

Solar Cycle 25 Update, Space Weather and Propagation



Cycle 25 is very awake!

Carl Luetzelschwab K9LA

e-mail: k9la@arrl.net

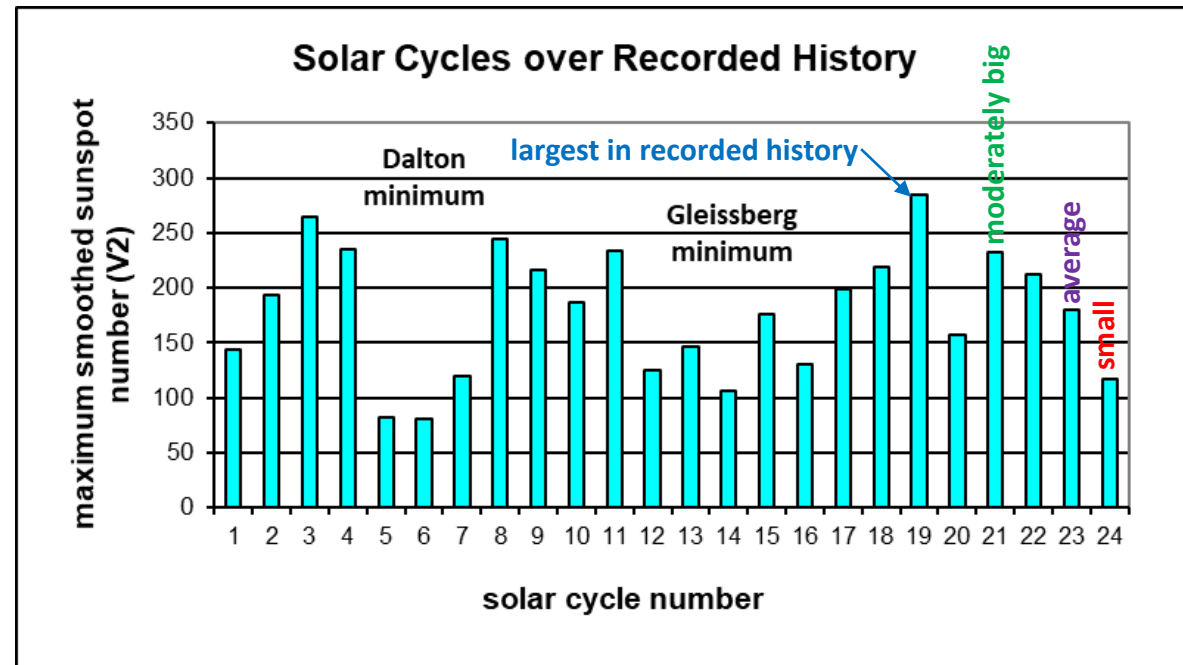
website: <https://k9la.us>

Agenda

- Quick update on Cycle 25
- Why are sunspots important?
- Space weather and propagation
- Disturbances to propagation
- Real-time assessment of the bands
- 10m long path

A Look at History

- 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 apparent third period of small solar cycles?

Predicting Solar Cycles

- I'm aware of at least 56 predictions for Cycle 25
- 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



