Cycle 25, Space Weather and Propagation for 2023

Carl Luetzelschwab K9LA

e-mail: k9la@arrl.net

website: https://k9la.us

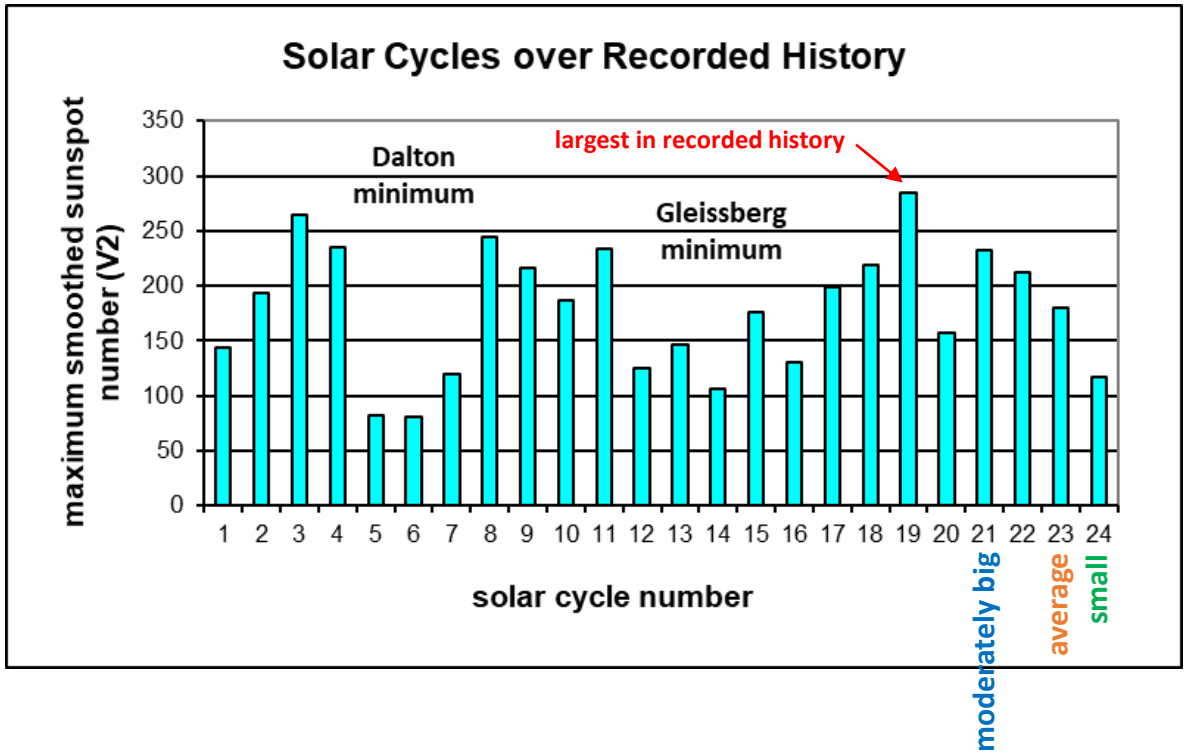
Agenda

- Cycle 25
  - Where is it headed?
- 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

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

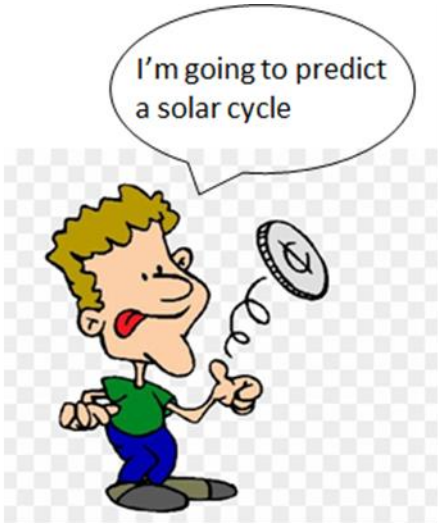


Will Cycle 25 get us out of this possible third period of small cycles?

Cycle 25 Predictions

- I'm aware of more than 50 predictions for Cycle 25
  - From very small to really big
  - There were over 50 for Cycle 24
- Why so many?
- Because we don't fully understand the sunspot cycle process
  - We know it has to do with how magnetic fields move inside the Sun and how plasma flows inside the Sun – but the nitty-gritty details are not yet fully clear
- Thus many methods are used to make a prediction
  - Precursor, spectral analysis, others

