Cycle 25 Update and Propagation

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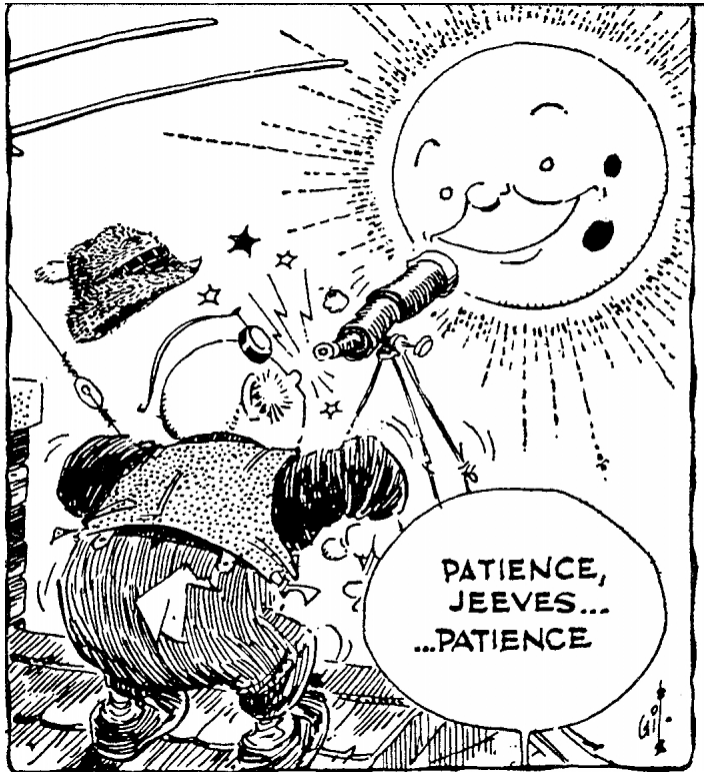
Agenda

- Cycle 25
  - Historical data
  - Predictions
  - Latest data
- MF and HF propagation
  - General summary
  - Short-term opportunities
  - Some history
- Sporadic E propagation
  - Focus on 6m
  - Short-term probabilities
  - Long-term probabilities

EAA AirVenture 2022 – July 25-31

- My wife Vicky AE9YL and I attended AirVenture on Wednesday and Thursday
- Theme was the 75th anniversary of the USAF
  - Lots of fast and loud aircraft
- We assisted Bob Inderbitzen NQ1R (from HQ) at the ARRL booth
- Vicky visited the KidVenture area
  - EAA donated 500 of the ARRL receivers for kids to build
  - 40-150 MHz, $14.95
- Stations on the air
  - W9ZL at KidVenture
  - W9W at ICOM
  - W1HQ at the ARRL booth (remoted to HQ)

