Amateur Radio License

Regulations and Operations

FCC Registration Number (FRN)

- Identifies you to the FCC
- You need one to get a license
- You can take the test without it (SS number works), but it is good to have, particularly if you don't have a SS number or taxpayer ID
- Google "FRN FCC", and the top link will get you there.

Todays Topics

- Radio Signals and Fundamentals

- Basic Operations

Radio Signal Fundamentals

Finding Where You are on the Radio Dial

- Described as Band, Frequency, or Wavelength
- Bands: HF, UHF, VHF
- Frequency: 50 MHz, 144 MHz, 440 MHz
- Wavelength: 6 m, 2 m, 70 cm
- Wavelength (in m) = 300 / (frequency in MHz)

Amateur Bands

Technician VHF/UHF Frequencies

- Recall that

$$\lambda = 300 / f$$

where f is in MHz, and λ is in m

Table 5-2
VHF and UHF Technician Amateur Bands
ITU Region 2

Band (Wavelength)	*Frequency Limits*
VHF Range	
6 meters	50 - 54 MHz
2 meters	144 - 148 MHz
1.25 meters	219 - 220 MHz
1.25 meters	222 - 225 MHz
UHF Range	
70 centimeters	420 - 450 MHz
33 centimeters	902 - 928 MHz
23 centimeters	1240 - 1300 MHz
13 centimeters	2300 - 2310 MHz
13 centimeters	2390 - 2450 MHz

Technician HF Frequencies

- 200 W PEP
- Mostly CW

Band	Freq	Mode
80 m	3.525-3.6 MHz	CW
40 m	7.025-7.125 MHz	CW
15 m	21.025-21.200 MHz	CW
10 m	28.000-28.300	CW, RTTY, Data
	28.300-28.500	CW, SSB

Typical Questions

- Unit of frequency
- Speed of light
- What happens to wavelength as frequency increases
- What are the limits of the VHF spectrum (remember that the band edges are all factors of 10, measured in meters).

Bands / Frequencies

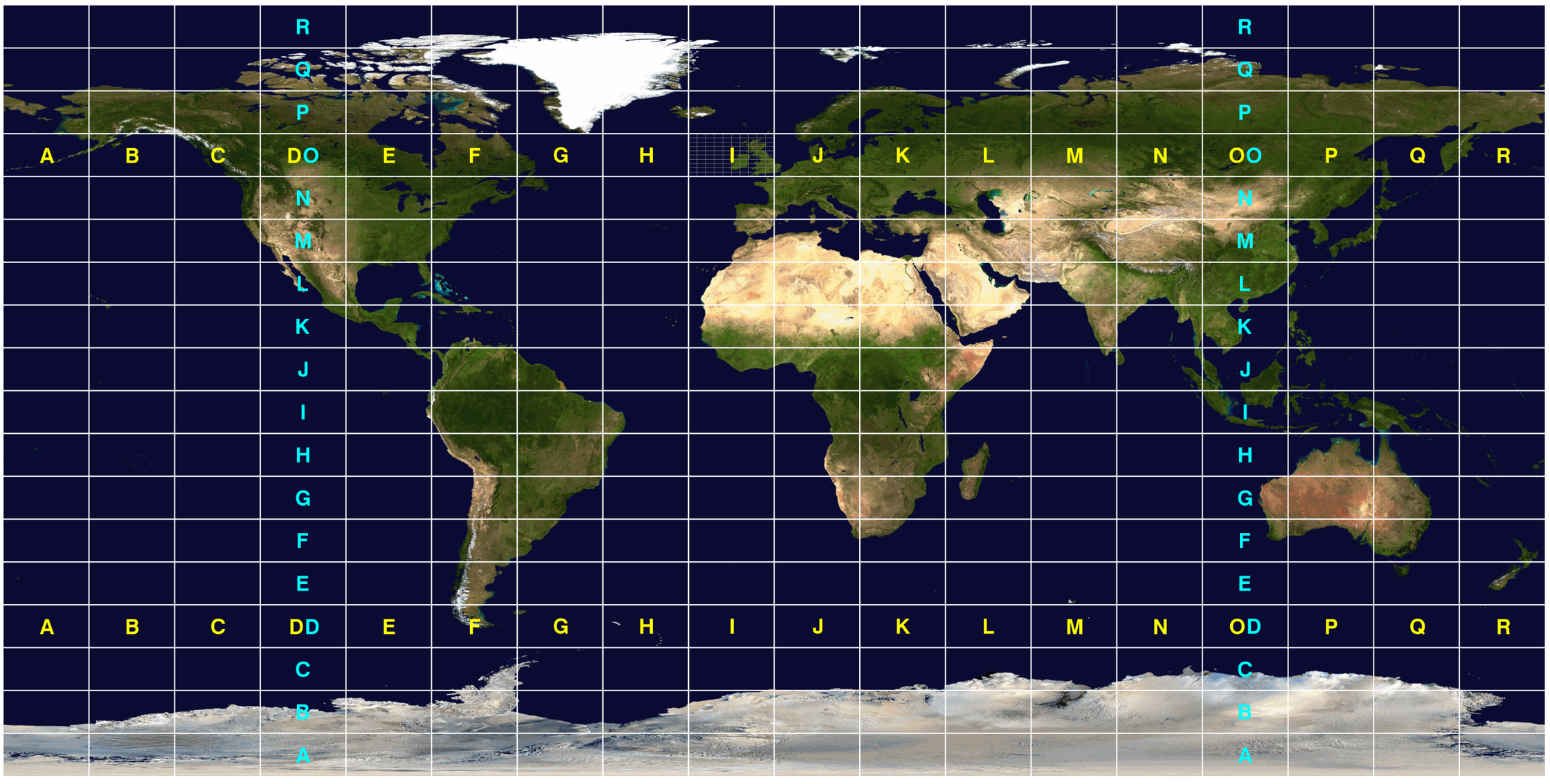
- What is the wavelength of the 144 MHz band? 30 MHz? 50 MHz?

- What are the limits of the amateur VHF band? UHF band? 220 MHz?

- What are the frequencies of the 70 cm band? 1.25 m? 6 m? 10 m?