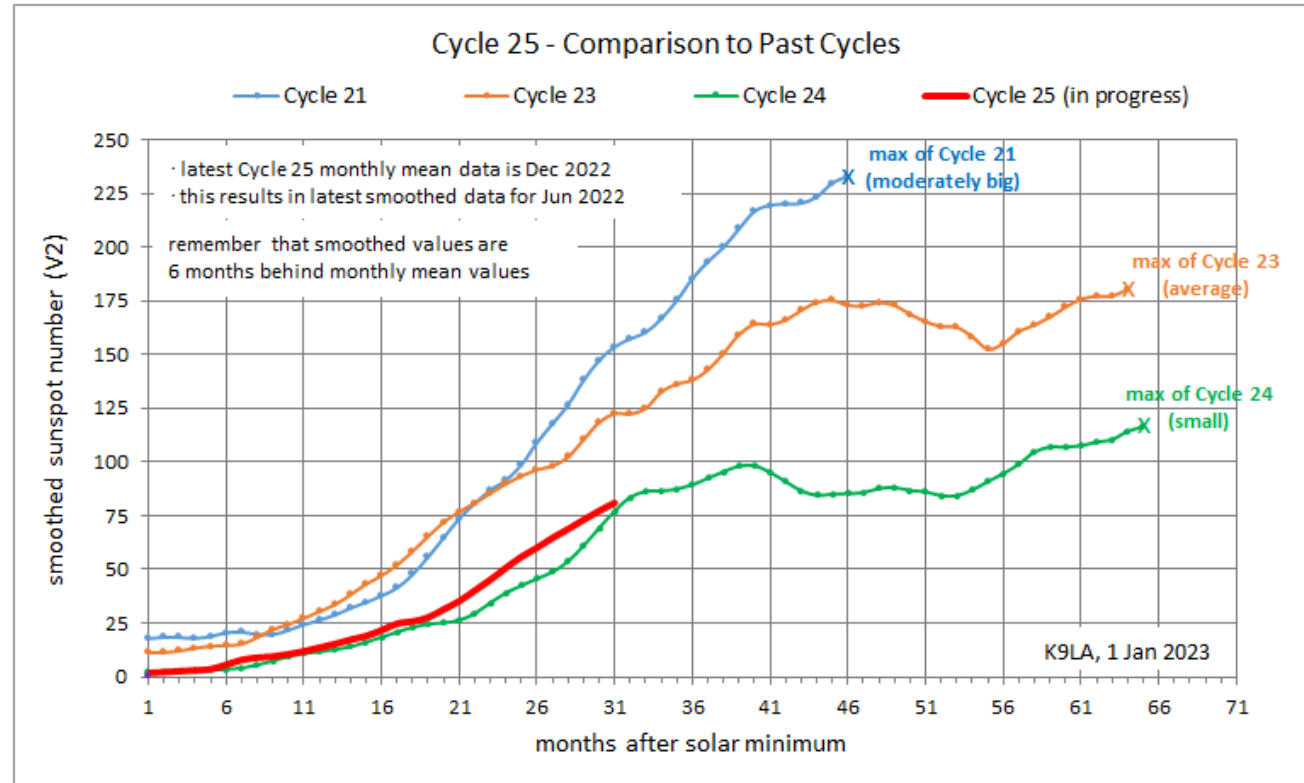
here's one of the many methods



The McIntosh Prediction

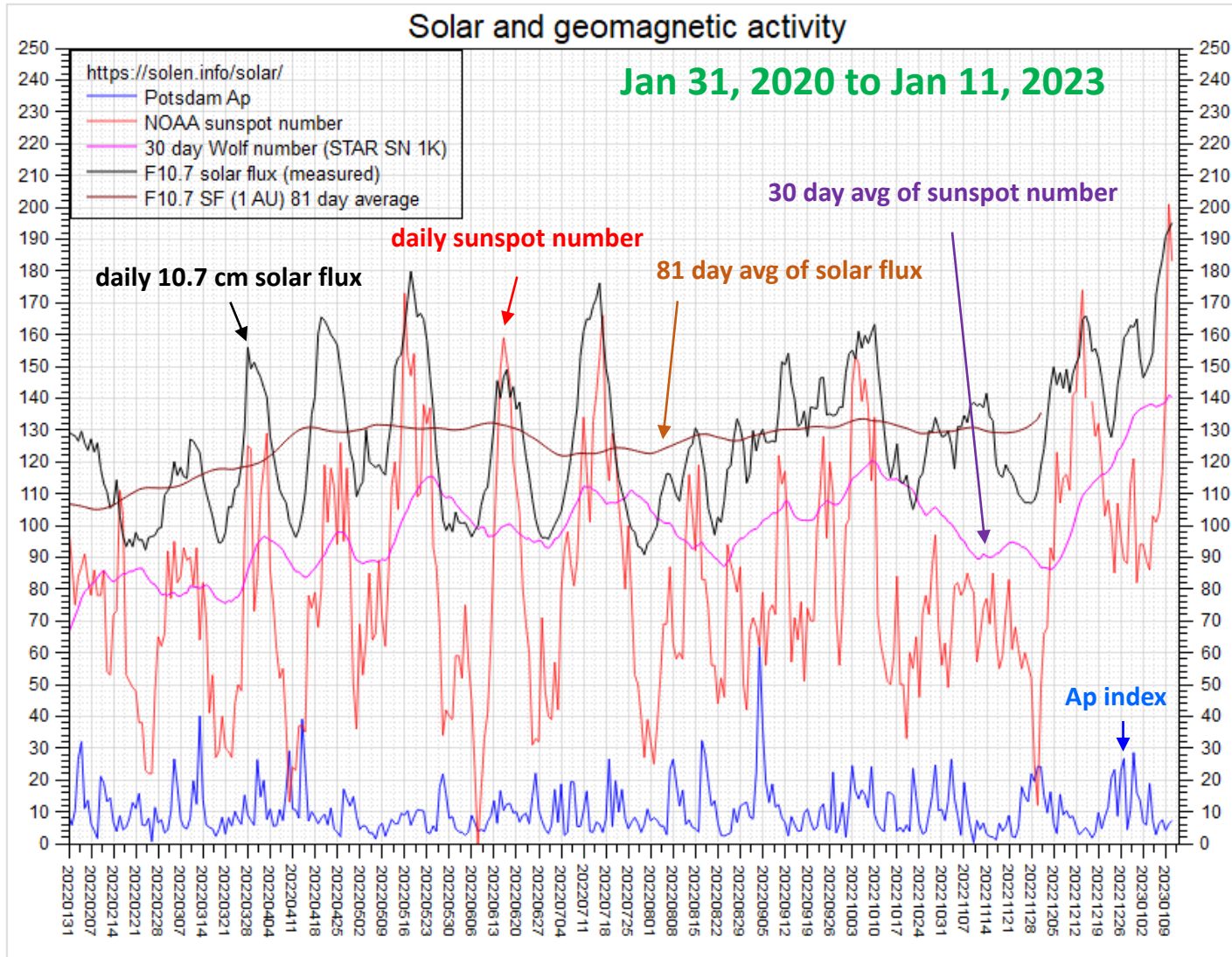
- Dr. Scott and colleagues have received much attention
- They are trying to understand the magnetic fields inside the Sun
- Original prediction in June 2020
 - Big cycle – smoothed sunspot number about 233 (similar to Cycle 21)
- Revised prediction in August 2021
 - Average cycle – about 190 (similar to Cycle 23) – Cycle 24 termination event didn't happen when expected
- We shall see what happens
- I'm cheering for their method and revised prediction