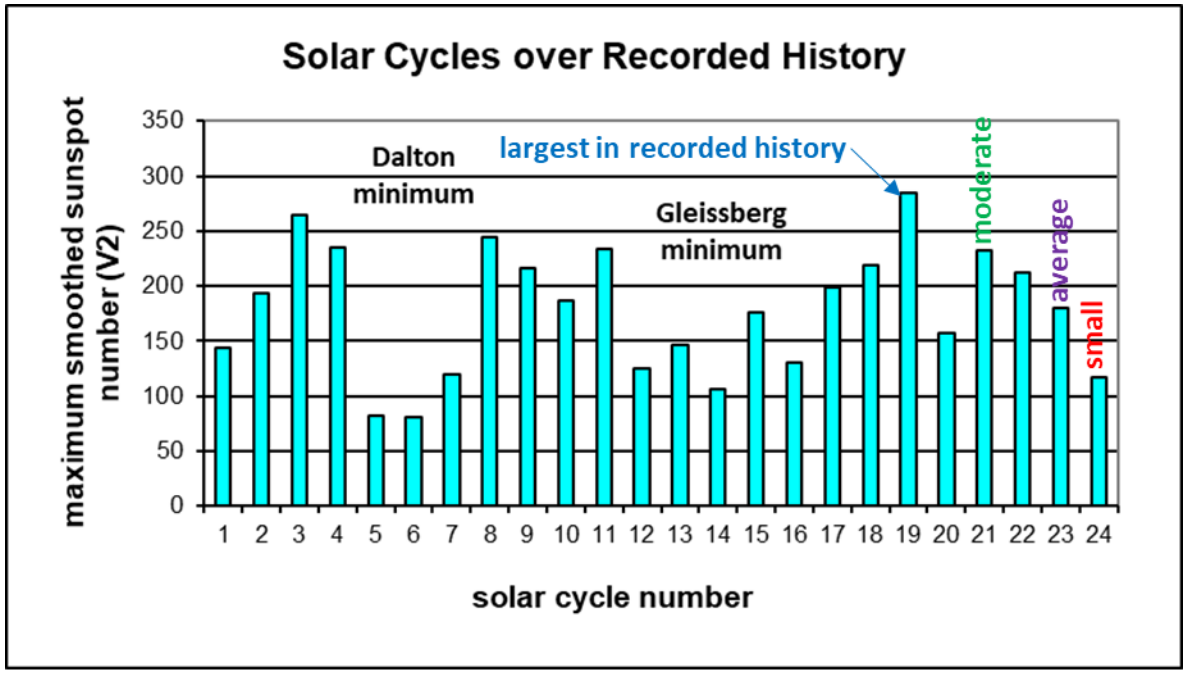
Cycle 25



from arrl.org

Historical Look at All 24 Cycles

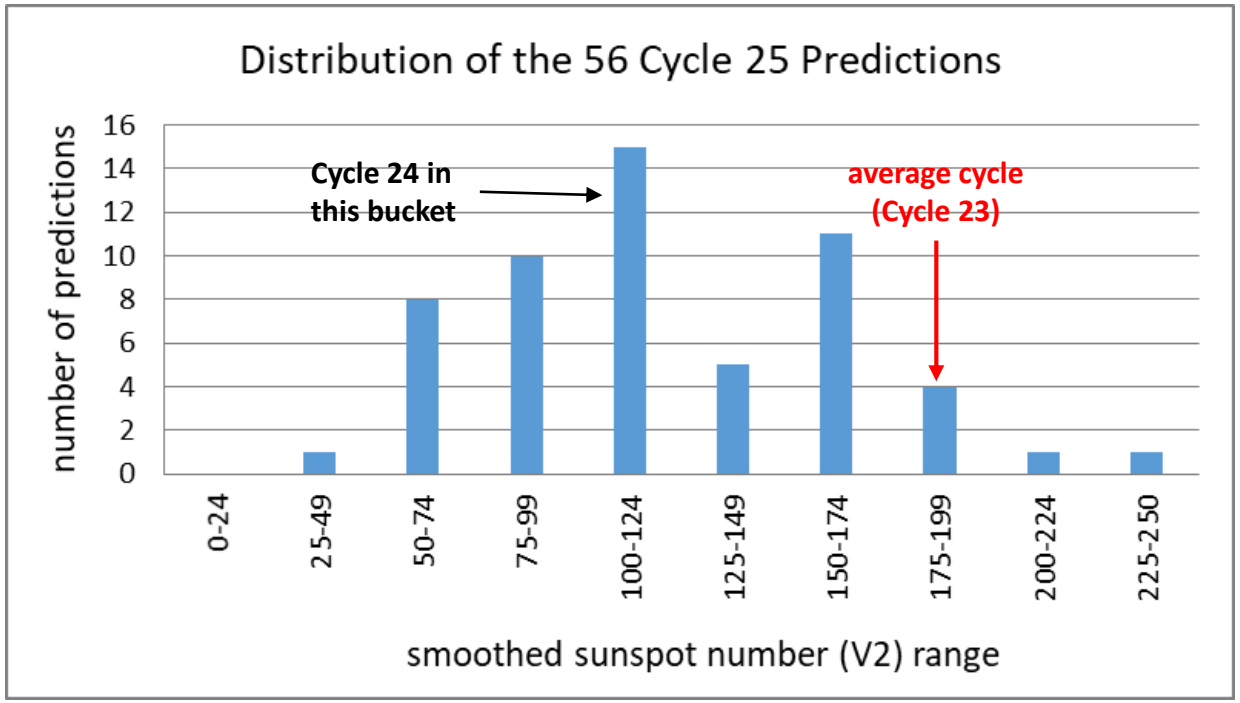
- Cycle 1 began in 1755
  - Maunder Minimum occurred from 1645-1715 with few sunspots
- We've gone through three periods of 'big' solar cycles
  - Cycles 1-4, 8-11, 17-23
- We've gone through two periods of 'small' solar cycles
  - Cycles 5-7, 12-16
- With Cycle 24, we appear to be in a third period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