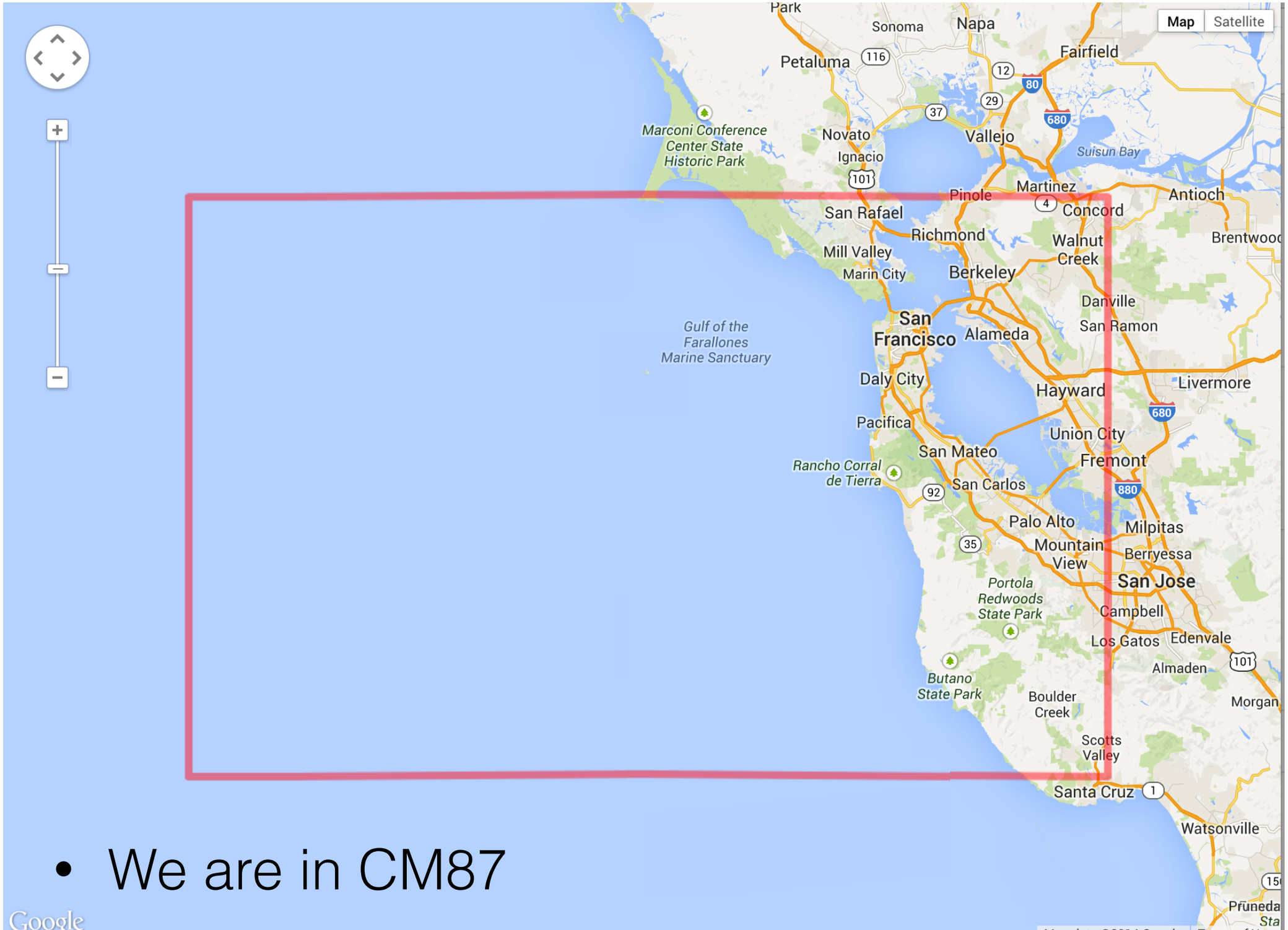
Grid Locator

- Shorthand for latitude and longitude



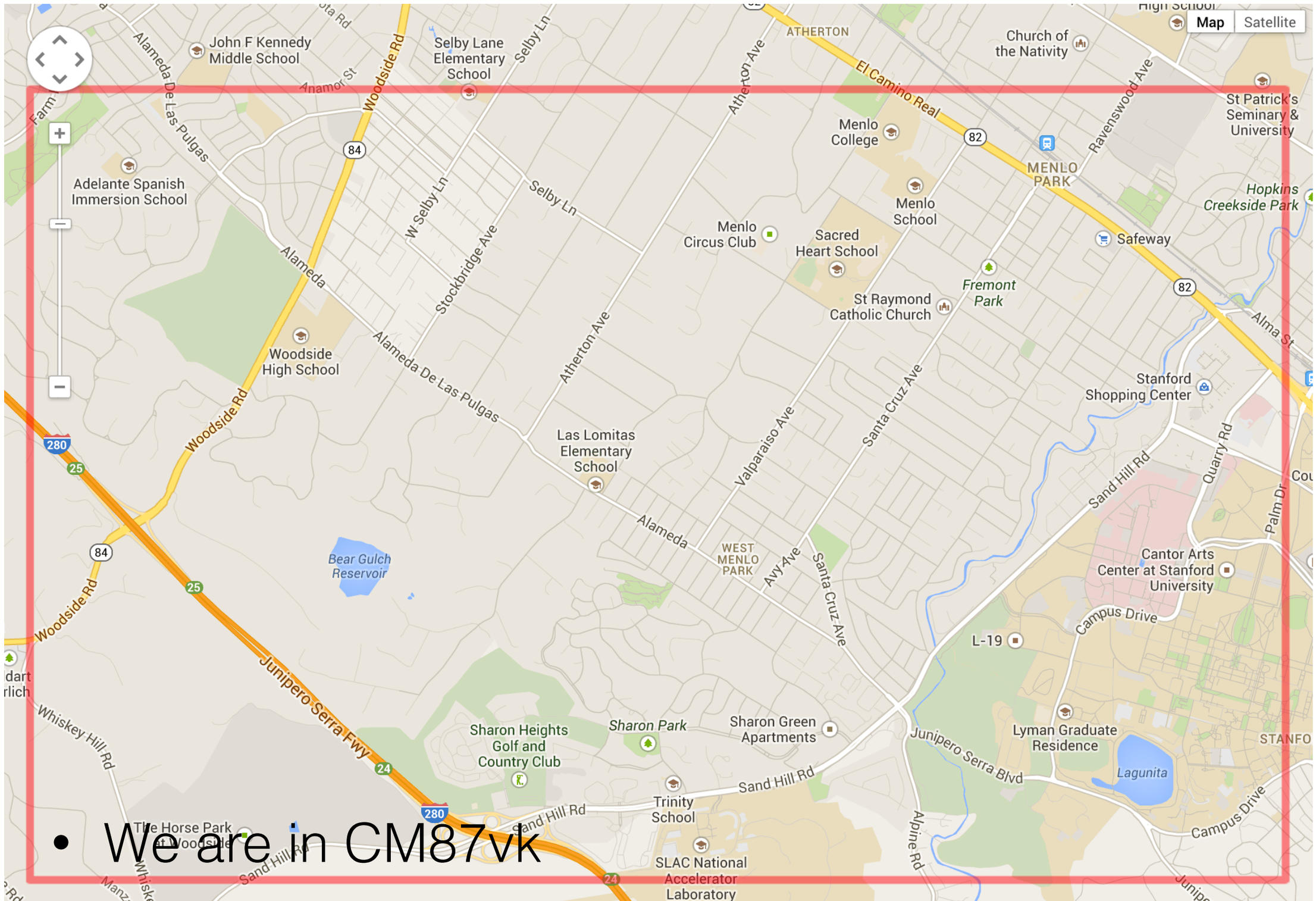
We are in CM

Grid Square Locator



- We are in CM87

Grid Square Locator



- We are in CM87vk

Technician Power Levels

- Use the minimum power required to get the job done.
- Up to 1500 watts peak envelope power (PEP).
  - Will generally require an external amplifier to achieve these power levels.
  - Some special cases where power is restricted.
- Some limited bands
  - 50 W PEP on 219-220 MHz
  - Geographical restrictions (Military bases, near Canada)

Primary and Secondary Allocations

- Many bands allocated to more than one service
  - Primary allocation : priority service
  - Secondary allocation : can’t interfere with primary user (and must accept interference from them)
- Some bands are primary for amateur radio
- Most bands UHF and above are secondary
- Bands are allocated differently in different countries

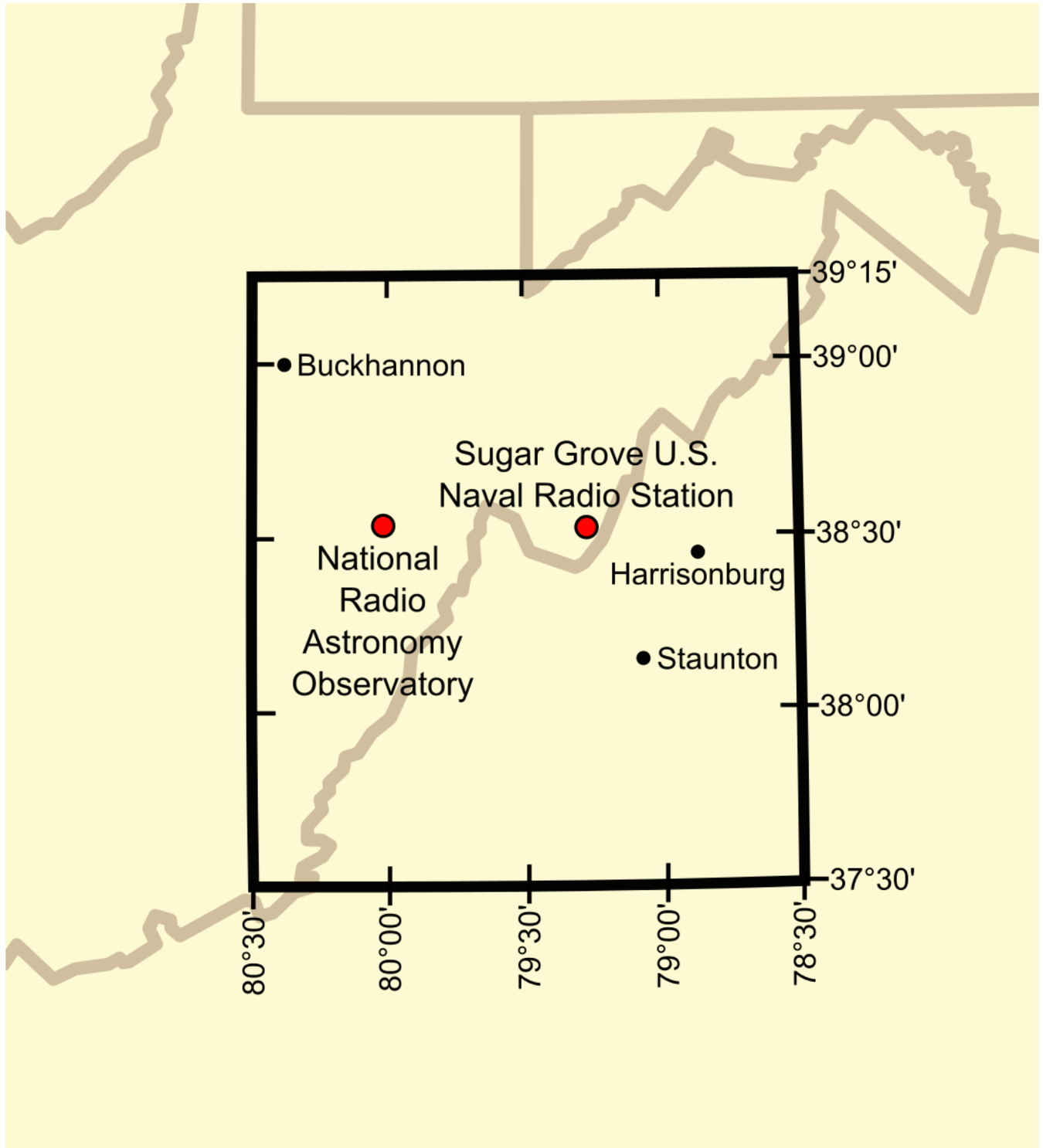
Line A

- Canada uses 420-430 MHz for radio location

- US users are secondary, and should not interfere. This band can’t be used within 50 miles of the Canadian Border

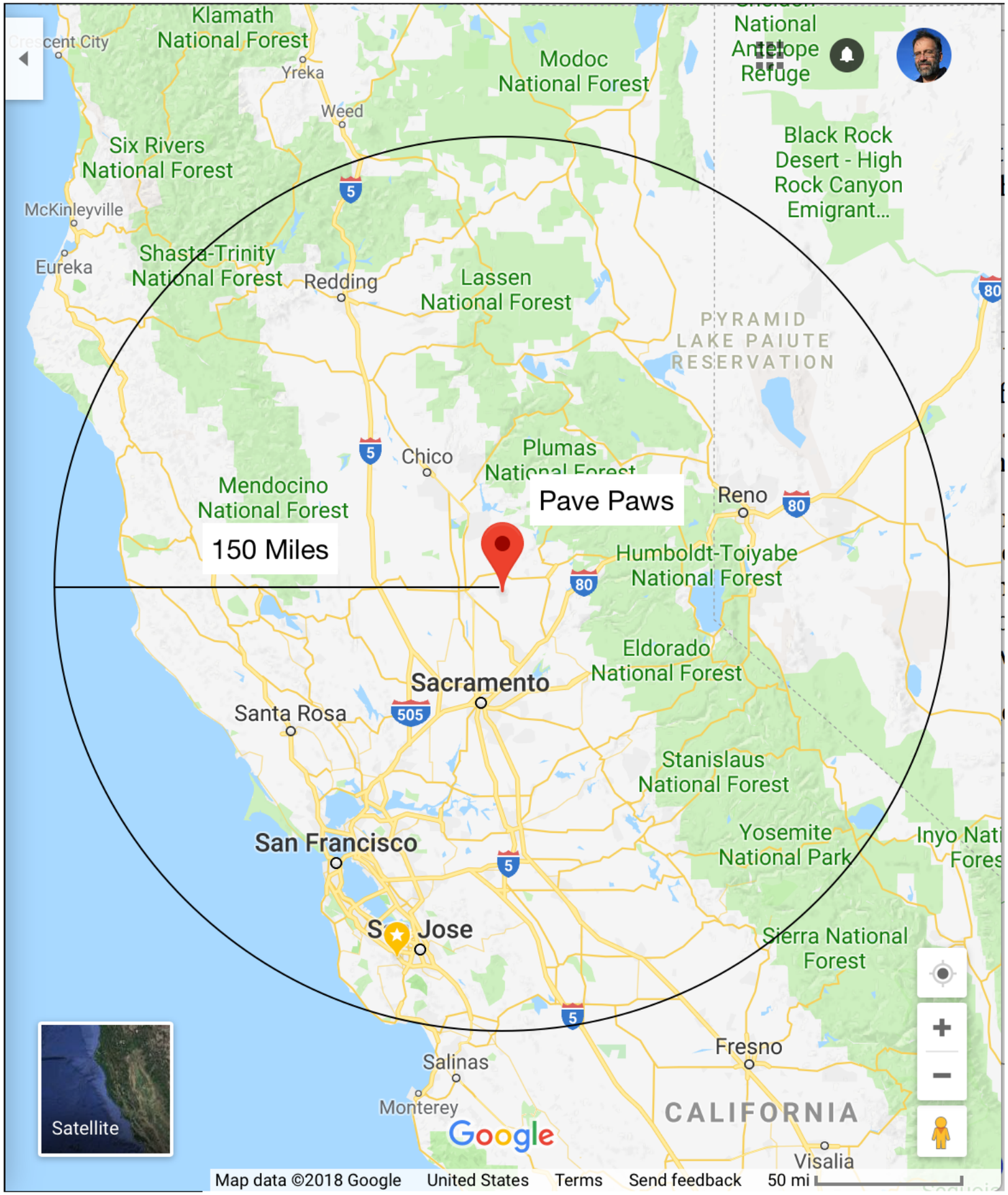
National Radio Quiet Zone

- All RF tightly regulated in rectangle
- Most restrictive within 10 miles of Green Bank (NRAO)



Pave Paws

- Huge radar for tracking ICBM’s coming into California.
- Uses UHF band 420-450 MHz
- Amateur’s must use less than 50W in the Central Valley



Pave Paws

- 50 W limit
- 150 mile radius from Beal AFB
- Other radars on Cape Cod, and in Alaska

International Rules

- International Telecommunication Union (ITU)
  - Founded as a UN agency in 1949
- Regions 1, 2 and 3.
  - We are region 2
- Reciprocal operating authorizations.
- These restrict some countries that we can contact.