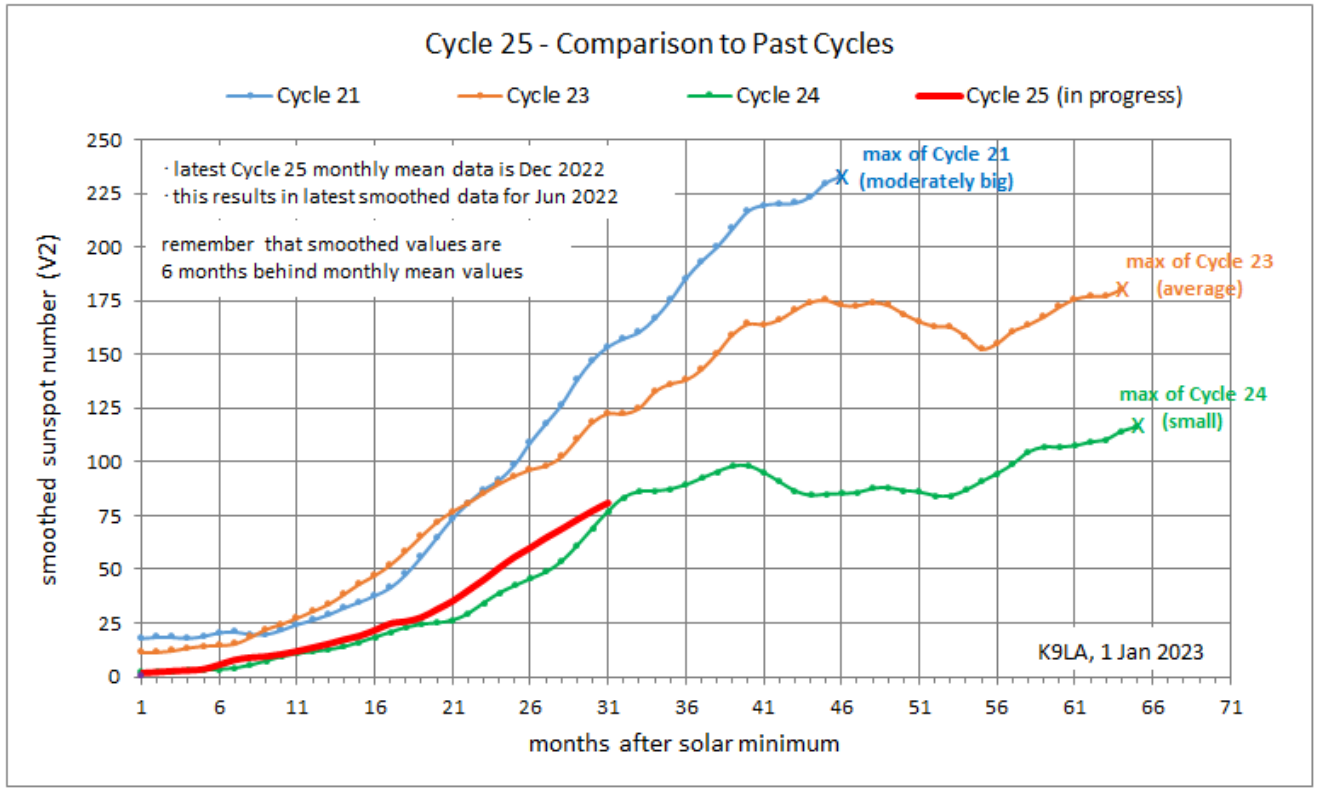
K9LA's method



☺

How Is Cycle 25 Doing?

- Solar minimum was in December 2019
- We currently have 31 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
  - Sunspots and 10.7 cm solar flux are proxies for EUV



Yesterday and today had significantly higher sunspot numbers, so there's still hope that Cycle 25 can make it up to an 'average' cycle

