# *ARRL, Cycle 25, Voyager 1*

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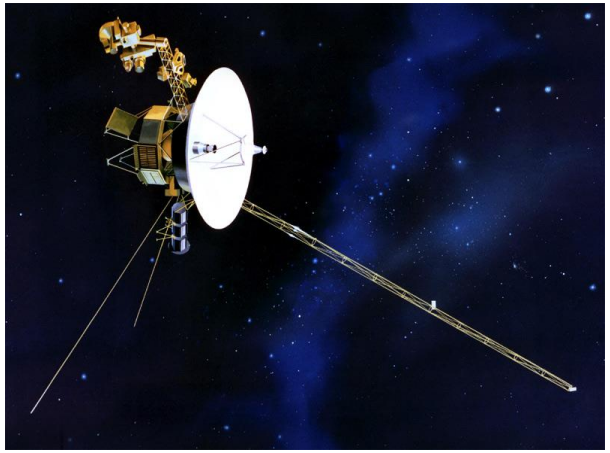
website: https://k9la.us (needs an update 😮)

# What We'll Cover

## ARRL Update

## Cycle 25

## Voyager 1



# ARRL Update – Central Division

- Central Division Director: Brent Walls N9BA
  - As of Jan 1, 2025
  - Greenfield, IN (near Indy)

- Central Division Vice Director: Josh Long W9HT
  - As of Jan 1, 2025
  - New Haven, IN (east side of Ft Wayne)

# ARRL Update - Issues

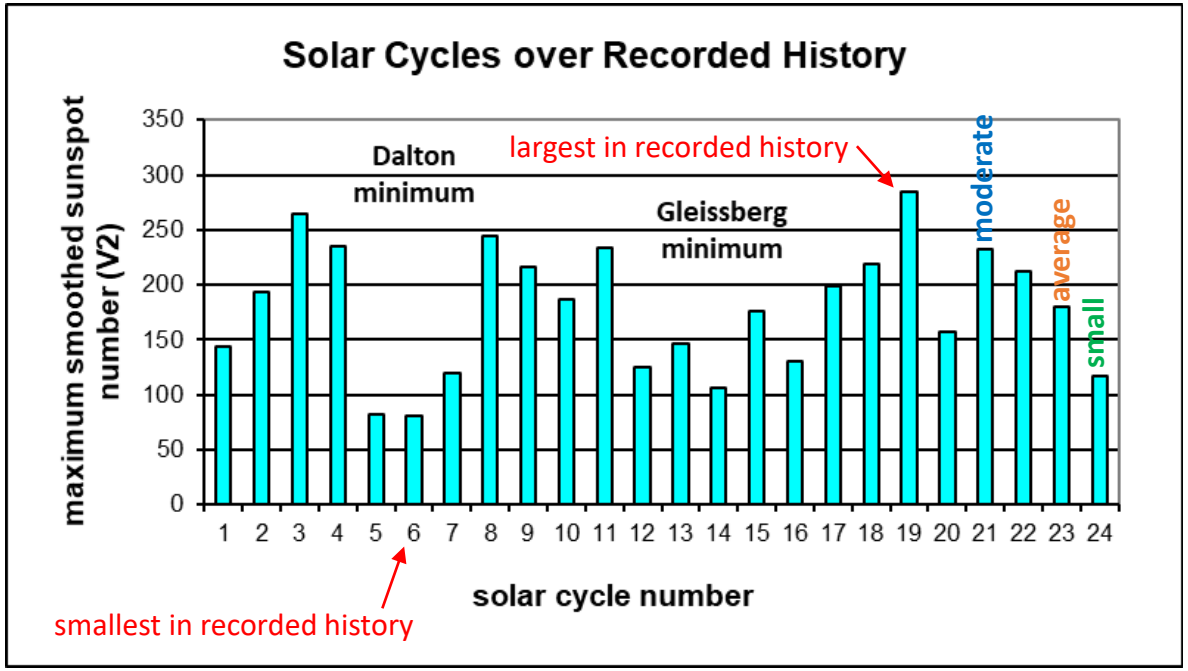
- ARRL Board Meeting Jan 17-18, 2025
  - Summary report via Jan 22 Member Bulletin – full minutes at a later date
- Cyber attack – major disruption
- HOA bills in Congress – expensive endeavor but big ROI
- HF trading – all appears to be quiet now

# ARRL Update - Issues

- Bills stuck at the FCC – Tech Enhancement, lower frequency limit for 75m, band plan, others
- Governance structure – time for a change?
- Code of conduct for the ARRL Board – working on this for years

