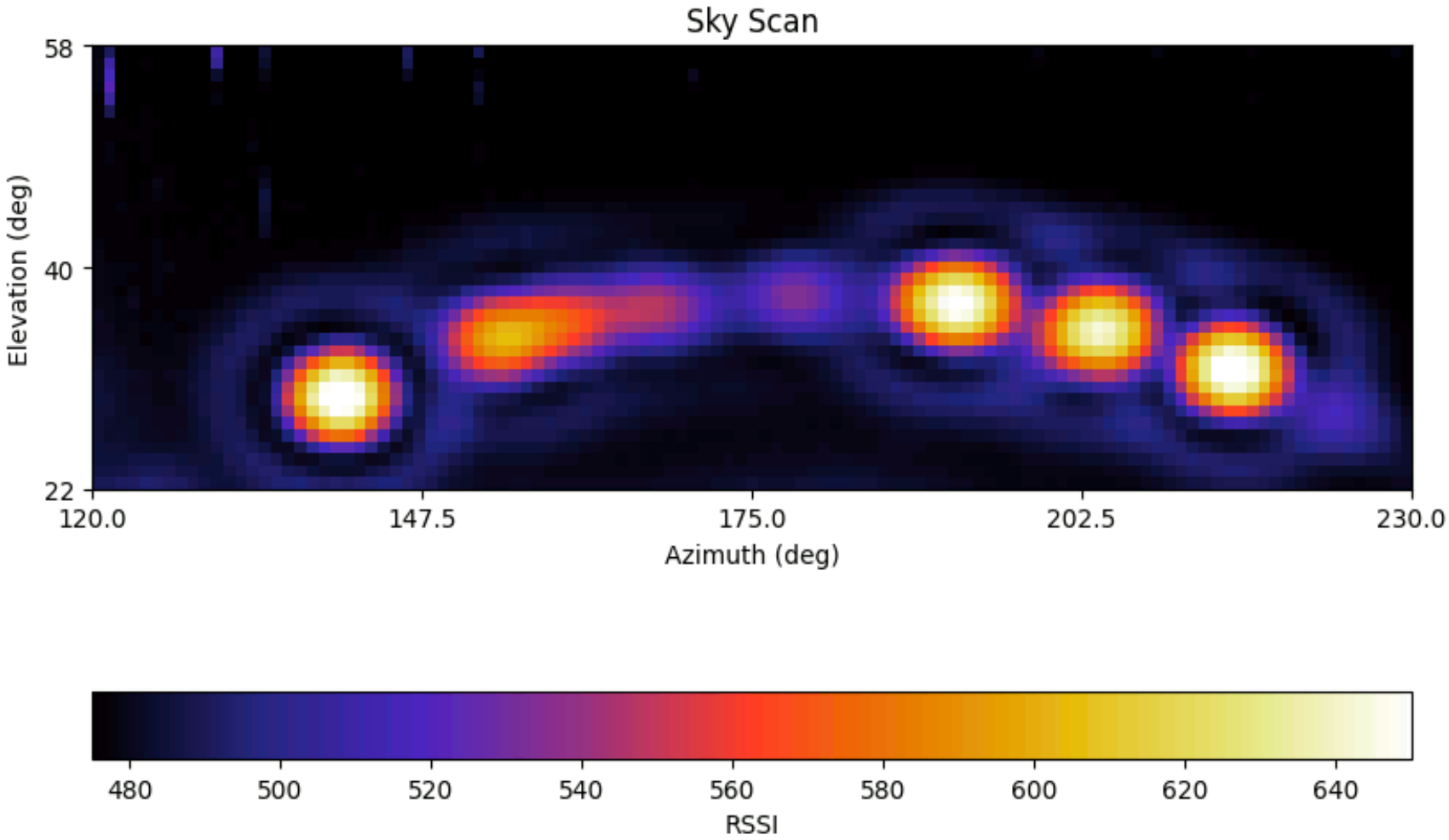
# Example: Wi-Fi



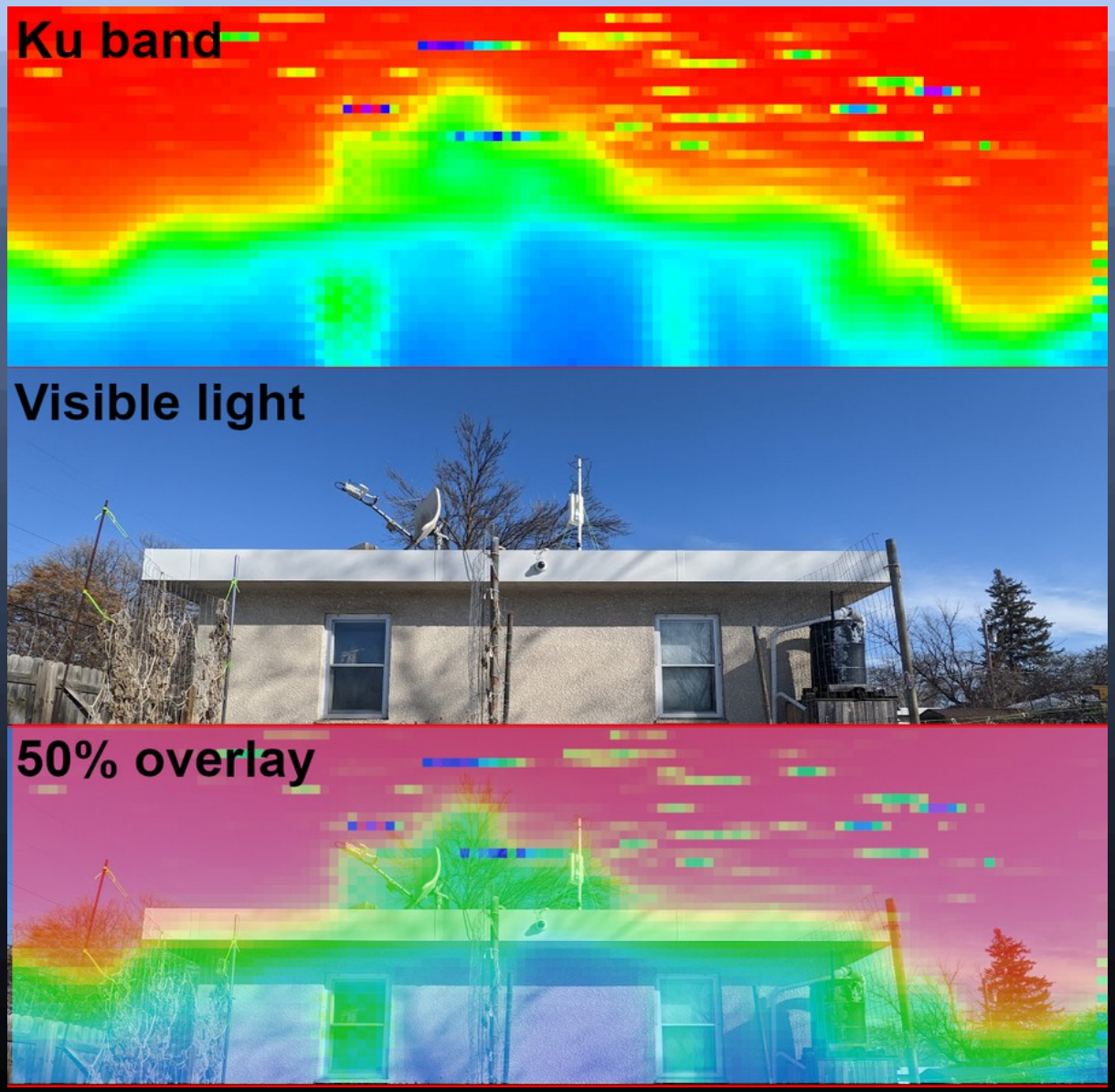
# Example: TV Satellites



# Example: Orbits animated



# Example: Structure Scans