ITU Regions

Operating in Other Countries

- You must follow the regulations for the ITU region you are in
- You can operate from a US flagged vessel
- Reciprocal operating authority : many countries have agreements with the US, just take your license
- International Amateur Radio Permit (IARP) : issued by ARRL here, allows you to operate in some North and South American countries. Extra (class 1) and Technician (class 2).
- CEPT : Agreement with European countries. You need your license, passport, and CEPT Notice. Same classes as IARP.

What types of international communications are permitted by an FCC-licensed amateur station? (T1C03)

A. Communications incidental to the purposes of the amateur service and remarks of a personal character

B. Communications incidental to conducting business or remarks of a personal nature

C. Only communications incidental to contest exchanges, all other communications are prohibited

D. Any communications that would be permitted on an international broadcast station

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With which countries are FCC-licensed amateur radio stations prohibited from exchanging information? (T1D01)

A. Any country whose administration has notified the International Telecommunications Union (ITU) that it objects to such communications

B. Any country whose administration has notified the American Radio Relay League (ARRL) that it objects to such communications

C. Any country banned from such communications by the International Amateur Radio Union (IARU)

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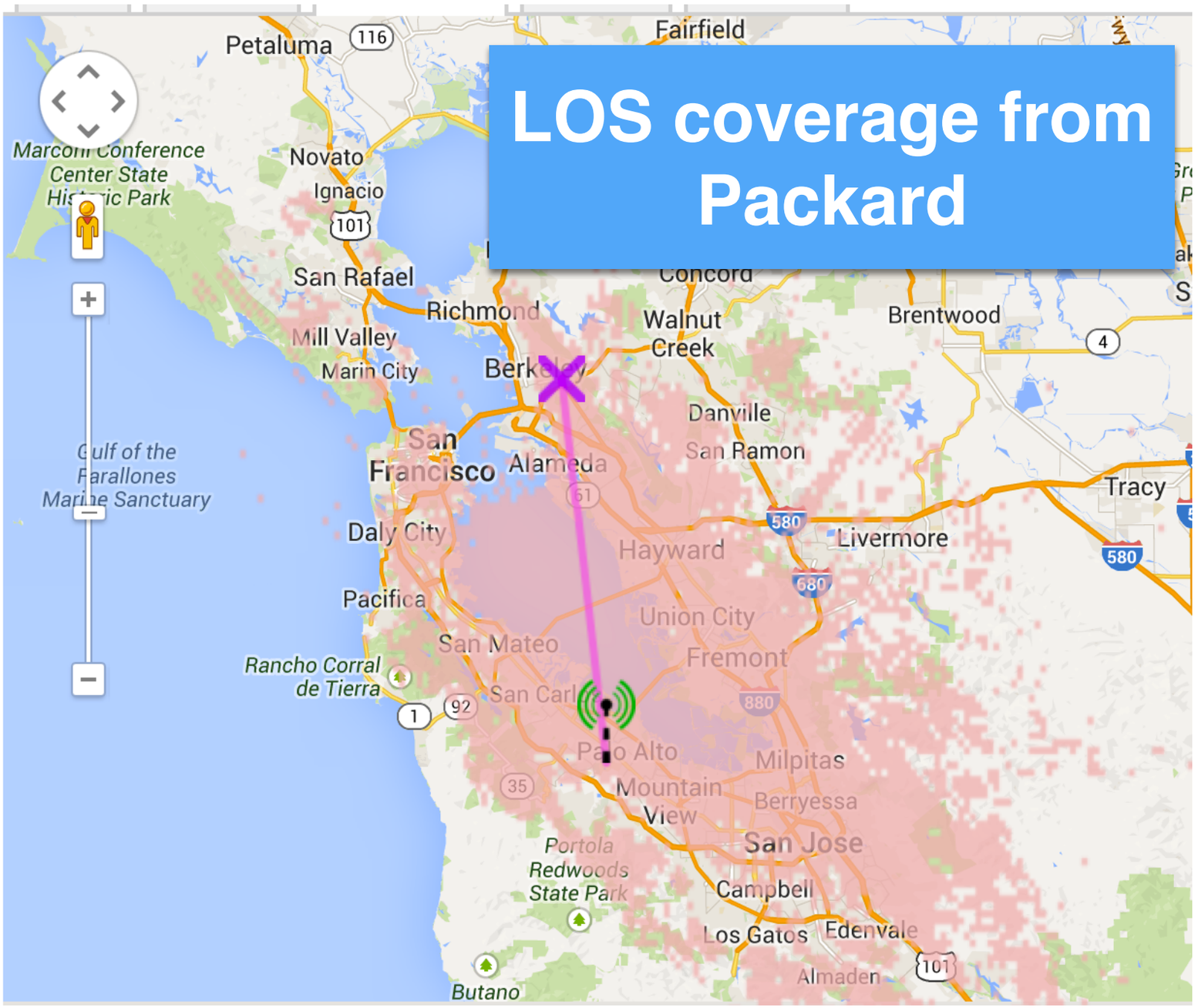
Propagation Modes

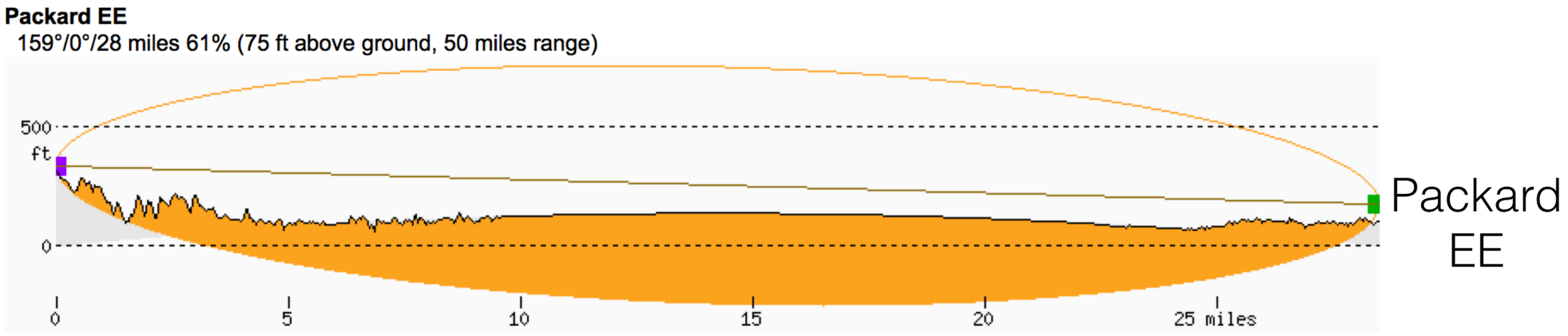
- Ground wave
  - Low HF and below, ground acts as waveguide
  - AM radio
- Line-of-Sight (LOS)
  - VHF and above, radio waves only slightly refracted or reflected by the atmosphere
  - FM Radio
- Sky wave
  - For HF, and sometimes VHF, the upper atmosphere acts as a reflector, bouncing radio waves back to earth far from the source
  - Short wave radio

Line-of-Sight

- At VHF and UHF radio waves effectively travel in straight lines
- Limited by radio horizon
- Slightly refracted by the atmosphere
  - Effective earth radius 4/3 the true radius
  - From a radio perspective, the earth is slightly flatter

Packard EE
to
Cory Hall, UCB

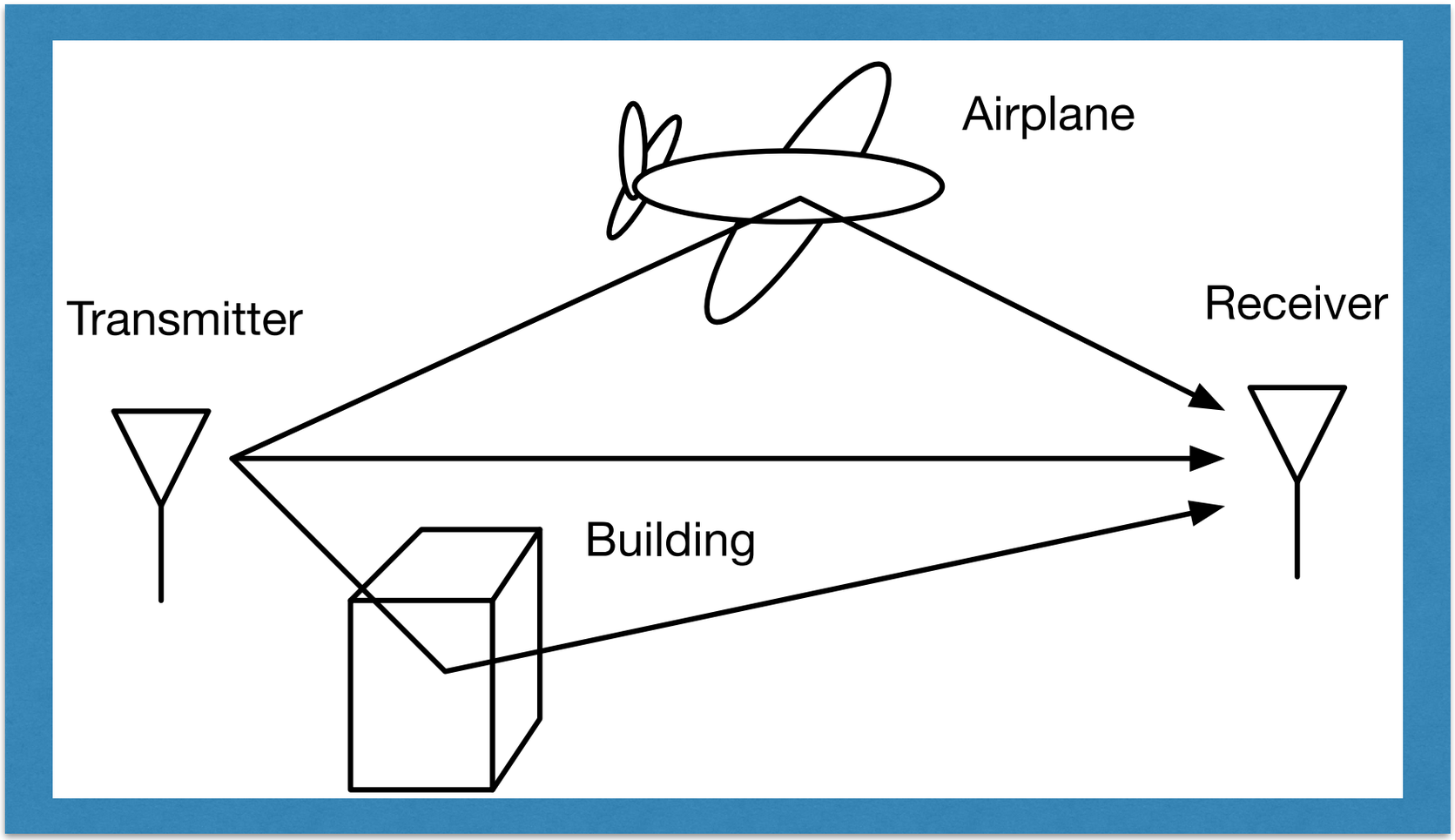




Propagation Path

Multipath

- Radio waves often travel by multiple paths, which can constructively or destructively interfere

