Cycle 25 and Propagation

Cycle 25 is very awake!

Carl Luetzelschwab K9LA

e-mail: k9la@arrl.net

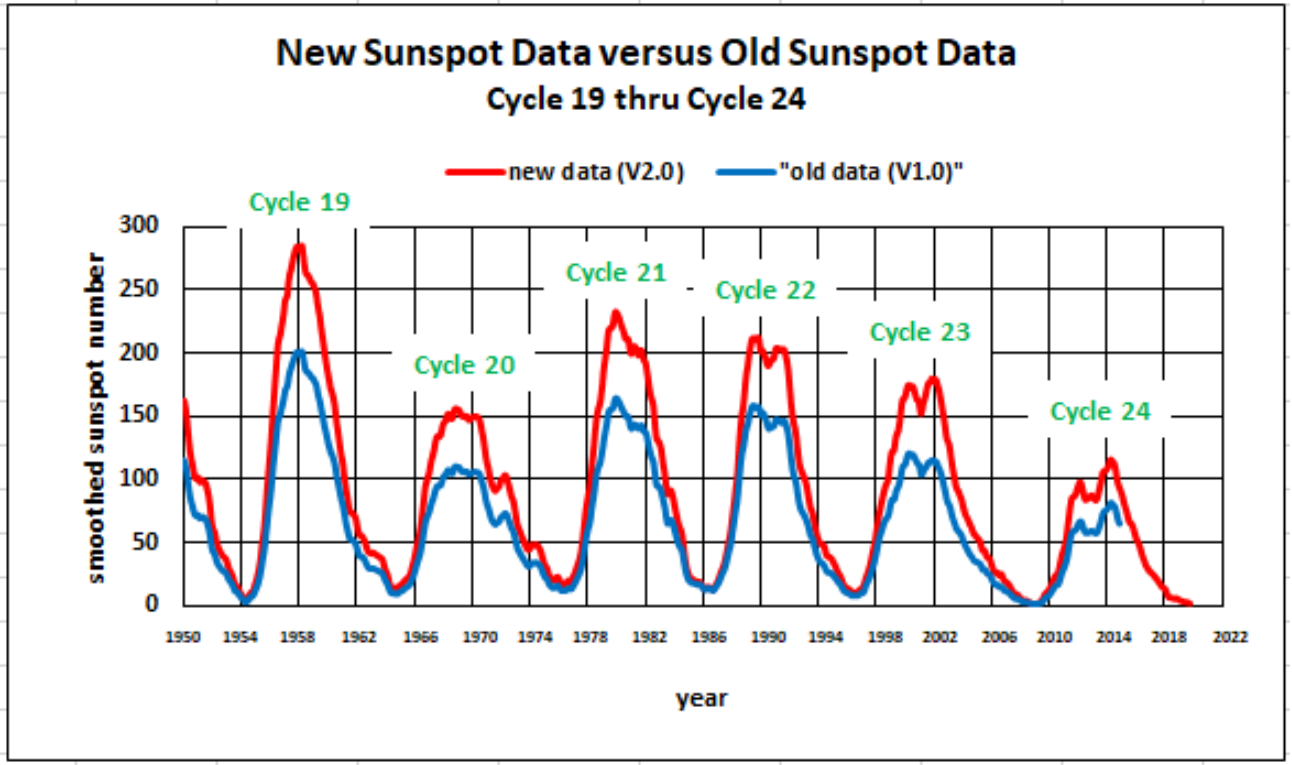
website: https://k9la.us

What We'll Cover

- Previous 24 solar cycles
- Solar cycle predictions
- Latest data on Cycle 25
- What to expect on HF and 6m
- Space weather

Caveat - A Comment About Sunspots

- As of July 1, 2015, we have new sunspot numbers
- A series of four workshops (2011, 2012, 2013 and 2014) were held to review old sunspot numbers – concern with old data (V1)

