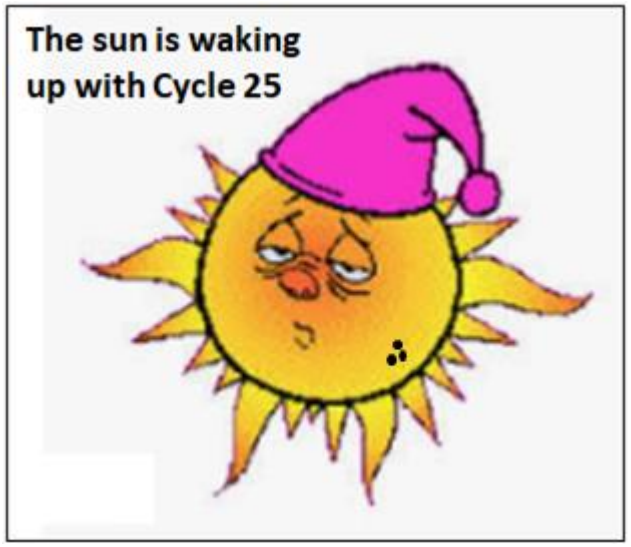
Here Comes Cycle 25



Carl Luetzelschwab K9LA

E-mail: k9la@arrl.net

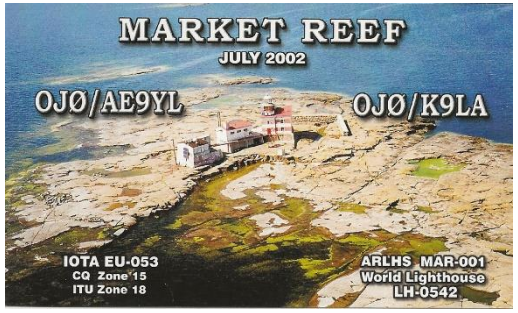
Website: https://k9la.us

A Little About K9LA

- Novice license in 1961 (WN9AVT)
- I enjoy
  - Learning about the sun and propagation
  - DXing
  - Contesting – mostly casual these days
  - Playing around with antennas
  - Fixing and using vintage equipment
    - More in queue than I'd like to admit
- My wife Vicky AE9YL and I enjoy traveling
  - Club meetings, conventions, DXpeditions

Vintage station - Johnson Viking Ranger II and Drake 2-B


YK9A – Feb 2001



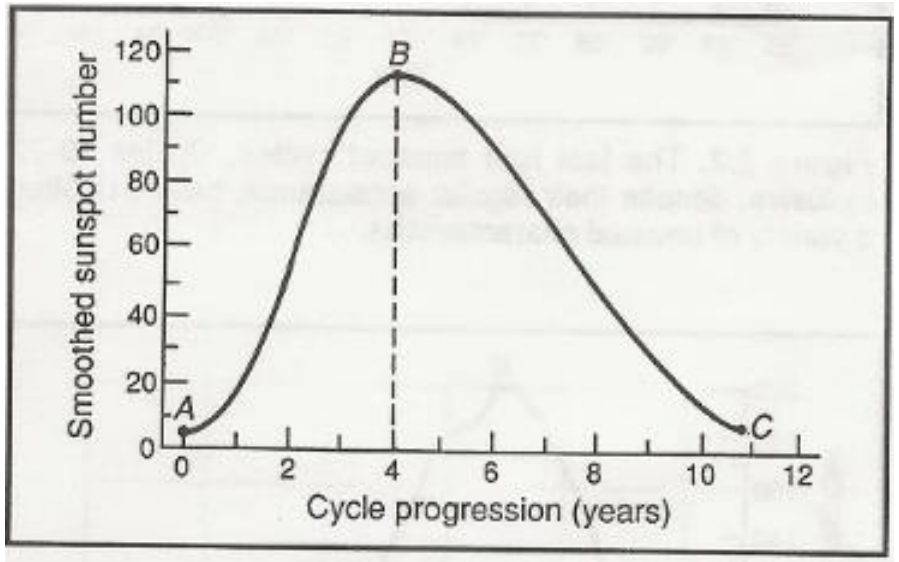
Questions We'll Cover

- What is a solar cycle?
- Why is it important?
- What did the previous solar cycles do?
- What will Cycle 25 do?
- What are some simple antennas for 15m, 12m, 10m and 6m?
- Recent sporadic-E research

What Is a Solar Cycle and Why Is It Important?

What Is a Solar Cycle?

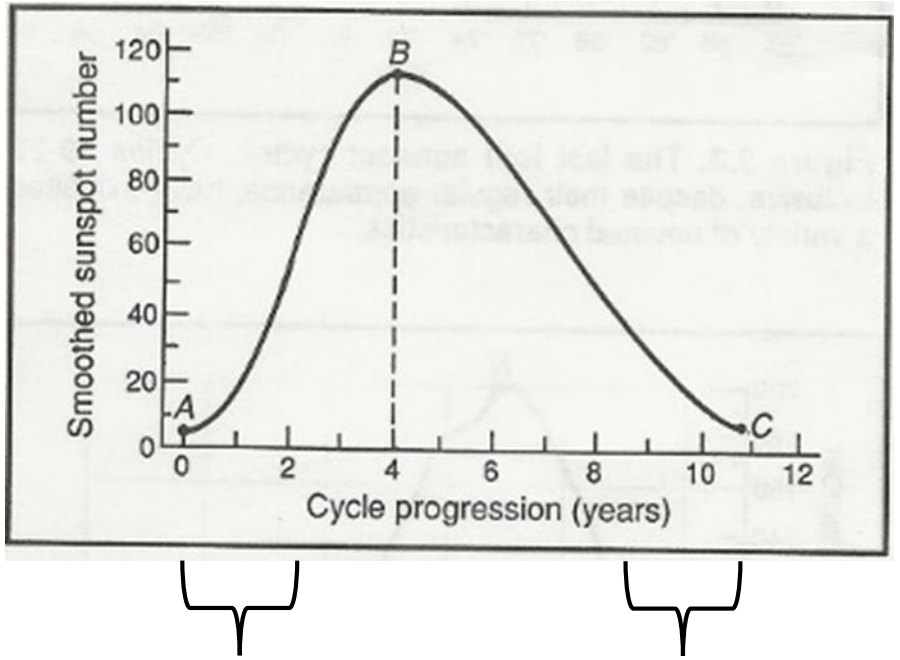
- Also known as a sunspot cycle
- It's the time period from a very low number of sunspots on the sun (solar minimum) through a maximum number of sunspots (solar maximum) and then back down to a very low number of sunspots
  - A to B to C in the plot on the right
- It's an approximate 11 year cycle
- On average
  - Rise time = 4 years
  - Descent time = 7 years



Why Are Solar Cycles Important?