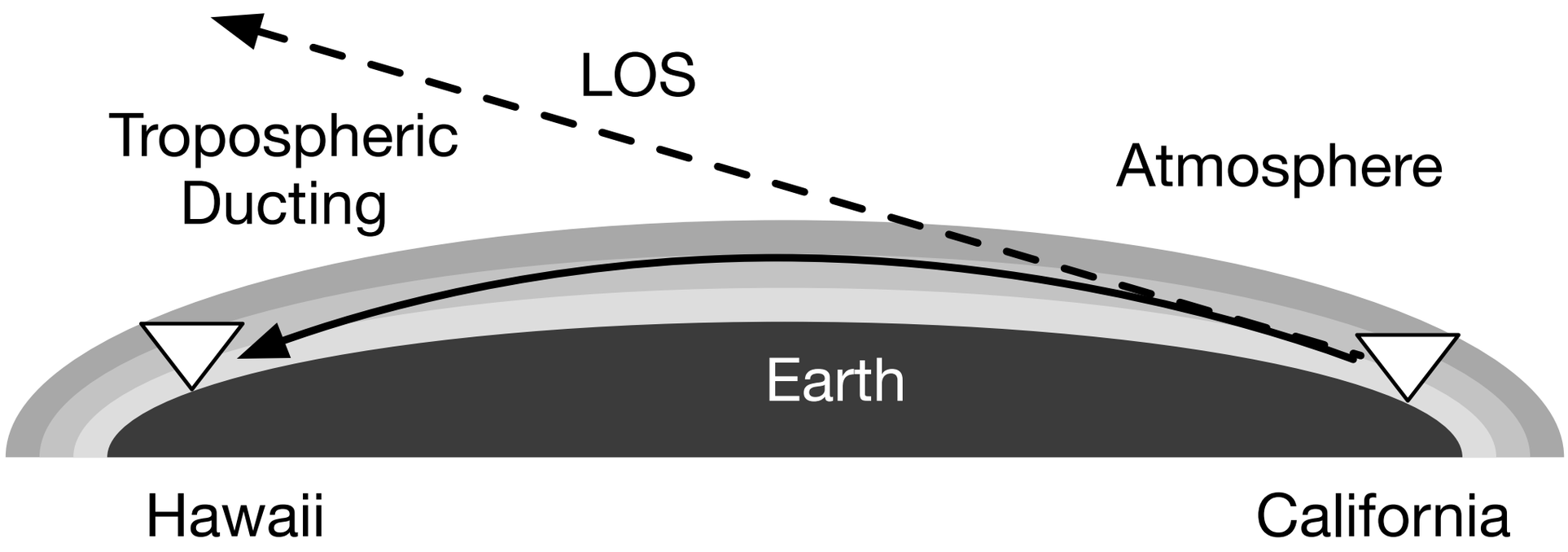


- Small changes in location can result in large changes in signal: “picket fencing”

Tropospheric Ducting

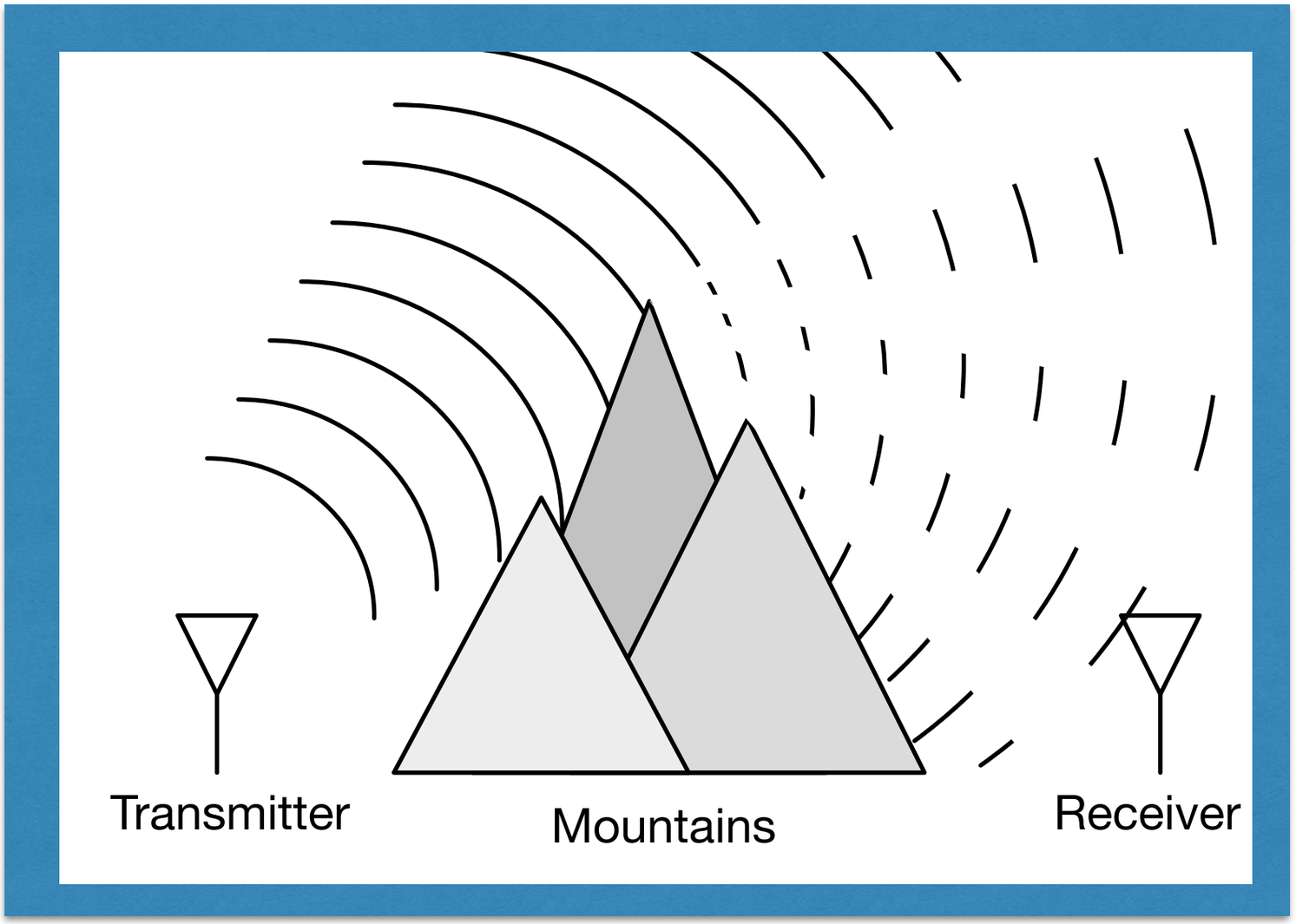
- Temperature and humidity inversions can cause the atmosphere to act as a wave guide

- Frequently in August VHF is ducted from California as far as Hawaii



Knife-Edge Diffraction

- Radio waves will diffract from sharp edges, some power will be delivered behind the obstruction