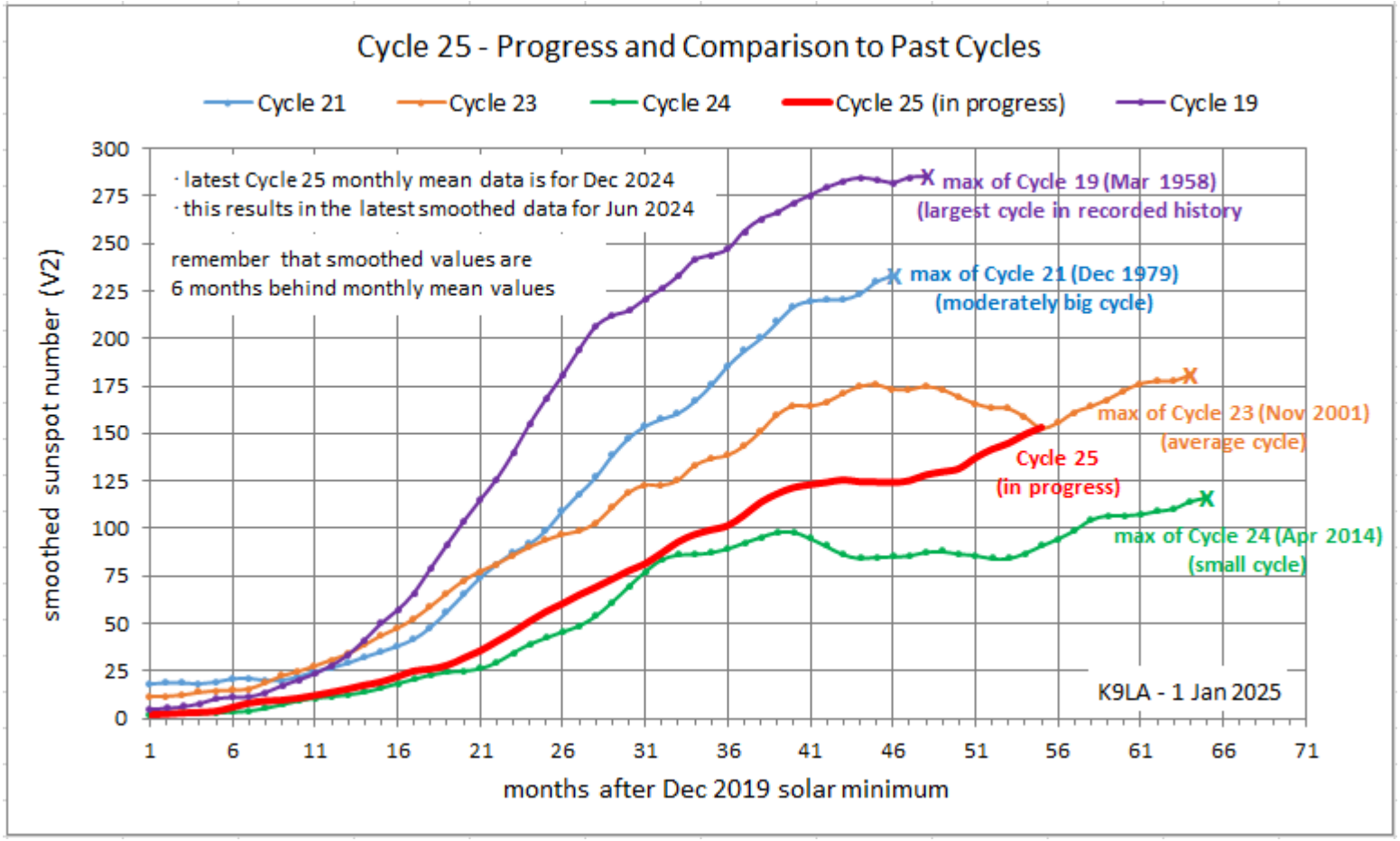
# Cycle 25 – Historical Data

- Cycle 1 began in 1755
  - Maunder Minimum (few sunspots) occurred from 1645-1715
- We've gone through 3 periods of big solar cycles and 2 periods of small solar cycles
  - Cycle 24 appears to have ushered us into a third period of small solar cycles
- Cycle 24 was the smallest in our lifetimes
  - 4th smallest in recorded history