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

Let's look at predictions for Cycle 25

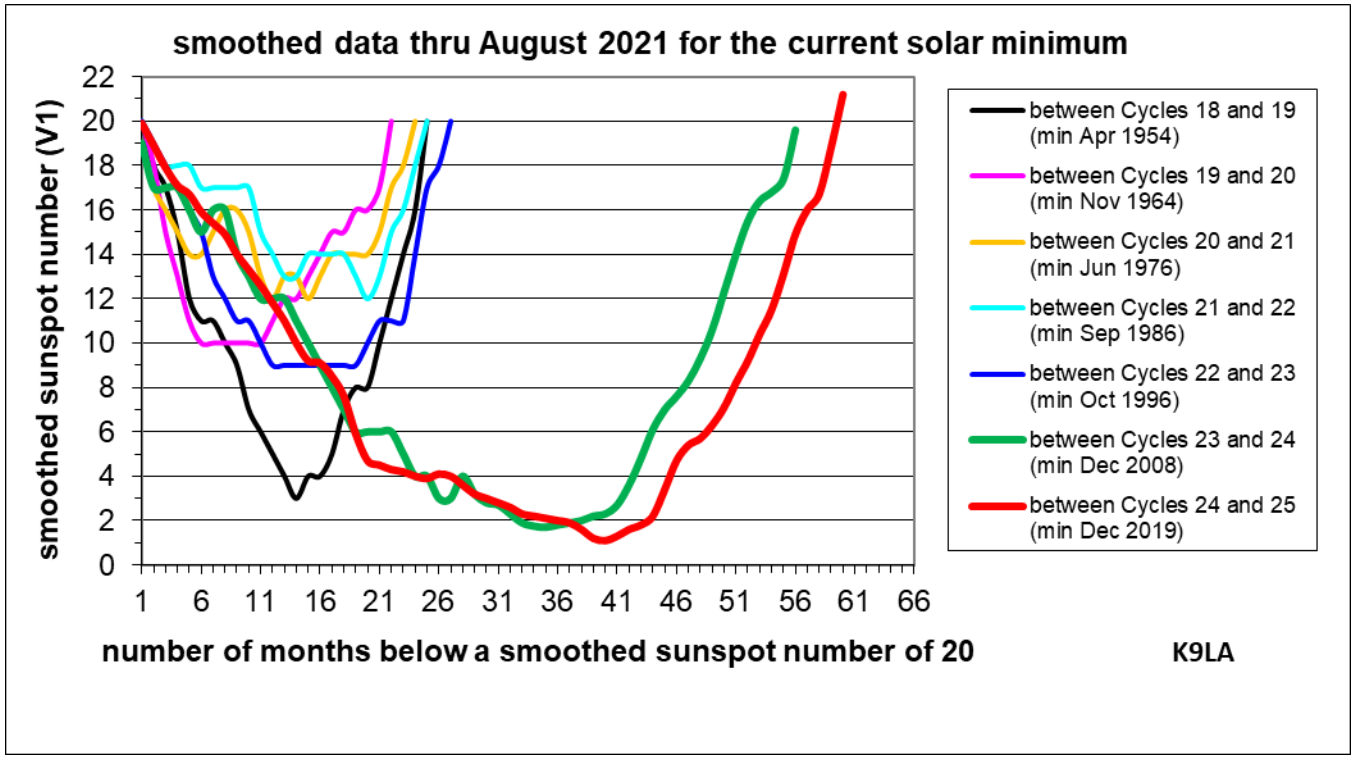
There Is a Consensus (but it doesn't mean it's correct!)