Space Weather and Propagation

There Are Many Space Weather Parameters

thermosphere climate index

electron flux

Ap

SFI

Bz

SN

Kp

X-ray

SW

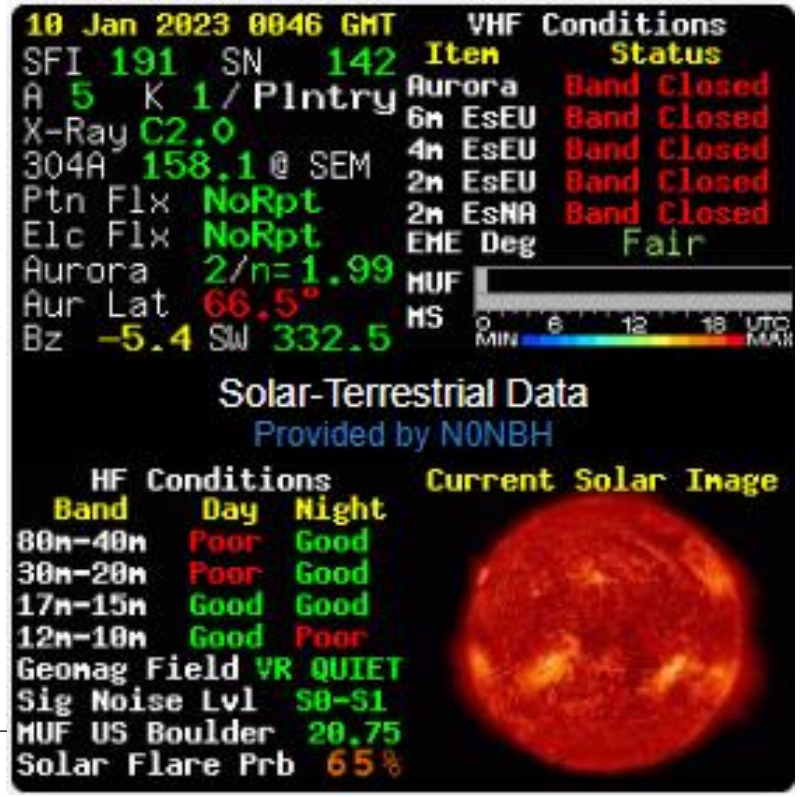
304A

neutron count

proton flux

Parameters That I Consider Important

- SFI – daily 10.7 cm solar flux
  - 65 (solar min) to 350 (big solar max)
- SN – daily sunspot number
  - 0 (solar min) to 450 (big solar max)
- K – 3-hr index – activity of the Earth's magnetic field
  - 0 to 9 – logarithmic - 0 is quiet, 9 is extremely disturbed
- A – daily index – average of the eight 3-hr K indices
  - 0 to 400 – linear – 0 is quiet, 400 is extremely disturbed
- Bz – north-south component of the IMF*
  - When large negative, IMF couples to Earth's magnetic field
- SW – solar wind speed – average ~400 km/sec
  - Big CME and CH can increase speed to 2000 km/sec



NØNBH banner from www.qrz.com

Maximum Useable Frequency (depends on path length, where the path is in the world, time of day, month, phase of solar cycle)

These parameters should give you an idea of what propagation is like

*** Interplanetary Magnetic Field (a.k.a. the Sun's magnetic field)**

But . . .

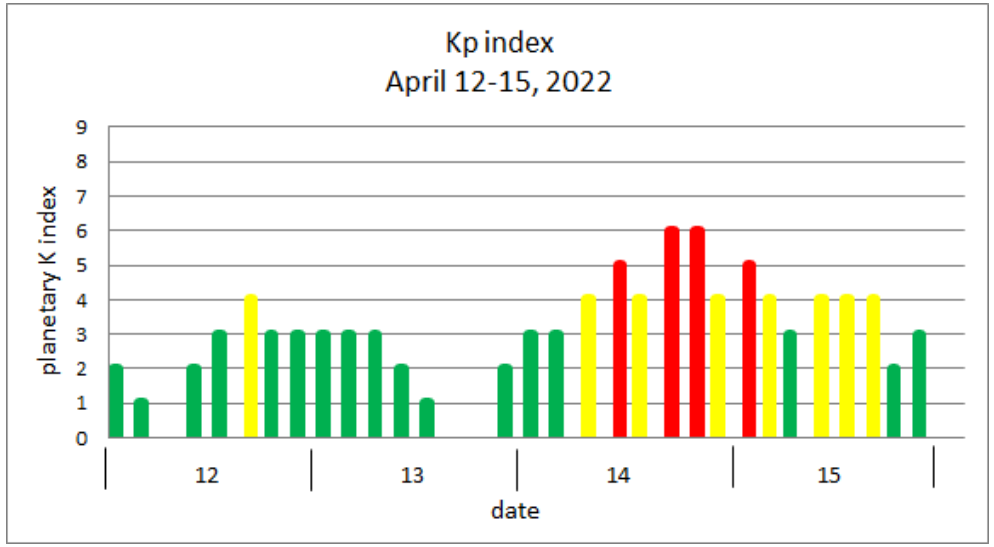
- These parameters do not give a unique mapping to the exact state of the ionosphere
  - We don't fully understand the variability of the ionosphere (especially the F2 region)
- For example, if yesterday's 10.7 cm solar flux was 100 and today it is 120, that doesn't necessarily mean the ionosphere is better for the higher HF bands
- We don't have daily propagation predictions
  - Our predictions give monthly median values of MUF and signal strength
    - Median = 50% probability (half the days of the month)
    - Correlated to the smoothed sunspot number (or smoothed 10.7 cm solar flux)
- In general,
  - Low SFI and SN say the higher HF bands (15m, 12m, 10m) are likely no good
  - High SFI and SN say the higher HF bands may be good – depends on geomagnetic field activity
  - Low K says all the bands should be good
  - High K says all the bands may not be good