***The big question – Will Cycle 25 get us out of this apparent third period of small solar cycles?***

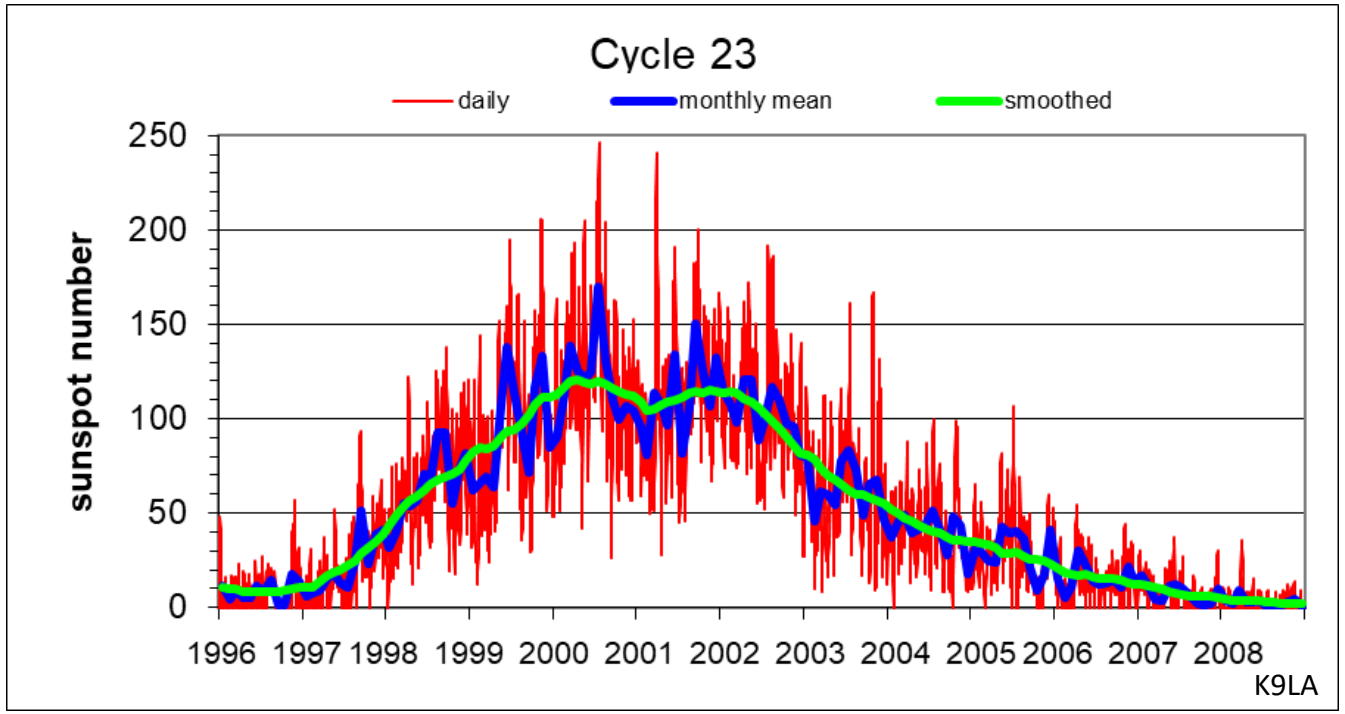
# Cycle 25 – Thru December 2024




- We have 55 months of smoothed sunspot numbers since solar minimum in December 2019
- Cycle 25 has surpassed the max of Cycle 24
- Will it get up to the max of Cycle 23?

- Keep your fingers crossed if you're an aficionado of 15m/12m/10m/6m
- If you're a traffic net op, you don't care