Latest Cycle 25 Performance



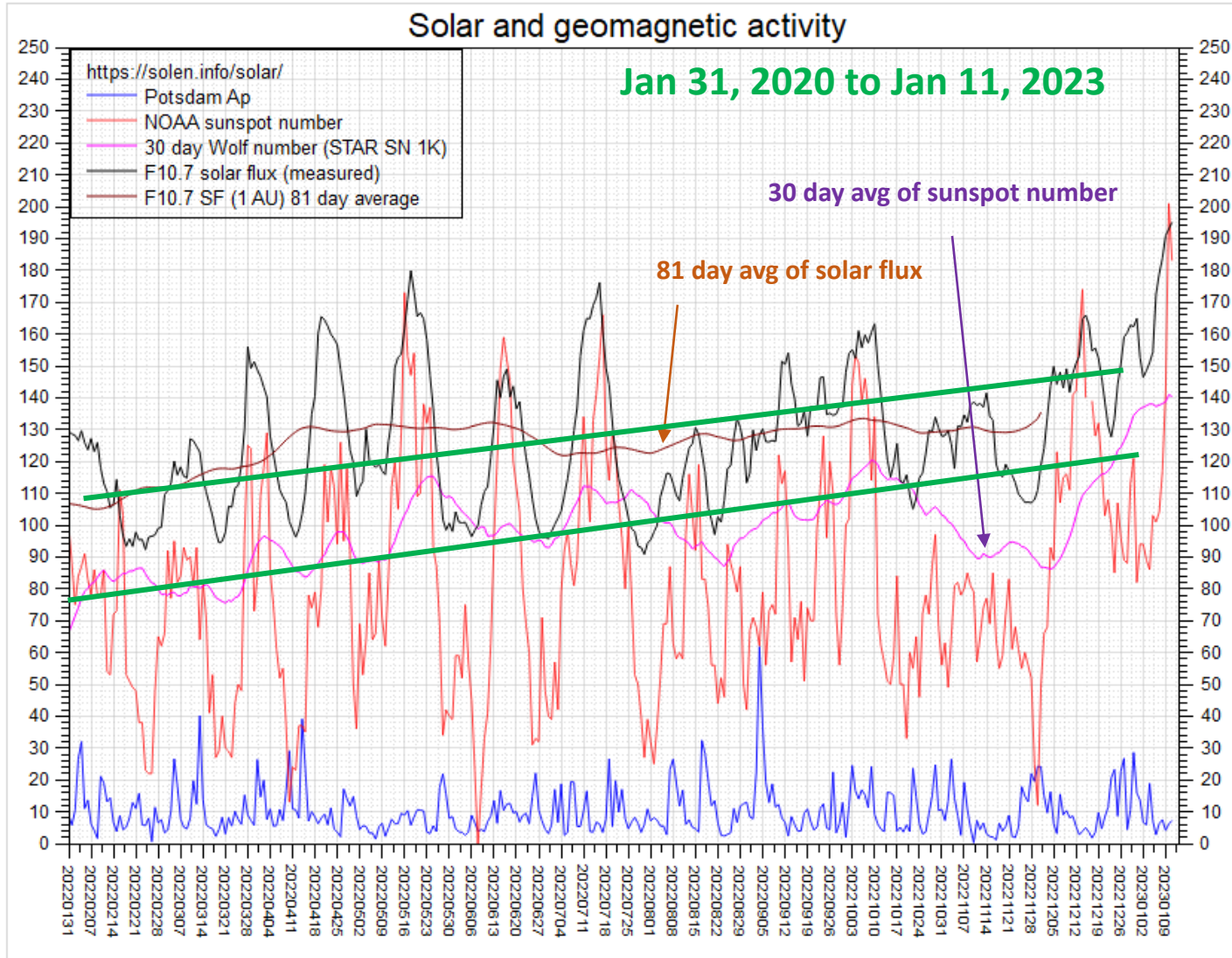
- We now have 31 months of smoothed sunspot number data
- So far, Cycle 25 appears to be tracking the small Cycle 24
- But January 2023 has been a good month for solar activity 😊 😊

Day-to-Day Variation of the F2 Region



- We see the approximate 27-day rotation of the Sun
- Note the trend in the 81 day avg of solar flux and the trend in the 30 day avg of sunspot number

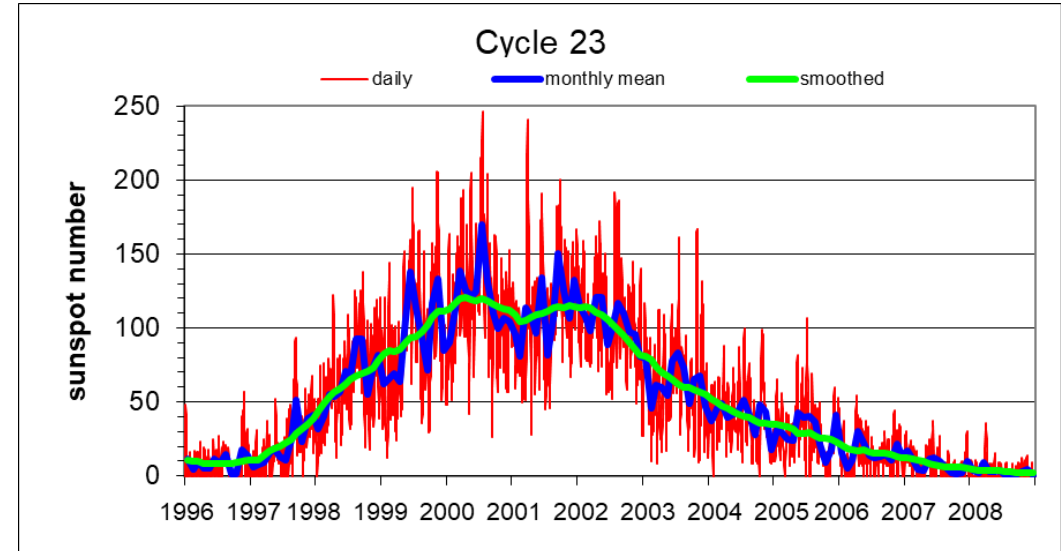
Day-to-Day Variation of the F2 Region



- Both trends (green lines) are increasing during each solar rotation
- Yay !!!