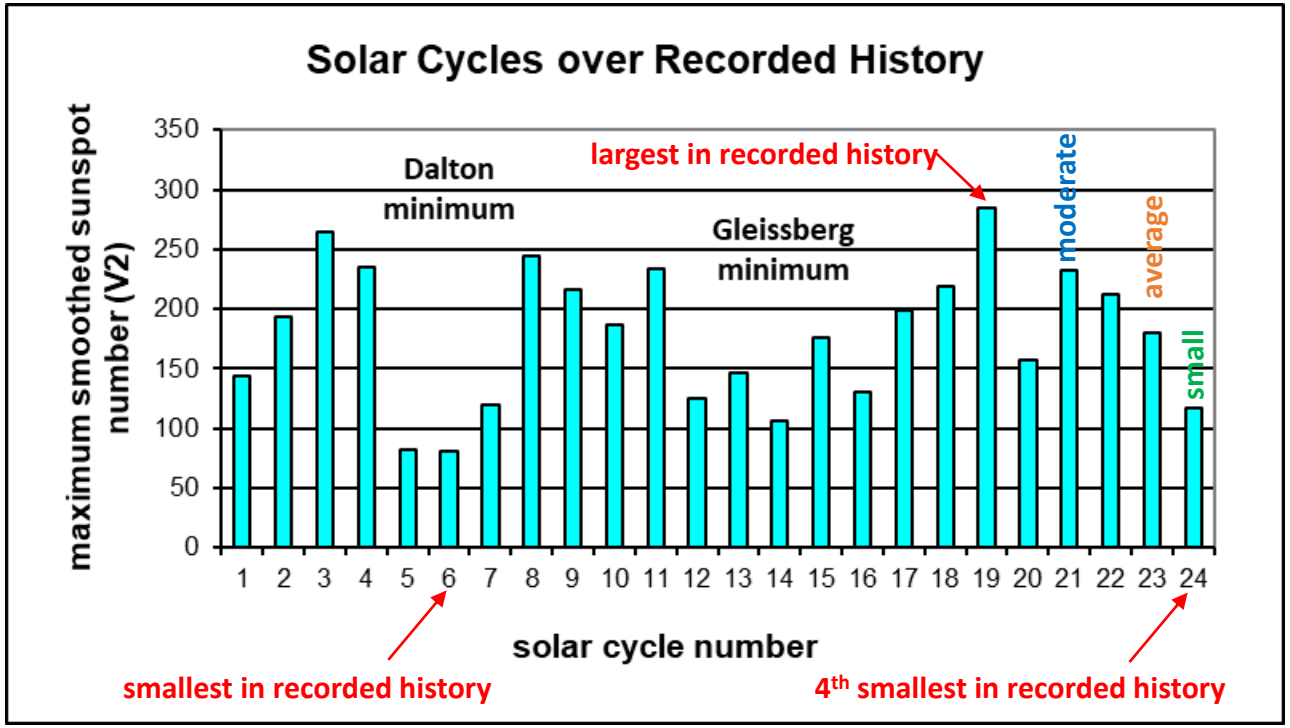


- The new sunspot record (V2) also goes back to 1750
- The model of the ionosphere in our propagation predictions is based on the V1 sunspot record
- V1 sunspot number = V2 sunspot number times 0.7