# Applications

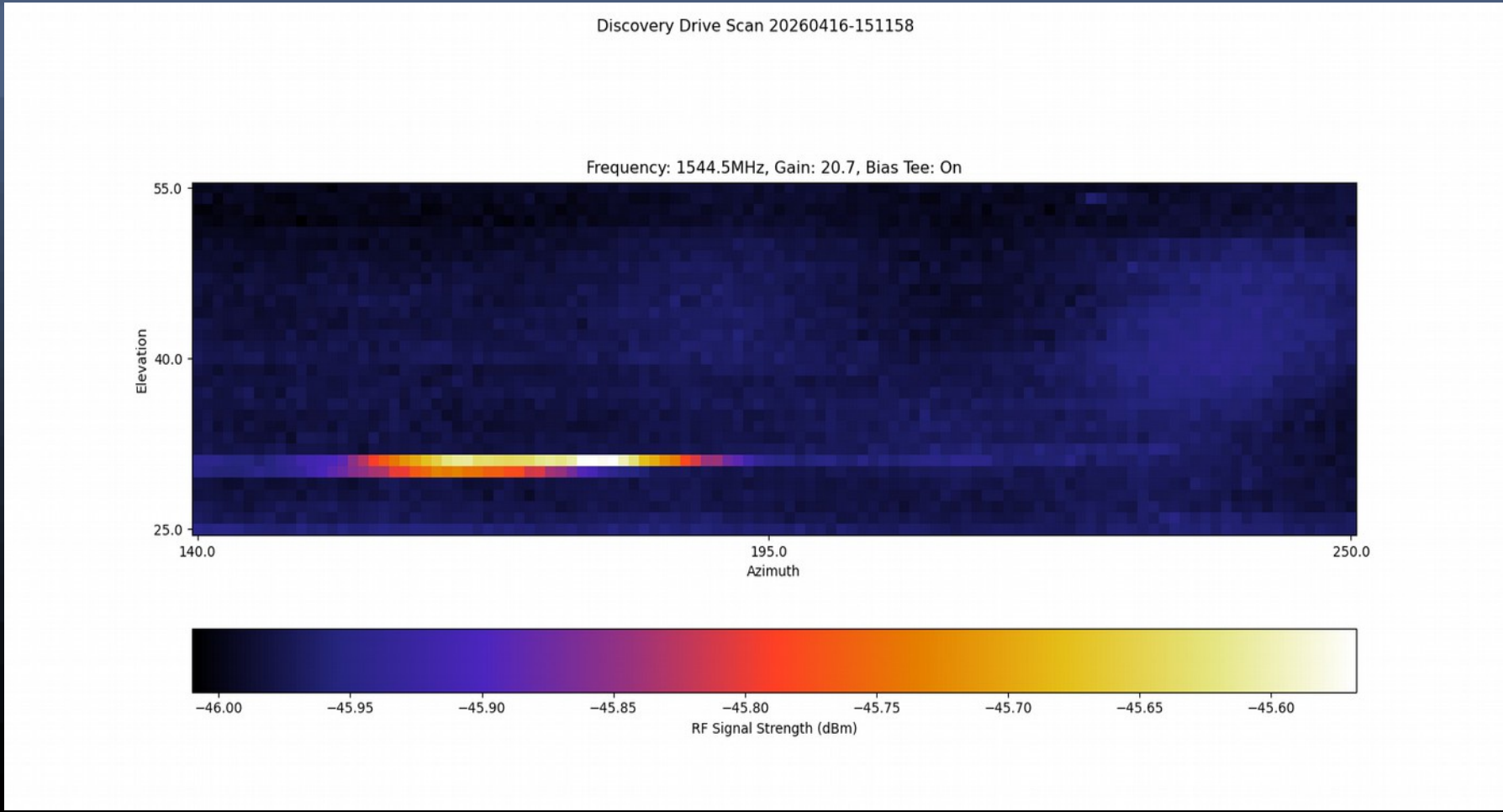
- Locate hidden signals
- Spot transient signals
- Visualize radio propagation
- Find Interference
- Validate security
- Learn about radio