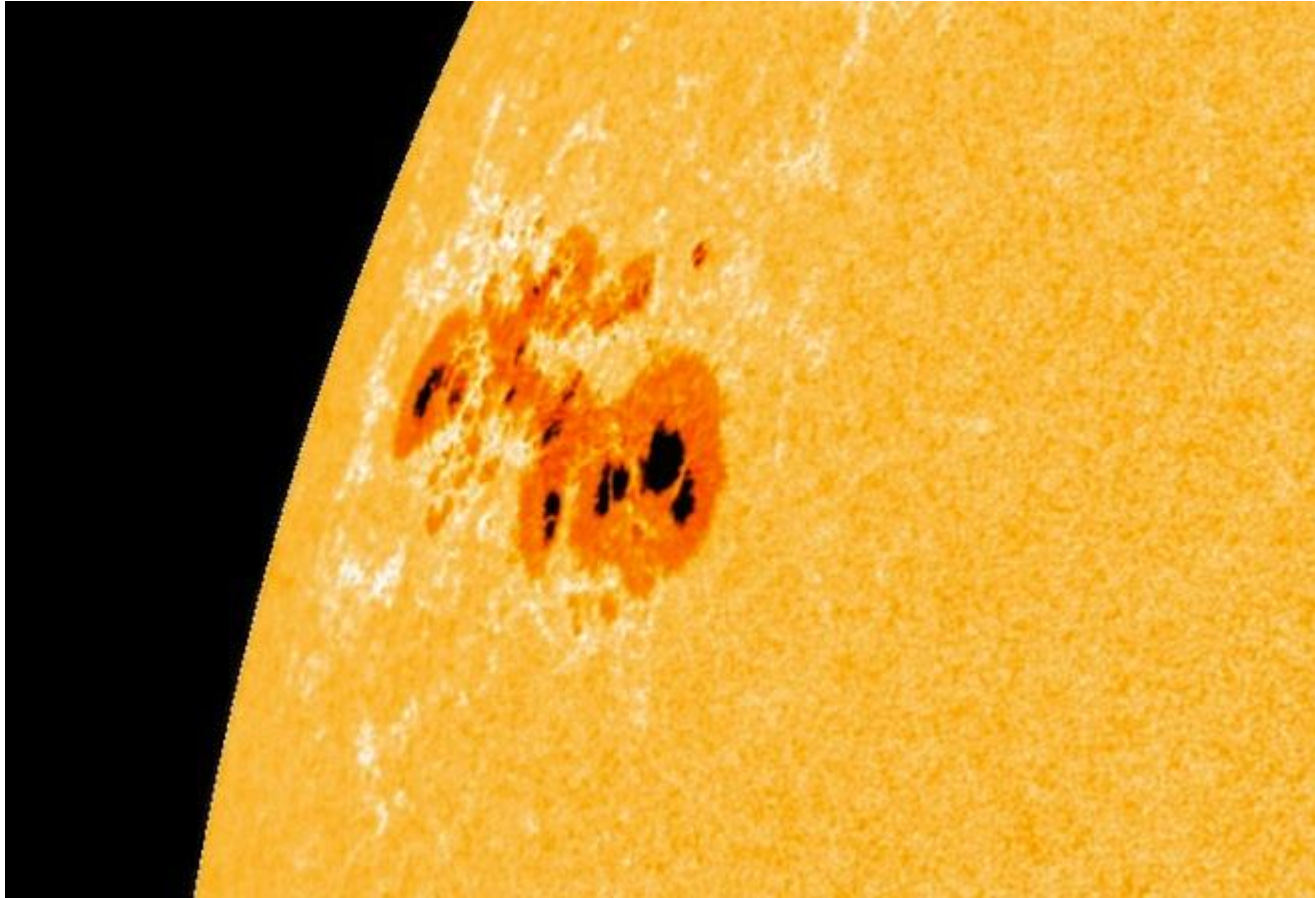
What Is a Smoothed Value?

- A smoothed sunspot number has been mentioned on several slides
- Count the number of sunspots each day – **daily sunspot number (very spiky)**
- Calculate average over a month – **monthly mean (still spiky)**
- Calculate running average of monthly means over 12 months – **smoothed sunspot number (spikes averaged out)**
- Similar issue with 10.7 cm solar flux and EUV (extreme ultra-violet)
 - Daily correlation between sunspot number, 10.7 cm solar flux and EUV is not very good



- Above is one reason to use smoothed values – gives a better picture of a solar cycle
- Second reason is because our propagation predictions are a correlation between a smoothed value and monthly median (50% probability) ionospheric parameters
 - We do not have daily predictions – our predictions are statistical over a month's time frame

Why Are Sunspots Important?



- The white area around a sunspot is called a plage (French for 'beach')
- These areas emit EUV radiation
 - Sunspots themselves do not ionize anything (nor does 10.7 cm solar flux)
- EUV radiation ionizes the atmosphere at F2 region altitudes
- F2 region is responsible for most of our long distance QSOs
 - And most QSOs at night

Space Weather and Propagation – A Caveat

- What we're trying to do is make simple statements about propagation based on very complicated atmospheric and ionospheric processes
- Slide 9 stated that our propagation predictions are statistical in nature over a month's time frame – we do not have daily predictions
 - Why not?
 - There are three sources that cause the F2 region of the ionosphere to vary day-to-day – which determines how much ionization there is
 - Solar radiation (parameters: 10.7 cm solar flux, sunspots, EUV)
 - Geomagnetic field activity (parameters: K, A, Bz, solar wind)
 - Events in the lower atmosphere that couple up to the ionosphere – we don't fully understand this last source – no parameters – lots of research ongoing
- Today's 10.7 cm solar flux may not tell us what's going on right now

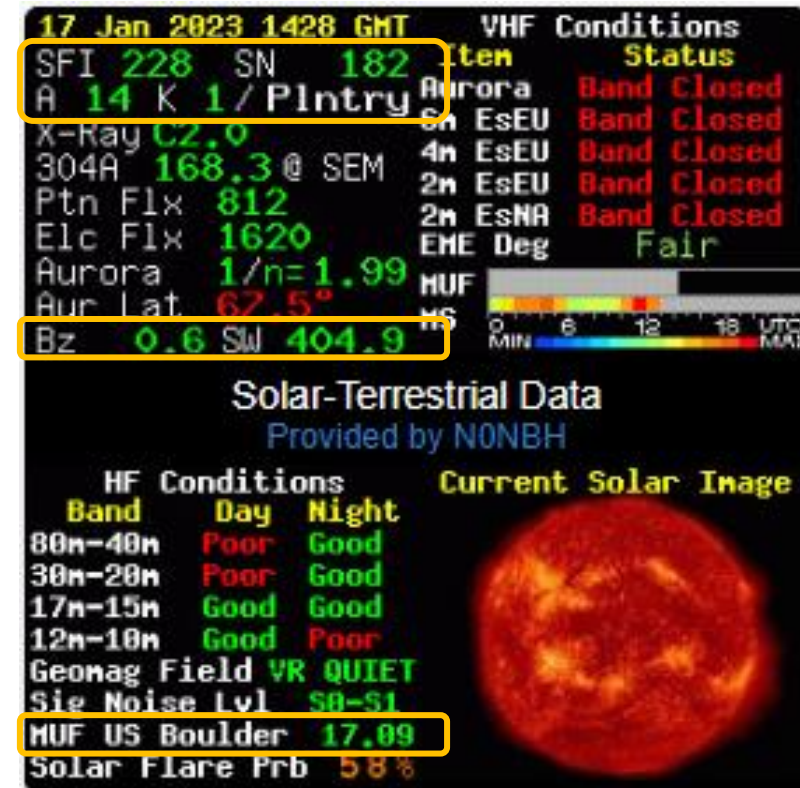
What We Desire for SFI, SN and K

- 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, gnd refl loss, local noise) to make the signal readable (or detectable)
- What we desire for good MF and HF propagation
 - Generally $K \leq 3$
 - Correlates to Bz pos or slightly neg, solar wind not too much higher than 400 km/sec
 - 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, but many weeks is good enough
- Where we are right now
 - Smoothed SFI ~120 and smoothed SN ~90

Where Do We Get These Parameters?