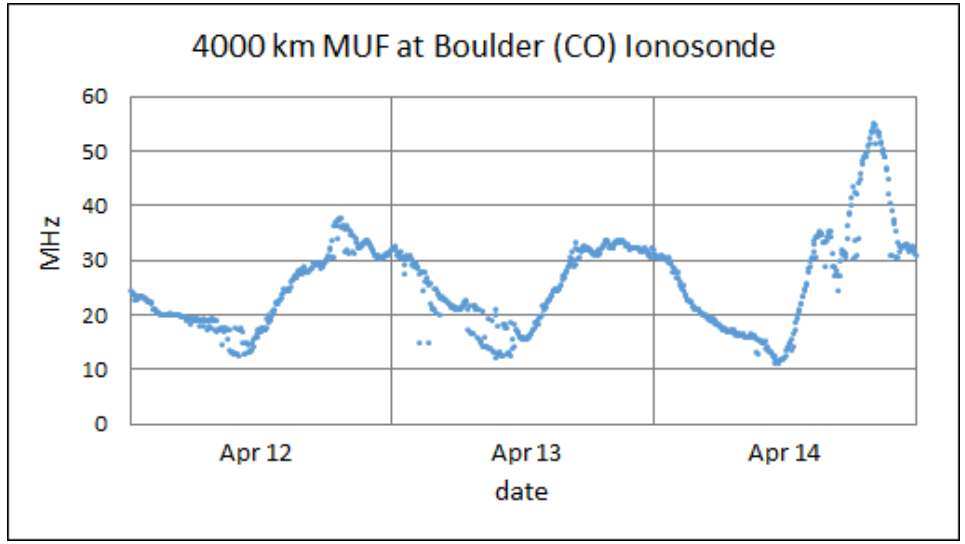
What We Desire

- 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, gnd refl loss, local noise) to make signal readable (or detectable)
- What we desire
  - Generally K $\leq$ 3
    - Correlates to Bz pos or slightly neg, solar wind not too much higher than 400 km/sec
    - Exception – VHF types like high K indices for propagation via aurora
  - SFI and SN
    - 15m: need SFI > 90 and/or SN > 35 for a long period
    - 10m: need SFI > 100 and/or SN > 70 for a long period
    - Ideally you should use smoothed values (average of several weeks will kind of suffice)
- Where we are right now
  - Smoothed SFI ~120 and smoothed SN ~90

Exception: A Moderate Spike in the K Index

- Remember that the ionosphere is very dynamic
- We cannot predict short-term openings