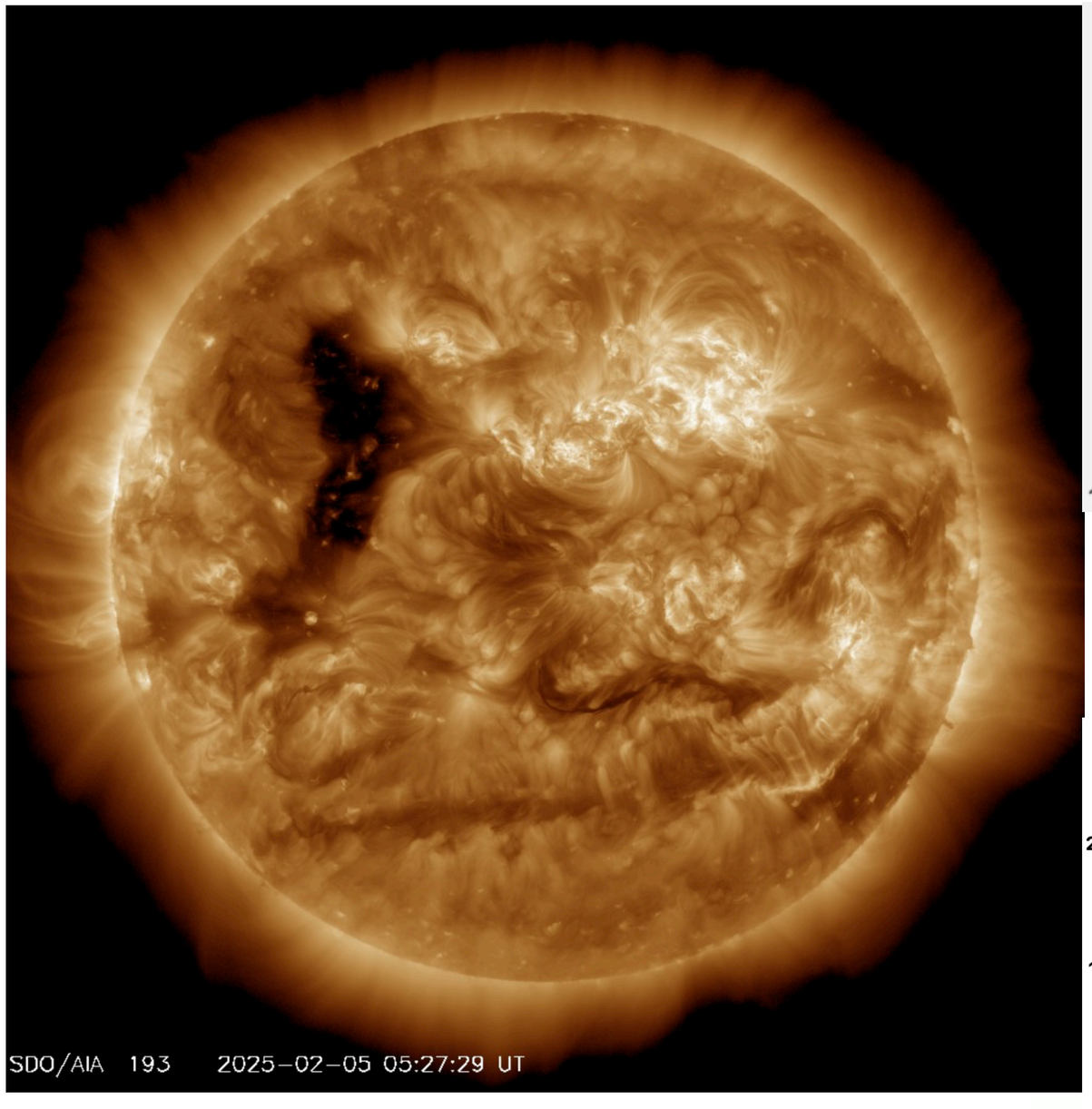


Diffraction Lobes

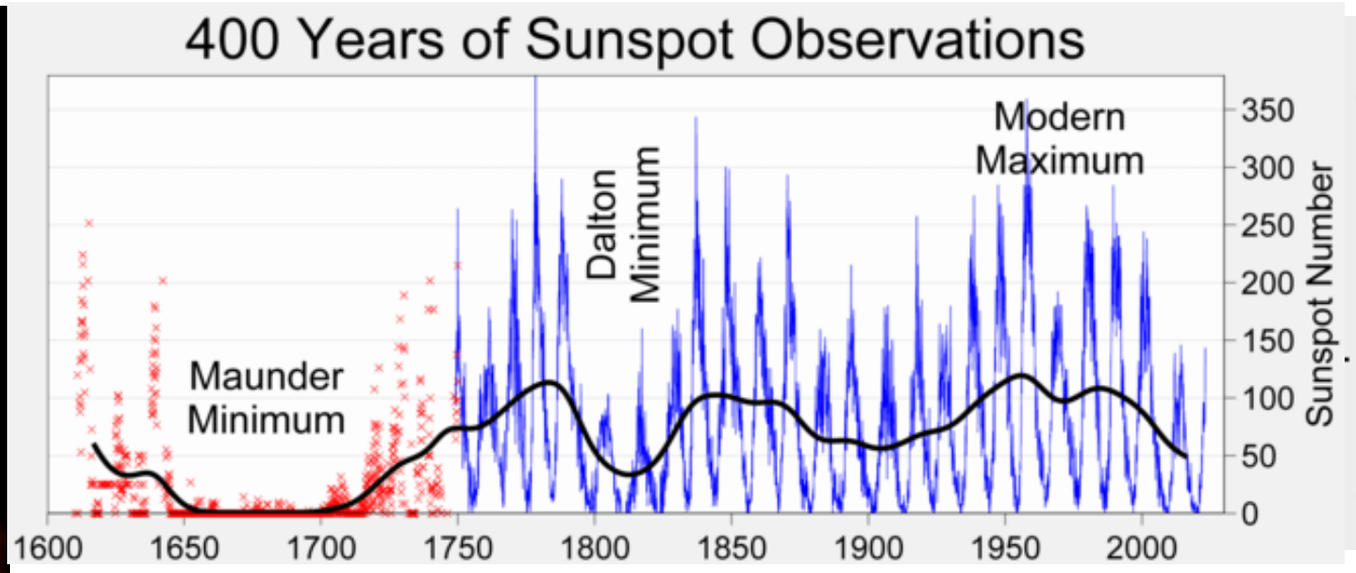
Ionospheric Propagation

- Sun ionizes the upper levels of the atmosphere
- Some layers attenuate, others reflect radio waves
- Varies day to night
- Driven by solar activity, number of sunspots (space weather), which varies periodically over a 11 (or 22) year cycle
- Sun has been extraordinarily inactive this past cycle, we are just starting the next