- They are important for the higher HF bands
  - 15m, 12m, 10m (and 6m)
  - The area around sunspots emits EUV (extreme ultraviolet) radiation to ionize the F2 region
    - The F2 region is responsible for most of our long-distance (DX) contacts on HF
  - More sunspots = more EUV = more ionization = higher MUF (maximum useable frequency) = best propagation on the higher HF bands
- They are important for 160m and the lower HF bands
  - 160m, 80m, 60m, 40m
  - Less sunspots = less ionospheric absorption and less disturbances = best propagation on the low bands

Best propagation on
15m, 12m, 10m, 6m

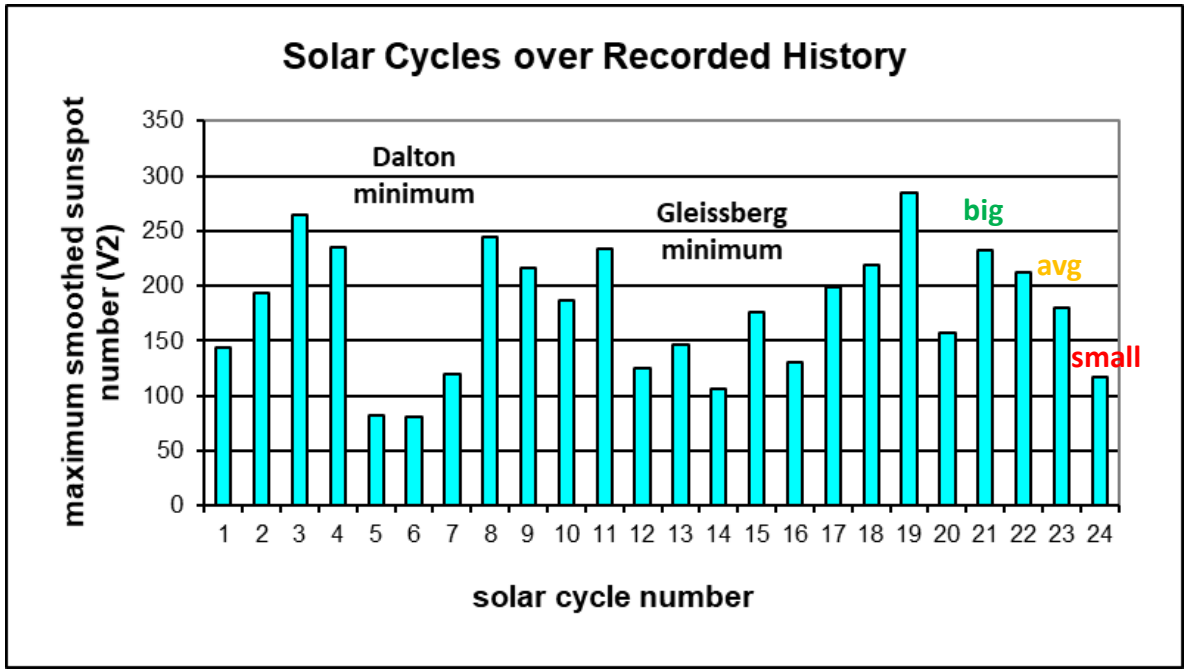


Best propagation on 160m, 80m, 60m, 40m

What Did the Previous Solar Cycles Do?

Recorded History

- Cycle 1 began in 1755
  - Maunder Minimum occurred from 1645-1715 with few sunspots
- We've gone through 3 periods of big cycles and 2 periods of small cycles
  - We appear to be in a third period of small cycles



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

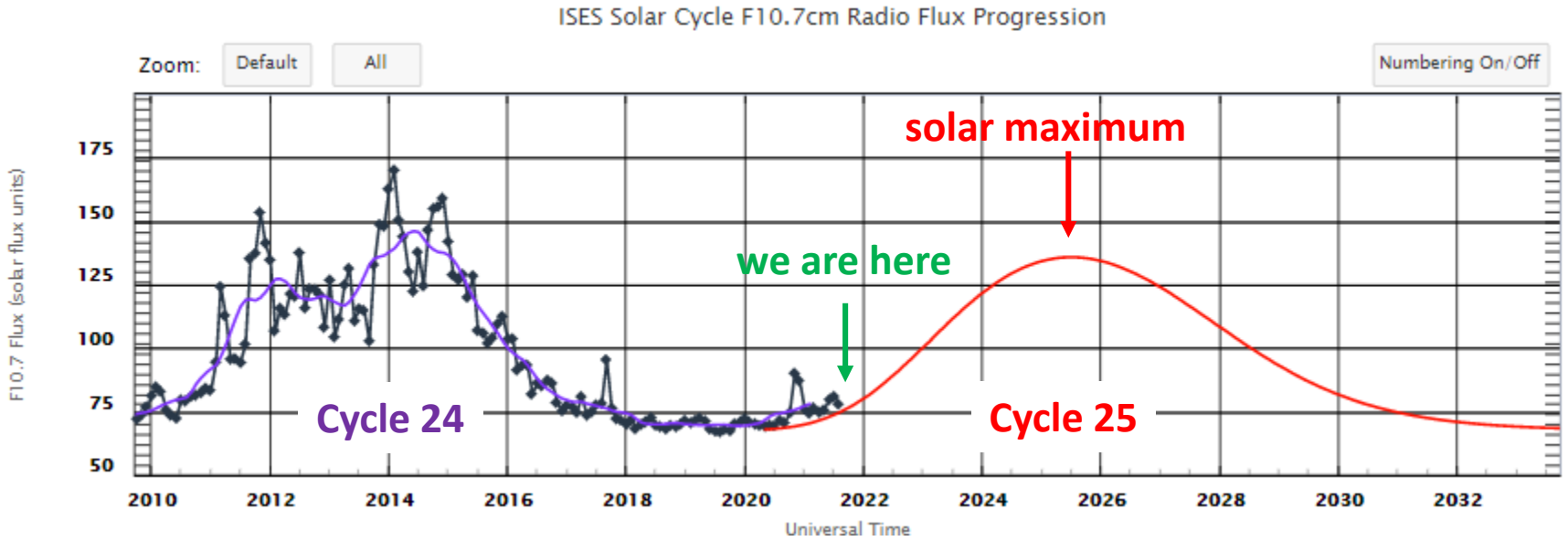
What Will Cycle 25 Do?

If you've only been licensed for 5 or so years, you're probably wondering what's so great about 15 meters, 12 meters and 10 meters.

