

Cycle 25, Space Weather and Propagation for 2023

Carl Luetzelschwab K9LA

e-mail: k9la@arrl.net

website: <https://k9la.us>



spiral aurora over Tromsø, Norway
December 11, 2022

Previous Presentations

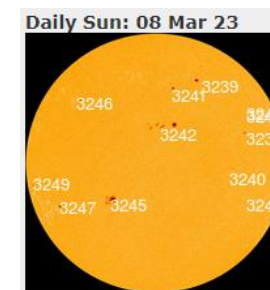
- May 2013
 - Cycle 24, disturbances to propagation, several DXpeditions
- February 2017
 - Cycle 24, Cycle 25, prediction software
- March 2023
 - Cycle 25, space weather, propagation for 2023, 10m long path

Agenda

- Cycle 25
 - How is it doing?
- Space weather and propagation
 - Do all those parameters tell us what the ionosphere is doing right now?
- Propagation forecast for 2023
 - What to expect on the bands
- 10-Meter long path
 - Add some spice to your operating this spring thru fall
 - Should apply to 15m and 12m, too
- Bonus slides from a question at the meeting

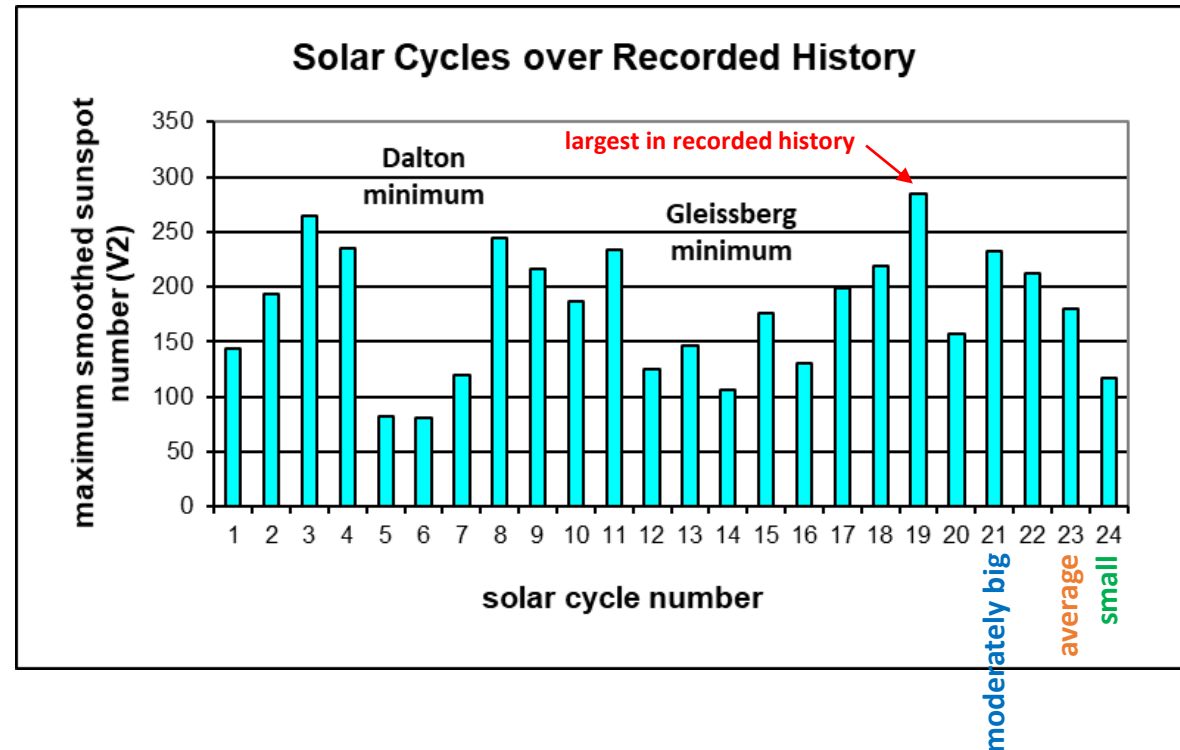


Cycle 25



Historical Look at All 24 Cycles

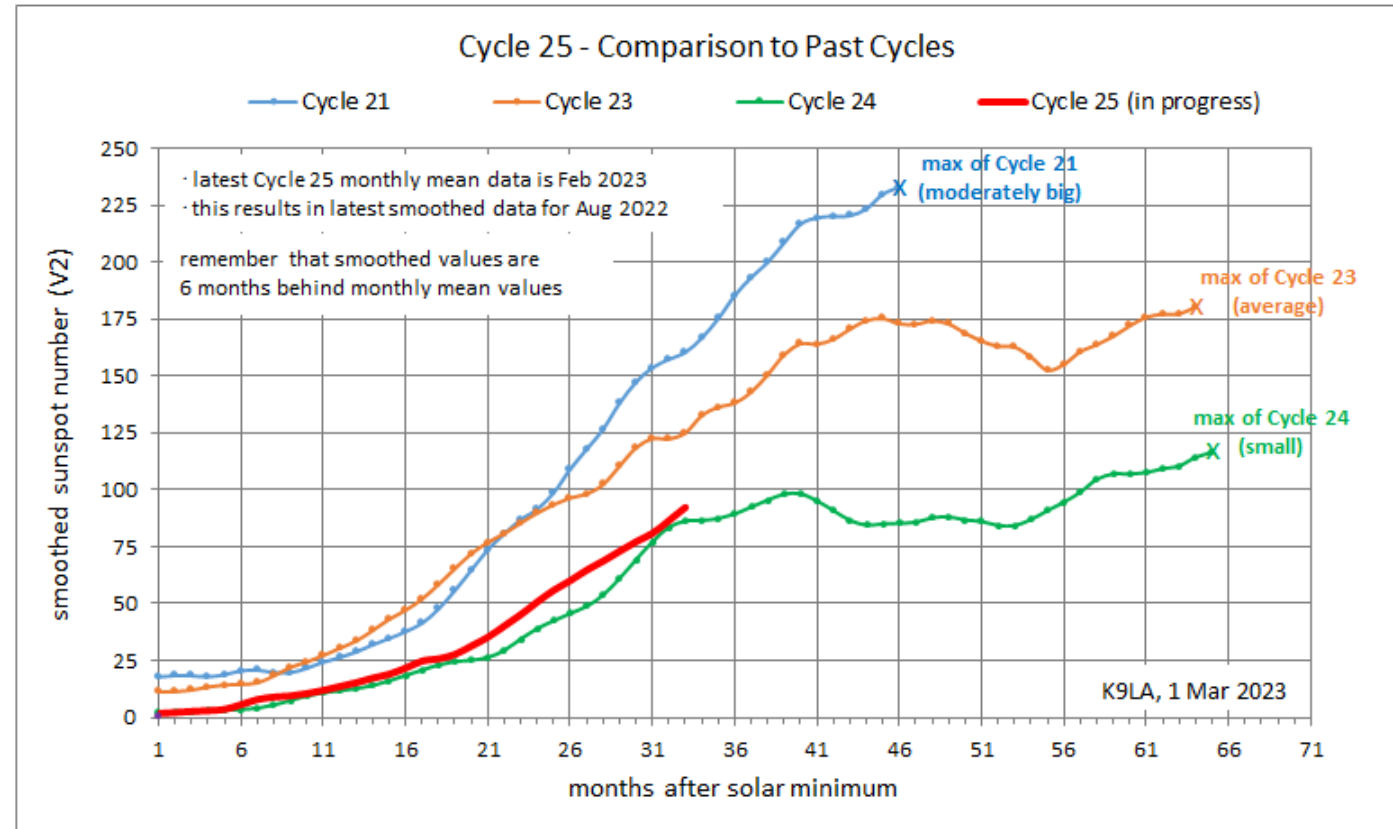
- Cycle 1 began in 1755
 - Maunder Minimum occurred from 1645-1715 with few sunspots
- We've gone through 3 periods of 'big' solar cycles
 - Cycles 1-4, 8-11, 17-23
- We've gone through 2 periods of 'small' solar cycles
 - Cycles 5-7, 12-16
- With Cycle 24, we appear to have entered a third period of small solar cycles



Will Cycle 25 get us out of this possible third period of small cycles?

How Is Cycle 25 Doing?

- Solar minimum was in December 2019
- We currently have 33 months of smoothed sunspot number data since solar minimum
- So far, we appear to be tracking the small Cycle 24
- Thankfully we have enough EUV (extreme ultra-violet) radiation for 15m, 12m and 10m
 - EUV is the true ionizing radiation for the F2 region of the ionosphere
 - Sunspots and 10.7 cm solar flux are proxies for EUV



Hopefully Cycle 25 will move up to an 'average' cycle

Space Weather and Propagation



Development of the Model of the Ionosphere

- With solar data and ionosphere data, the result we desired was a correlation between a daily solar parameter (sunspots or 10.7 cm solar flux) and what the ionosphere is doing today
- That didn't happen – the correlation was poor
- Why? Because there are three sources of variability of the ionosphere and we only understand two of them
 - Solar radiation – sunspots, 10.7 cm solar flux, EUV and MUF US Boulder
 - Geomagnetic field activity – K index, A index, Bz and solar wind
 - Events in the lower atmosphere coupling up to the ionosphere – no parameters (yet)
- It's tough to make a daily model with data from only 2 of the 3 sources