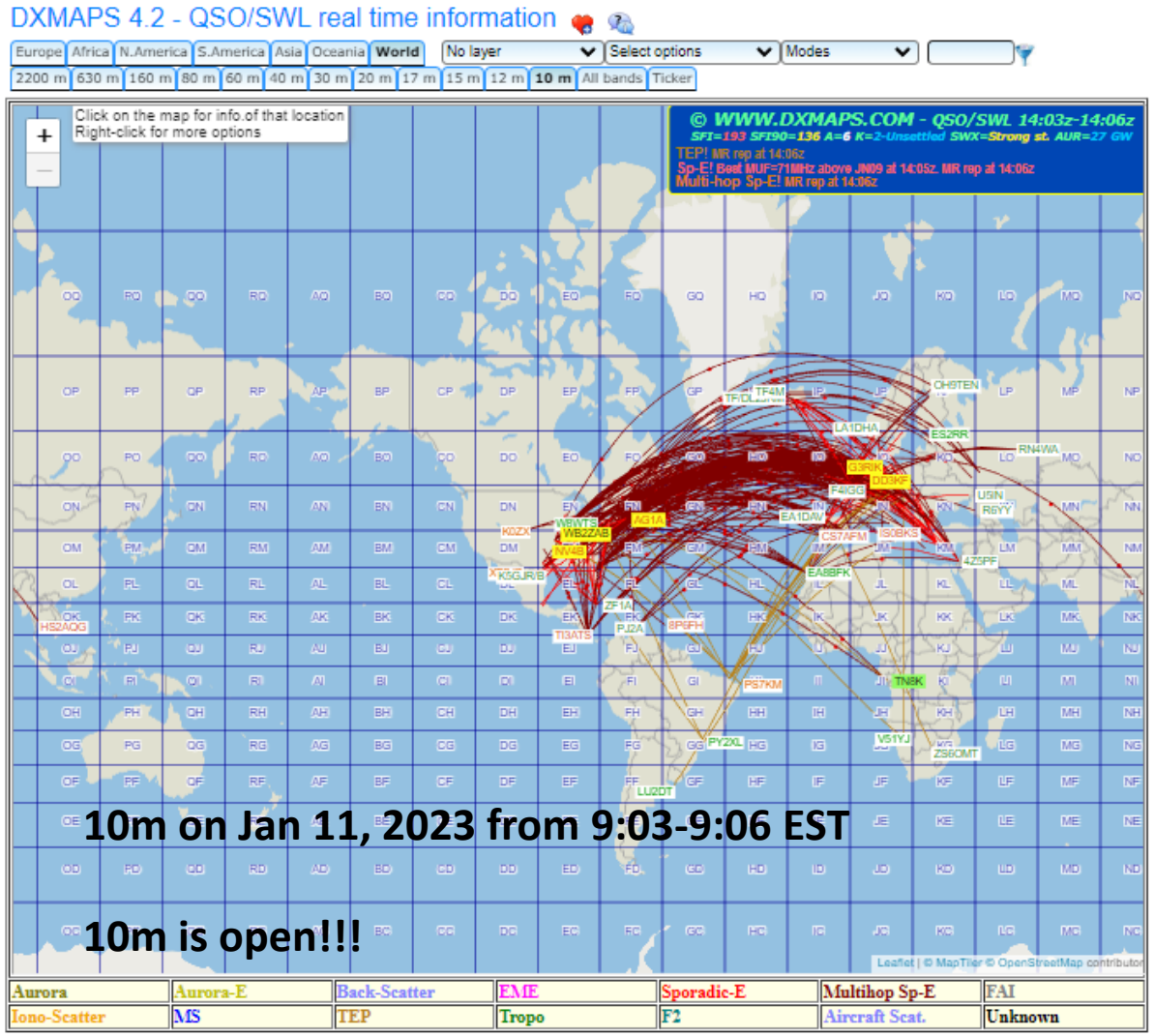


6m F2 openings on Apr 14, 2022

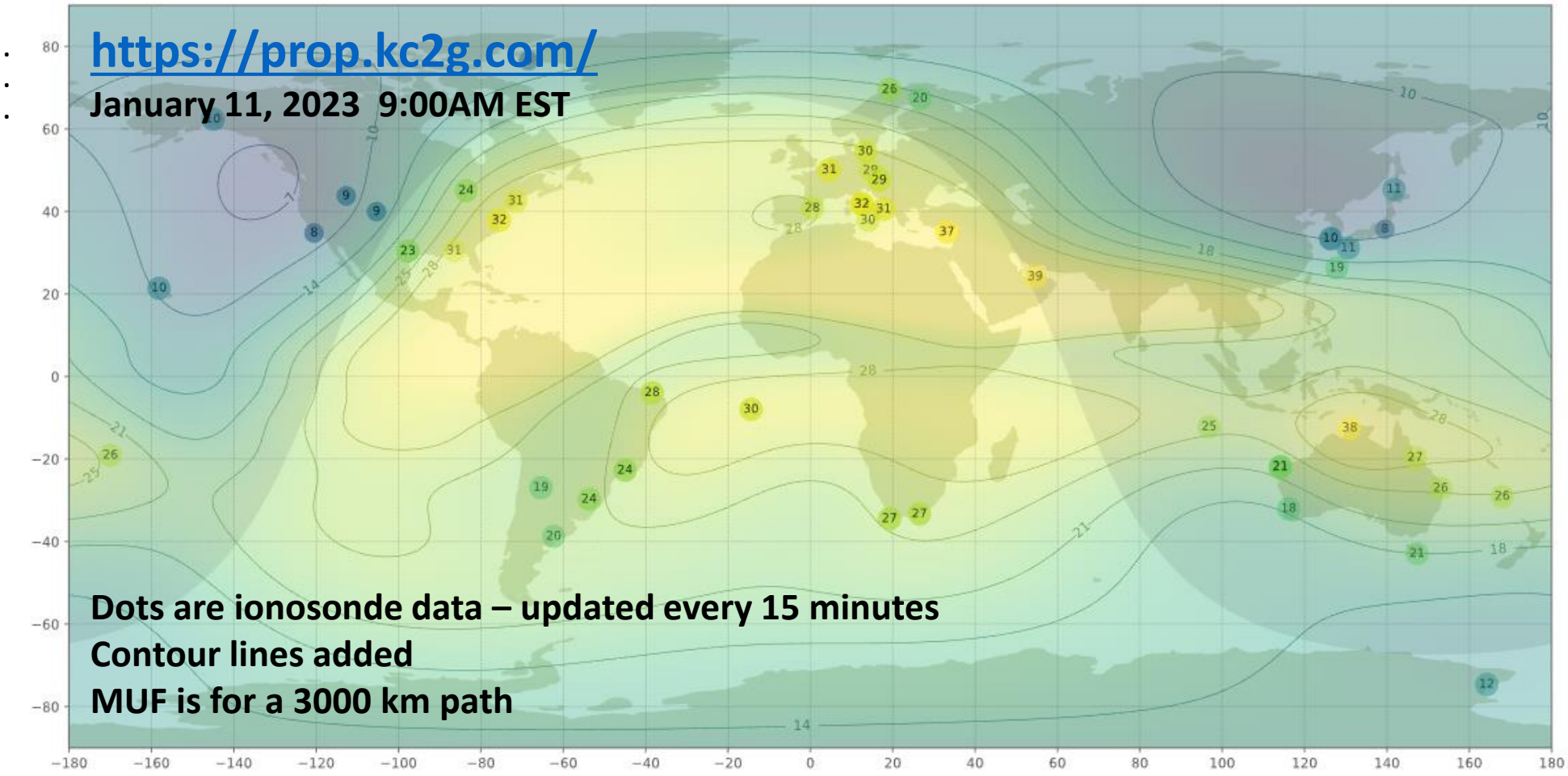
- Keep an eye on the K index
- If a moderate spike occurs, check the higher HF bands and 6m