All I can say is have patience and wait for Cycle 25 to be near solar maximum

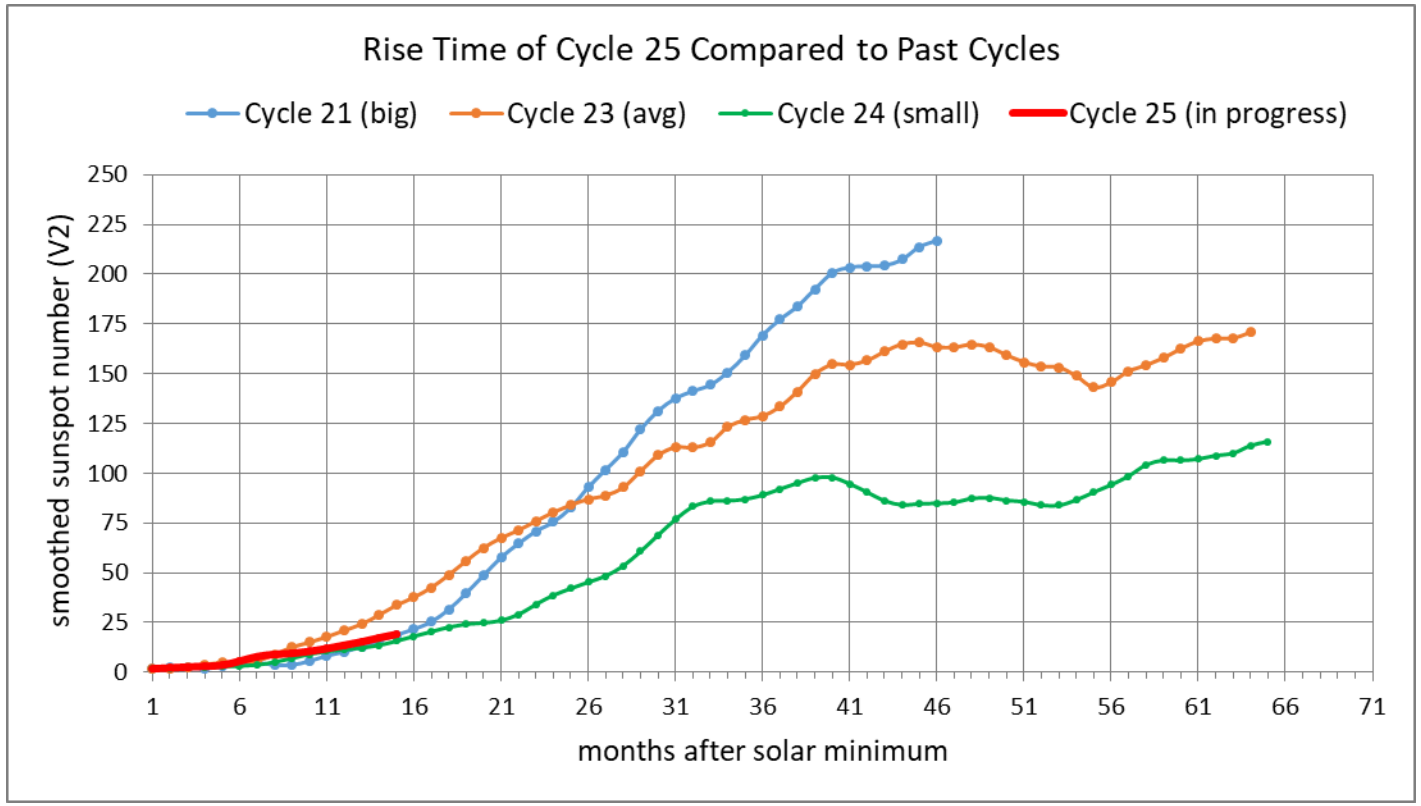
Prediction from NOAA/NASA

- Here's the forecast from the Solar Cycle 25 Prediction Panel



- This is one of <u>many</u> predictions (50 of 56 = 89%) that forecasts a Cycle 25 similar to or smaller than Cycle 24
- Four predictions (4 of 56) are for an average cycle (similar to Cycle 23)
- Two predictions (2 of 56) are for a big cycle (similar to Cycle 21)

How Is Cycle 25 Doing?

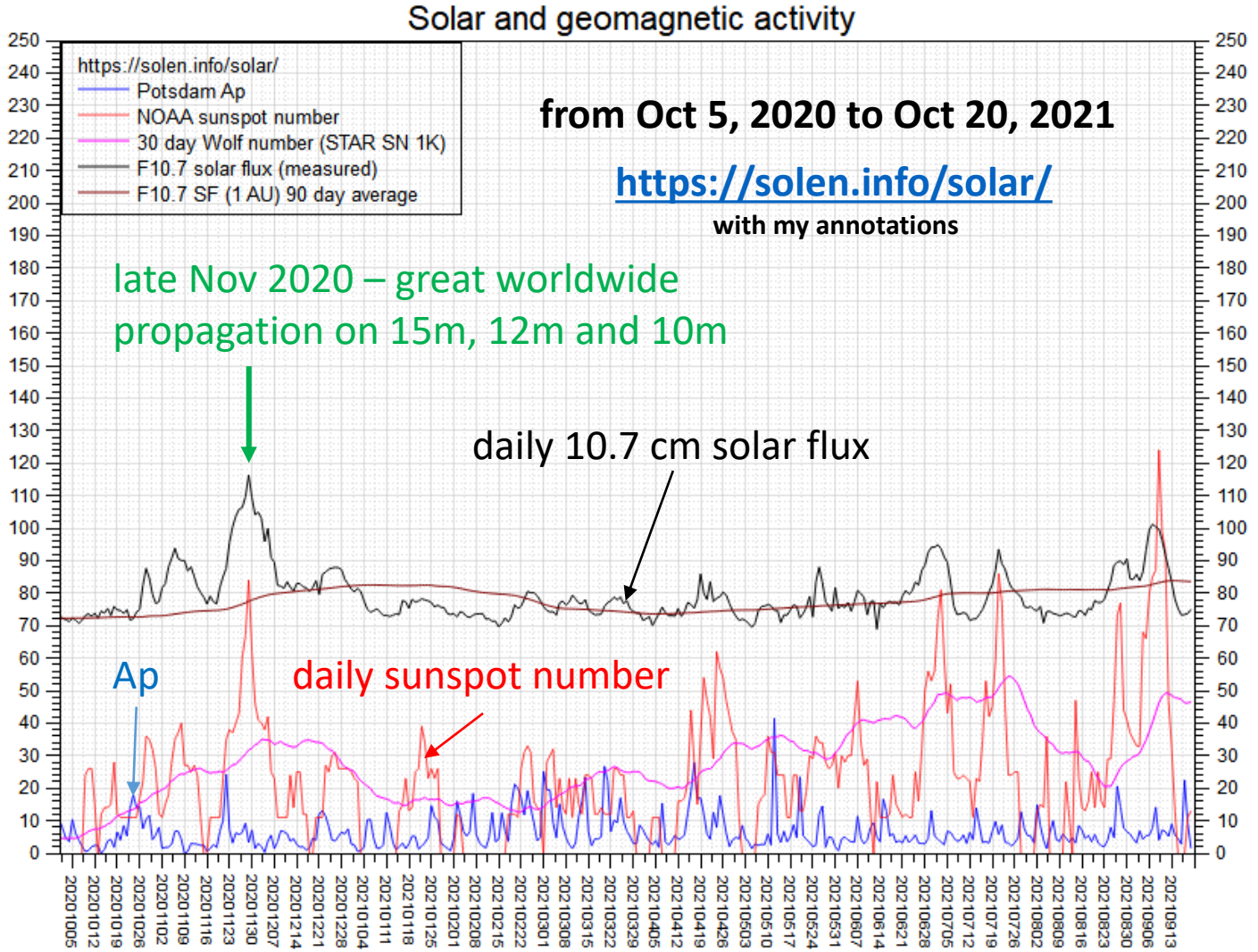


- Cycle 25 is starting its ascent – kind of slow right now
- Will it follow the big Cycle 21 (blue), the small Cycle 24 (green) or in between (orange)?
- 6 to 12 more months of data may give us a better clue as to where it's headed