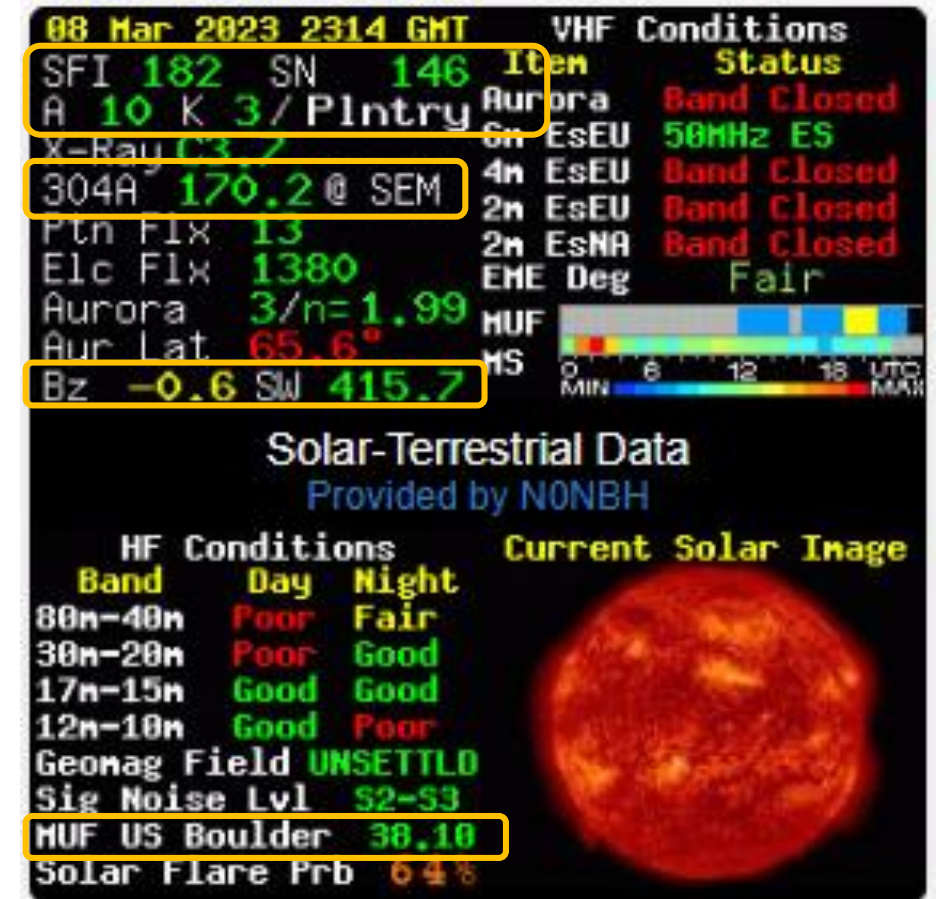
Here's What We Ended Up With

- A monthly median model of the ionosphere
 - Median implies 50% probability
 - Correlated to a smoothed solar parameter (long-term average of daily data)
 - Our understanding of the ionosphere is statistical over a month's time frame
- Our propagation predictions give monthly median MUF and signal strength
 - There's a distribution about these median values
 - The MUF on any given day in the month could be somewhat higher to much lower than the median
 - The signal strength on any given day in the month could be somewhat higher to much lower than the median
 - Plugging in the daily 10.7 cm solar flux and the current K index won't make the predictions more accurate

Parameters That I Consider Important

- Earlier I mentioned SN, SFI, EUV, K, A, Bz and solar wind
- One place to get them is from the NØNBH banner at www.qrz.com
- Let's review SN, SFI, EUV, MUF US Boulder, K, A, Bz and solar wind
- Note 'MUF US Boulder' at the bottom

These parameters should give you a general idea of what propagation is like



Descriptions of Those Parameters

- **SFI** – 10.7 cm solar flux – from 65 to 350
 - SN – sunspot number – from 0 to 450
 - EUV – extreme ultra-violet radiation
 - MUF US Boulder – MUF when Boulder is midpoint of 3000 km path
- general correlation
- **K** – 3-hr index of the activity of the Earth's magnetic field – from 0 to 9 (logarithmic)
 - A – avg of the eight daily K indices – from 0 to 400 (linear)
 - Bz – north/south component of the IMF* – from +50 to -100
 - SW – solar wind speed – average for quiet time is 400 km/s – from 350 km/s to 2000 km/s
- general correlation

We'll focus on the parameters in green

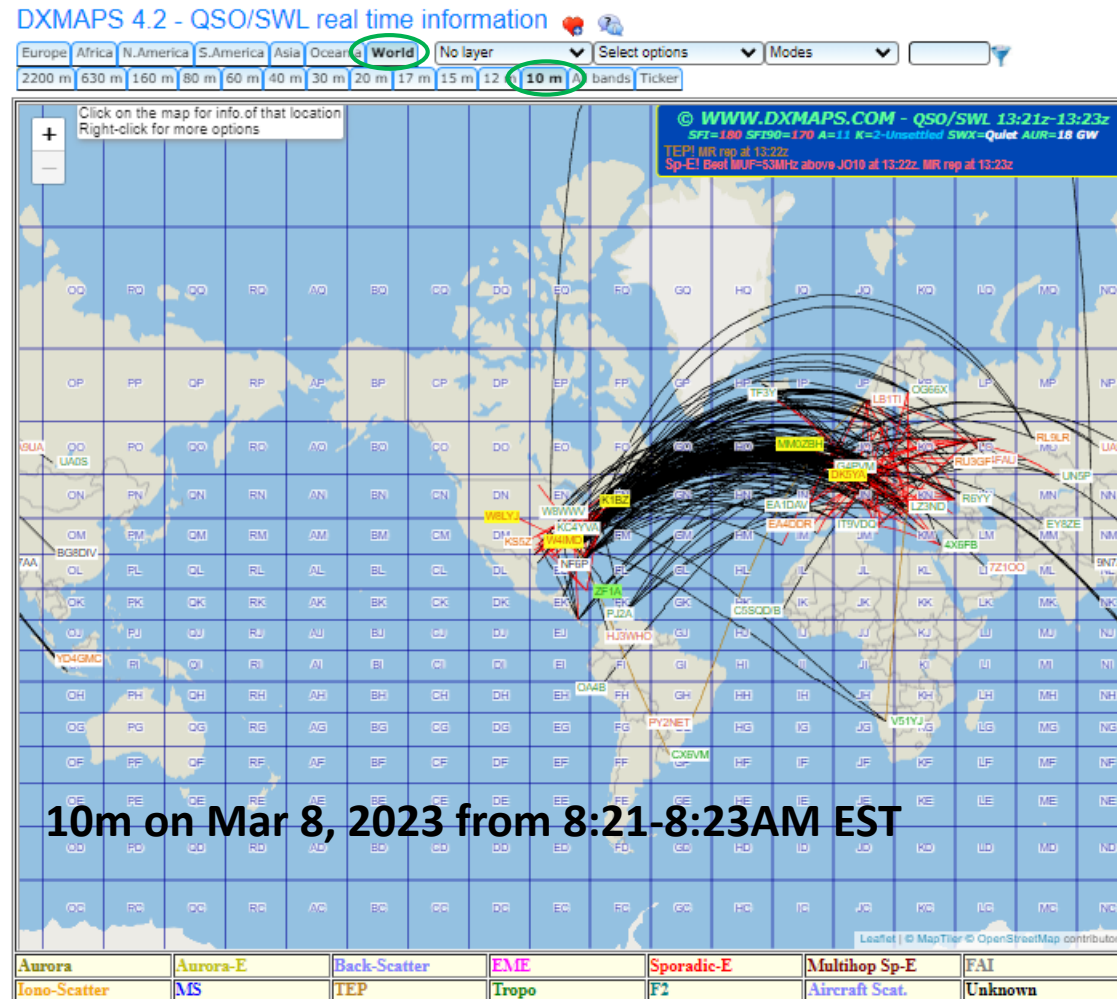
** IMF is Interplanetary Magnetic Field (Sun's magnetic field)*