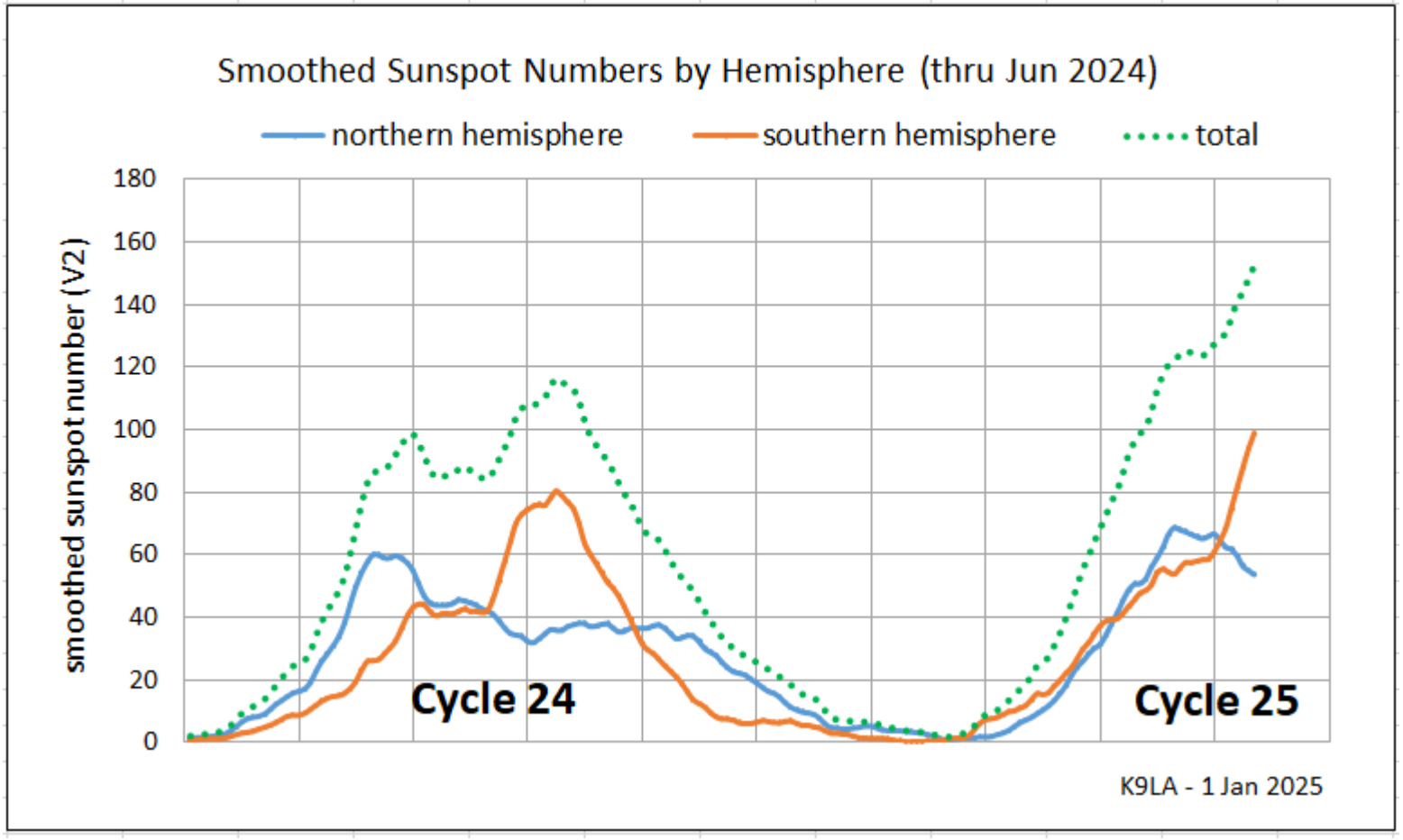
# Cycle 25 – Smoothed Sunspot Numbers




- Daily data (red) is spiky
- Monthly mean data (blue) is still spiky
- Smoothed data (green) takes out the spikes
  - 12-month running average of monthly means
- Similar results for 10.7 cm solar flux

- **Smoothed sunspot numbers are used for two reasons**
  - **Official measurement of a solar cycle**
    - **Best way to see what a solar cycle is doing by eliminating all the spikes**
  - **Best correlation between sunspots and what the ionosphere is doing**

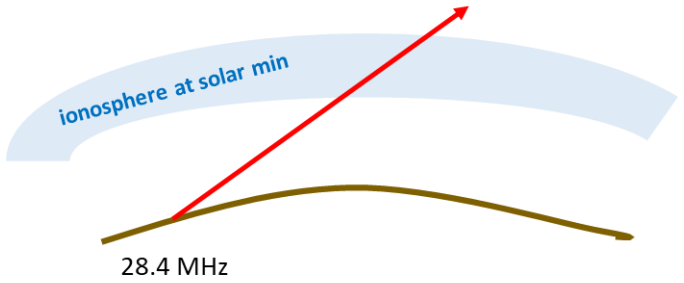
# Cycle 25 – One Peak or Two Peaks?

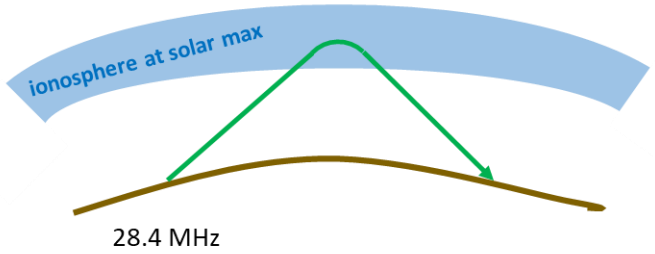



- There appears to be a northern hemisphere peak
- No southern hemisphere peak yet
- Will there be a peak, an obvious valley in between and a second peak?

# Cycle 25 – What Allows a QSO?

- Enough $F_2$ region ionization* to refract (bend) the signal back to Earth




* Ionization is the number of free electrons that have been detached from atoms or molecules by extreme ultraviolet radiation (EUV) from the Sun. EUV is the true ionizing radiation – sunspots and 10.7 cm solar flux are proxies for EUV.

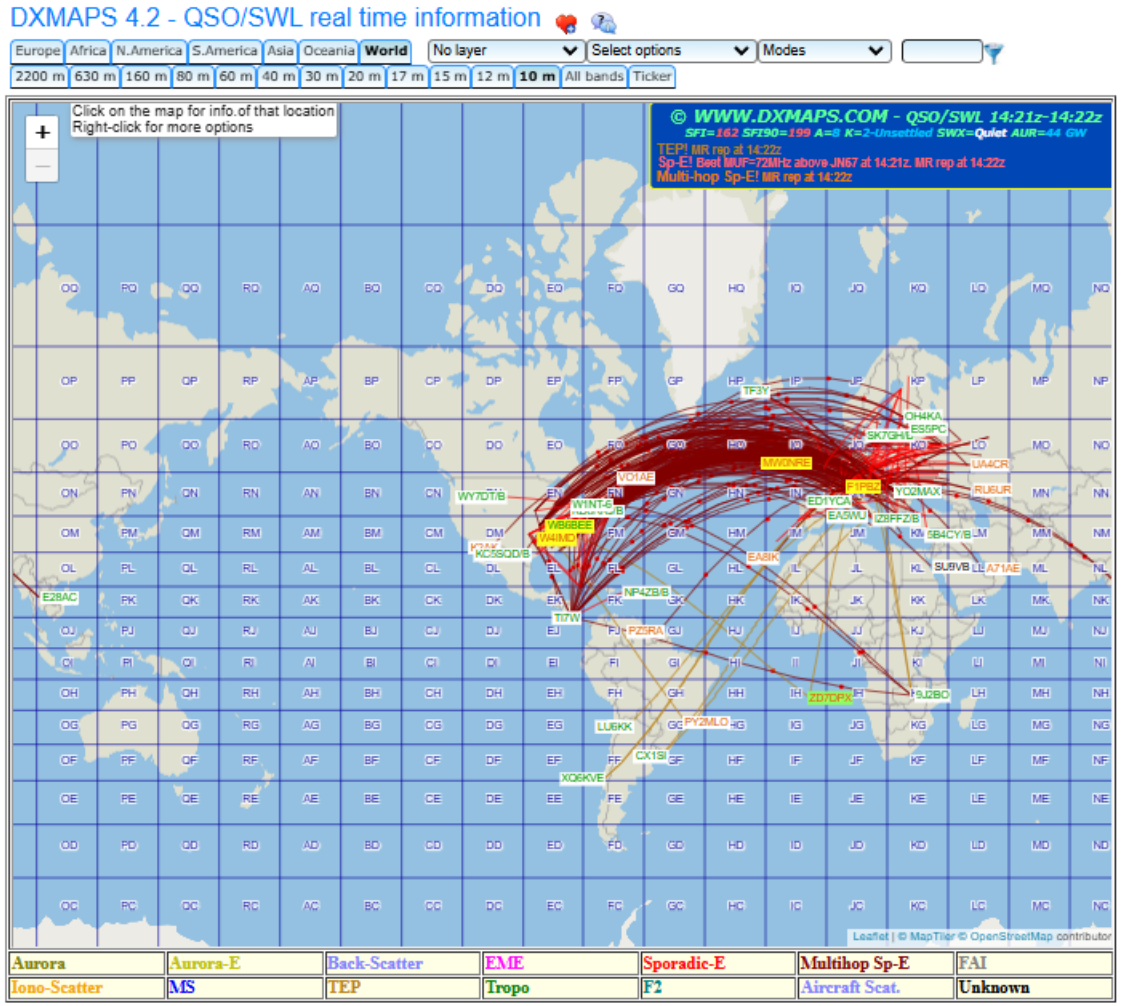
- Low enough losses to be able to hear the signal with your ears or to decode the signal with a digital mode
  - We can control transmit power, transmit antenna gain and pattern, receiver sensitivity, receive antenna gain and pattern
  - We can't control free space path loss, ionospheric absorption (in the D region), ground reflection loss, polarization loss