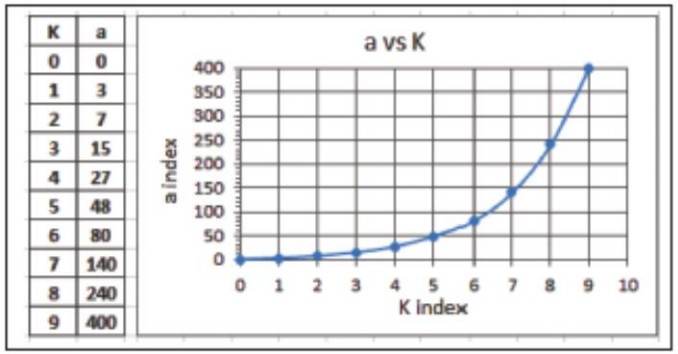
The Bands Right Now

- 15m offers decent worldwide propagation on a few days of the month
- 12m is kind of quiet
  - Occasional openings to the south and to VK/ZL
- 10m is mostly noise
  - Very occasional openings to the south and to VK/ZL
- Digital modes offer more opportunities due to their signal-to-noise ratio advantage
  - FT8/FT4 offers more opportunities than CW, CW offers more than SSB
- The low bands (160m, 80m, 60m, 40m) are good at night
- 30m, 20m, 17m are generally good throughout a solar cycle
- Check the higher bands when:
  - There is a big spike in SFI/SN – like late last year (see next slide)
  - When there is a moderate spike in the K index – possible enhanced propagation on low and mid latitude paths

Big Spike in SFI/SN



translation of Ap to K



K	a
0	0
1	3
2	7
3	15
4	27
5	48
6	80
7	140
8	240
9	400

late Nov 2020

the great propagation was short-lived – went back to solar minimum conditions

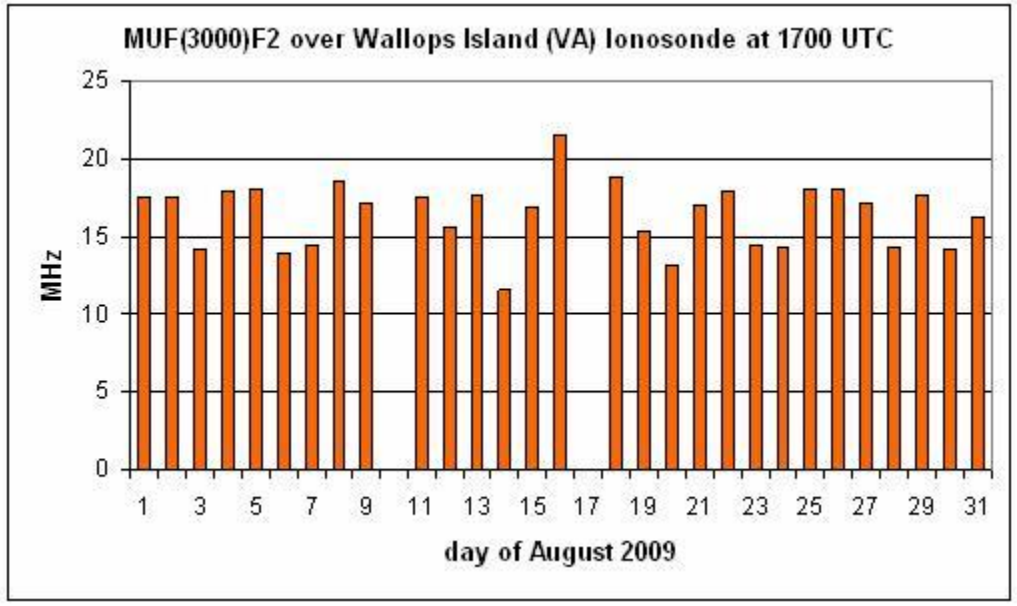
note the (lack of) short-term correlation between SFI and SN – two different processes in the sun

Pop Quiz

If the 10.7 cm solar flux is 80 today, will propagation be better tomorrow on the higher HF bands (15m, 12m, 10m) if the 10.7 cm solar flux is 90 tomorrow?

The Answer

- Not necessarily – why not?
- What the ionosphere is doing today is not well correlated to today's SFI or SN or EUV
- The reason – there are two other factors that determine the amount of ionization at any given place and time
  - Geomagnetic field activity – the K index
  - An event in the lower atmosphere coupling up to the ionosphere – we have no parameter for this yet
- What does this mean?



*In August 2009, the MUF for a 3000 km path over Wallops Island, VA varied from 11 MHz to 22 MHz when the sunspot number for every day was **zero**. The 10.7 cm solar flux was **67 +/- 2**. The K index was **<3** on all days. This shows the impact of events in the lower atmosphere coupling up to the ionosphere.*

What This Means

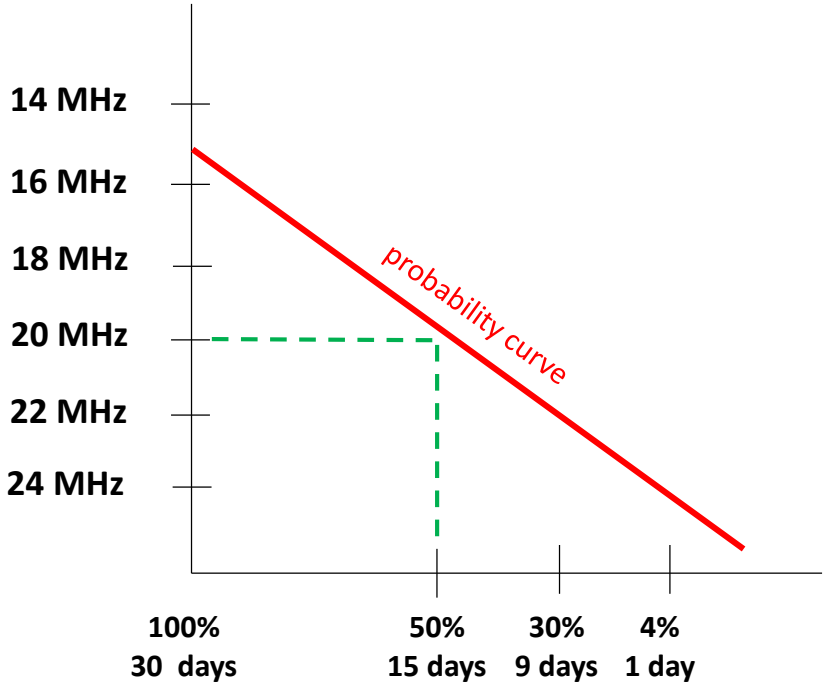
- The model of the ionosphere in propagation programs is not a daily model
- It's a monthly median model (median implies a 50% probability)
  - Long ago scientists determined that today's ionosphere does not correlate well to today's solar radiation
  - They had to find a different correlation – longer-term
  - Monthly median ionospheric parameters are correlated to a smoothed sunspot number
    - "smoothed" is more averaging of the monthly mean
- Our predictions are statistical in nature over a month's time frame