# Applications: Hidden Signals

- Spot rogue APs / Wireless Networks

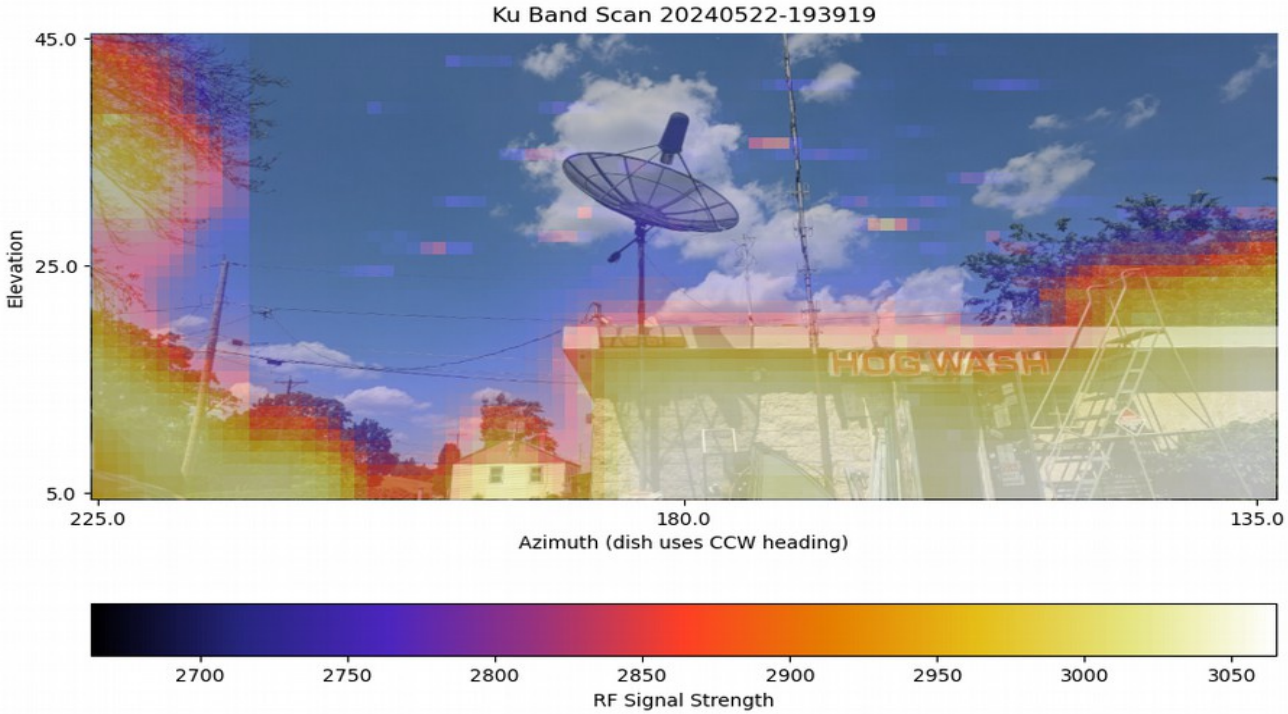
# Applications: Transient Signals

- Example: SARSAT Repeater on GPS



# Applications: Radio Propagation

- Find dead zones
- More efficiently site network nodes



# Applications: Radio Propagation

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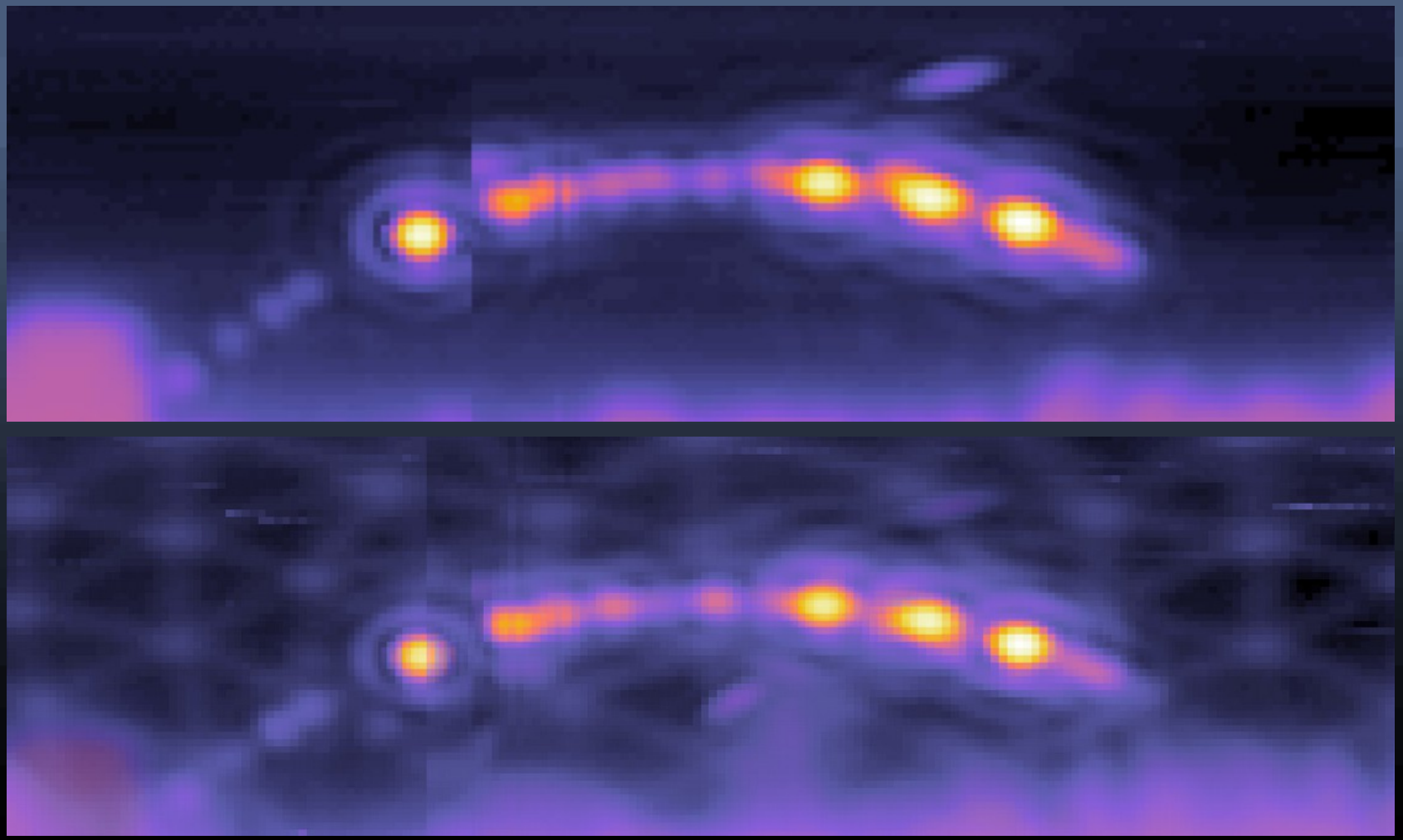
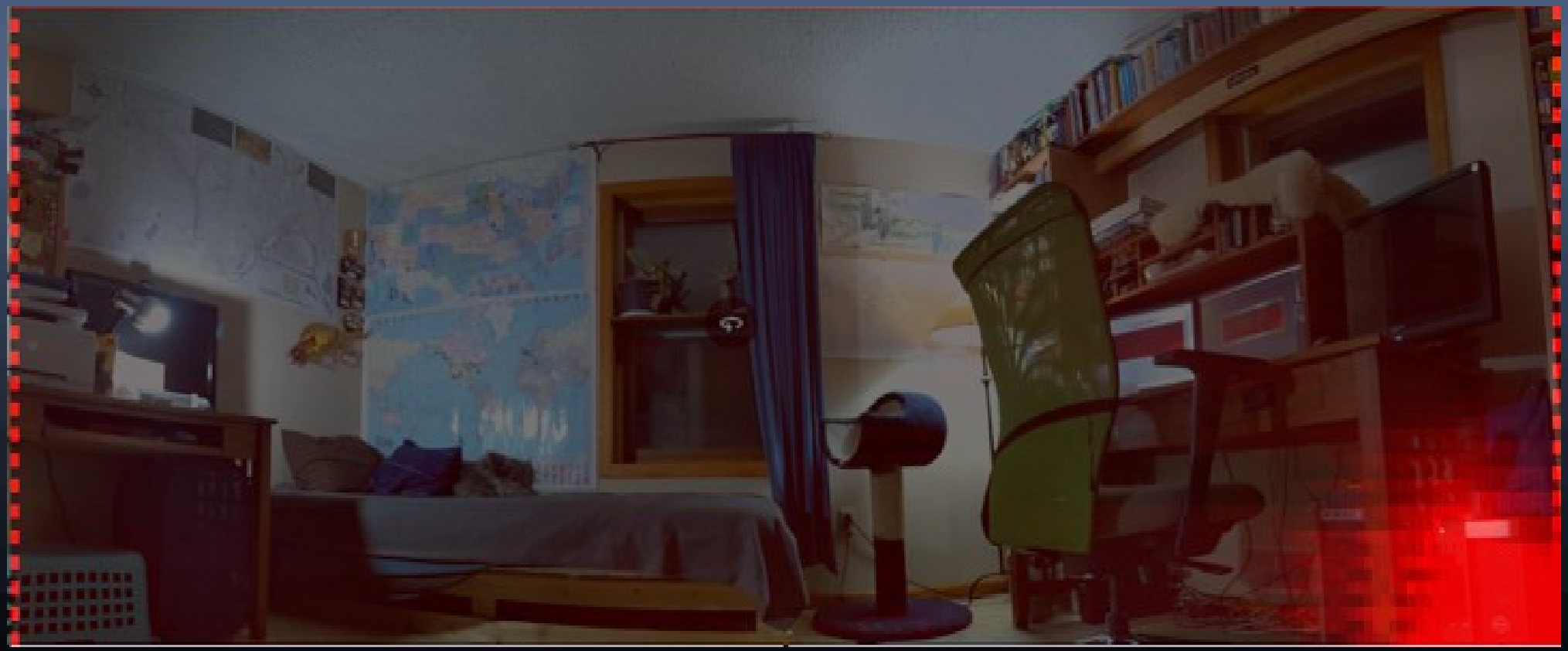


# Applications: Find Interference

- Locate Potential RFI sources



# Applications: Validate Security

- Faraday Cage / Bag
- TEMPEST Shielding

# Implementation

- Directional Antenna
- Motor Drive
- Microcontroller (or hacked controller)
- Software / Firmware
  - Scanning
  - Processing

# Antenna Types

- More focused / directional is better
- Polarity
  - Linear (V/H)
  - Circular (RH/LH)
- Beamwidth
  - Larger beam means less focused.
  - Wide beamwidth sees wider area weakly
  - Narrow beamwidth sees smaller area strongly

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# Antenna Types

- Lots of easy 3D-Printed / laser cut options
- Easy to re-purpose WiFi antennas

# Rotator Options

- Portable TV dishes ~$50
- Security Camera Pan/Tilt Mounts ~$100
- Commercial Antenna Rotators ~$1000
- Full DIY ~$???

# Rotator Options: TV Dishes

- Winegard Carryout
- Winegard Trav'ler
- Dish Tailgater
- Other models
- Low resale demand
- $0-$50 on FB/CL

# Rotator Options: TV Dishes

- Often have a serial debug / control port
- Often have manual-control firmware interface
- Sometimes need RS485 or 422 adapter


# Rotator Options: TV Dishes

- Can interface with firmware directly
- Can also interpret to standard rotor protocol
- Manual commands to go to arbitrary position
- Read signal from onboard hardware (Sat TV)
- Or read modified antenna feed with SDR
- I usually use separate script for processing