Previous 24 Solar Cycles

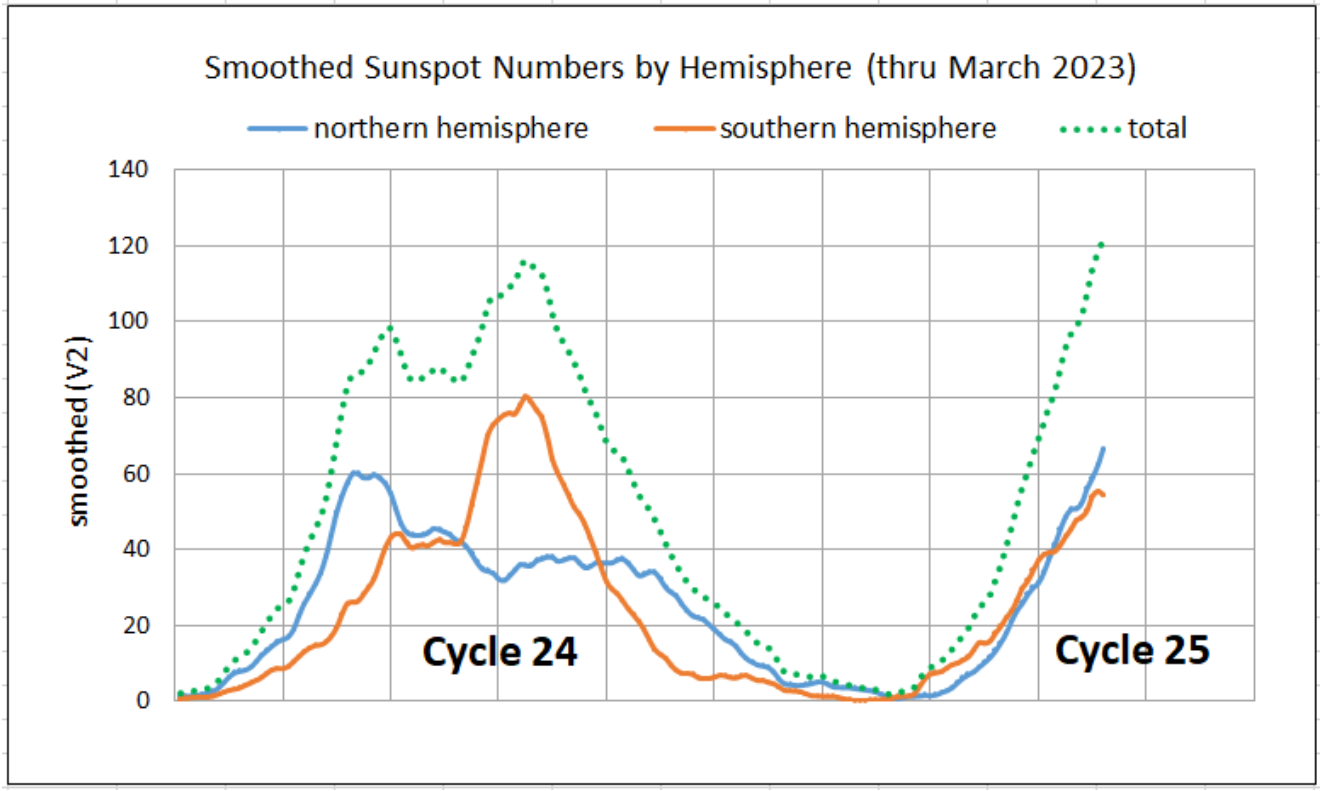
A Look at All Previous Solar Cycles

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



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

Cycle 25 – One Peak or Two Peaks?

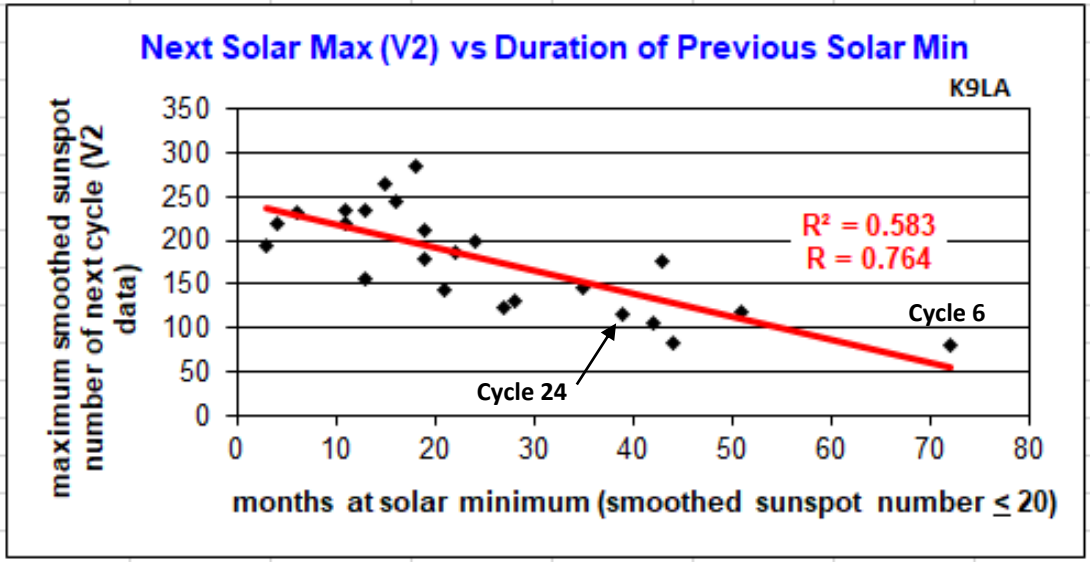


- Best guess is one peak due to the two solar hemispheres working together so far – but watch the southern hemisphere
- Also tends to confirm that Cycle 25 will be bigger than Cycle 24

Solar Cycle Predictions

Solar Cycle Predictions

- I'm aware of over 60 predictions for Cycle 25
  - From a small cycle (NOAA/NASA consensus) to a big cycle
  - Why so many?
- Because we don't fully understand the sunspot cycle process
  - We know it has to do with magnetic fields and plasma inside the Sun – but the nitty-gritty details are not yet fully clear
- Thus many methods are used to make a prediction
  - Example: precursor method →