Our Propagation Predictions

- Let's run a propagation prediction over a given path for a desired month at a given time by inputting the smoothed sunspot number for that month
- The outputs are monthly median values
  - Assume the monthly median MUF is predicted to be 20.0 MHz
  - Assume the monthly median signal strength is predicted to be S6
- On half the days of the month (50%), the MUF should be at least 20.0 MHz
- On half the days of the month (50%), the signal strength should be at least S6
- There's a distribution about these median values
  - On lower frequencies, the probability is higher
  - On higher frequencies, the probability is lower

Our Propagation Predictions – con't

- From the previous slide, assume the monthly median MUF is 20.0 MHz
- The MUF should be at least 15 MHz on all the days of the month
- The MUF should be at least 24 MHz on 1 day of the month
- Similar trend for signal strength
- In general, the MUF can vary from +20% to -40% of the median on any given day of the month
- In general, the signal strength can vary from a couple S-units higher to several S-units lower than the median on any given day of the month



Unfortunately we don't which are the good days and which are the bad days

When Cycle 25 Really Gets Going

- Propagation on the higher bands (15m, 12m, 10m) will basically “follow the sun”
- Look to the northeast through southeast in the mornings
  - Europe, Africa, Caribbean, South America, Central America
- Look to the southeast through southwest around local noon
  - Africa, Caribbean, South America, Central America
- Look to the southwest through northwest in the afternoon and evening
  - Caribbean, South America, Central America, VK, ZL, Pacific, Japan and Southeast Asia

Fun with 100 Watts and Wires

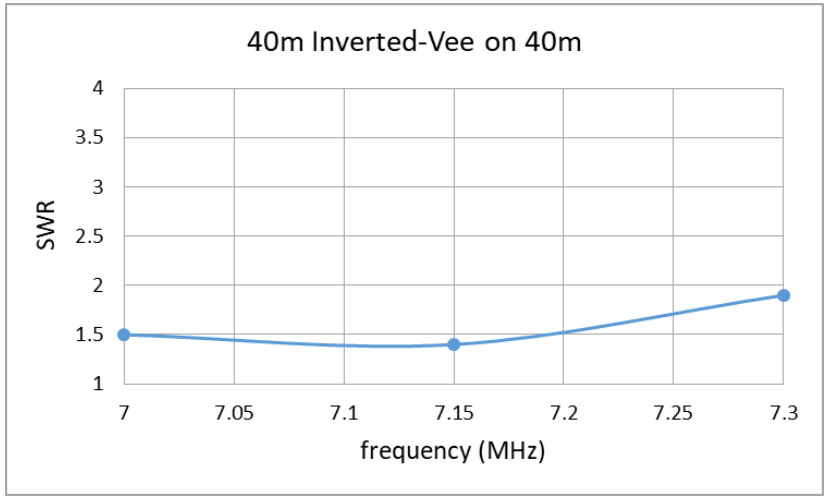
- Don’t forget the low bands at solar minimum
- Antennas are getting bigger as you go lower in frequency, but you may be able to put up a 40m dipole or inverted-vee
  - About 33 ½ feet on each side of center
- I have a 40m inverted-vee with its apex at 40 feet
- I participated in the ARRL International DX CW contest in February
  - I worked 48 countries on 40m using my Ten-Tec OMNI VII at 90 Watts
  - I also worked more 4 countries on 15m with the 40m inv-vee (more on this later)
- Don’t shy away from 100 W and a wire antenna on 40m

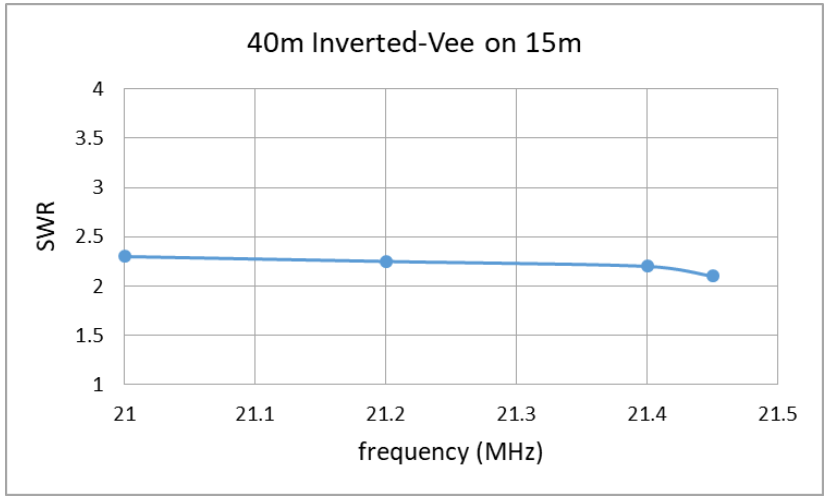
Antennas for the Higher HF Bands

for when we have daily worldwide openings

Antennas for 15m

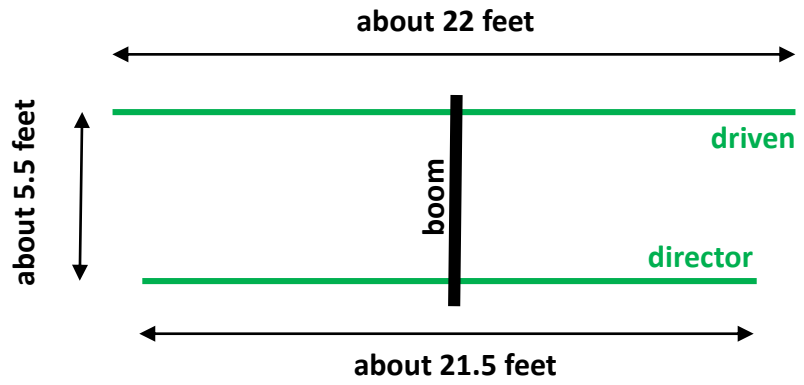
- Use your 40m dipole/inverted-vee
  - Works as a 3/2-wavelength antenna
    - A bit of gain in some directions
  - Lowest SWR on 15m may be above 21.450 MHz
    - Probably need to use a tuner – either your rig's internal tuner or an external tuner
- Vertical with four elevated radials
  - I have a Hustler 4BTV – gives decent results
- 15m dipole/inverted-vee
  - Overall length about 22 feet
  - Put it up at 20 feet