# Rotator Options: Security PTZ

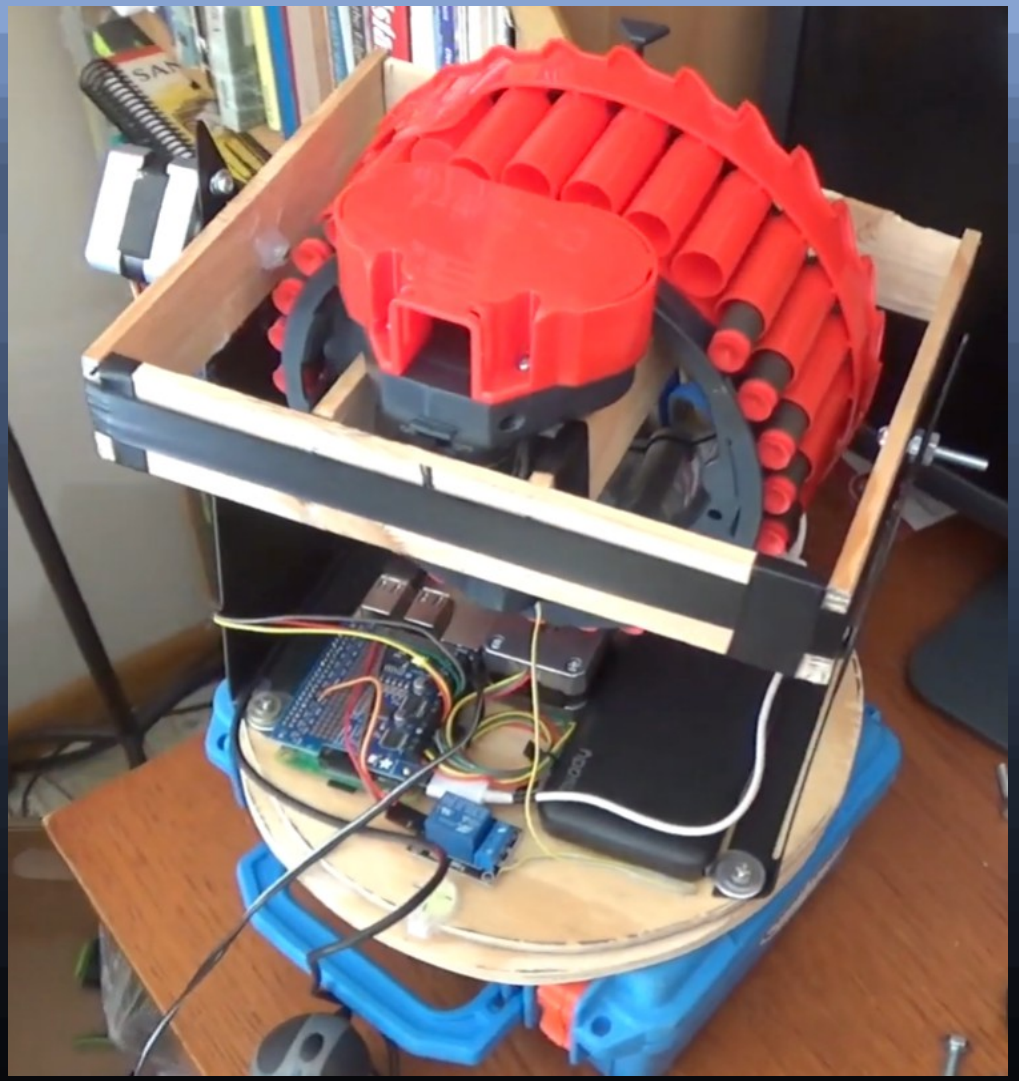
- More expensive
- More weatherproof
- Oddball power
- Heavier
- Pots optional
- More suited for outdoor / permanent installtion

# Rotator Options: Commercial

- Yaesu
- Discovery Drive
- AntRotor
- Others

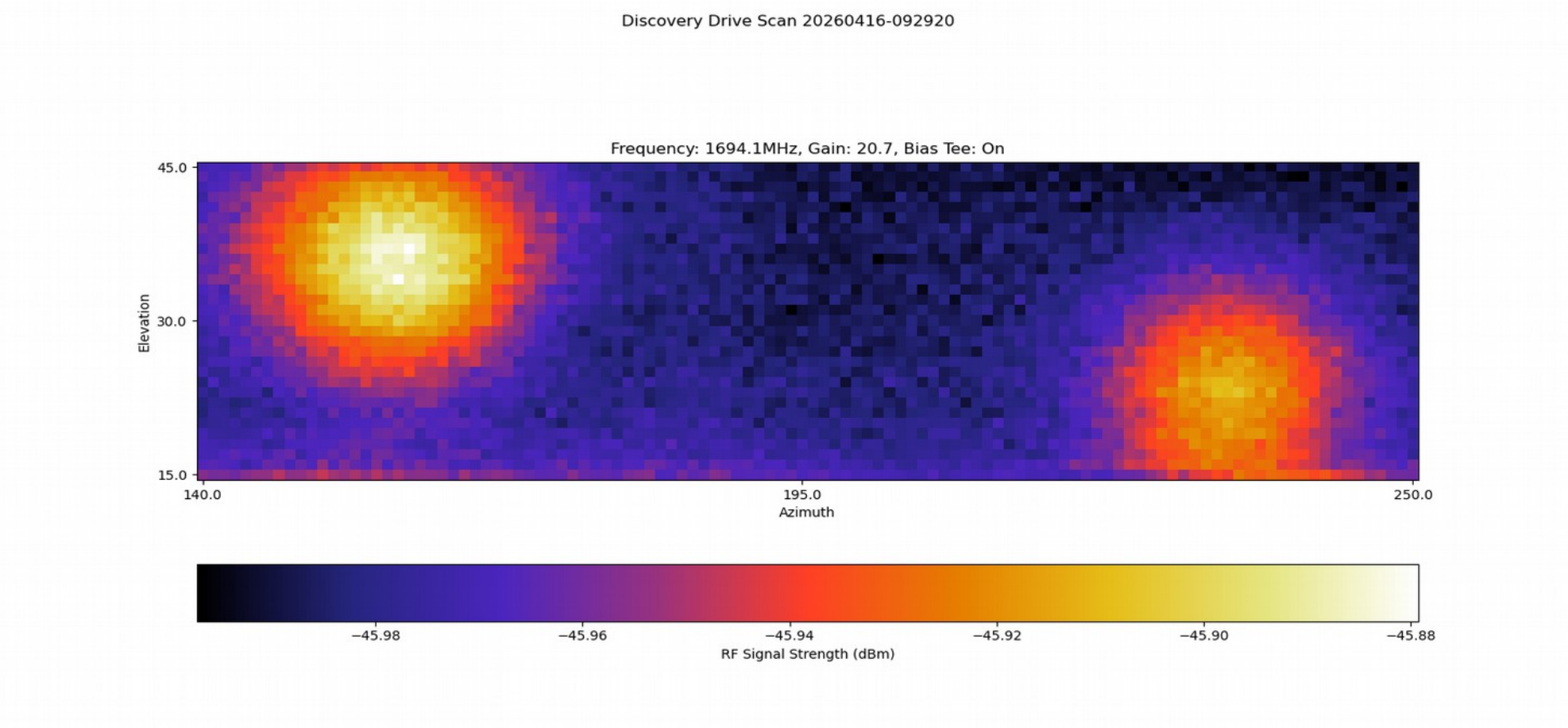
# Rotator Options: DIY

- Depends on skill level
- Lots of designs
- I'm not good at these!



# More Examples

- Geostationary Weather Satellites (Small Dish)