# Cycle 25 – Bands for 2025

Our MF/HF/VHF bands fall into three categories

1) Those critically dependent on loss – best around solar min
   - 160m, 80m/75m, 60m
   - Ionospheric absorption inversely proportional to (frequency)$^2$
2) Those critically dependent on ionization – best around solar max
   - 15m, 12m, 10m, 6m
   - Amount of refraction inversely proportional to (frequency)$^2$
3) Those that somewhat depend on loss and somewhat depend on ionization – decent throughout a solar cycle
   - 40m, 30m, 20m, 17m (a.k.a. the transition bands)

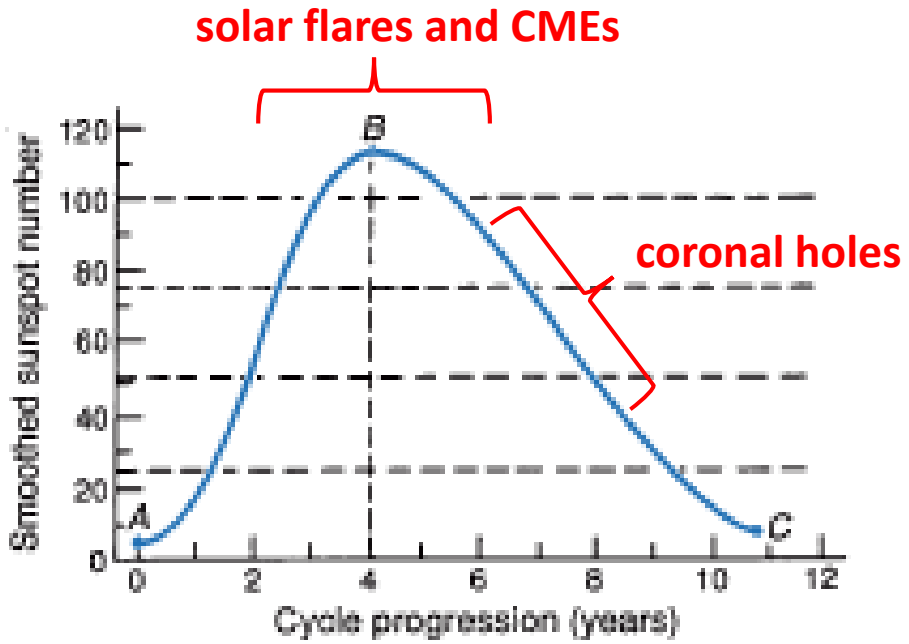
# Cycle 25 – The Bands Right Now




- Visit dxmaps.com and select ‘view’ and ‘band’
- Example: Tuesday January 28, 2025
- 10m QSOs from 1421-1422 UTC (9:21-9:22AM EST)
- Other methods
  - WSPRnet, PSKreporter, IARU/NCDXF beacons, Reverse Beacon Network, others

# Cycle 25 – Disturbances to Propagation

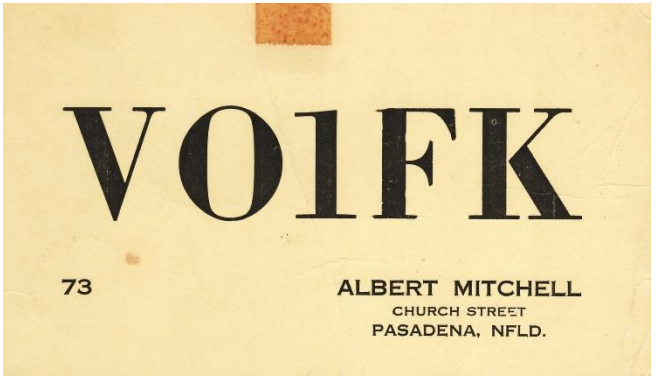
- Geomagnetic storm
  - Caused by a Coronal Mass Ejection (CME) or a Coronal Hole (CH)
  - Elevated K indices
  - Deplete $F_2$ region electrons for days
- Solar radiation storm
  - Believed to be caused by a CME in conjunction with a big solar flare
  - More absorption in polar cap for a couple days
- Radio blackout
  - Caused by a big solar flare
  - Lower frequency signals disappear on daylight side of Earth for about an hour