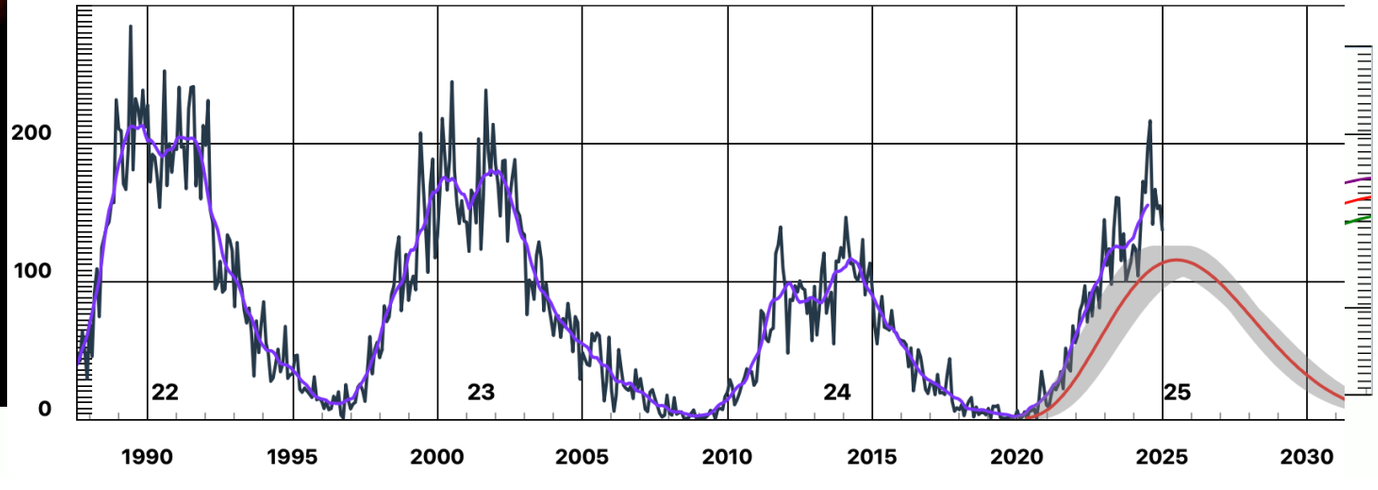
Solar Activity



Recent Solar Activity



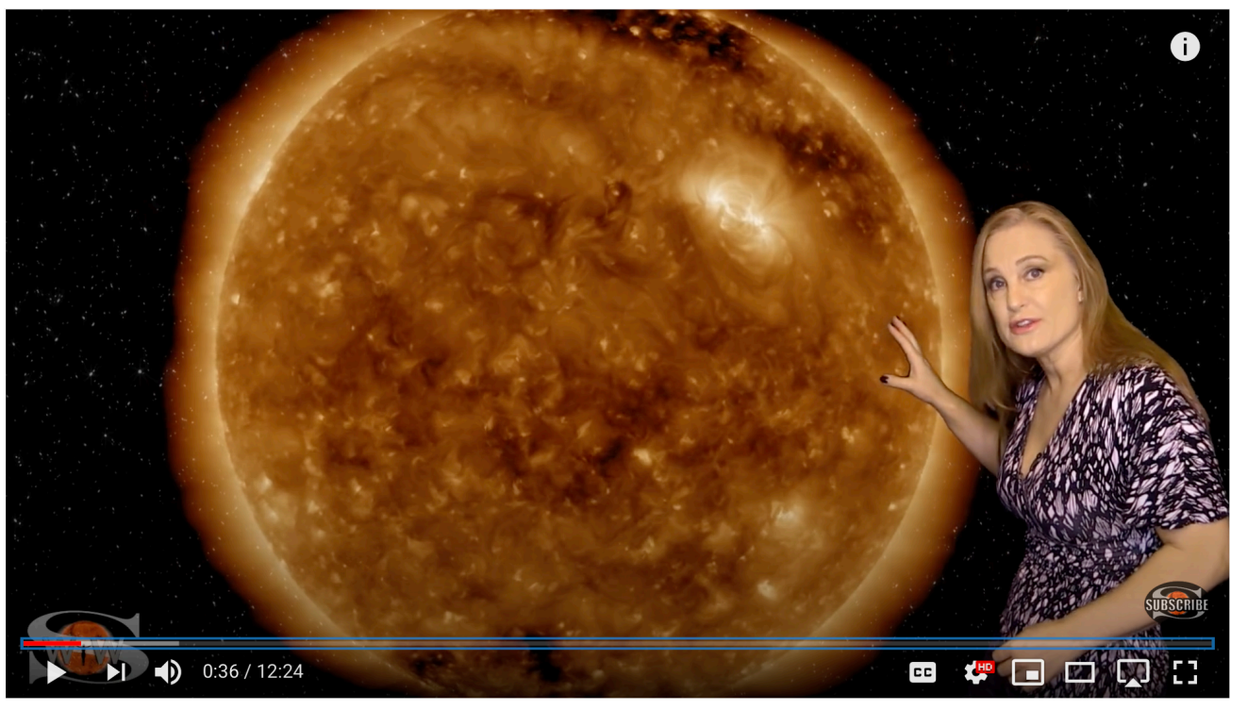
History of Sun Spot Number

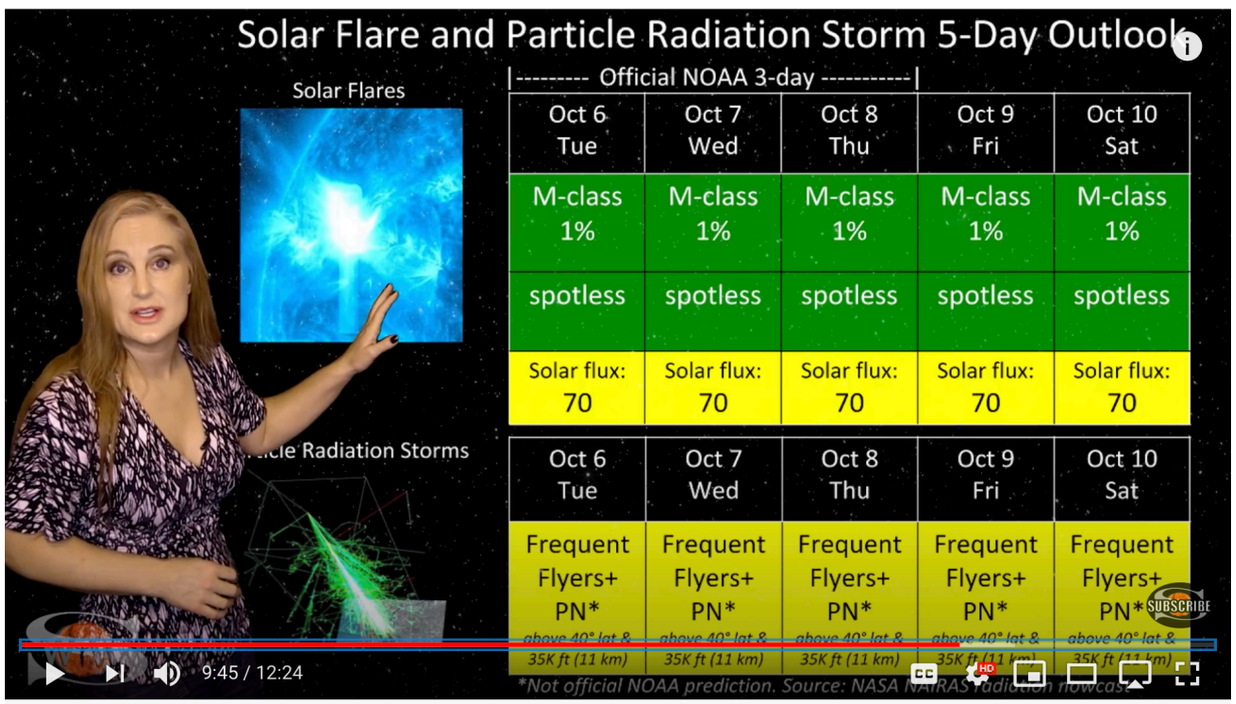


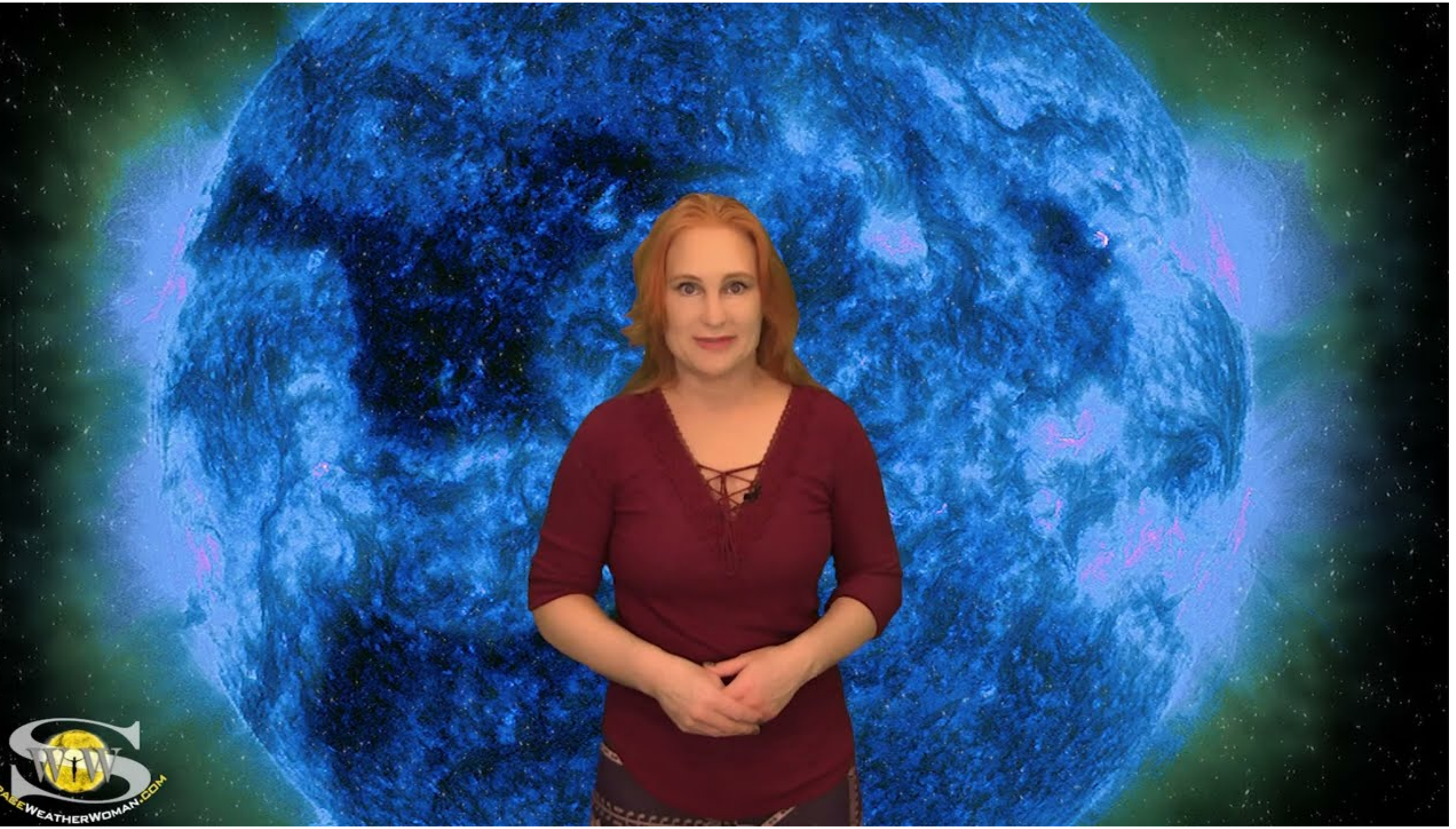
Recent Solar Cycles

Solar Weather Report

- Tamitha Skov on YouTube
- Updated weekly
- Highly recommended

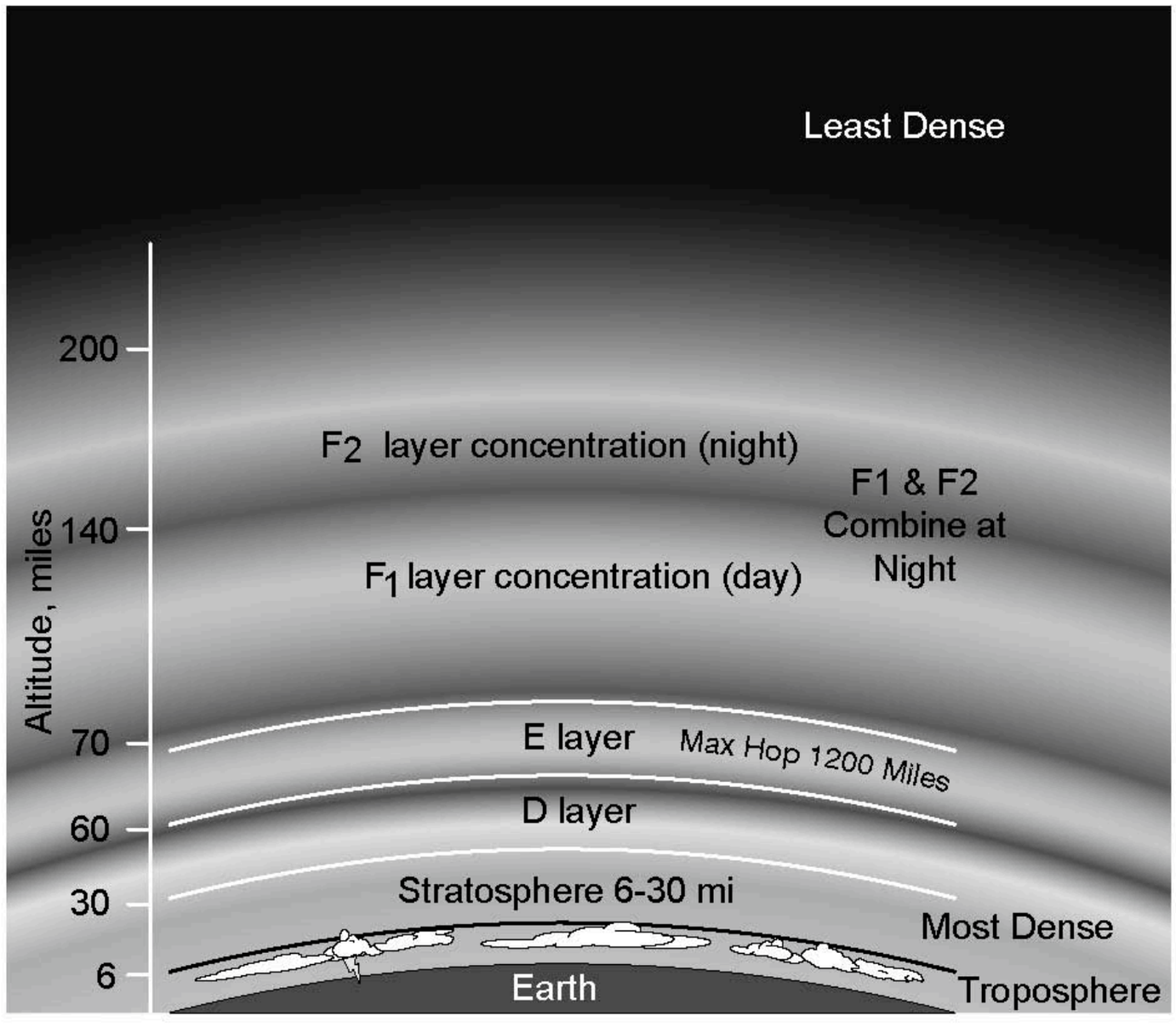





DAEEWEATHERWOMAN.COM

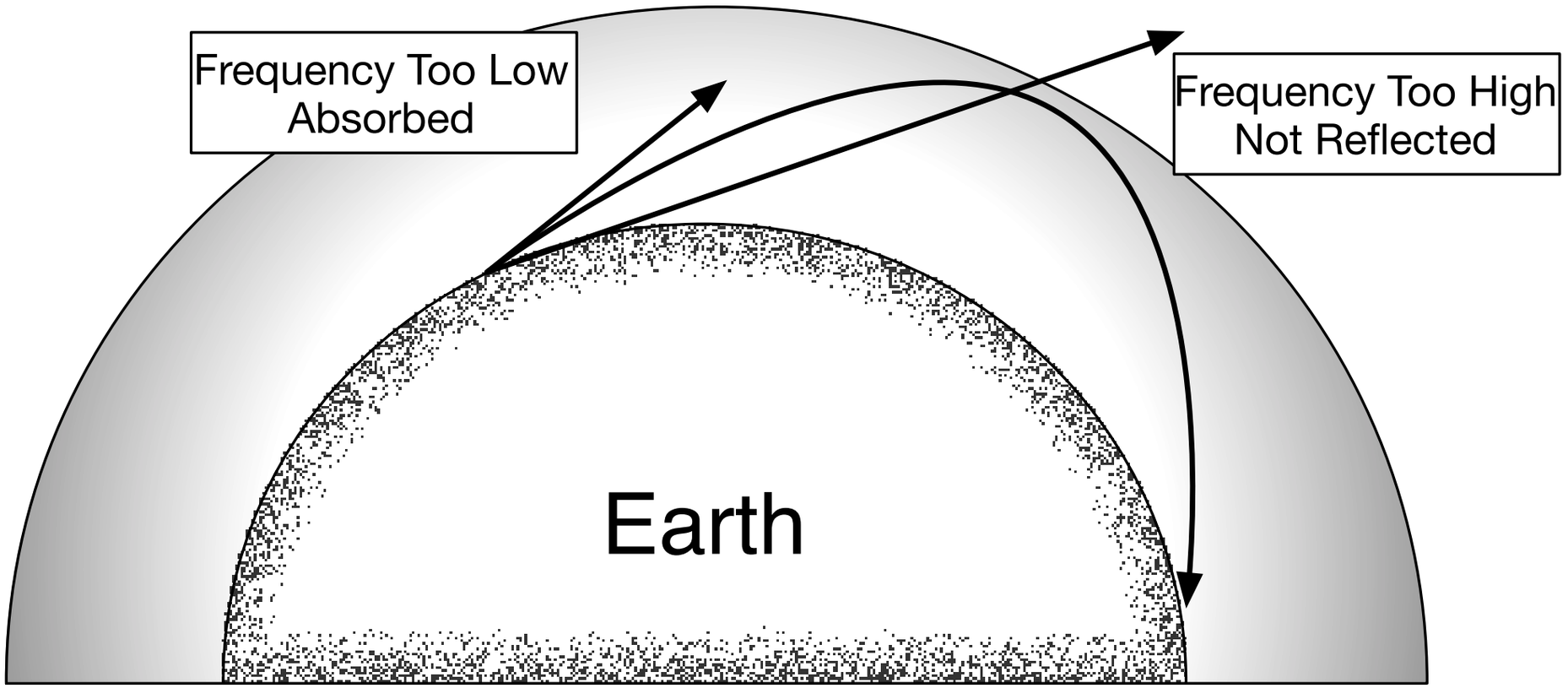
Ionosphere

- Sun ionizes atmosphere during daytime
- Layers dissipate and combine at night
- Some layers reflect (E, F), some layers absorb (D)