# More Examples

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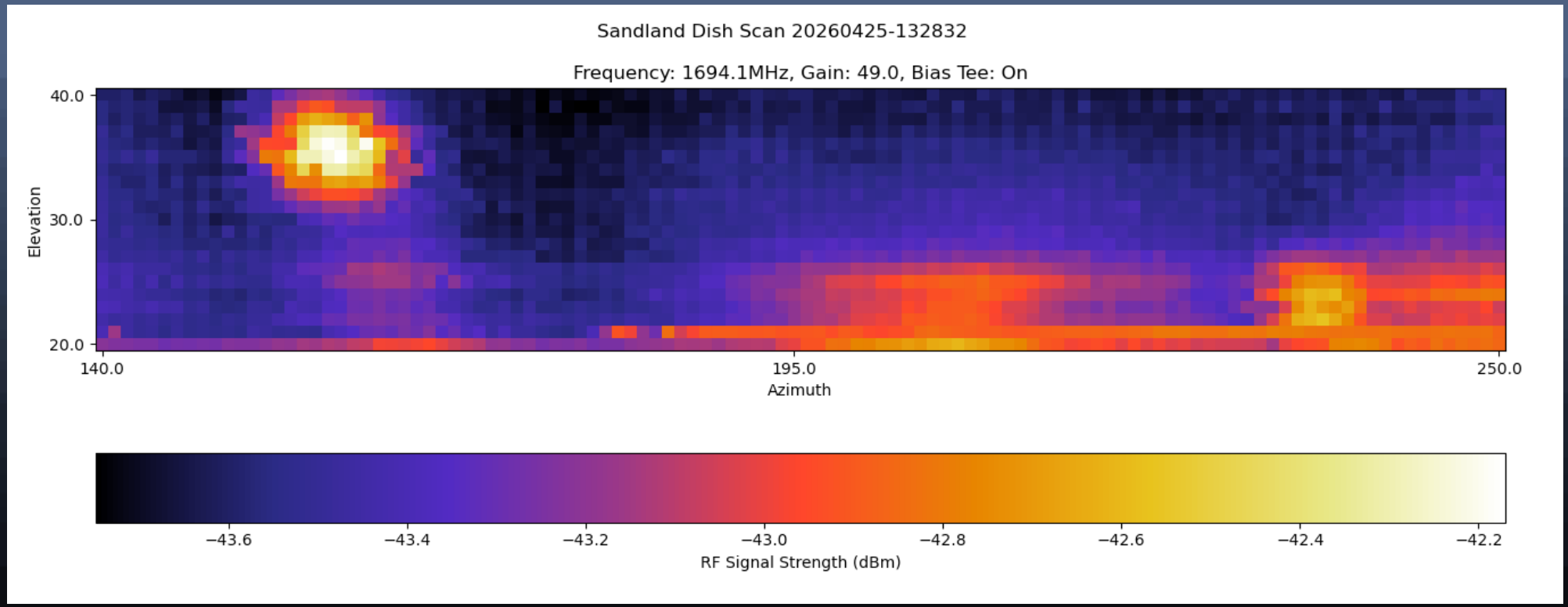
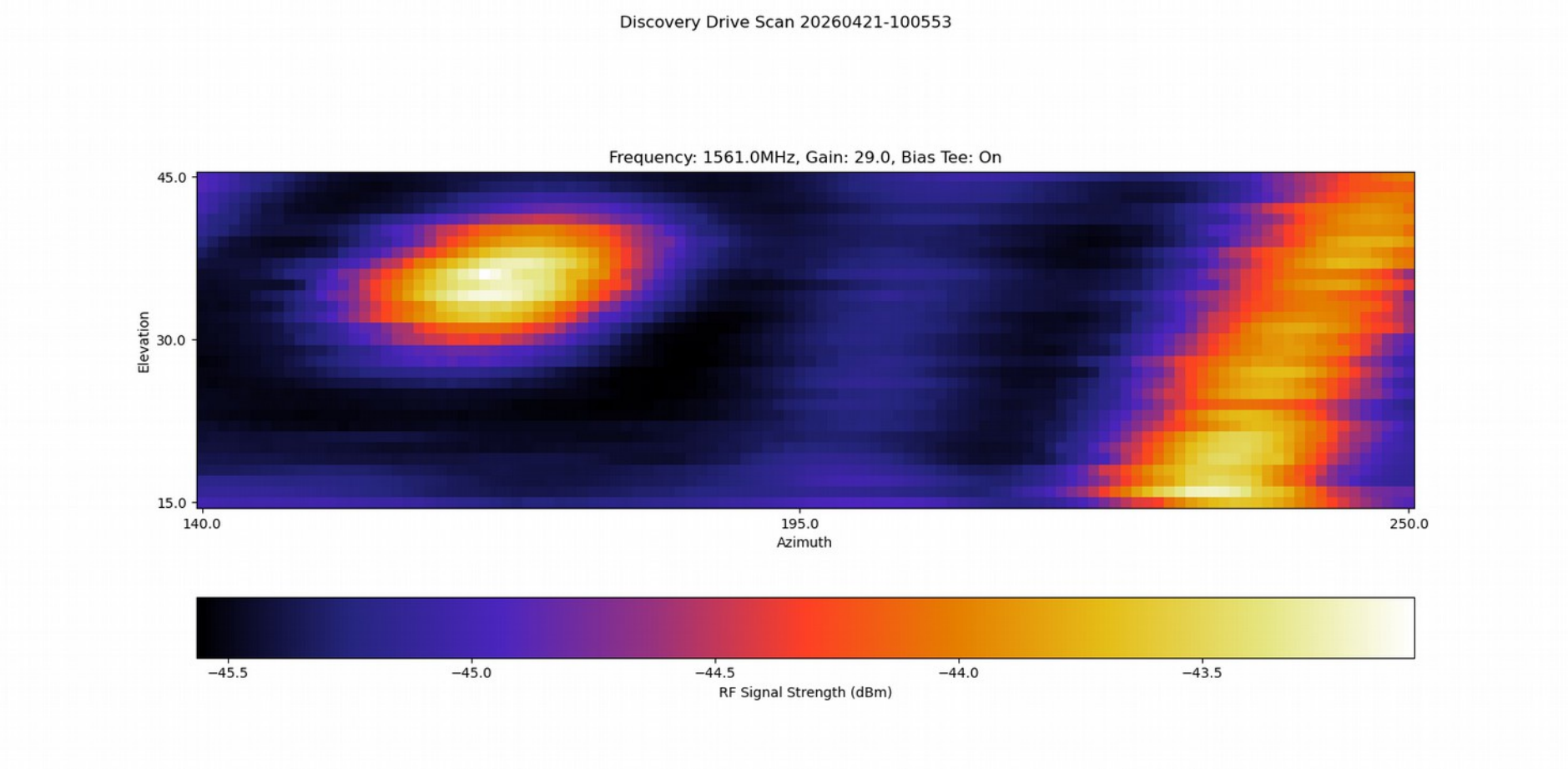