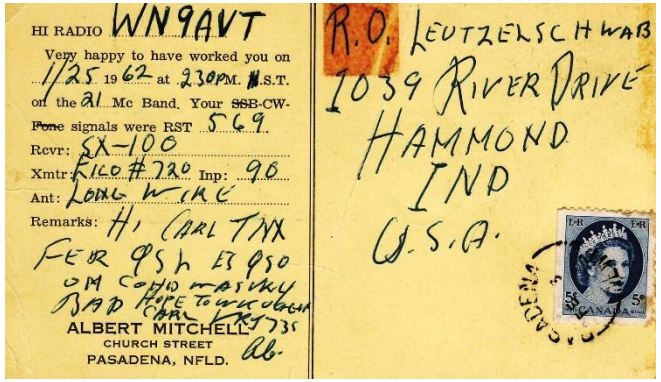



- ***At solar maximum, we have to take the BAD (solar flares and CMEs) with the GOOD (high MUFs)***
- ***Coronal holes tend to disturb the $F_2$ region more than CMEs***

# What Is DX?

- When I was a Novice (1961/1962), DX to me was WV6's and KN7's
  - Roughly 34 miles/Watt
- After working some WV6's and KN7's, then DX to me meant a foreign country
  - Worked VO1FK in Newfoundland on 15m
  - Roughly 35 miles/Watt
- Nowadays I can work Japan via long path (18,452 miles) with 100 Watts on 10m
  - Roughly 185 miles/Watt



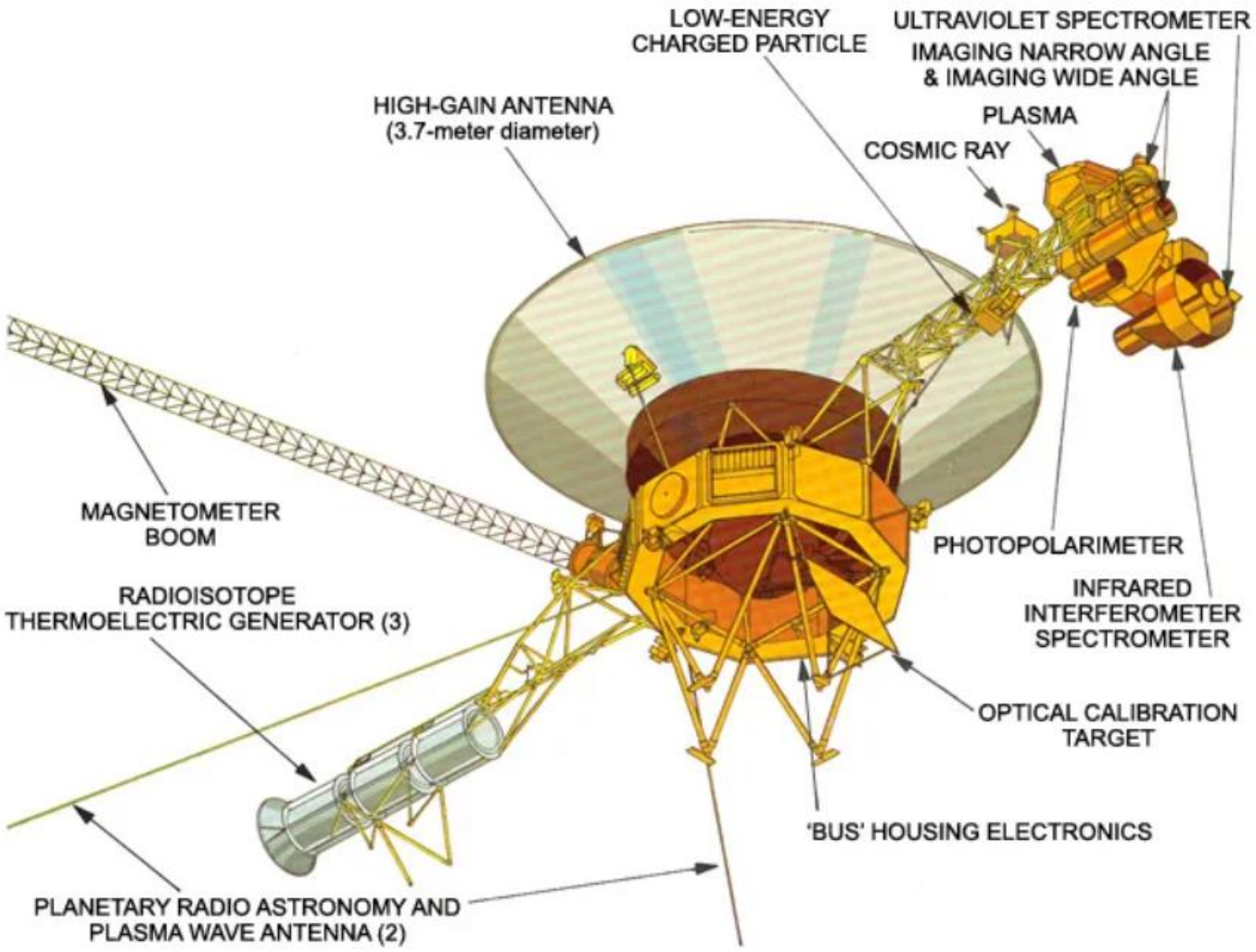
# DX – 185 miles/Watt

- Pretty darn good, right?