What We Desire for SFI and K

- We need two conditions for a QSO to occur
 - Enough ionization (MUF) to refract the signal back to Earth
 - Low enough loss (absorption, FSPL, antenna gains, transmitter power, receiver MDS, ground reflection loss, local noise) to make signal readable (or detectable)
- What we desire
 - Generally $K \leq 3$
 - Exception – VHF types like high K indices for propagation via aurora
 - SFI for the higher HF bands (15m, 12m, 10m)
 - 15m: need smoothed SFI > 90
 - 10m: need smoothed SFI > 100
 - Even if SFI is at its minimum, 17m and lower frequencies are still open
- Where we are right now
 - Smoothed SFI ~120

What Are the Bands Doing Right Now?

- If you don't want to mess with propagation predictions or with all those space weather parameters, go to dxmaps.com
- Select a view (World, NA, . . .)
- Select a band
- Other methods
 - KC2G MUF map (next slide)
 - PSKreporter
 - WSPRnet
 - Reverse Beacon Network
 - IARU/NCDXF beacons

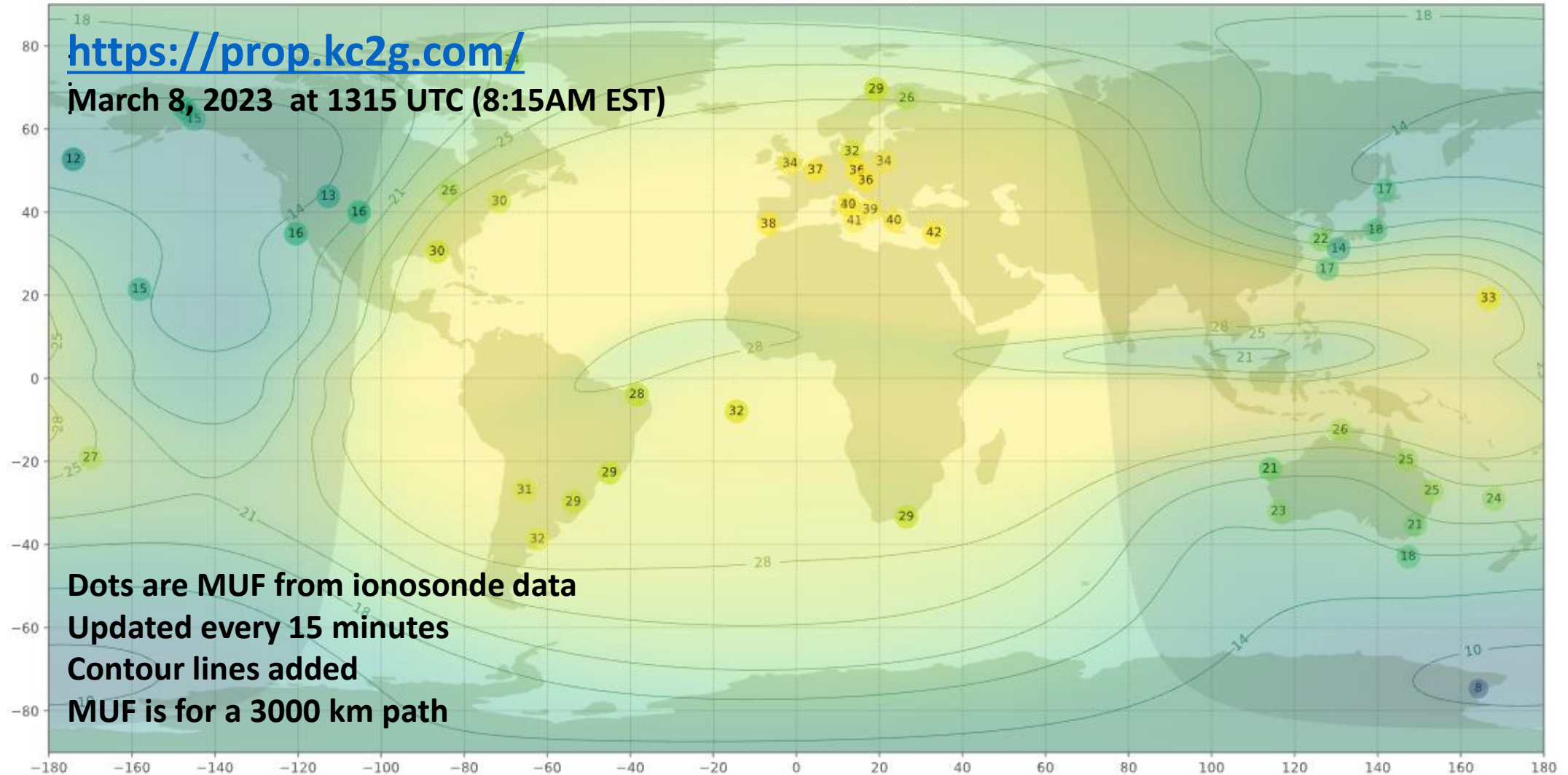