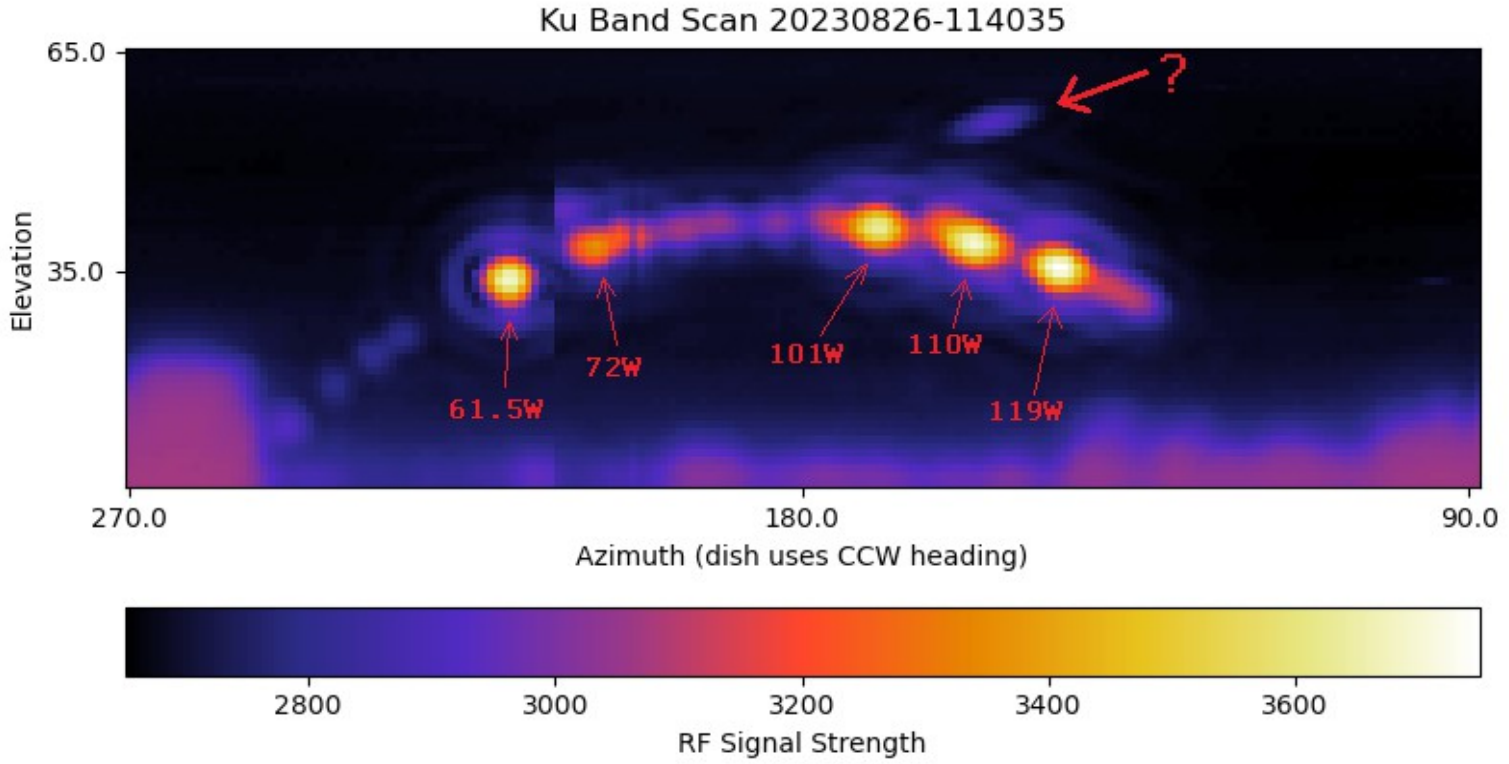
# More Examples

- Navigation Satellites



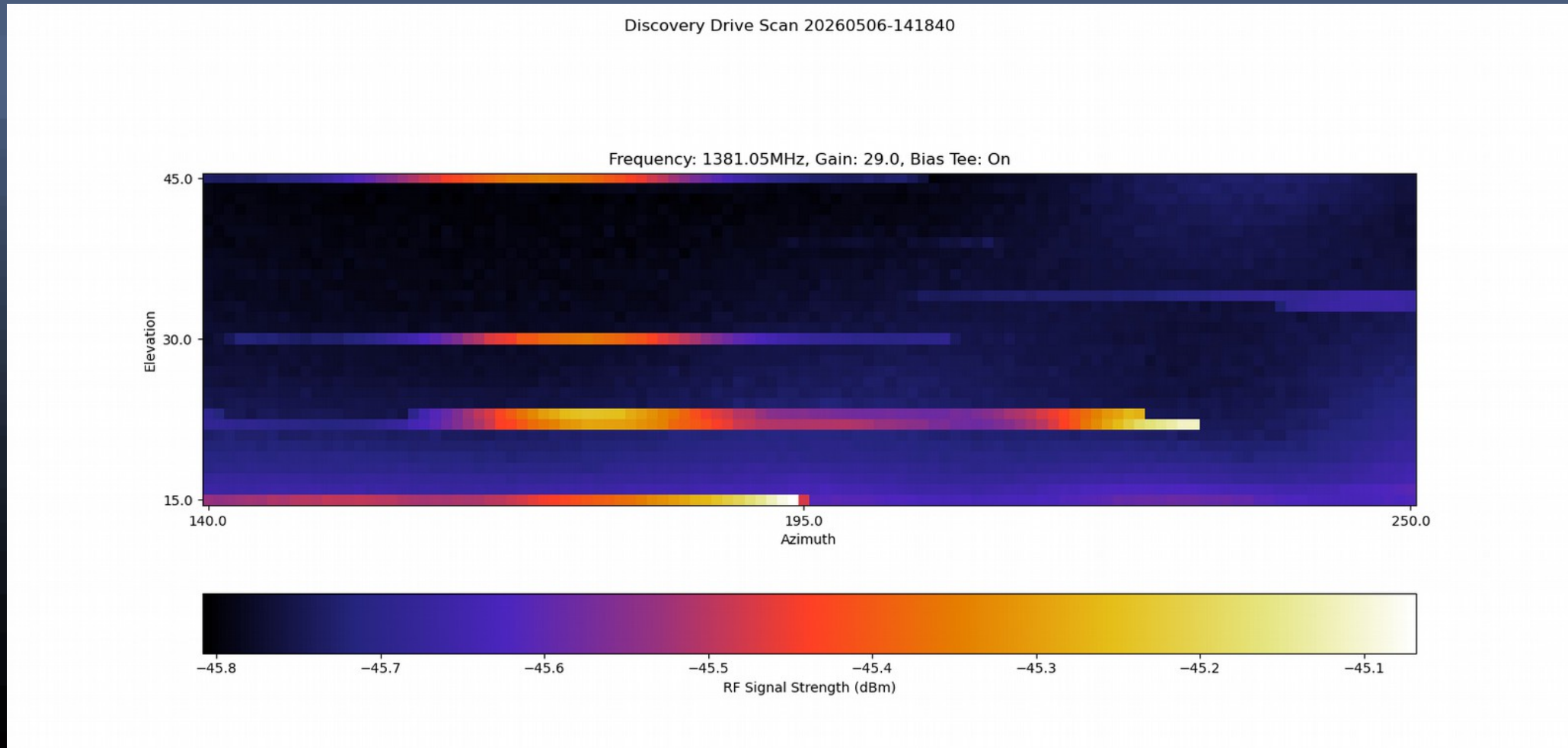
# More Examples

- Inclined Orbits



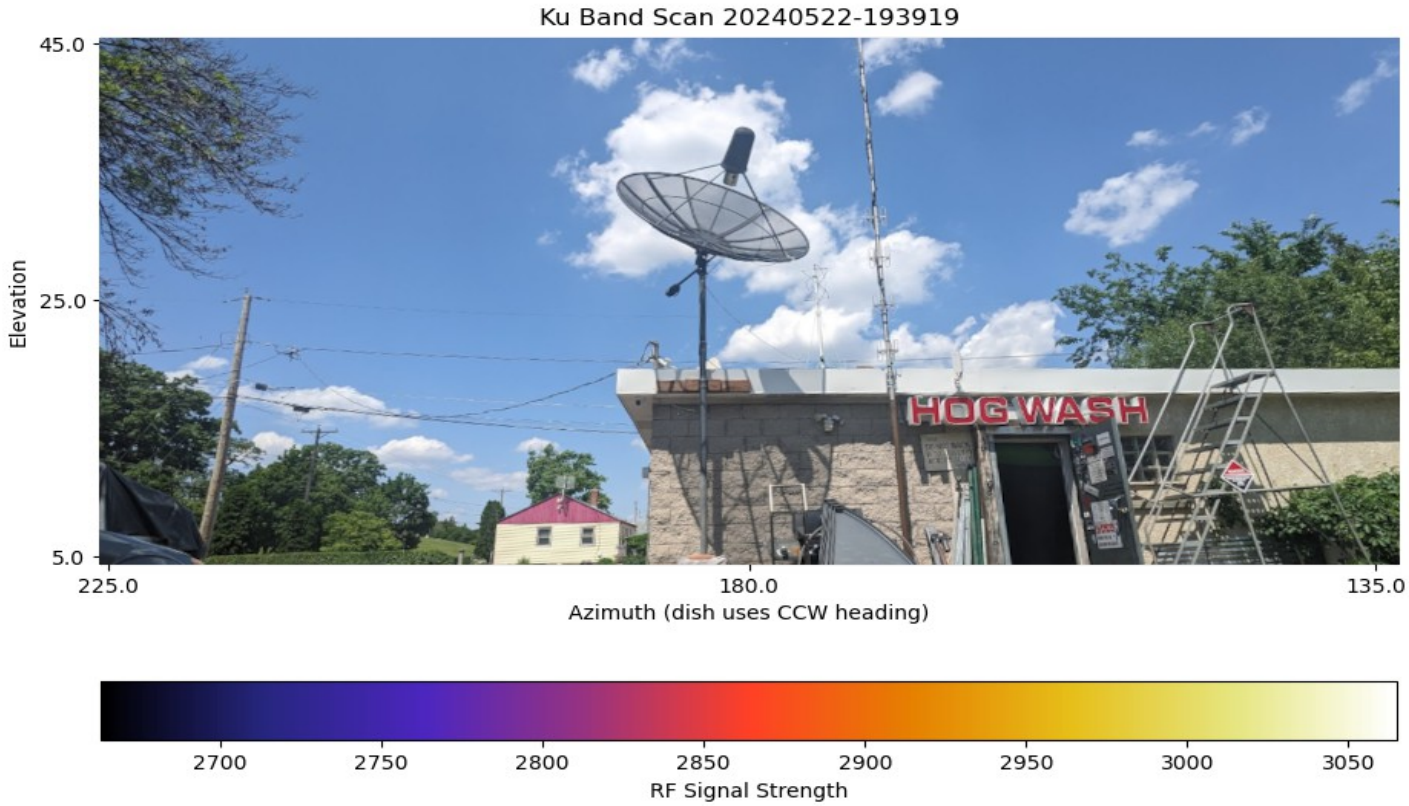
# More Examples

- Nuclear Detection System