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



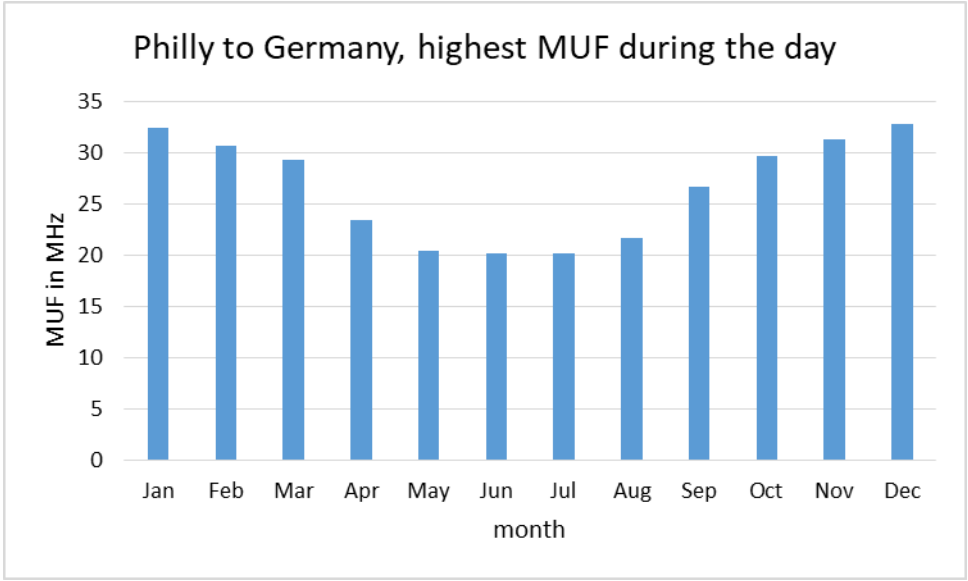
What's the MUF Doing Right Now?



Propagation Forecast for 2023

By the Bands

- 160m, 75m/80m, 60m, 40m (ionospheric absorption is critical)
  - Don’t know what to say about 160m – should be better than it is
  - The other low bands should be good at night
- 30m, 20m, 17m
  - Should be great all year
- 15m, 12m, 10m (MUF is critical)
  - Should be great for winter/spring contests (ARRL Int’l DX in Feb and Mar, et al)
  - 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