Real-Time Assessment of the Bands

for websites on previous slide

- dxmaps.com
- KC2G MUF map – <https://prop.kc2g.com/>
- PSKreporter - <https://pskreporter.info/pskmap.html>
- WSPRnet - <https://www.wsprnet.org/drupal/wsprnet/map>
- Reverse Beacon Network - <https://www.reversebeacon.net/>
- IARU/NCDXF beacons - <https://www.ncdxf.org/beacon/>

What's the MUF Doing Right Now?



Propagation Forecast for 2023

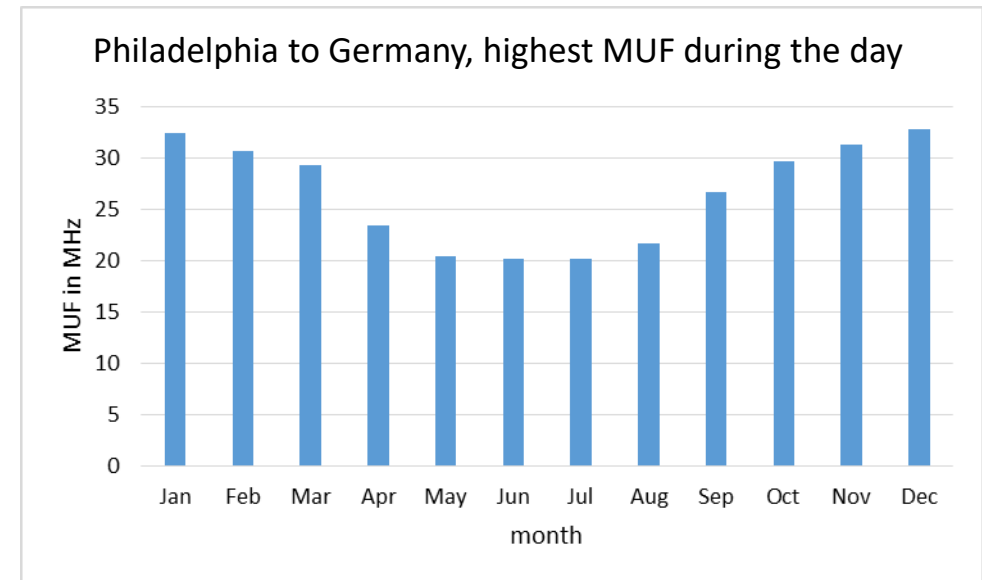


By the Bands

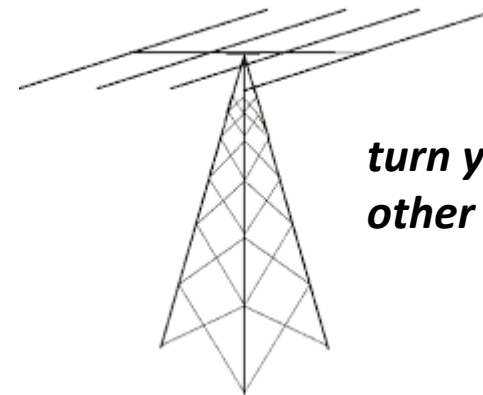
- 160m, 75m/80m, 60m, 40m (ionospheric absorption is critical)
 - The low bands should be good at night
 - Caveat - don't know what to say about 160m – should be better than it is
- 30m, 20m, 17m
 - Should be great all year

By the Bands

- 15m, 12m, 10m (MUF is critical)
 - Should be great for spring contests
 - Should be great for fall/winter contests
 - CQ WW DX in Oct and Nov, et al
 - IARU contest in July will suffer from degraded summer propagation (due to change in atmospheric composition)
 - But watch for sporadic E