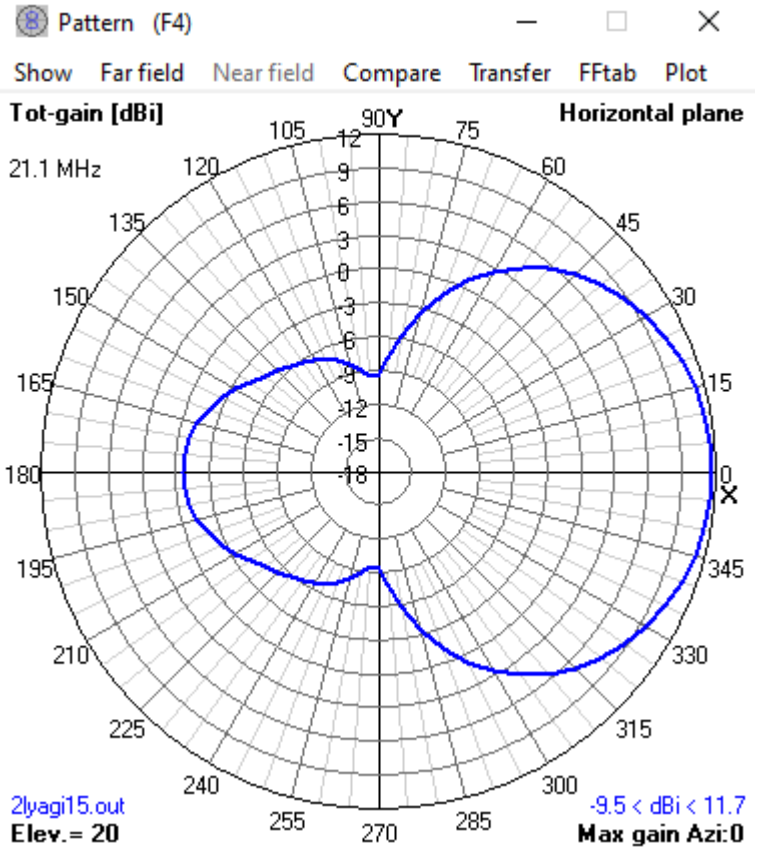




Another Antenna for 15m

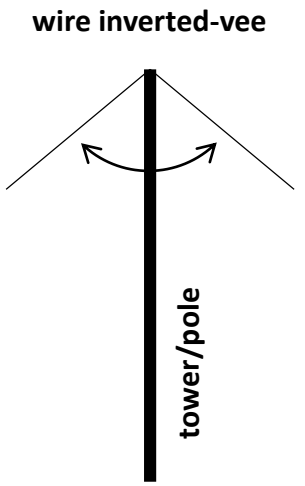
- 2-element Yagi
  - Driven element and director
  - Aluminum tubing
  - About 5dB gain over a dipole
  - A rotator is required due to F/B and F/S ratios
- A height of 20 feet would work very well

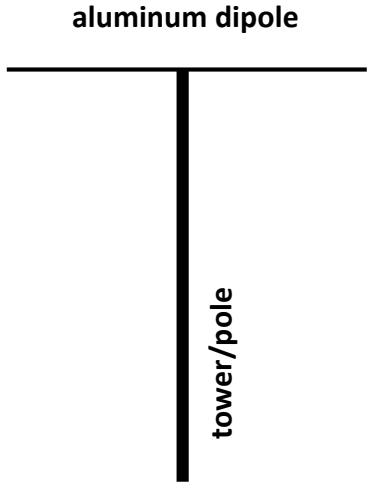




Antennas for 12m

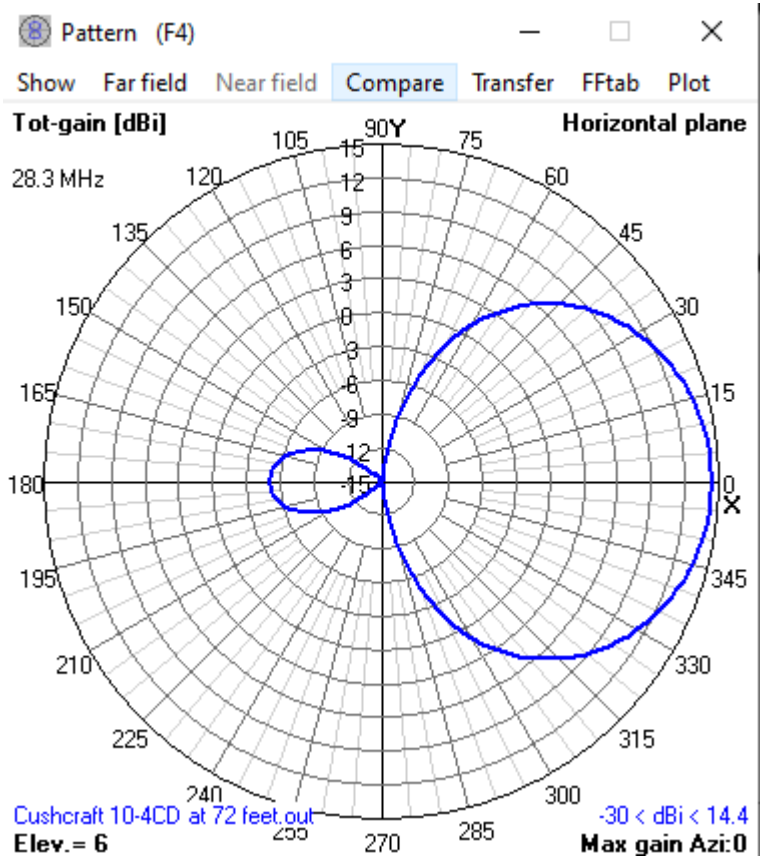
- Inverted-vee
  - Each side about 9.25 feet
  - Keep angle > 90 degrees
- Dipole made with aluminum tubing
  - About 18.5 feet from tip-to-tip
- 2-element Yagi
  - A bit smaller than the 15m Yagi
  - Scale it from the approximate dimensions on previous slide
- 3-element Yagi