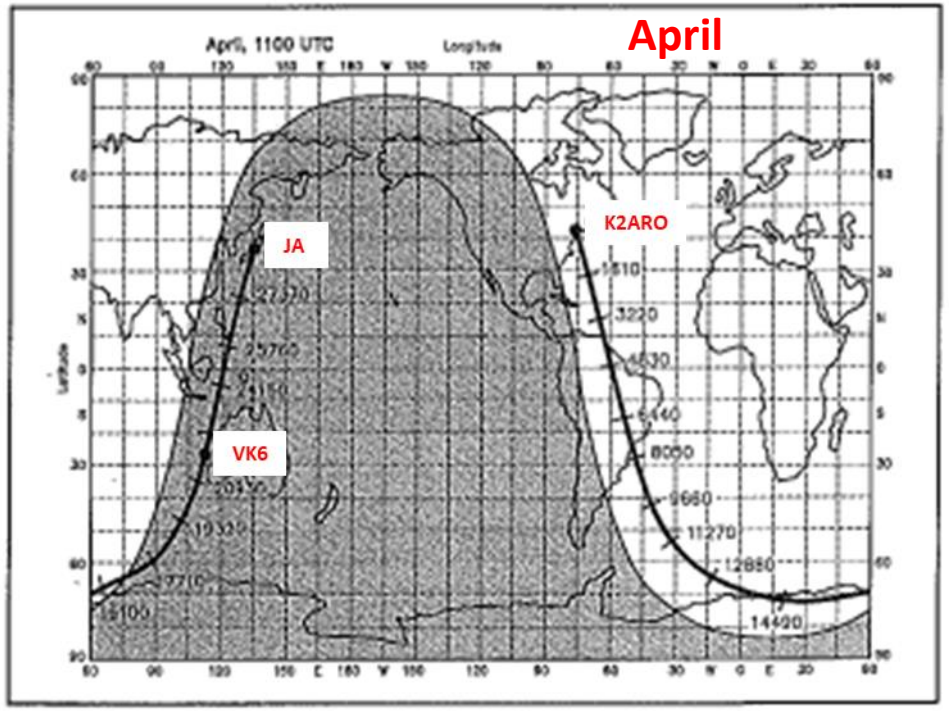


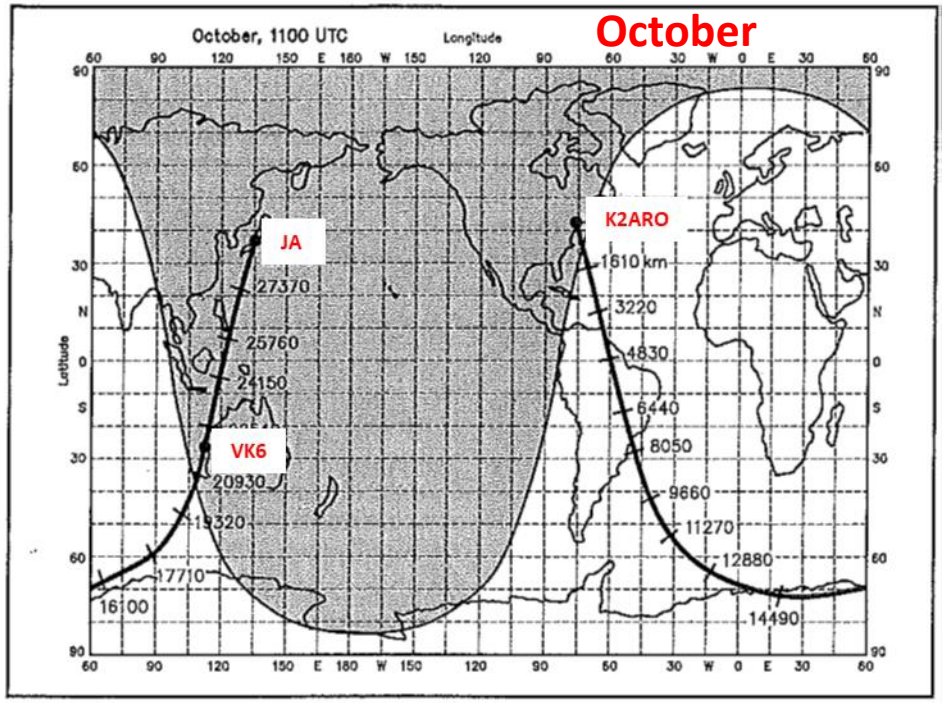
10-Meter Long Path

What Got Me Interested

- CQ WW DX PH in October 1986
  - I was K9LA/5 in the DFW area from April 1979 – July 1988
- Local 2m DX net announced VS6DO (Hong Kong) on 28510 via long path
  - Easily worked him at 1411 UTC (8:11 AM local)
  - 400 Watts (GLA-1000) to a Cushcraft A3 tri-bander at 40 feet
- Acquired long path logs from Gus K2ARO, John NT5C (SK), et al
- Skeds with Yuu JH3DPB (SK) in April 1992 (I was in Ft Wayne now)
  - Longest duration QSO was 2 hr 15 min
  - Began at 1100 UTC (6:00 AM for me, 8:00 PM for Yuu)
  - Ended at 1315 UTC (8:15 AM for me, 10:15 PM for Yuu)

Typical Long Path

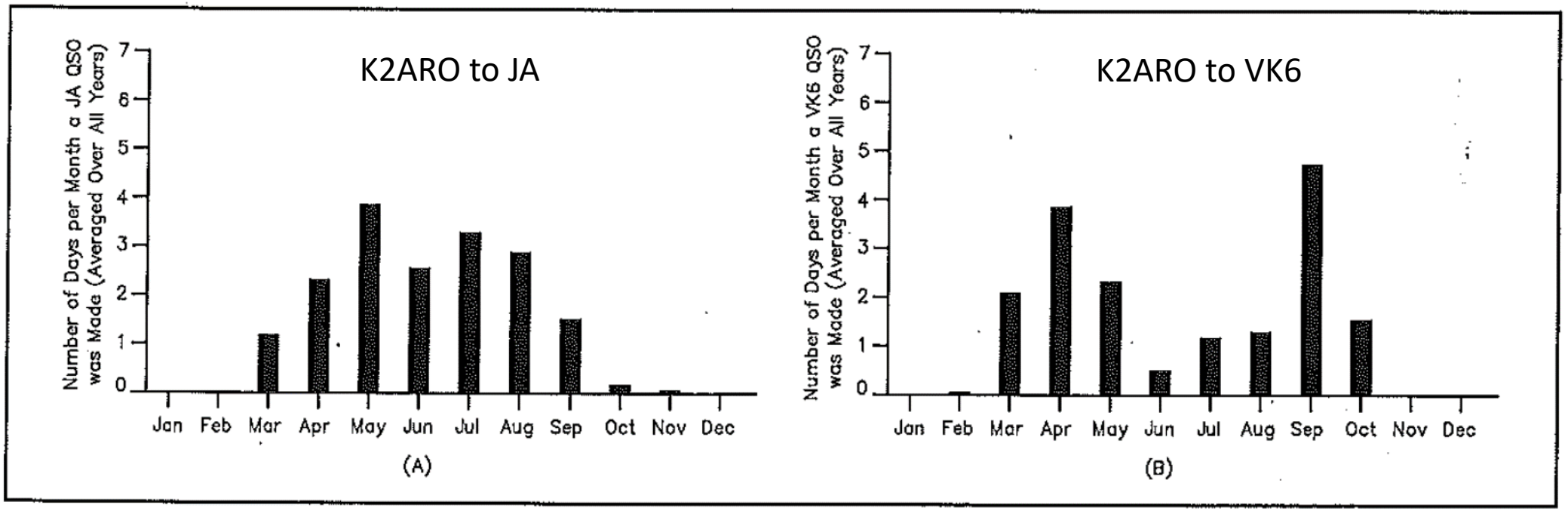




- 10m long path not necessarily a grayline path*
- Mar 22nd to Sep 22nd most productive
  - 90% of JA QSOs, 77% of VK6 QSOs
- Before Mar 21st and after Sep 23rd
  - 10% of JA QSOs, 23% of VK6 QSOs