# More Examples

- Structures in various heatmap palletes



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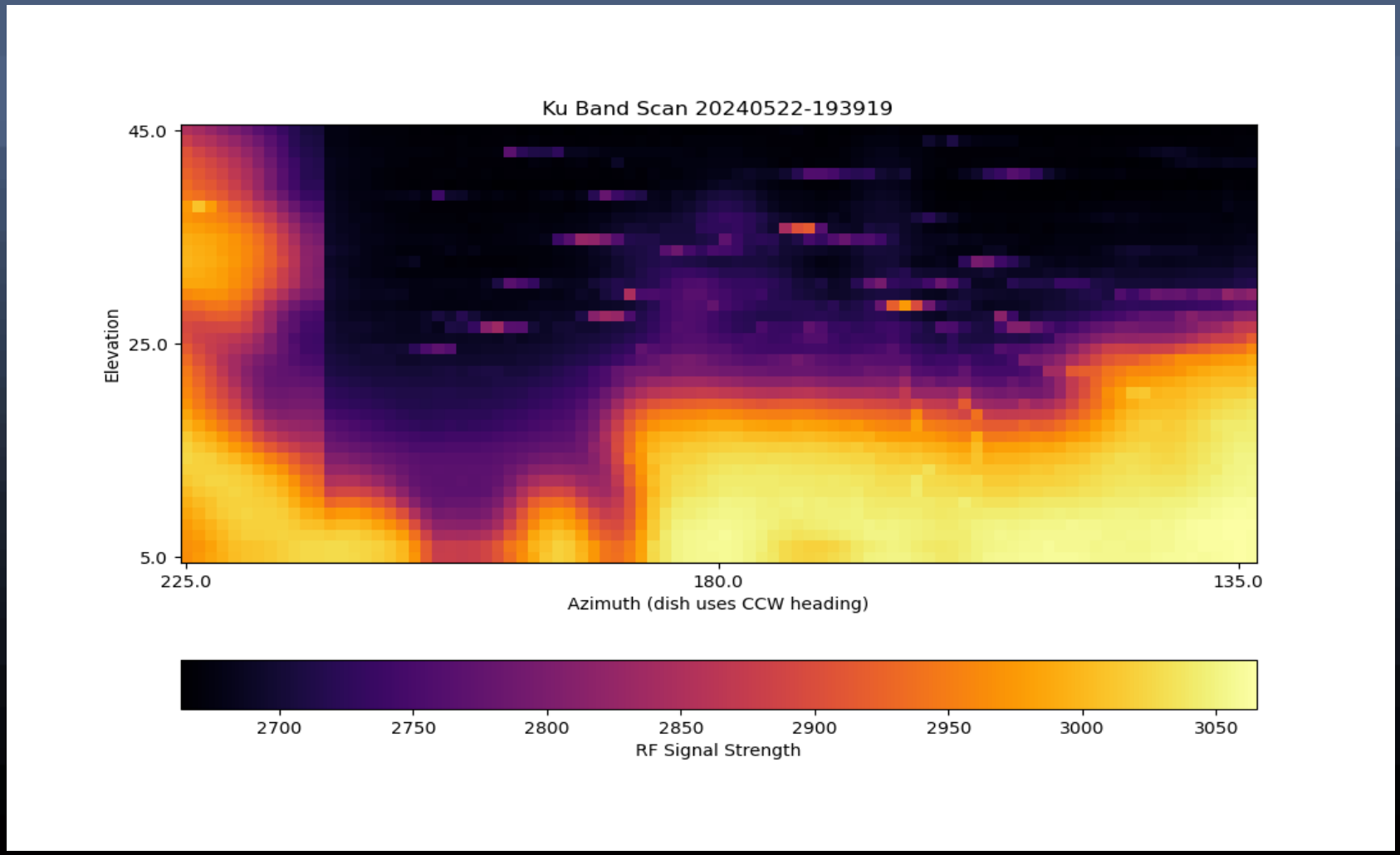

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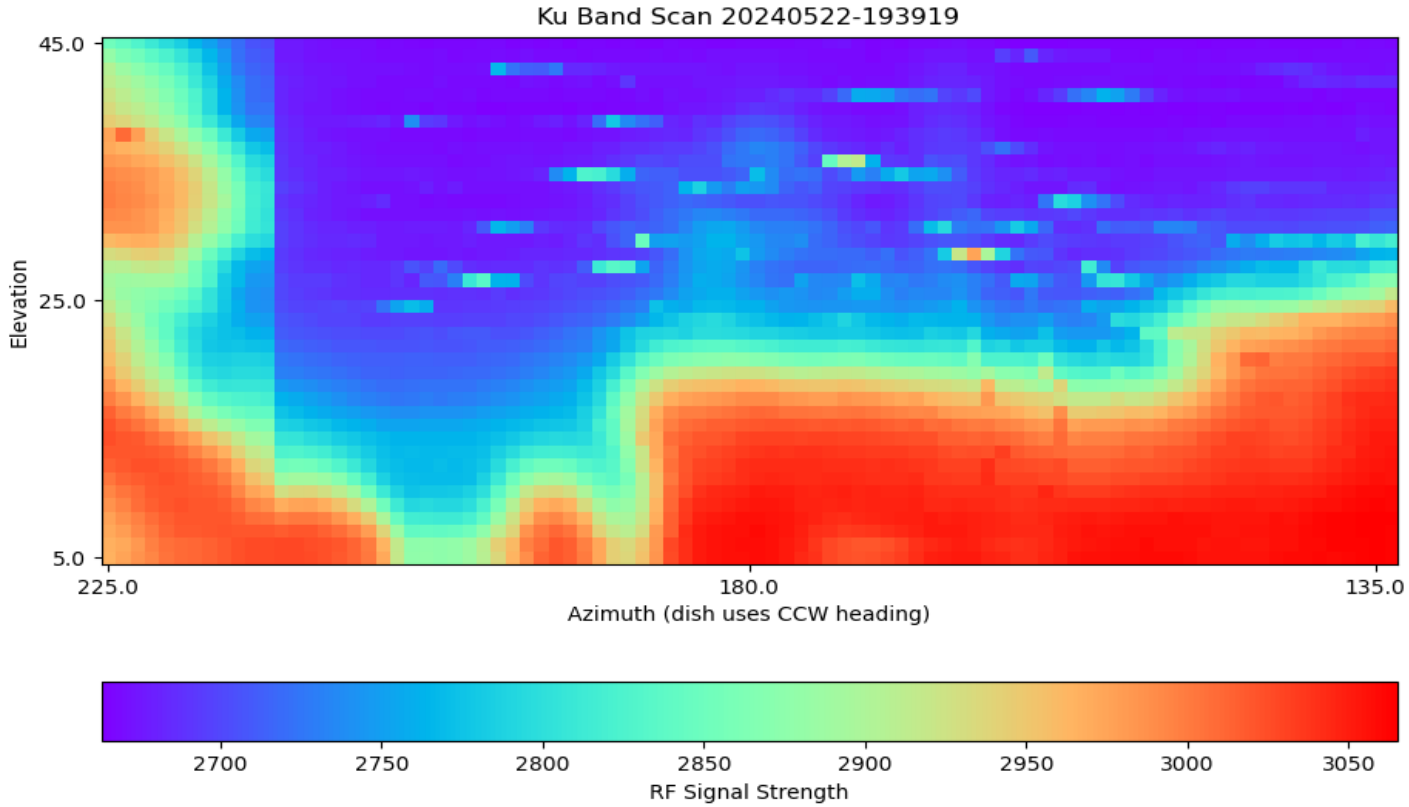