- How about 674,000,000 miles/Watt?


- That's the value for ***Voyager 1***
  - It's 15.5 billion miles from Earth
  - Transmit power = 23 Watts
    - Very high antenna gains on both ends help

# Voyager 1 – An Overall Look



# Voyager 1 – Timeline

| Date | Event |
|---|---|
| 1977-09-05 | Spacecraft launched at 12:56:00 UTC |
| 1979-03-05 | Encounter with the Jovian system |
| 1980-11-12 | Encounter with the Saturnian system |
| 1990-02-14 | Pale blue dot (Earth) image taken |
| 2004-12-17 | Passed the termination shock at 94 AU* and entered the heliosheath* |
| 2012-08-25 | Crossed heliopause* at 121 AU, entered interstellar space |
| 2023-11-14 | Issues with onboard computer, unable to send usable data back to Earth |
| 2024-04-22 | Engineers re-establish communication with the probe |

** AU is Astronomical Unit – 1 AU is 93 million miles (average Earth-to-Sun distance)*

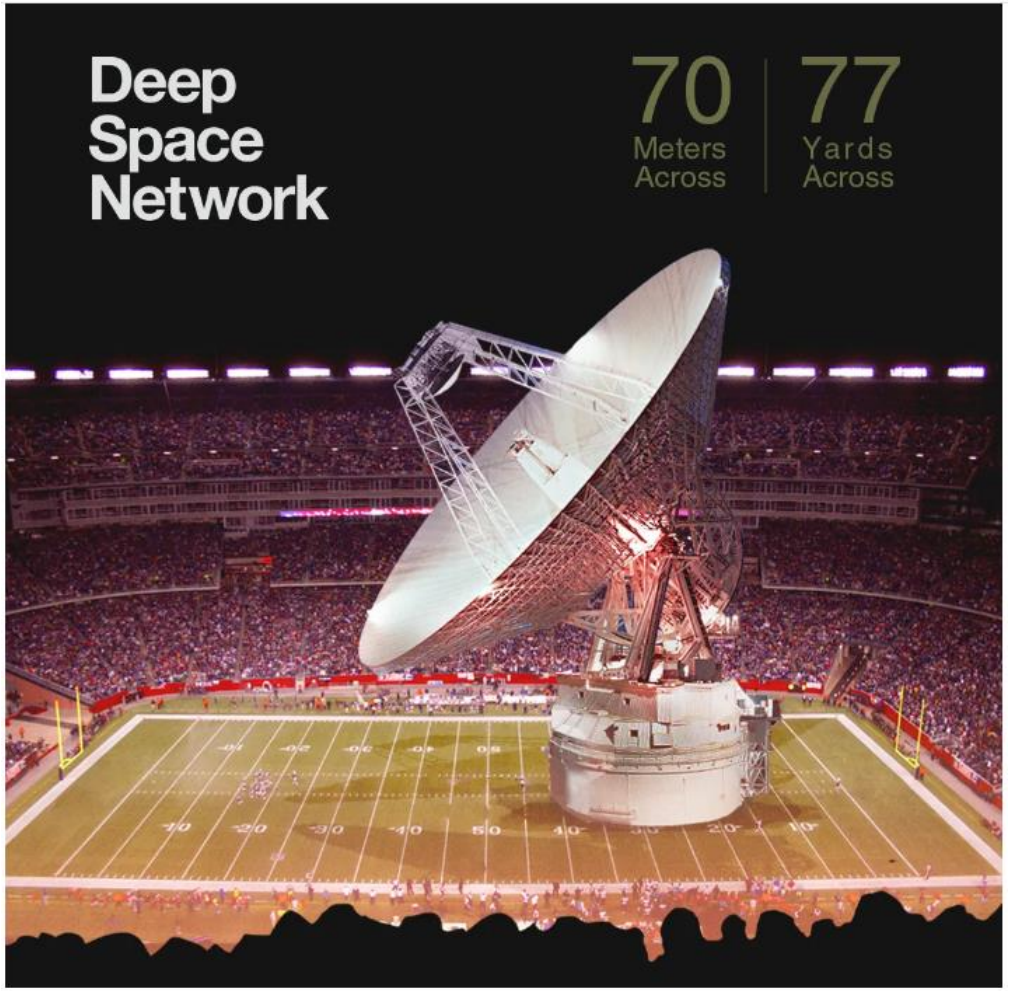
** heliosheath – where solar wind slows down and interacts with interstellar space*