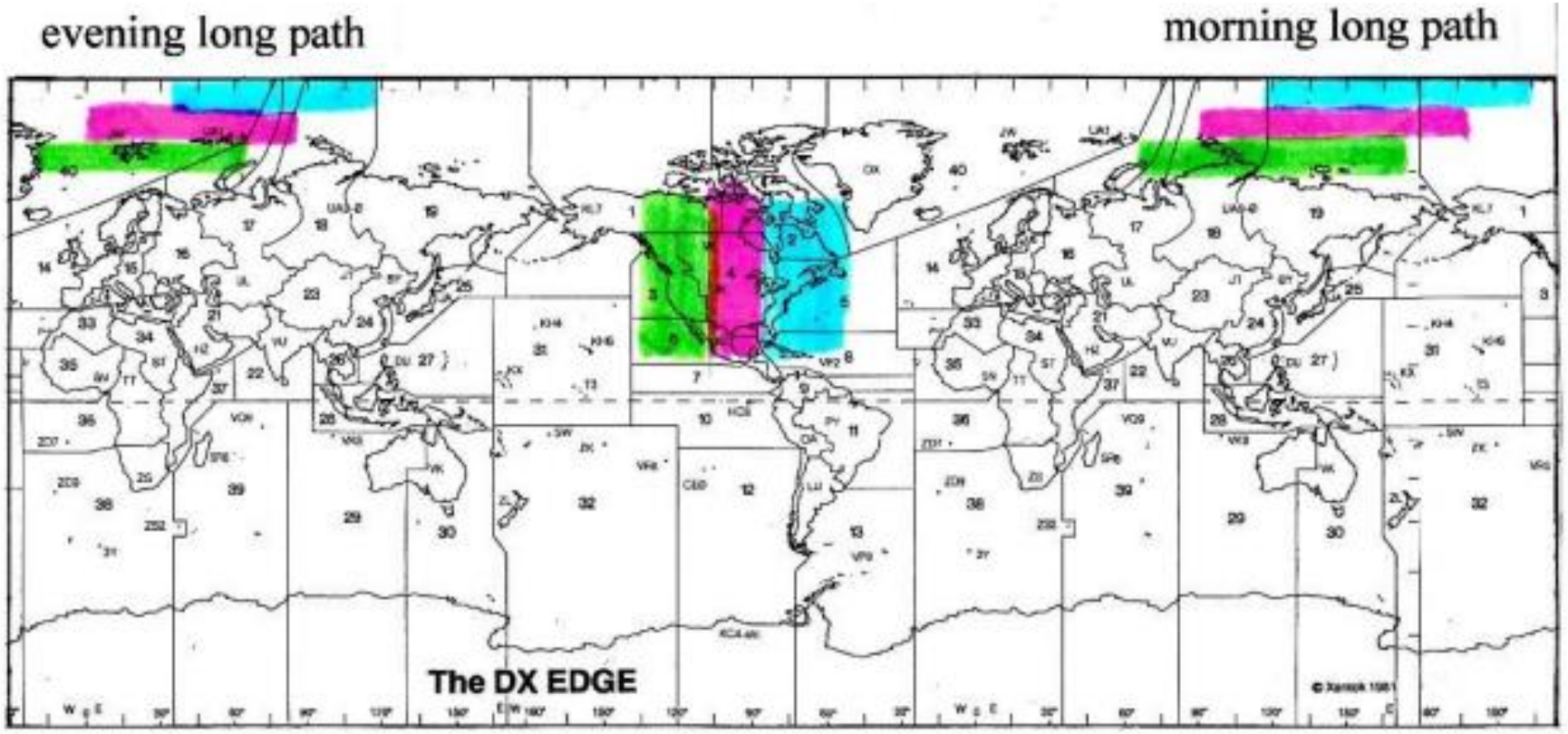
** A grayline path is when the entire path aligns with or is very near the terminator*

K2ARO Data



- 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

The Big Picture



The real question - is anyone on the other end?

For more details: https://k9la.us/A_Refresher_on_10m_Long_Path.pdf

Summary

- Cycle 25 is awake and is in its ascent
- Solar maximum likely around 2025 or so
- So far it kind of looks like another small cycle
  - We'll either confirm or refute that around 2025
  - But the last two days have shown significant increase in the daily sunspot number – there's hope for an average cycle!
- 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
- 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