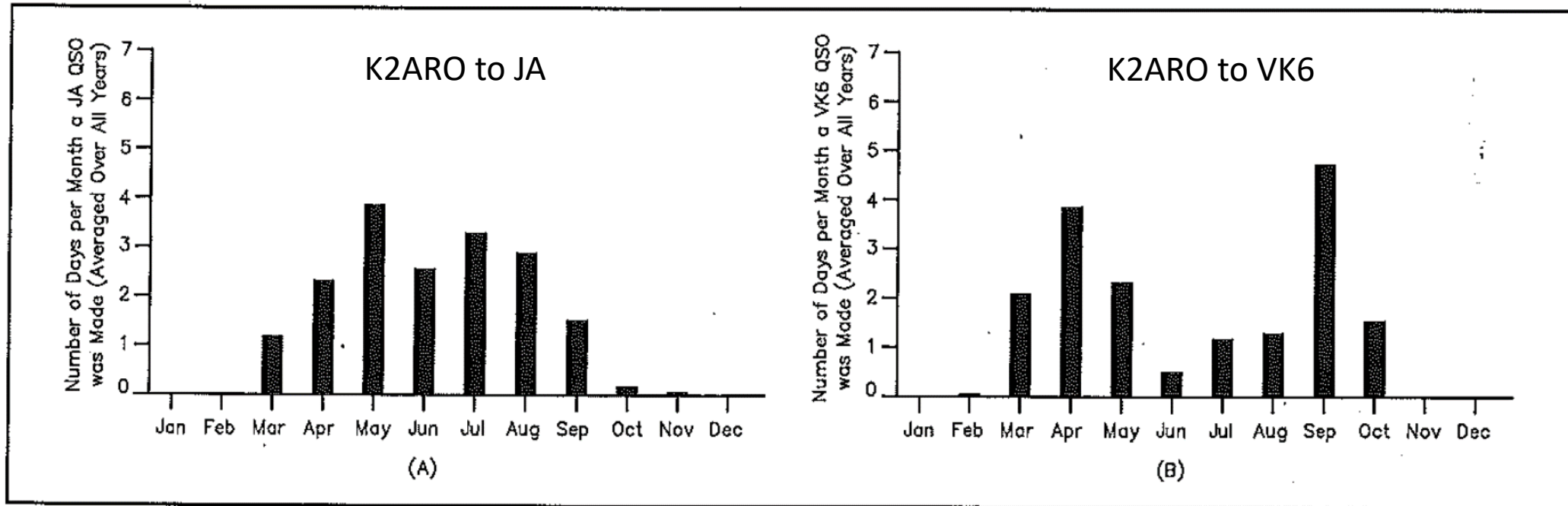
10-Meter Long Path



***turn your antenna the
other way around***

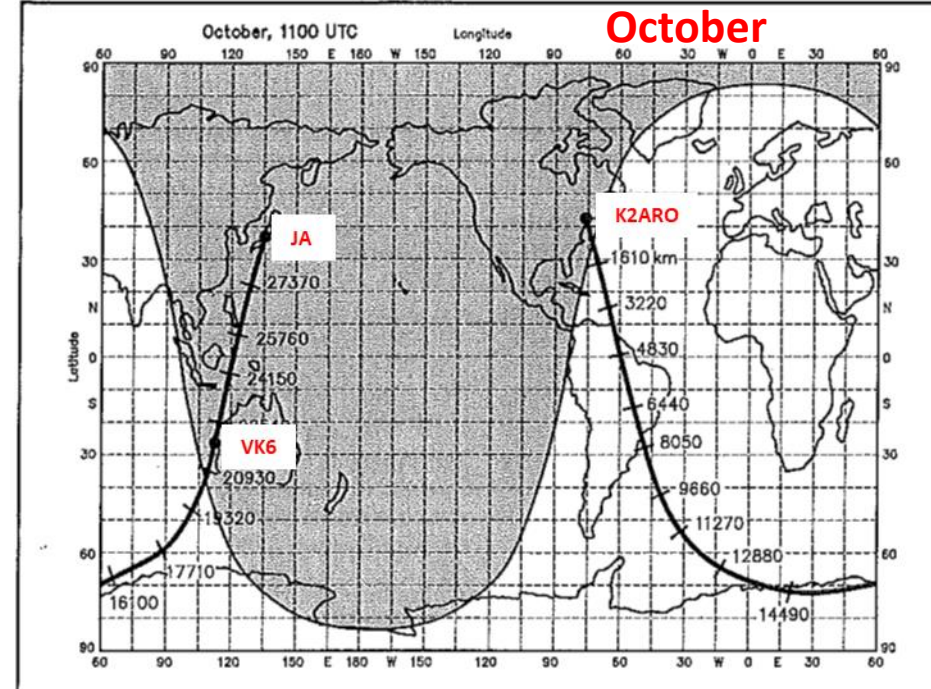
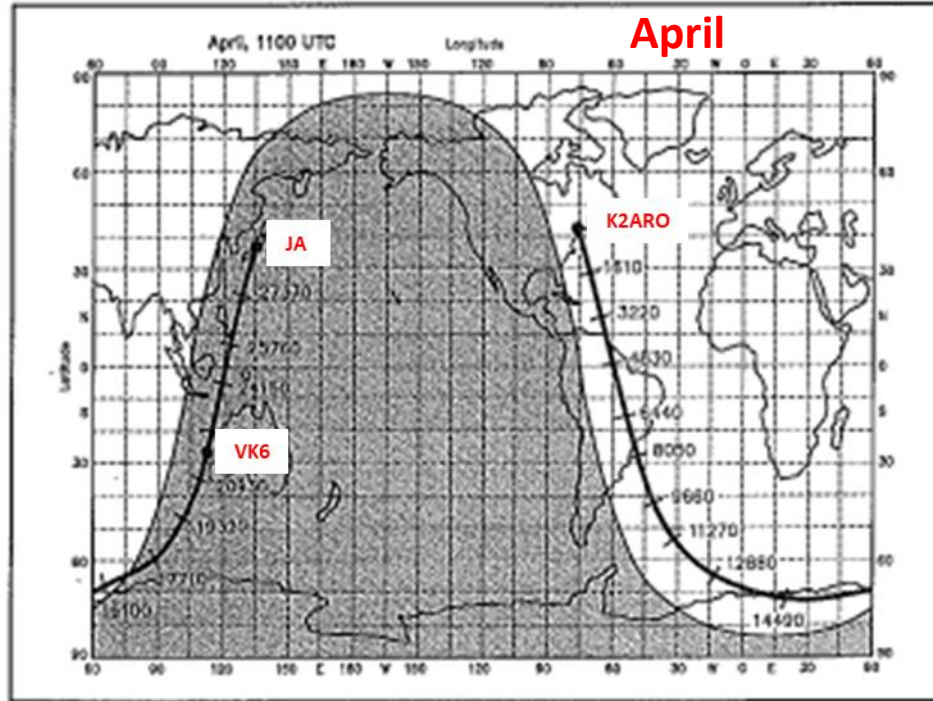
K2ARO Data