** heliopause – the boundary between solar wind and interstellar wind (leave our solar system)*

# Voyager 1 – Technical Details

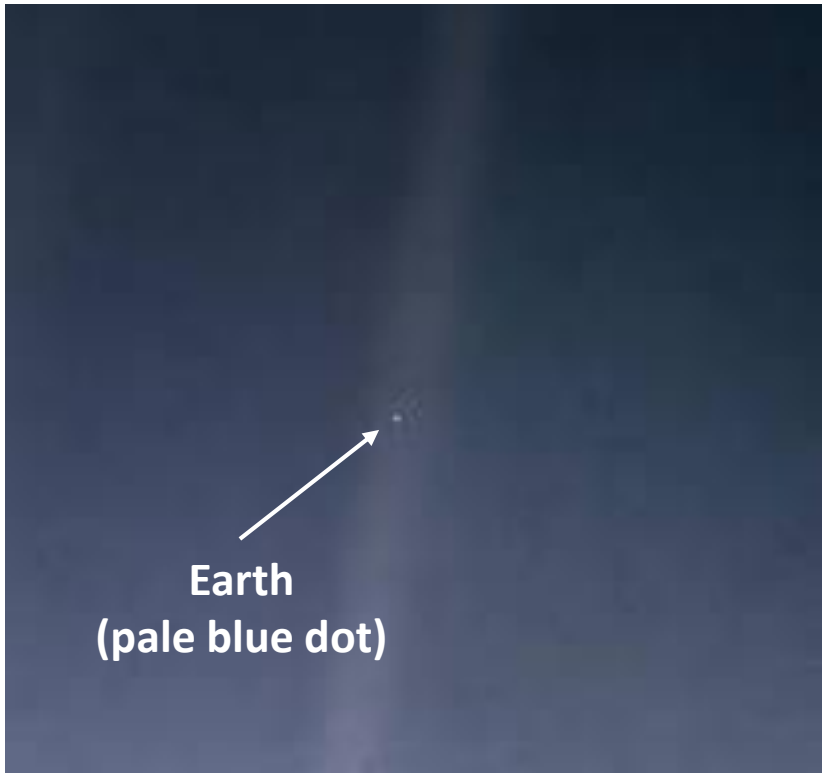
- Voyager 1 transmitting to Earth
  - 2.3 GHz (S-band) or 8.4 GHz (X-band)
  - 23 Watts
  - 12 foot diameter dish: gain = 37 dB at 2.3 GHz, 48 dB at 8.4 GHz
- Earth receiving Voyager 1
  - Deep Space Network (DSN) locations
    - Goldstone (CA), Madrid (Spain), Canberra (Australia) – every 120$^{o}$ of longitude
  - Deep Space Network antennas
    - 70m diameter dish: gain = 62 dB at 2.3 GHz, 74 dB at 8.4 GHz
    - 34m diameter dish: gain = 56 dB at 2.3 GHz, 67 dB at 8.4 GHz
- Earth transmitting to Voyager 1
  - 2.1 GHz, lots of power, DSN antennas

# DSN Antenna – 70m Dish




- At 15.5 billion miles away, a radio signal from Voyager 1 takes 23 hours to reach Earth
- Voyager 1's power source will likely be depleted in the mid-2030s, resulting in loss of communications
- Voyager 2 is about 6 years behind Voyager 1
  - Still operational and communicating well with Earth

# Voyager 1 – Earth from 3.7 Billion Miles




- Photo of Earth from Voyager 1 in February 1990
- Carl Sagan wrote in his book **Pale Blue Dot: A Vision of the Human Future in Space** "*Look again at that dot. That's here. That's home. That's us.*"
- Voyager 1 will never exit the Milky Way galaxy
  - Its speed is too low to escape the galaxy's gravitational pull into intergalactic space.

# Propagation References

- Propagation chapters of the ARRL Handbook and the ARRL Antenna Book
- Here to There: Radio Wave Propagation *(from the ARRL)*
  - https://home.arrl.org/action/Shop/Store
- The Little Pistol's Guide to HF Propagation – Bob NM7M (SK) *(out of print)*
  - https://k9la.us/NM7M_The_Little_Pistol_s_Guide_to_HF_Propagation.pdf
  - Easy reading, 15Meg download on K9LA website
- The CQ Shortwave Propagation Handbook – 4th Edition (*out of print*)
  - https://store.cq-amateur-radio.com/shop/the-cq-shortwave-propagation-handbook-4th-edition-cd/
  - A 2021 update from the 1995 edition – unfortunately CQ went under
- Radio Propagation Explained – GØKYA *(from the RSGB)*
  - https://www.amazon.com/Radio-Propagation-Explained-Steve-Nichols/dp/1910193283
- K9LA web site – https://k9la.us/

# Summary

- Cycle 25 has surpassed Cycle 24
  - Enough solar EUV to provide great propagation on 15m, 12m, 10m
  - Enough solar EUV to provide some $F_2$ propagation on 6m
  - Cycle is doing a bit better than the NASA prediction of a small cycle
  - Could see great propagation out to 2027
- Don’t give up on the low bands – QSOs still possible
- Use the internet to see what’s going on right now on the bands
- Get on the air and have fun!
  - Use FT8 for its advantage over SSB and CW – especially on 6m
  - If you can hear the FT8 tones with your ears, try CW and SSB