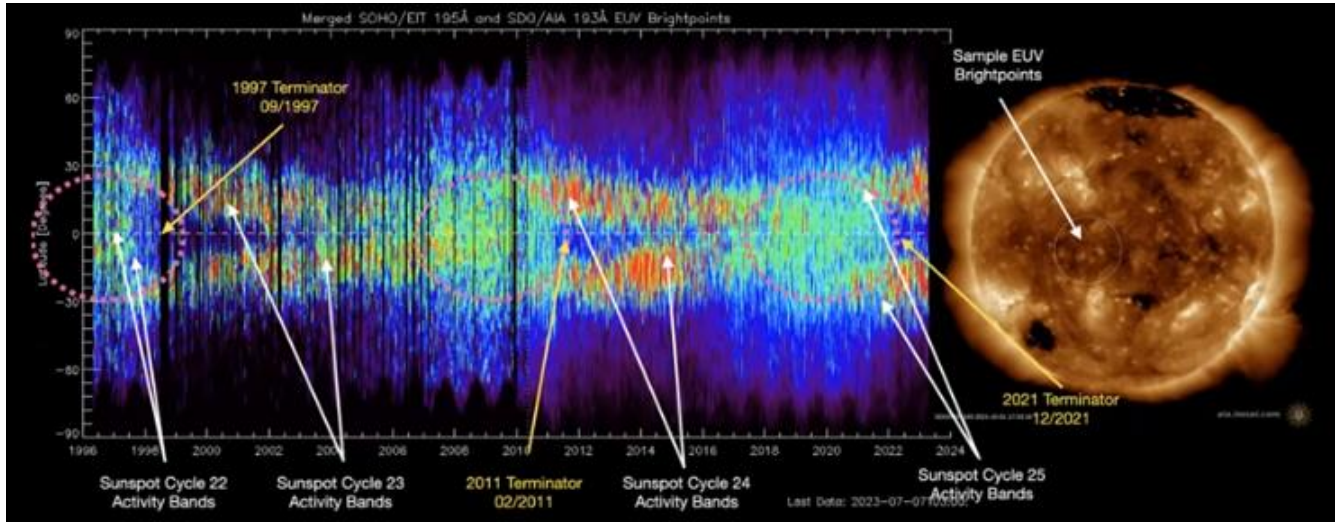
Prediction For A Big Cycle

- Dr. Scott McIntosh, et al, predicted a big cycle in June 2020
  - It ran against the NOAA/NASA consensus of a small cycle like Cycle 24

- This prediction of a big cycle has received much publicity
- Dr. McIntosh has given many updates of their Cycle 25 prediction to the Front Range 6 Meter group
- If the prediction comes true, it would be similar to Cycles 21 and 22
  - Excellent worldwide propagation on the higher HF bands
    - 15m, 12m, 10m
  - Lots of worldwide 6m propagation via the F_2 region around solar maximum, too
- **But . . .**

. . . They Revised Their Prediction

- In August 2021, Dr. McIntosh, et al, downsized their prediction to slightly above an average cycle
  - The terminator event for Cycle 24 was much later than expected
- New prediction is similar to Cycle 23
  - Still lots of worldwide propagation on the higher HF bands
  - Decent worldwide propagation via the F_2 region on 6m