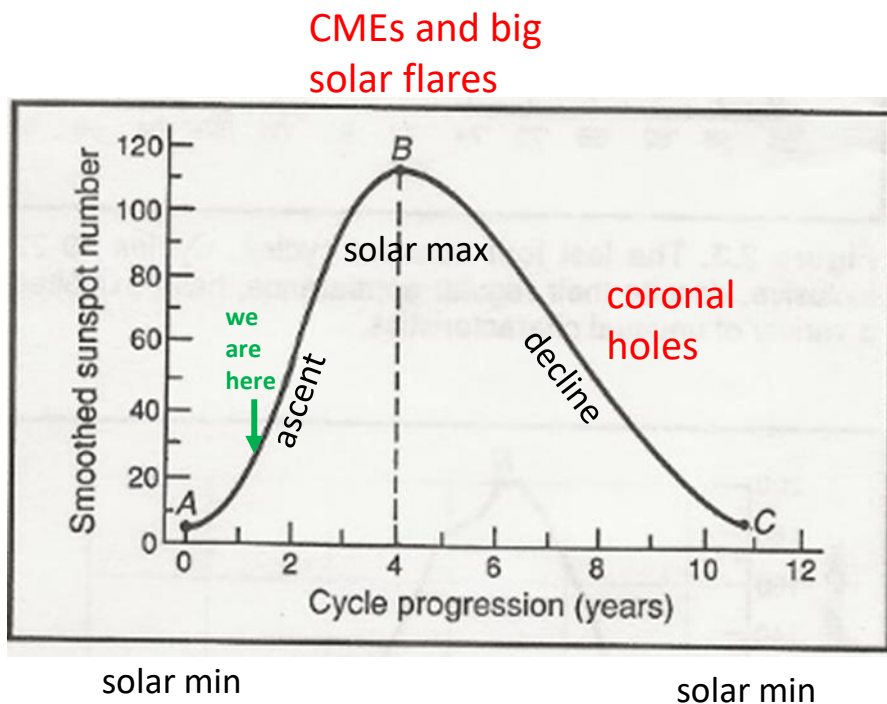
- One place is the NØNBH banner at www.qrz.com
- SFI, SN, K, Bz, SW are in the gold boxes
- Note MUF US Boulder in the gold box at the bottom
 - This is the MUF over the Boulder ionosonde assuming it's the midpoint of a 3000 km path (for example, W6 to the Midwest)
 - It is pretty close to real-time (every 15 minutes)

NØNBH banner at www.qrz.com



This morning at 6:28 AM PST

When Do Disturbances Occur?

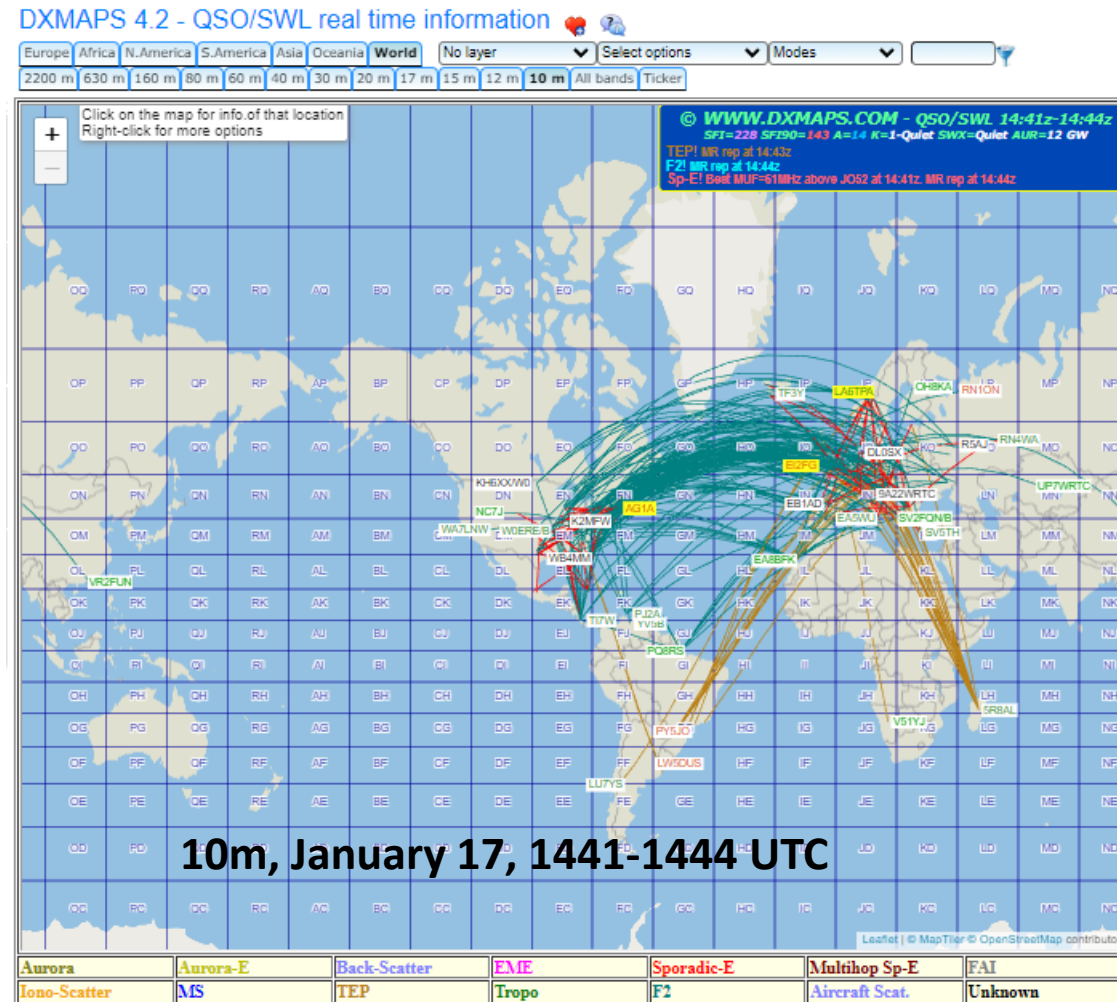


The A index maximizes at solar max (CMEs), and maximizes even higher during the decline of a solar cycle (CHs)