- 50 of the 56 predictions (89%) are for a below average cycle
- 4 are for an average cycle
- 2 are for a larger-than-average cycle

Solar Minimums in Our Lifetimes

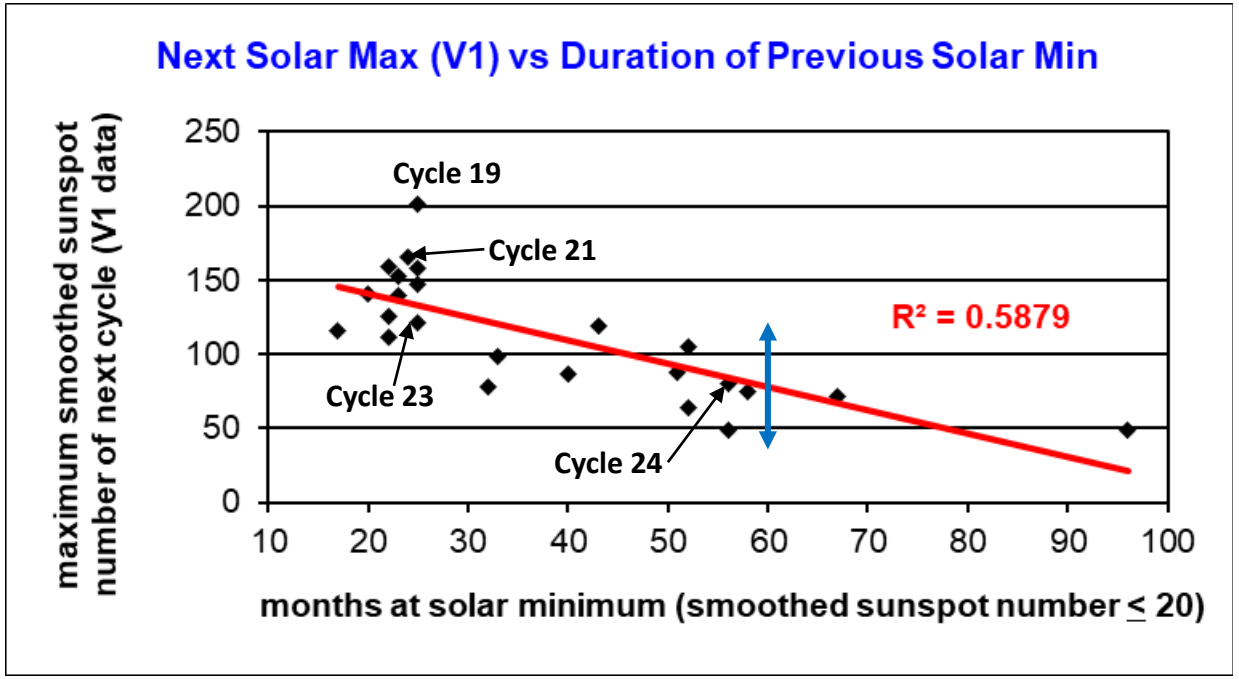
- We became used to short solar minimum periods – about 2 years duration
- But then along came the solar minimum between Cycles 23 & 24 – about 5 years duration
- Solar minimum between Cycles 24 & 25 was long, too



So what does this tell us?