Data from Jan 1979 thru Dec 1993 (Cycles 21 and 22)



- 10m long path available from March thru October
- More pronounced drop out to VK6 in the summer months
 - Suspect that VK6 is more multi-hop whereas JA can have TEP hop

Typical Long Path



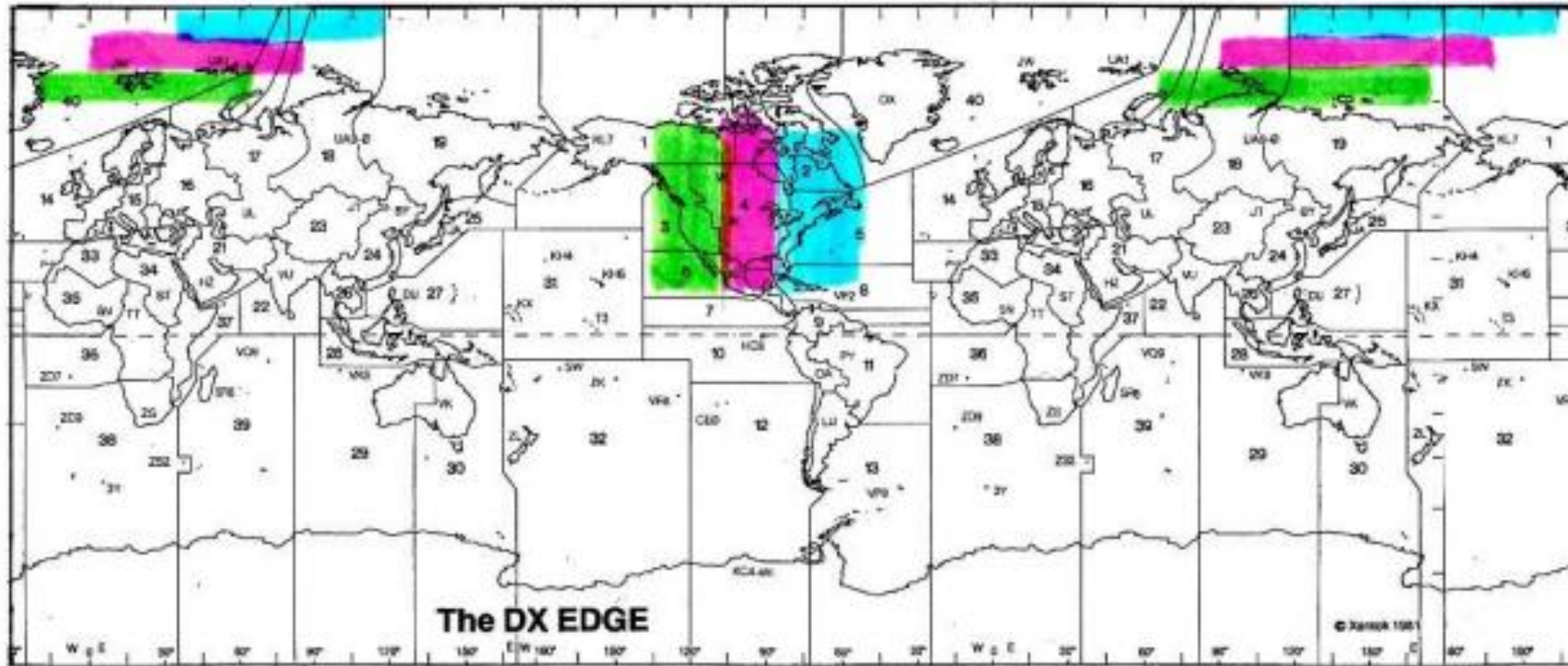
- 10m long path not necessarily a grayline path*
- Mar 22nd to Sep 22nd most productive
 - 90% of JA QSOs, 77% of VK6 QSOs
- Before Mar 21st and after Sep 23rd
 - 10% of JA QSOs, 23% of VK6 QSOs