Usable Frequencies

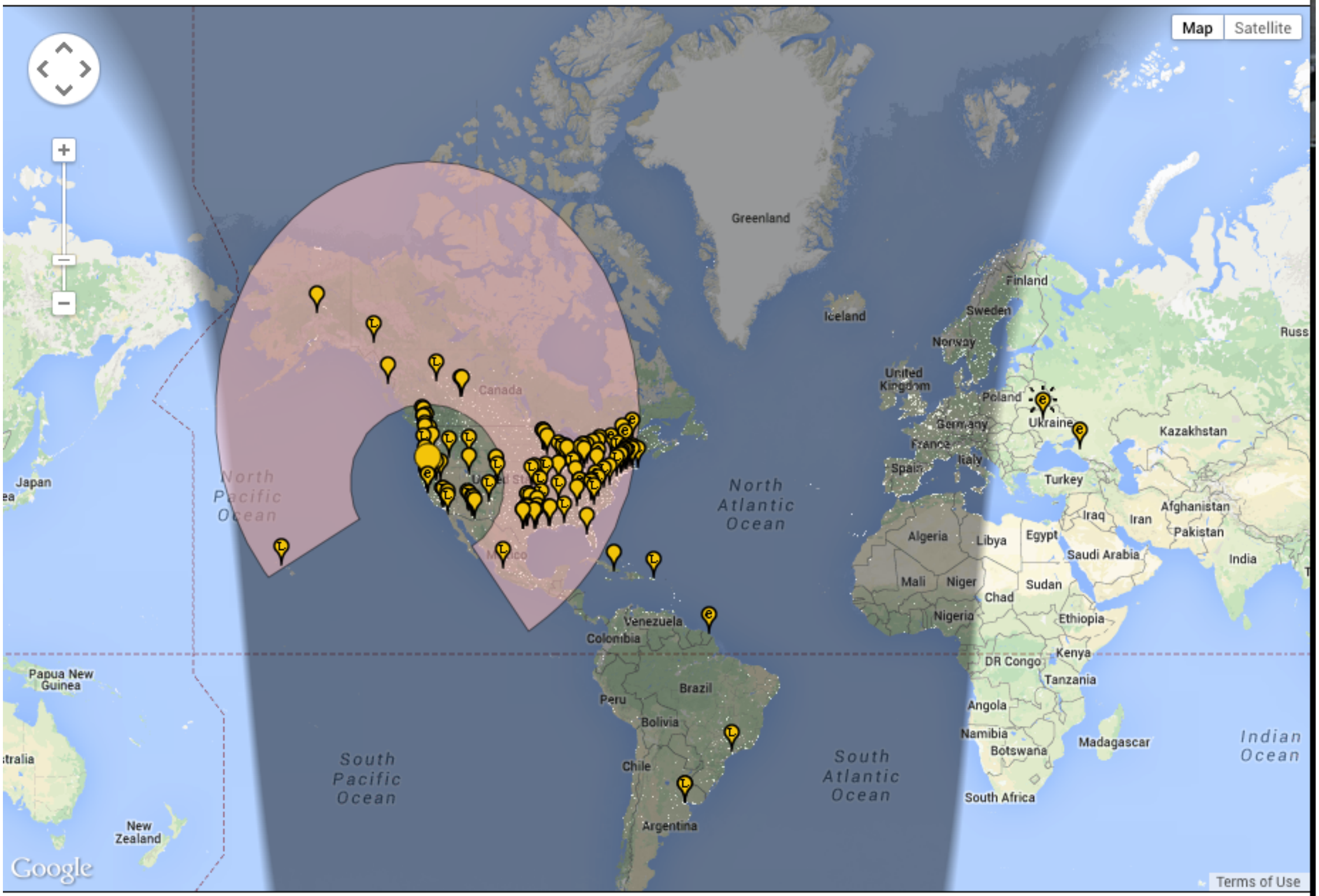
- Lowest usable frequency (LUF): absorption
- Maximum usable frequency (MUF): no reflection
- Web sites calculate these for you for any day or time



On 20m , show signals rcvd by the callsign ag6wh using all modes over the last 6 hours Go! Display options Permalink

Automatic refresh in 3 minutes. Small markers are the 124 transmitters (show logbook) heard (distance chart) at AG6WH (292 reports, 22 countries last 24 hours; 629 reports, 28 countries last week).

There are 251 active monitors on 20m. Show all on all bands. Legend



System statistics. Comments, problems etc to Philip Gladstone. Online discussion of problems/issues. Last modified: August 11, 2014 at 7:21:28 PM PDT

Reception records: 531,278,187 g+1 301

PSKREPORTER.INFO

10 m, 28 MHz : Day

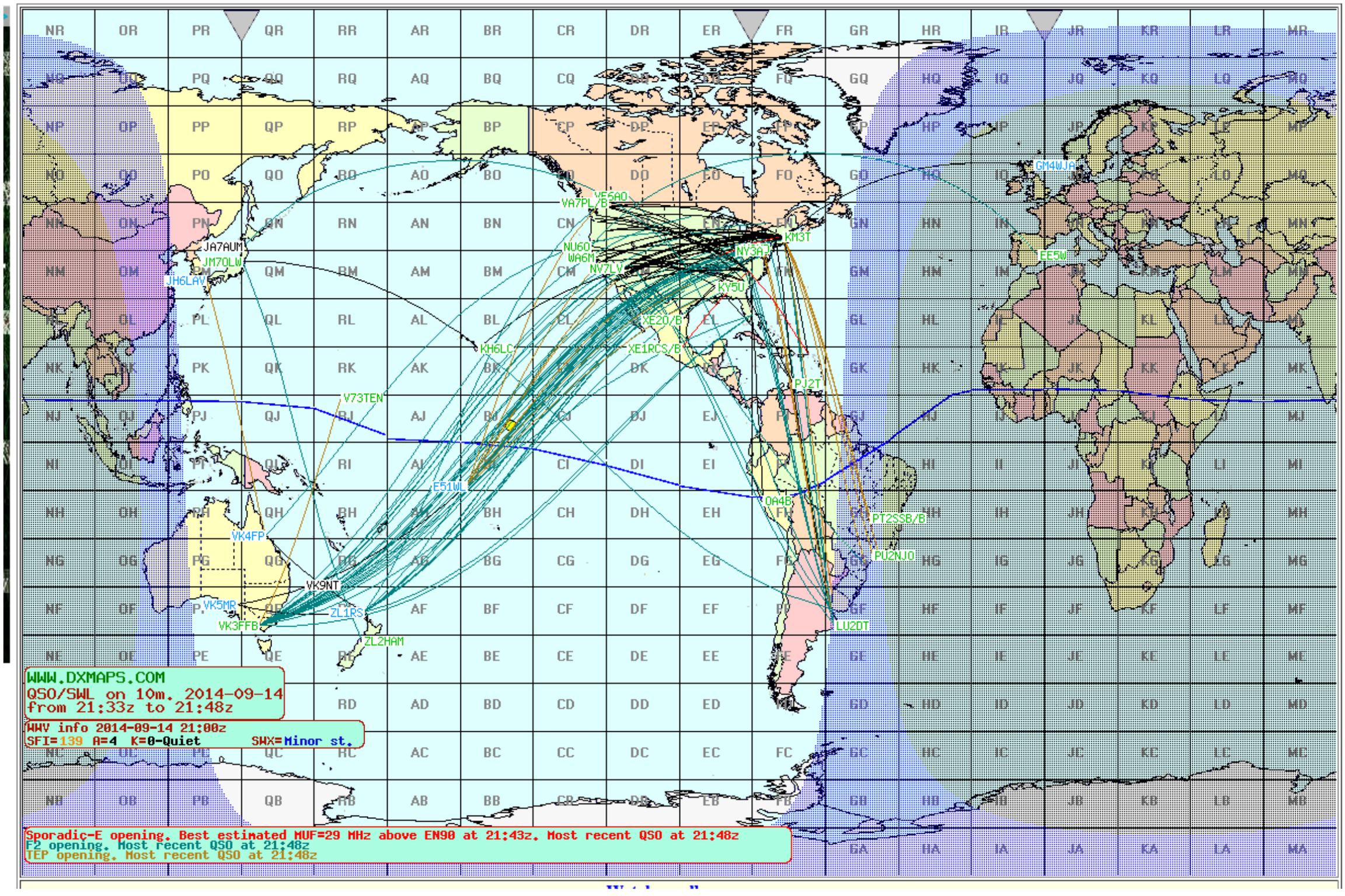
DXMAPS 2.6 - QSO/SWL real time maps

Europe | Africa | North America | South America | Asia | Oceania | **World**

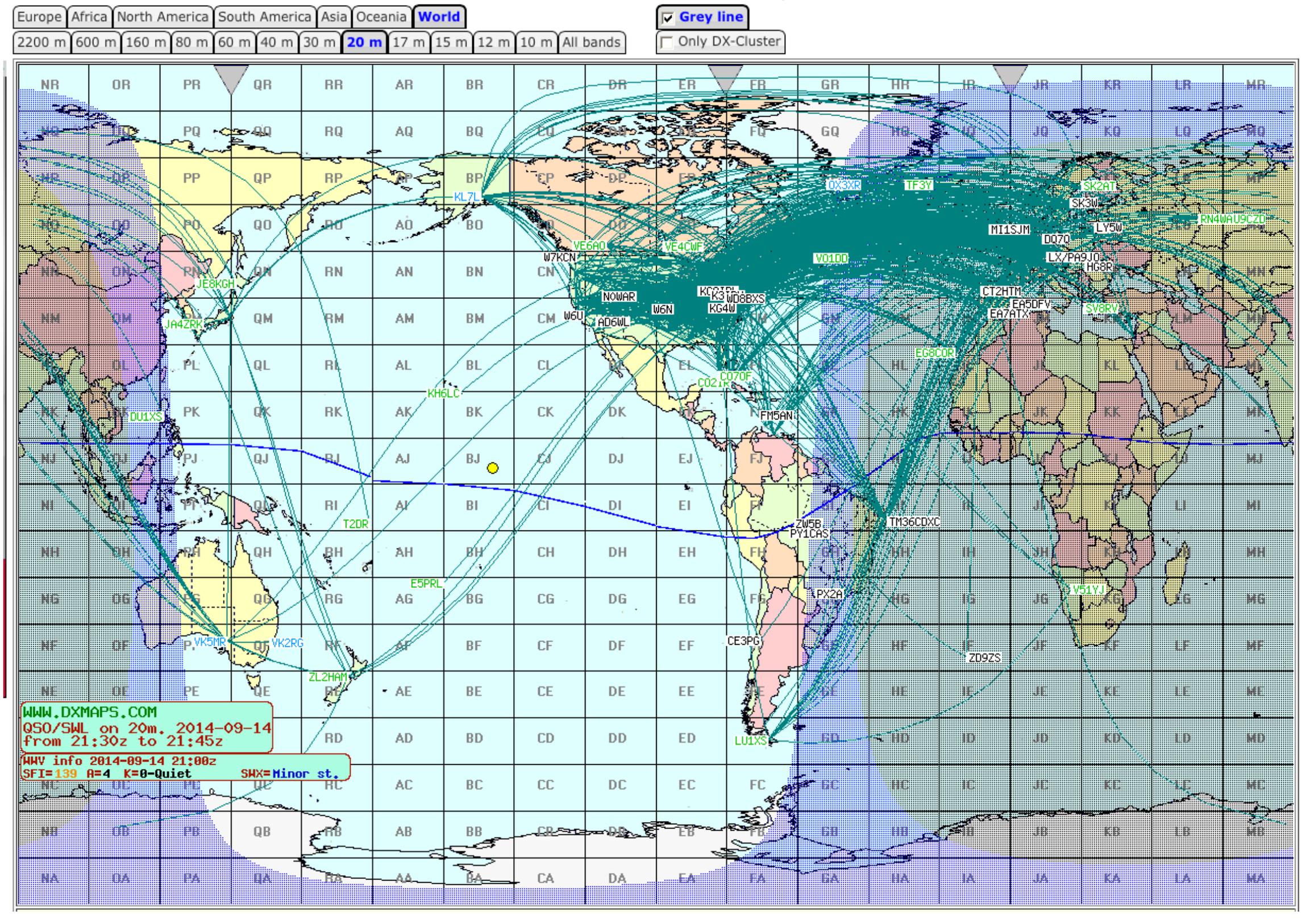
2200 m | 600 m | 160 m | 80 m | 60 m | 40 m | 30 m | 20 m | 17 m | 15 m | 12 m | **10 m** | All bands

☑ Grey line

☐ Only DX-Cluster



20 m, 14 MHz : Grayline



40 m, 7 MHz : Night

DXMAPS 2.6 - QSO/SWL real time maps

Europe | Africa | North America | South America | Asia | Oceania | **World**

2200 m | 600 m | 160 m | 80 m | 60 m | **40 m** | 30 m | 20 m | 17 m | 15 m | 12 m | 10 m | All bands