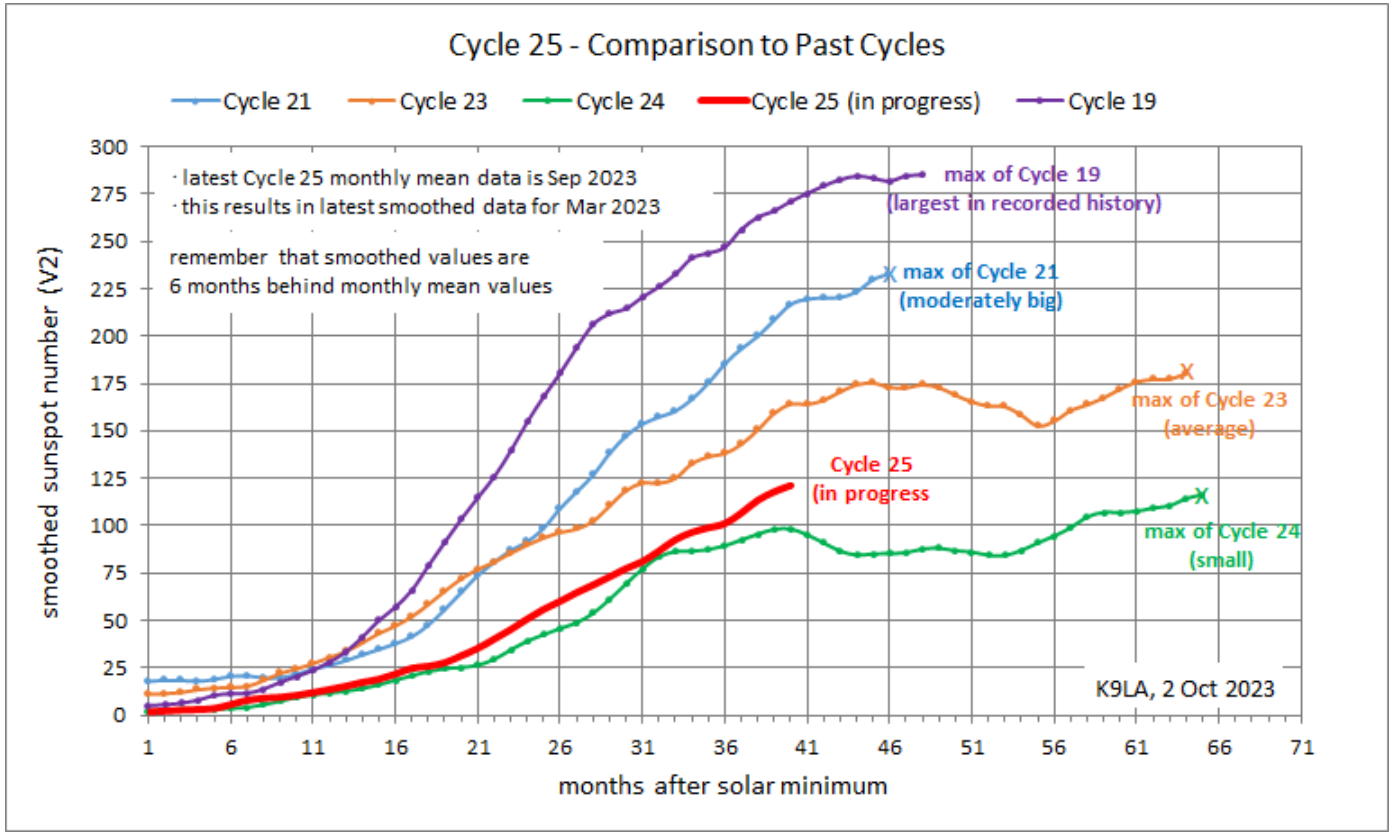


Terminator Cycle 22 – 09/1997
Terminator Cycle 23 – 02/2011 > 13yrs 5mo – small Cycle 24
Terminator Cycle 24 – 12/2021 > 10yrs 10mo – average Cycle 25

We'll gladly take a cycle similar to Cycle 23 over a cycle similar to Cycle 24!

Latest Data on Cycle 25

The Latest Cycle 25 Data



7 Sep 2023 prediction by Upton and Hathaway (134 +/-8)

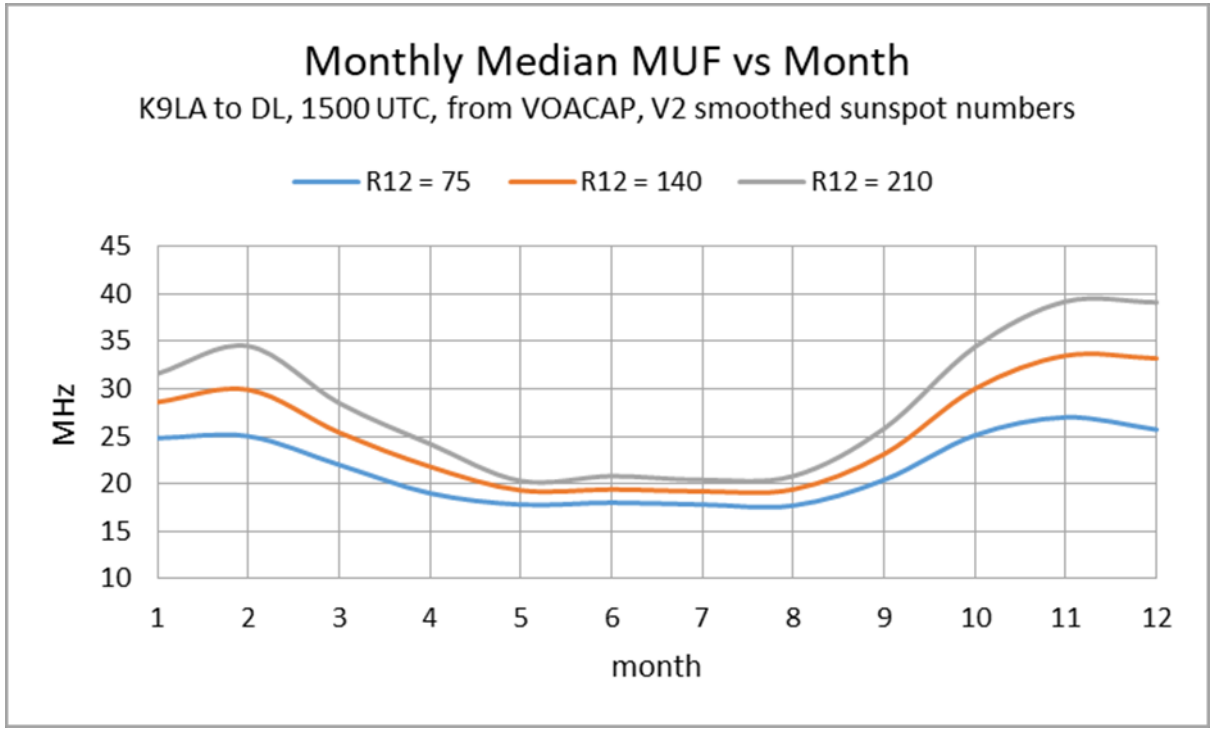
JGR Space Physics
https://doi.org/10.1029/2023JA031681