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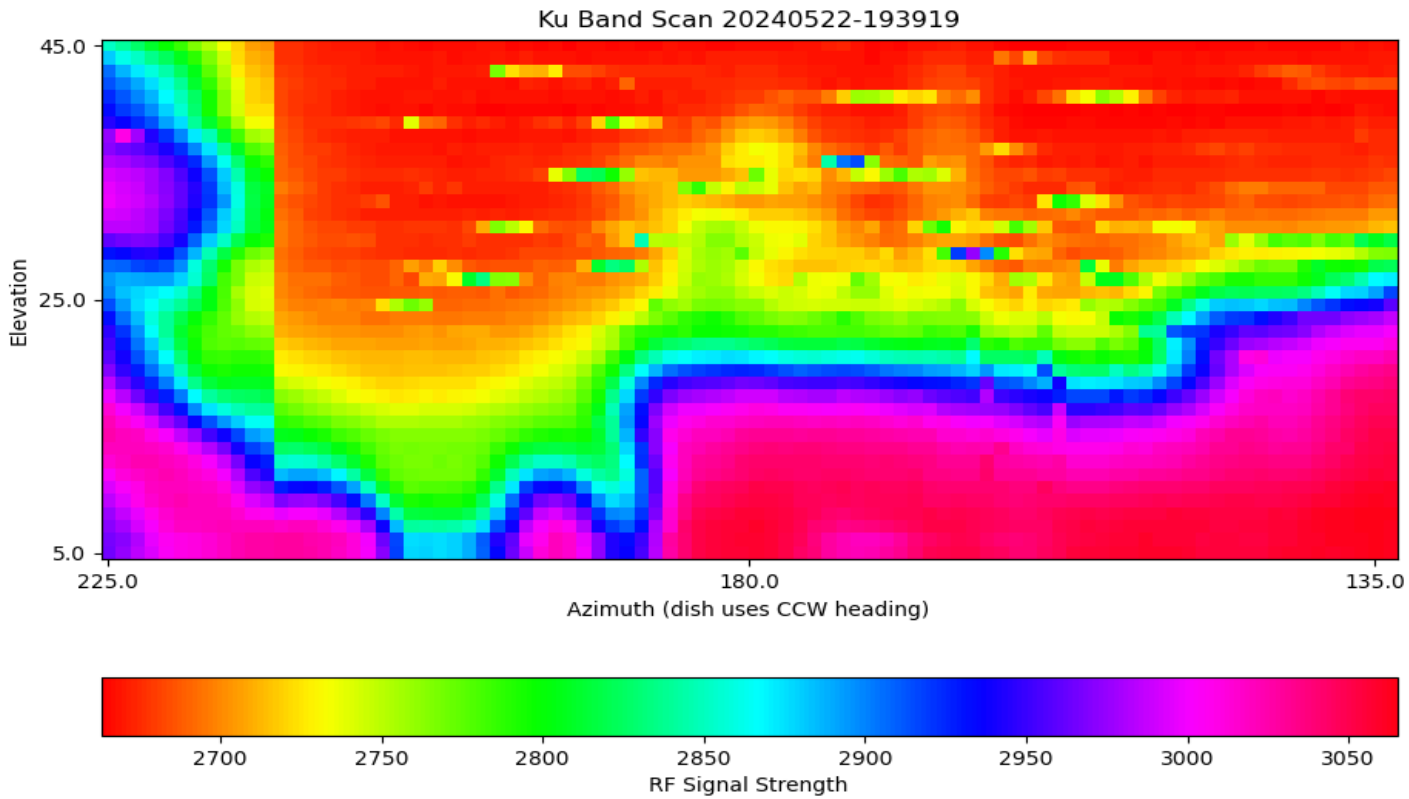
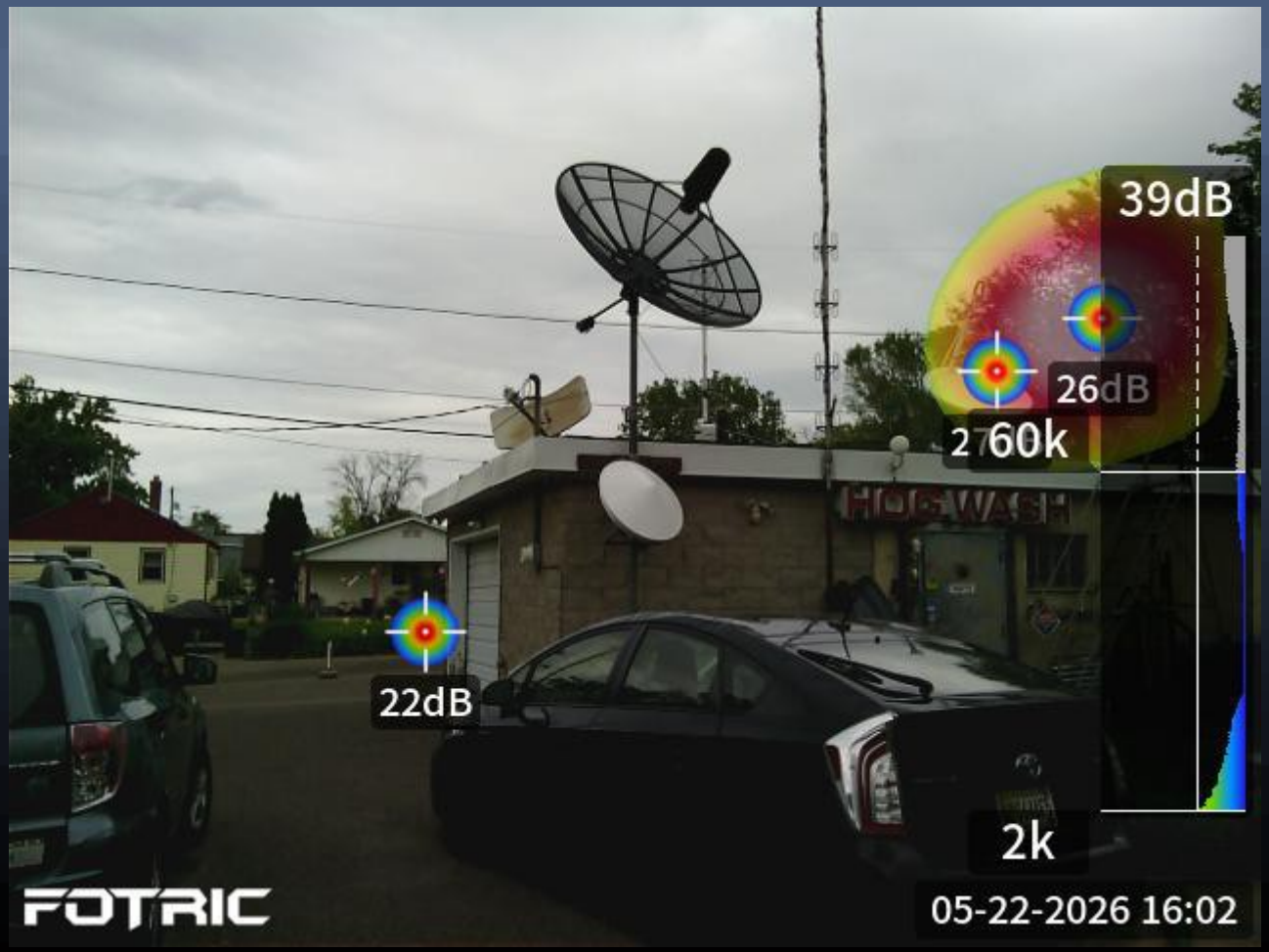


# More Examples

- Structures in IR

# More Examples

- Structures in Acoustic



# More Information

- https://github.com/saveitforparts
- https://saveitforparts.com/
- https://www.youtube.com/saveitforparts
- discord.gg/SB4bJFy3vj
- gabe@saveitforparts.com

# Questions?