- CMEs most prevalent around solar max
 - Geomagnetic storm
- Big solar flares most prevalent around solar max
 - Solar radiation storm and radio blackout
- Coronal holes most prevalent during the decline of a solar cycle
 - Geomagnetic storm
- Quietest time of a solar cycle is the ascent
- Geomagnetic storm is the worst of the three disturbances due to its duration and effect on the worldwide F₂ region

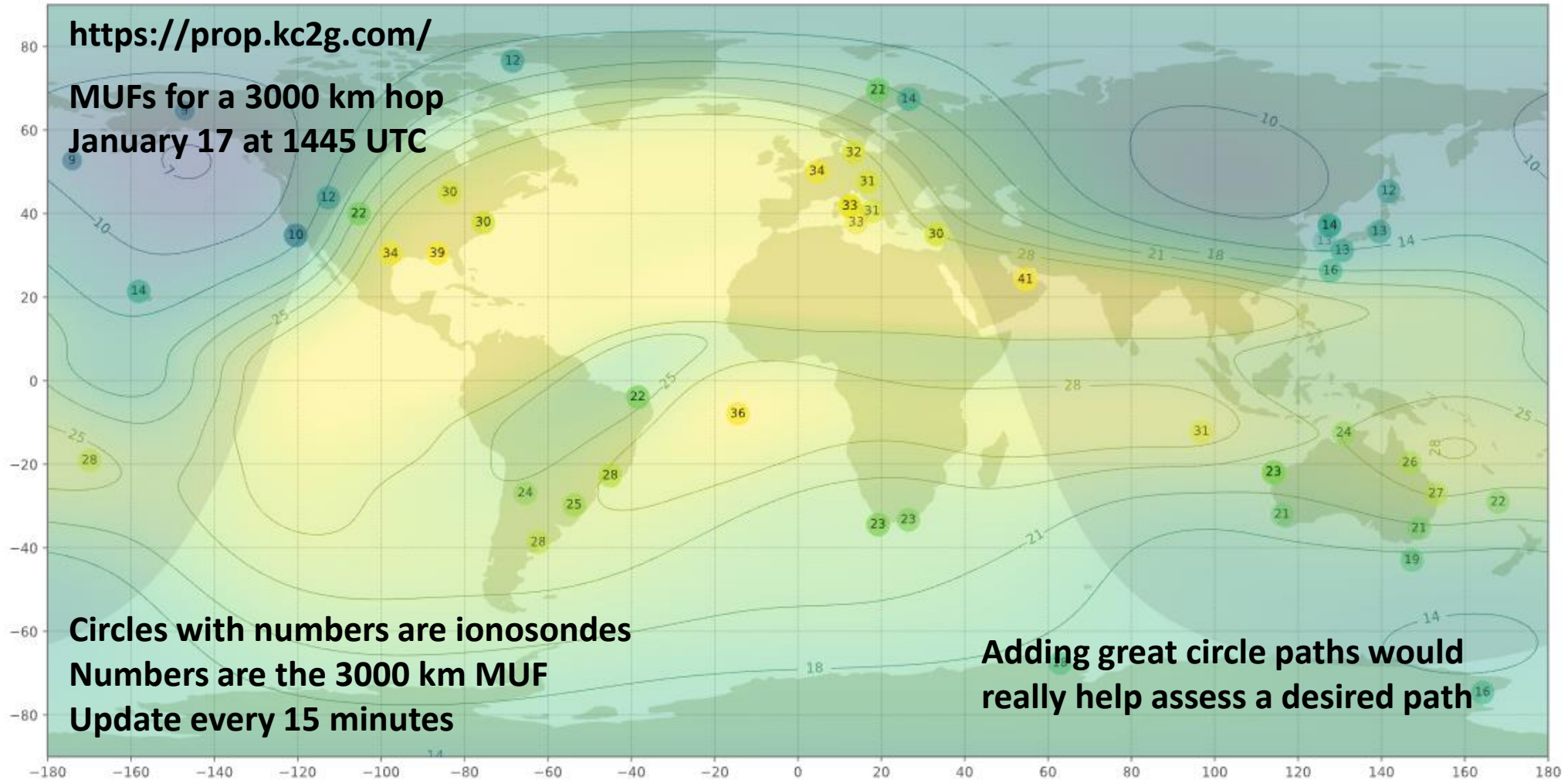
Real-Time Assessment of the Bands

- 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
- Similar websites/applications for a real-time assessment
 - KC2G MUF map (see next slide)
 - PSKreporter
 - WSPRnet
 - Reverse Beacon Network
 - IARU/NCDXF beacons
 - ViewProp by ZL2HAM
 - WX6SWW (space weather woman)