- For now, Cycle 25 is doing somewhat better than the small Cycle 24
- 6m comment – smoothed sunspot number of 130 (V2) is a smoothed 10.7 cm solar flux of about 140 – far from the 'accepted' value of 200 for 6m F_2

What to Expect on HF and 6m

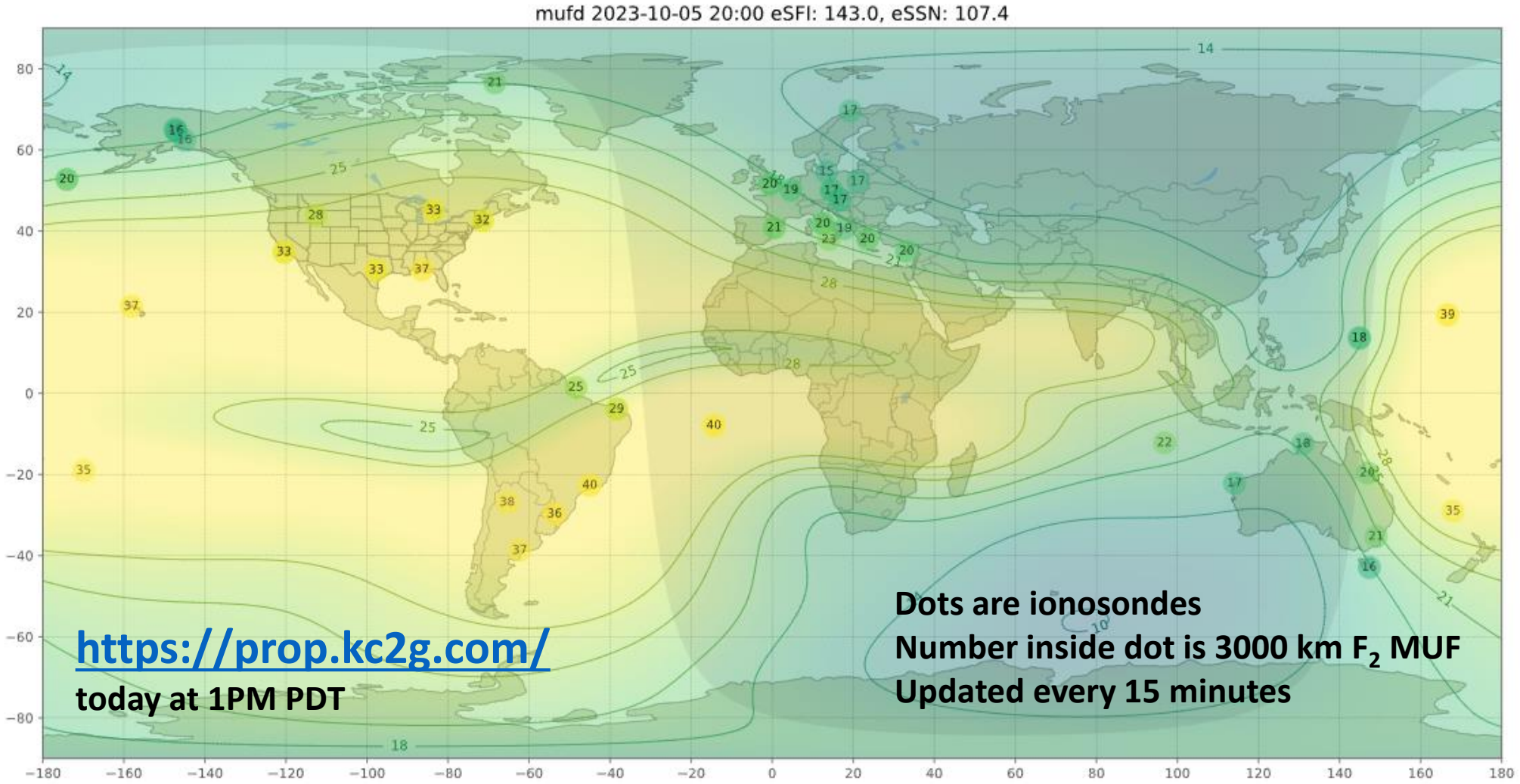
Propagation Right Now

- We're coming out of the F_2 region 'summer slump'
- In the northern hemisphere, lower daytime F_2 region MUFs than in fall/winter
- Caused by a change in the composition of the atmosphere
  - Decreased O/N_2 ratio in the summer
  - Increased O/N_2 ratio in the winter
- During summer, watch for E_s
  - Wasn't much of a season
    - Has the pattern of Es shifted?
  - Major E_s season is close to being over