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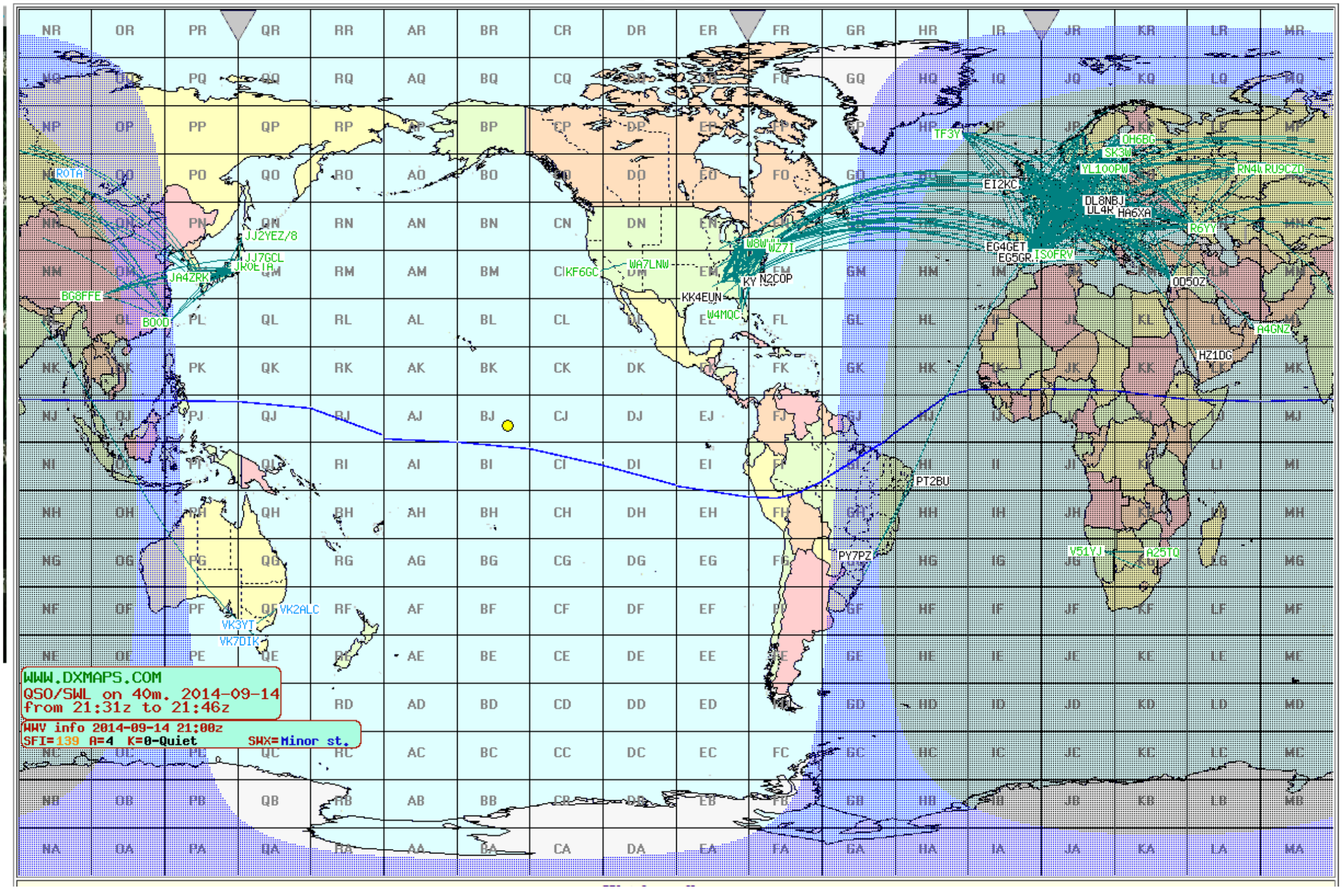
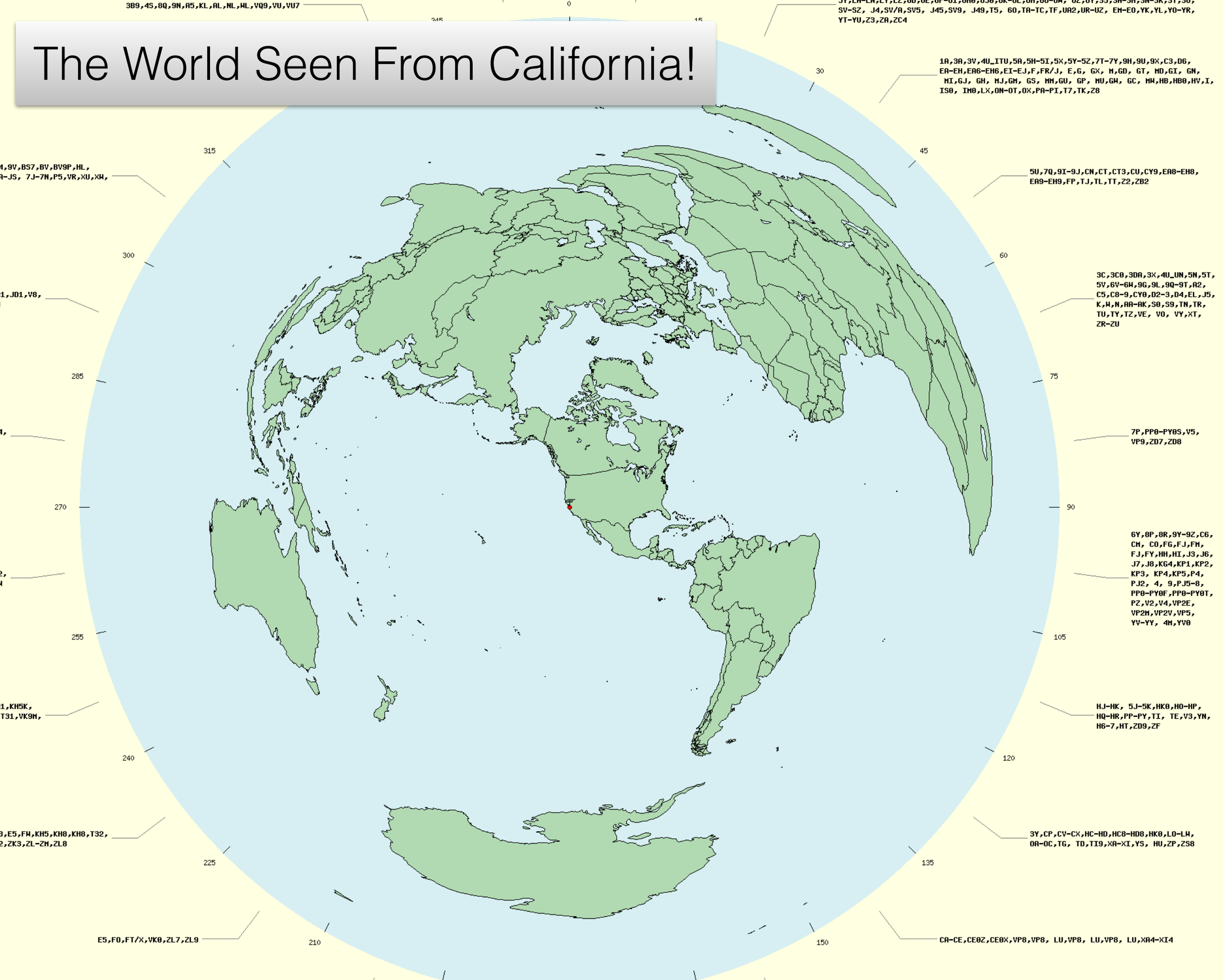


The World Seen From California!



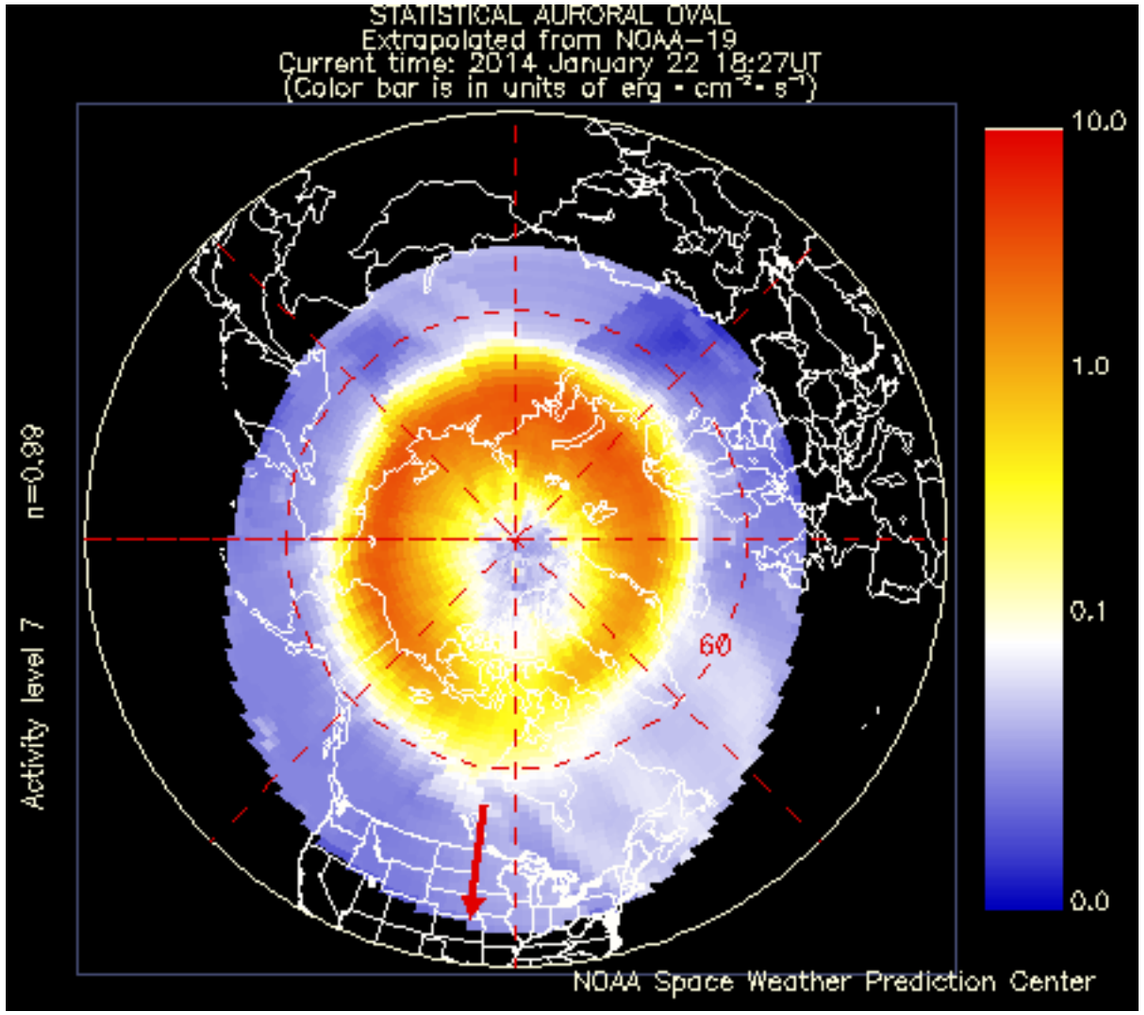
Other Radio Reflectors

- Meteor trails
- Aurora
- Satellites
- Moon

Aurora

- Aurora is due to charged particles from the sun following the earth's magnetic field lines

- These reflect radio waves over thousands of miles



Next Time

- Antennas
- Cables, connectors, and impedence matching

Questions?