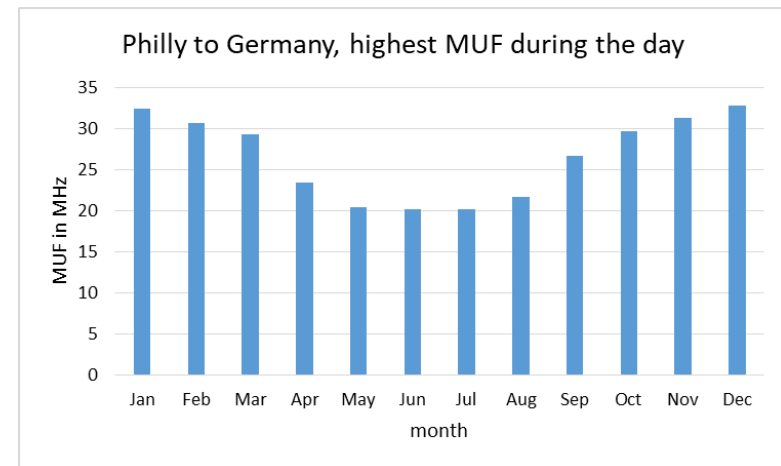
Real-Time MUFs

mufd 2023-01-17 14:45 eSFI: 134.7, eSSN: 96.4



What We Can Expect in 2023

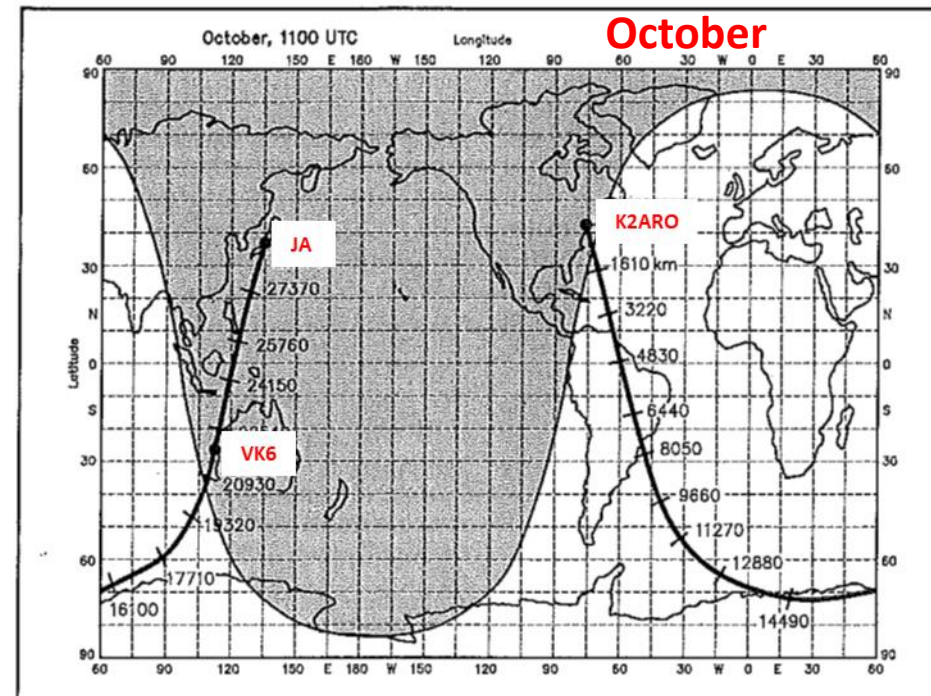
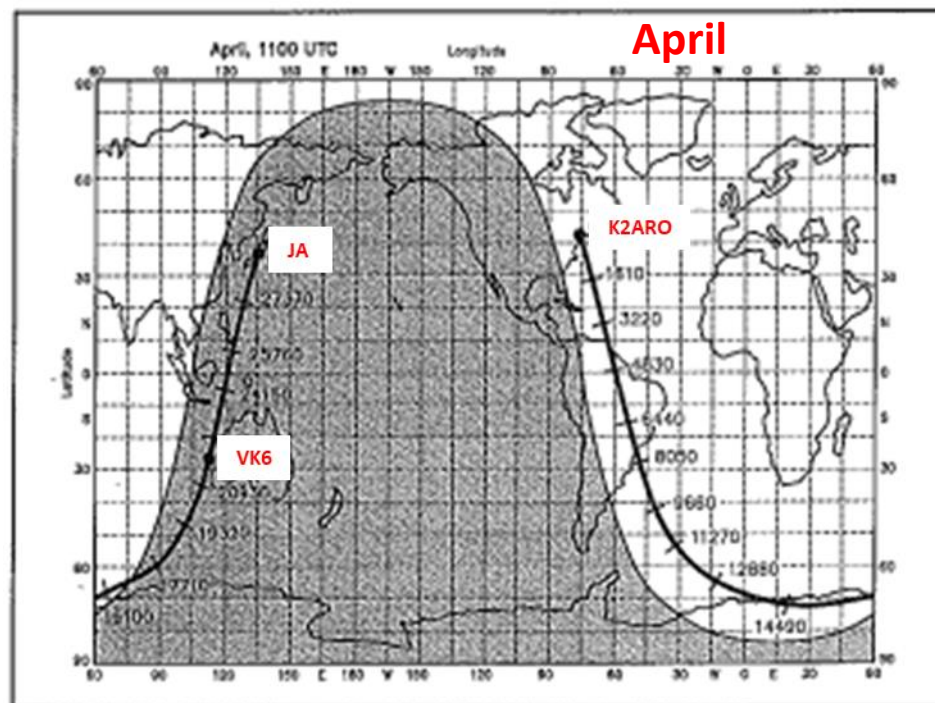
- 160m, 75m/80m, 60m, 40m (absorption is critical)
 - Should be good at night – 160m kind of iffy because of disturbances
- 30m, 20m, 17m
 - Should be great all year
- 15m, 12m, 10m (MUF is critical)
 - Should be great for winter/spring contests (ARRL Int'l DX in Feb and Mar, et al)
 - Should be great for fall/winter contests (CQ WW DX in Oct and Nov, et al)
 - IARU contest in July will suffer from degraded summer propagation (but watch for sporadic E)
- 6m F2 (MUF is critical)
 - F2 should be even better this coming fall/winter
 - Check when K index spikes to 5 and 6
 - Don't forget sporadic E in the summer