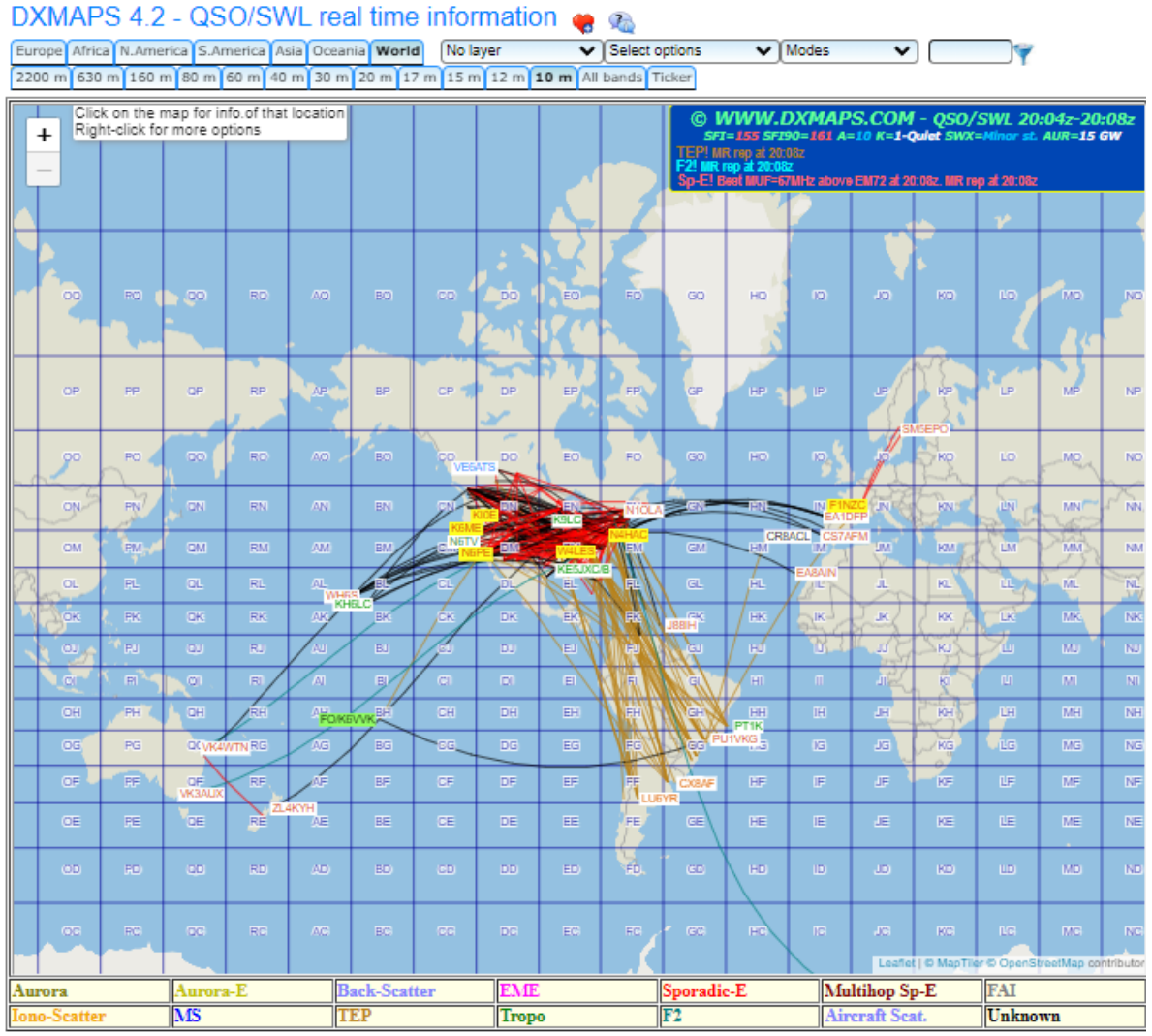


- Atomic oxygen (O) conducive to F_2 region electron production
- Molecular nitrogen (N_2) conducive to F_2 region electron loss

Worldwide MUFs



Real-Time Assessment of Propagation



- Visit dxmaps.com
  - Select view and band
  - Shows who is working who
  - Suggests mode (F_2, E_s, TEP, etc)
- Other similar websites
  - PSKreporter
  - WSPRnet
  - Reverse Beacon Network
  - IARU/NCDXF beacons
  - ViewProp by ZL2HAM
  - WX6SWW (space weather woman)
  - W3LPL assessment (Daily DX and Weekly DX from W3UR)