* A grayline path is when the entire path aligns with or is very near the terminator

The Big Picture

North America
evening long path

North America
morning long path

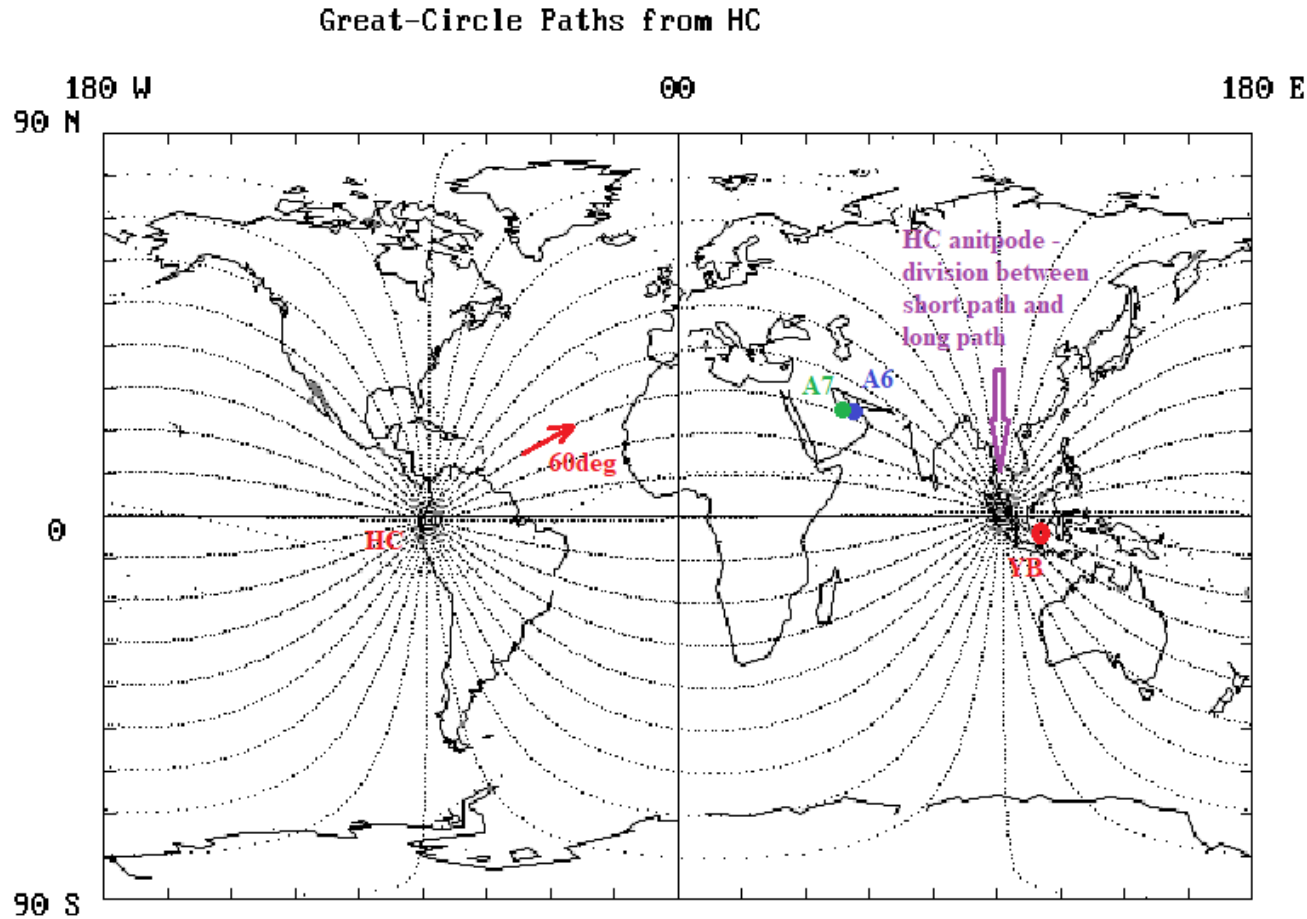


*The real question -
is anyone
on the
other end?*

For more details: [https://k9la.us/A Refresher on 10m Long Path.pdf](https://k9la.us/A%20Refresher%20on%2010m%20Long%20Path.pdf)

Data from logs from K2ARO, N6AV (SK), NT5C (SK) and skeds with JH3DPB (SK)

HC to A7, A6, YB on 60° Heading on 6m



to	short path	long path
A7	59° / 13988 km	
A6	59° / 14284 km	
YB		64° / 21288 km

- On a heading of 60°
 - A7 is short path
 - A6 is short path
 - YB is long path
- Path stays at low latitudes where the ionosphere is most robust

Summary

- Cycle 25 is awake and is in its ascent – maybe up to an ‘average’ cycle
- Solar maximum around 2024/2025
- So far it kind of looks like another small cycle
 - We’ll either confirm or refute that around 2025
- Even if it is a small cycle, now and around solar maximum will offer worldwide propagation with modest power (100W) and simple antennas (vertical or dipole) on 15m, 12m and 10m
- Should have more 6m F2 propagation this fall/winter
- The digital modes offer an advantage over CW and SSB
 - Can decode a signal farther down in the noise
 - This is a big deal on 10m and 6m where the MUF is critical
- There are tools on the internet to determine what the bands are doing right now