Antennas for 10m

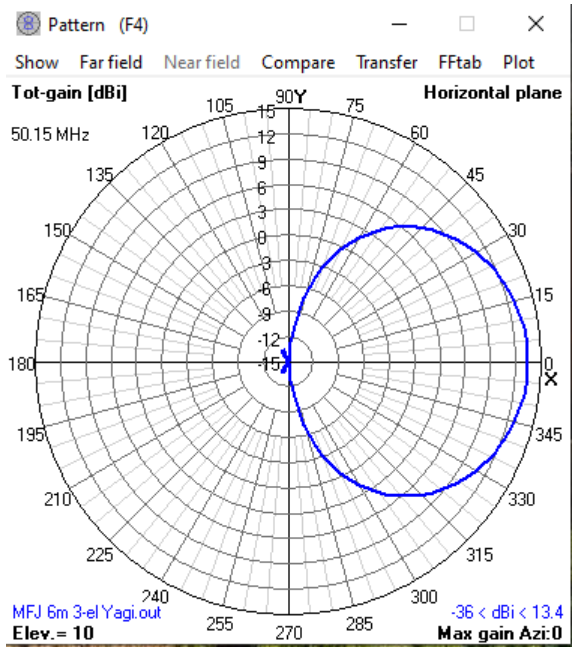
- Dipole (made of aluminum) is relatively small
  - About 16.5 feet tip-to-tip
  - It will give great results at 15-20 feet high
- Multi-element Yagis are quite reasonable
  - I have a 4-element Cushcraft 10m Yagi
    - 16 foot boom, elements about 17 feet tip-to-tip
    - Used it to work many stations with my homebrew QRP (250 milliwatts) 10m DSB transceiver during big Cycle 22



Antennas for 6m

- A multi-element Yagi is very doable – even for small property lots
  - Small and lightweight
- I have an MFJ-1762 3-element 6m Yagi
  - 9 foot elements, 6 foot boom, about 3 pounds
  - Great F/B – but what do you do when E_s is open in more than one direction?
- When E_s opens the band in multiple directions, just about any antenna will work that has a reasonable SWR on 6m
  - Very strong signals
  - I've used my 40m inverted-vee

MFJ-1762

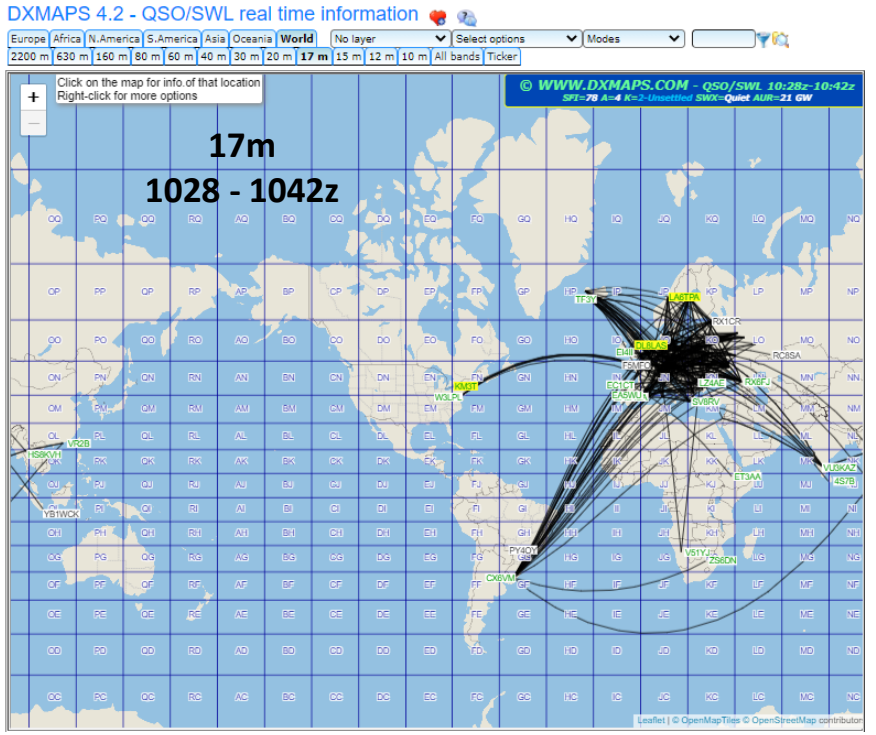


Some References to Start With

- Propagation
  - Propagation chapters of the ARRL Antenna Book and the ARRL Handbook
  - “The Little Pistol’s Guide to HF Propagation” by Bob Brown NM7M (SK)
    - Available for free on my website at https://k9la.us - 15Mb file
  - The CQ Shortwave Propagation Handbook – 4th Edition (updated in 2021)
- Antennas
  - ARRL Antenna Book
- Solar info
  - Lots of data on the internet – pay attention to SFI, SN and the K index
  - https://spaceweather.com/, https://www.swpc.noaa.gov/, https://www.solarham.net/, NØNBH banner at https://www.qrz.com/, https://www.spaceweatherwoman.com/