Space Weather

A Caveat

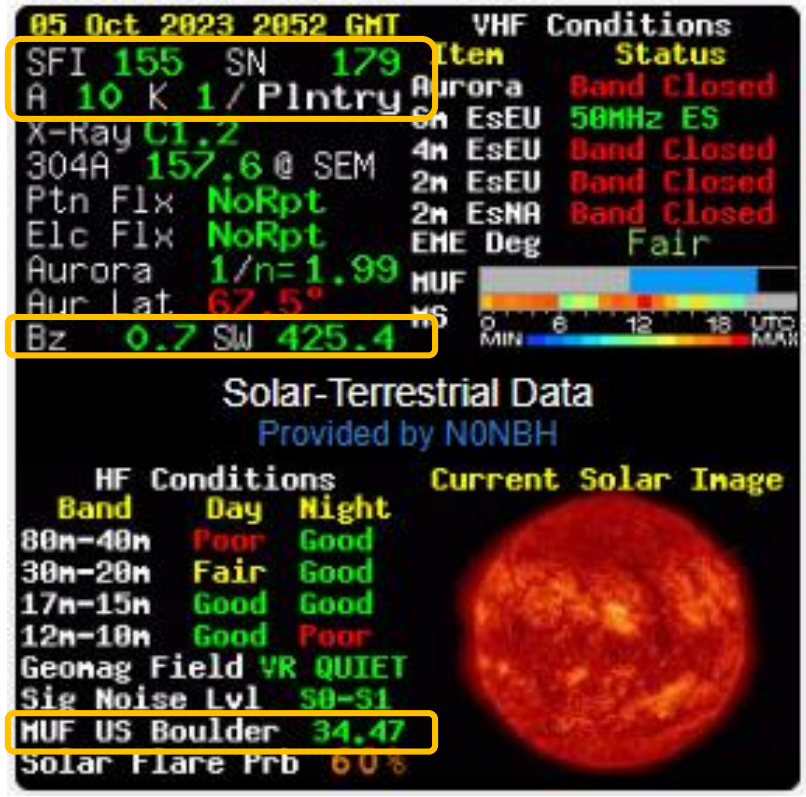
- What we're trying to do is make simple statements about propagation based on very complicated atmospheric and ionospheric processes
- Our propagation predictions are statistical in nature over a month's time frame – we do not have daily predictions
  - Why not?
  - There are three sources that cause 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 (ionospheric 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 ≤ 3**
    - Correlates to Bz pos or slightly neg, solar wind not too much higher than 400 km/sec
    - A index is the average of the eight 3-hr K indices
  - **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 may be 'good enough'
- Where we are right now
  - Smoothed SN ~130 and smoothed SFI ~140

Where Do We Get These Parameters?

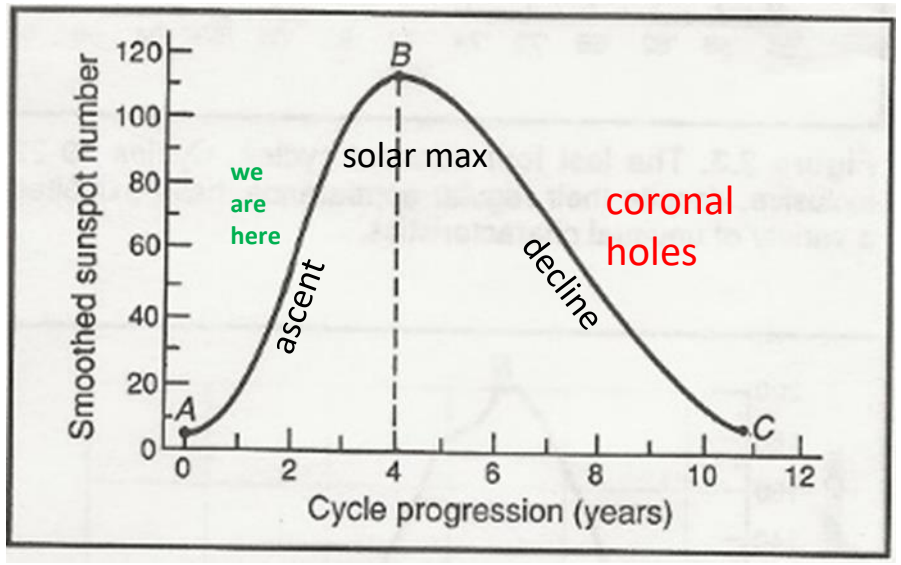
- One place is the NØNBH banner at www.qrz.com
- SFI, SN, K, Bz, SW are in the gold boxes
- Note MUF US Boulder in the gold box at the bottom
  - This is the F2 region MUF over the Boulder ionosonde assuming it's the midpoint of a 3000 km path (for example, W6 to the Midwest)
  - It is pretty close to real-time (every 15 minutes)



Today at 2052 UTC (1:52 PM PDT)

When Do Disturbances Occur?

CMEs and big solar flares



solar min

solar min

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 F_2 region

Summary

- Cycle 25 is ascending – <u>hopefully</u> up to an average cycle
- Some 6m F_2 propagation, and excellent worldwide 15m/12m/10m F_2 propagation should occur this coming fall/winter

I'm ready for any 6m propagation with my new rig

☺