What Got Me Interested in 10m Long Path

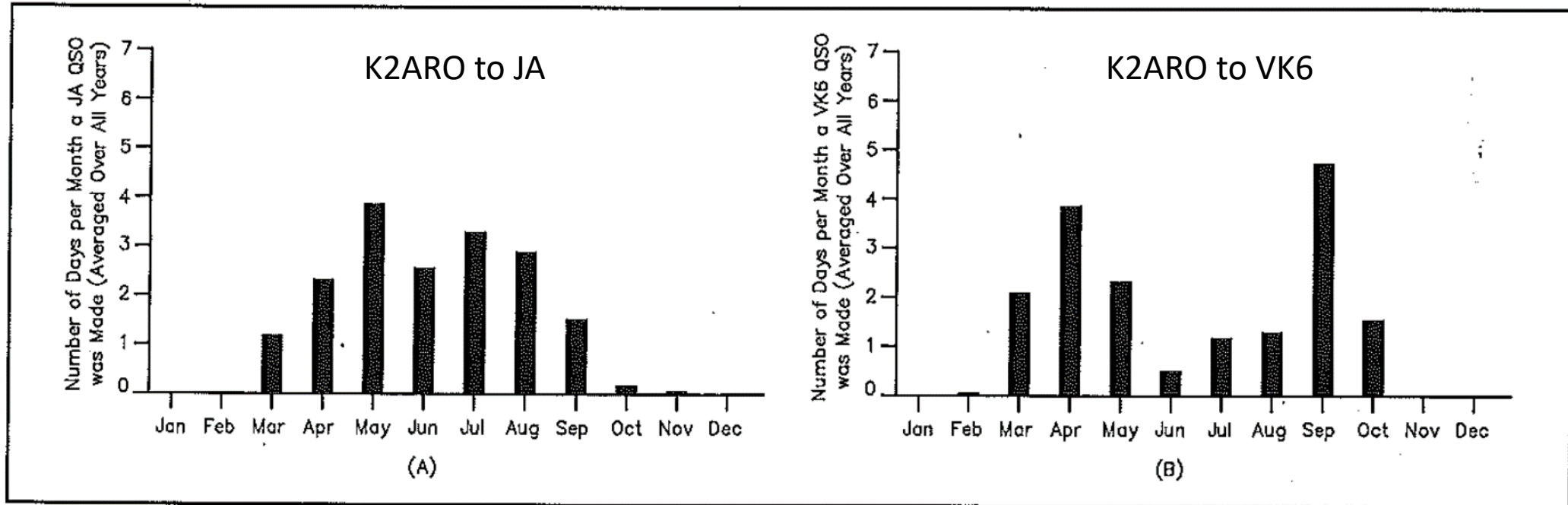
- CQ WW DX PH in October 1986
 - I was K9LA/5 in the DFW area from April 1979 – July 1988
- Local 2m DX net announced VS6DO (Hong Kong) on 28510 via long path
 - Easily worked him at 1411 UTC (8:11 AM local)
 - 400 Watts (GLA-1000) to a Cushcraft A3 tri-bander at 40 feet
- Acquired logs from Gus K2ARO, Jerry N6AV (SK), John NT5C (SK), Bill K5FUV, 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 10m Long Paths



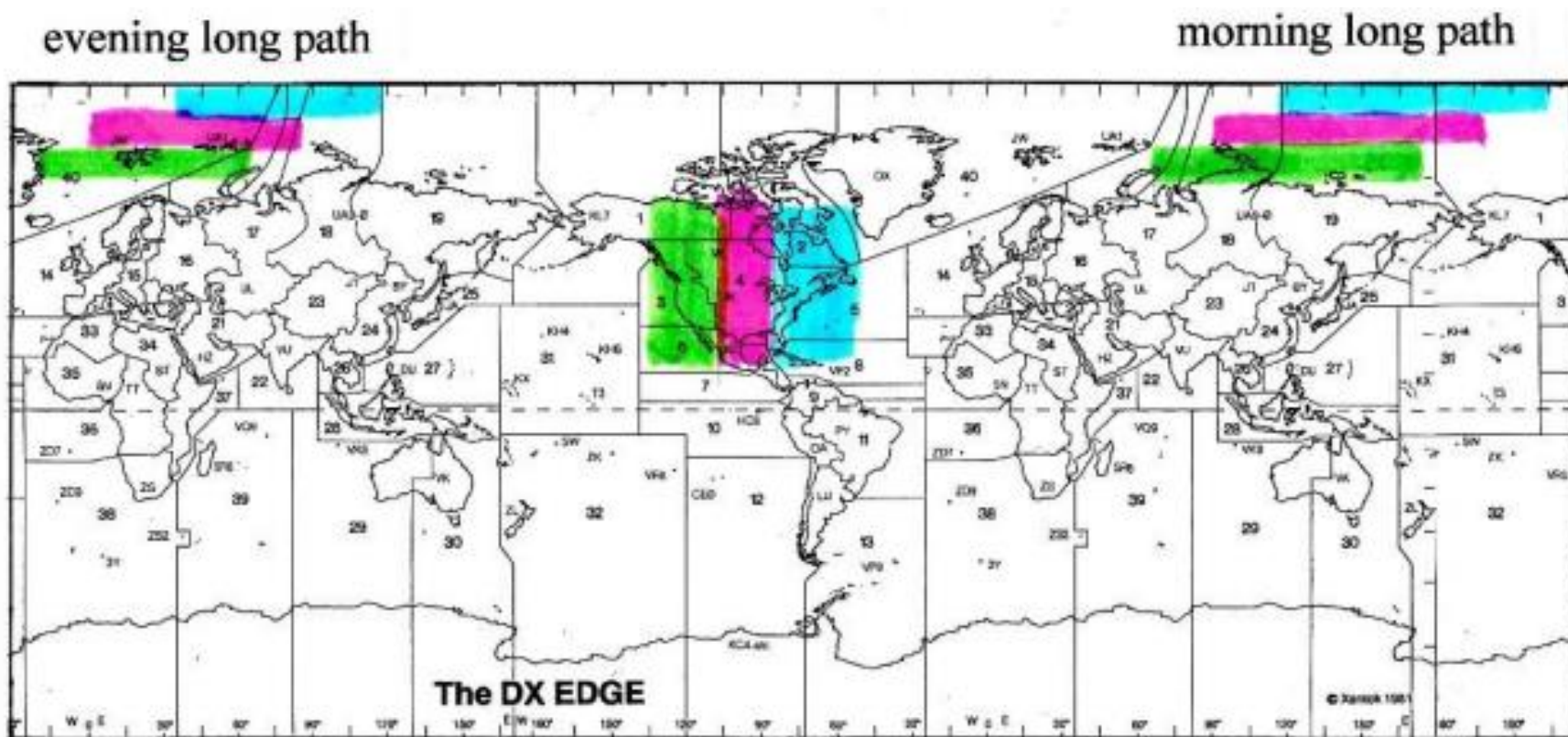
- Mar 22nd to Sep 22nd most productive
 - 90% of JA QSOs, 77% of VK6 QSOs
- Before Mar 21st and after Sep 23rd
 - 10% of JA QSOs, 23% of VK6 QSOs

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 for North America



The big question - is anyone on the other end?

For more details: [https://k9la.us/A Refreshers on 10m Long Path.pdf](https://k9la.us/A_Refreshers_on_10m_Long_Path.pdf)

Summary

- Cycle 25 is awake and still going up
- Solar maximum likely in 2024/2025
- So far it kind of looks like another small cycle
 - But January has much greater SFI/SN – let's hope it continues
- Even if it is a small cycle, now and around solar maximum will offer worldwide propagation with modest power and simple antennas on 15m, 12m and 10m
- Should have more 6m F2 propagation in the fall/winter months
- 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
- Check out 10m long path
 - Applies to 15m and 12m, too

Get radio-active on HF!