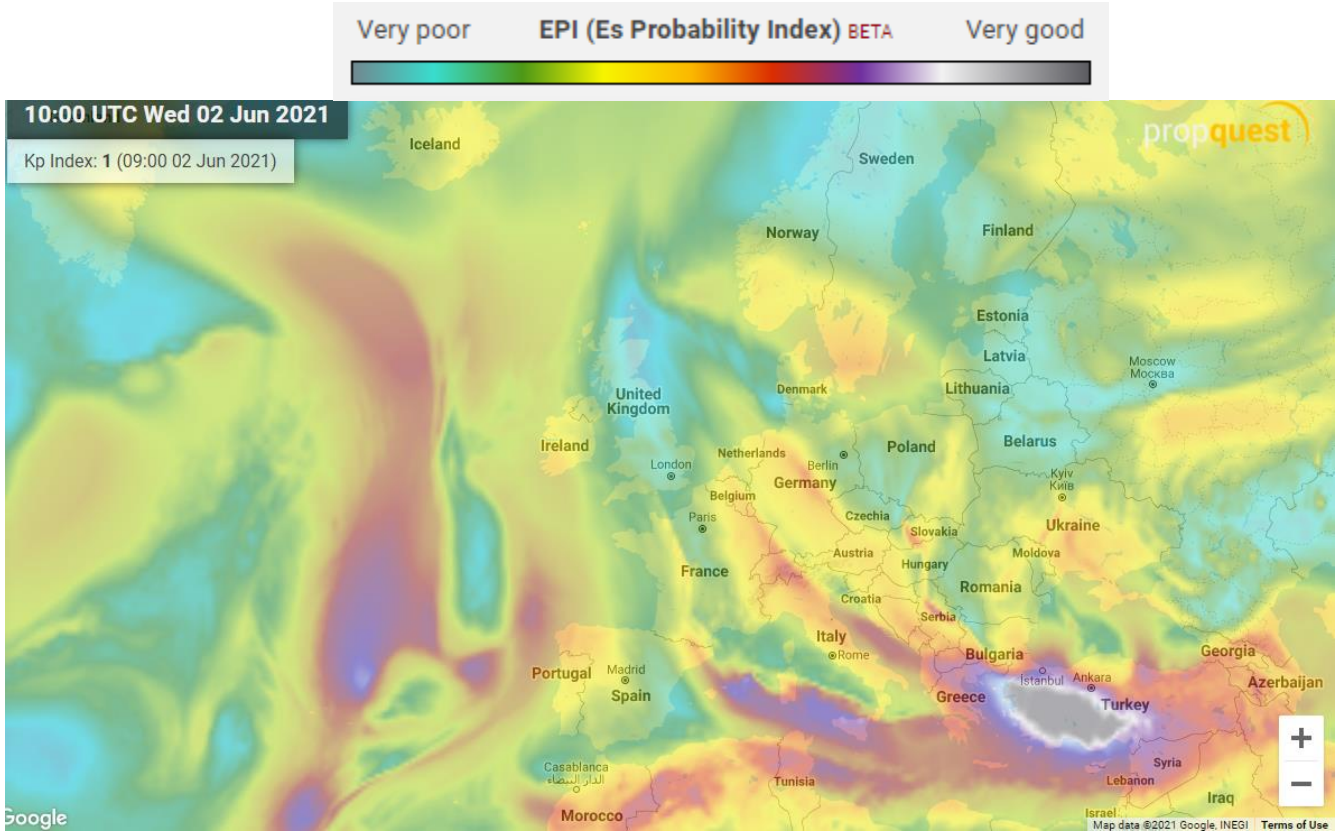
More References

- Real-time QSOs (who is working who right now)
  - https://www.dxmaps.com/spots/mapg.php?Lan=E
  - https://pskreporter.info/pskmap.html
  - http://www.wsprnet.org/drupal/
  - http://www.reversebeacon.net/main.php
- Real-time ionosphere (what the ionosphere is doing right now)
  - http://prop.kc2g.com/ - shows worldwide MUFs (maximum usable frequencies) for a 3000 km path
  - Uses ionosonde data with contour lines added
  - Updated every 15 minutes

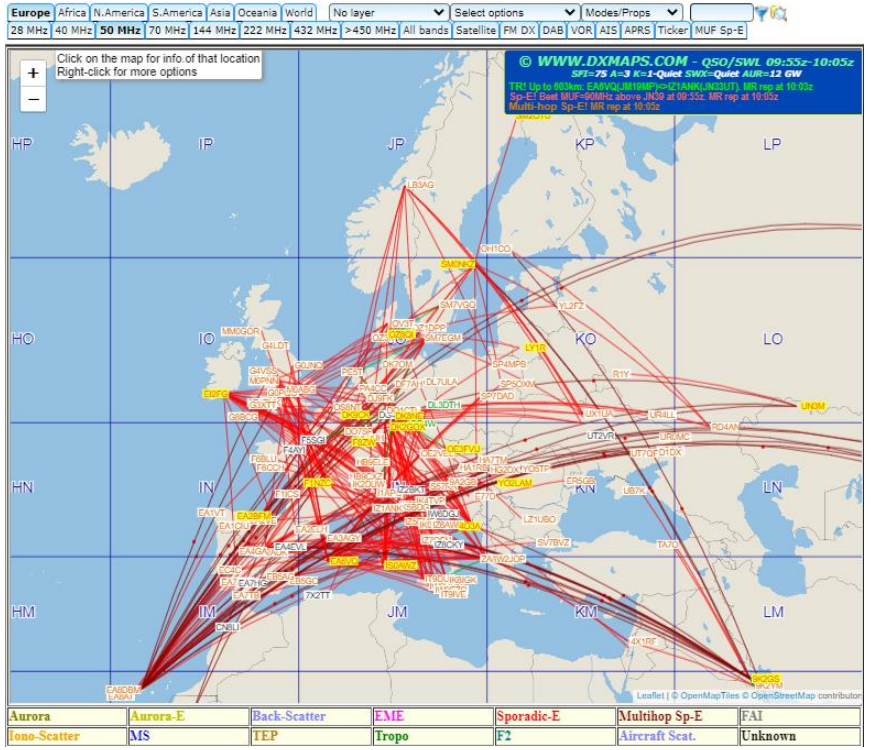


Sporadic-E and Tropospheric Events

Jim G3YLA (retired BBC meteorologist) makes a daily sporadic-E forecast called EPI (Es Prediction Index) at http://propquest.co.uk/map.php



EPI, June 2, 1000 UTC over North Atlantic and Europe



dxmaps.com, June 2, 0955-1005 UTC

More Sporadic-E and Tropospheric Events

- Joe K1YOW also looking at sporadic-E and tropospheric events – but in the winter months
- Here's his article from CQ magazine
  - https://hamsci.org/sites/default/files/publications/202011_CQ_Dzekevich_K1YOW_SporadicE.pdf

Figure 6: January 04, 2018 DX Maps image showing an east-west E_s path

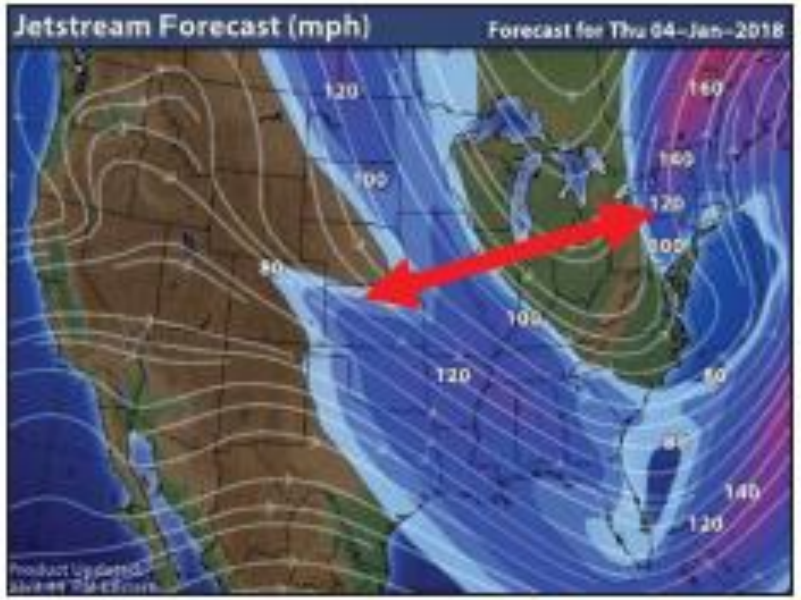


Figure 7: January 04, 2018 E_s path shown on NOAA jet stream wind speed map

Summary

- Cycle 25 is beginning its ascent
- Most forecast a below average Cycle 25, a few forecast a big Cycle 25
  - All we can do is wait to see what happens
- Solar min is best for the low bands (160m, 80m, 60m, 40m)
- 30m, 20m, 17m are good throughout a solar cycle
- Solar max is best for the higher bands (15m, 12m, 10m)
  - Lots of things to do with modest power and modest antennas
- Don’t forget sporadic-E on 6 meters during the summer and in December
- Antennas are reasonable on 15m, 12m, 10m, 6m
- Use the digital modes for their advantage over SSB and CW

Get radio-active on HF!