Solar Minimum vs Next Solar Maximum

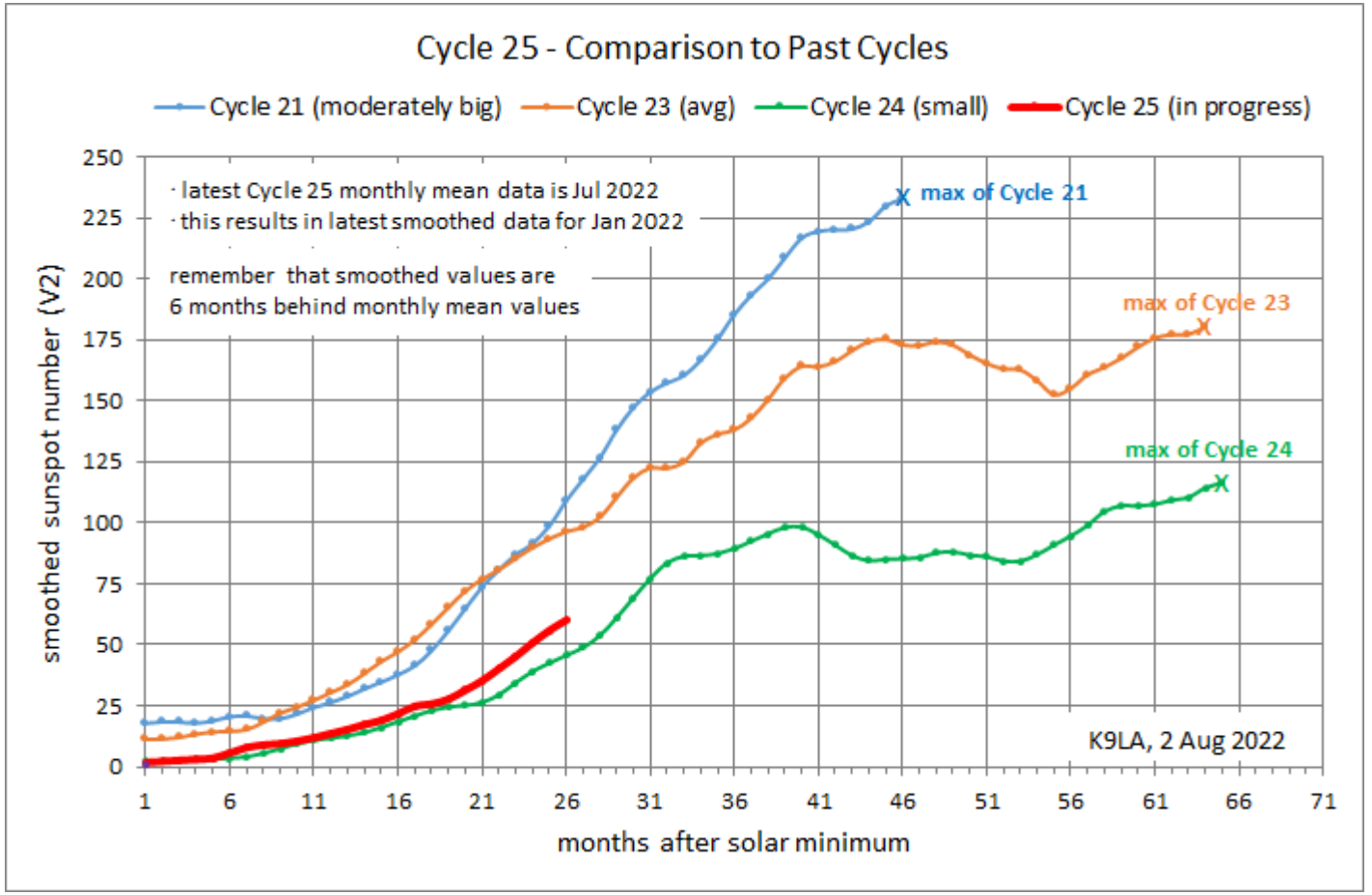
- The longer the solar minimum duration, the smaller the next cycle
- But it's not a perfect correlation
- Cycle 19 – biggest cycle in recorded history
- Cycle 21 – moderately big cycle
- Cycle 23 – an average cycle
- Cycle 24 – smallest cycle in our lifetimes – 4th smallest cycle in recorded history



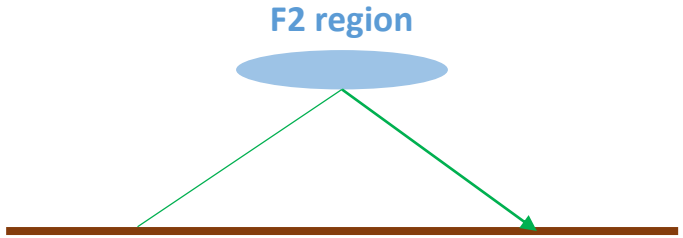
All we can do is wait to see what happens

How Is Cycle 25 Doing?

- All the curves start when the smoothed sunspot number numerically minimized
  - December 2019 for the start of Cycle 25
- We currently have 25 months of smoothed sunspot number data
- Where will Cycle 25 end up?
- Need more sunspots for worldwide 15m, 12m and 10m propagation via the F2 region on a daily basis



MF and HF Propagation

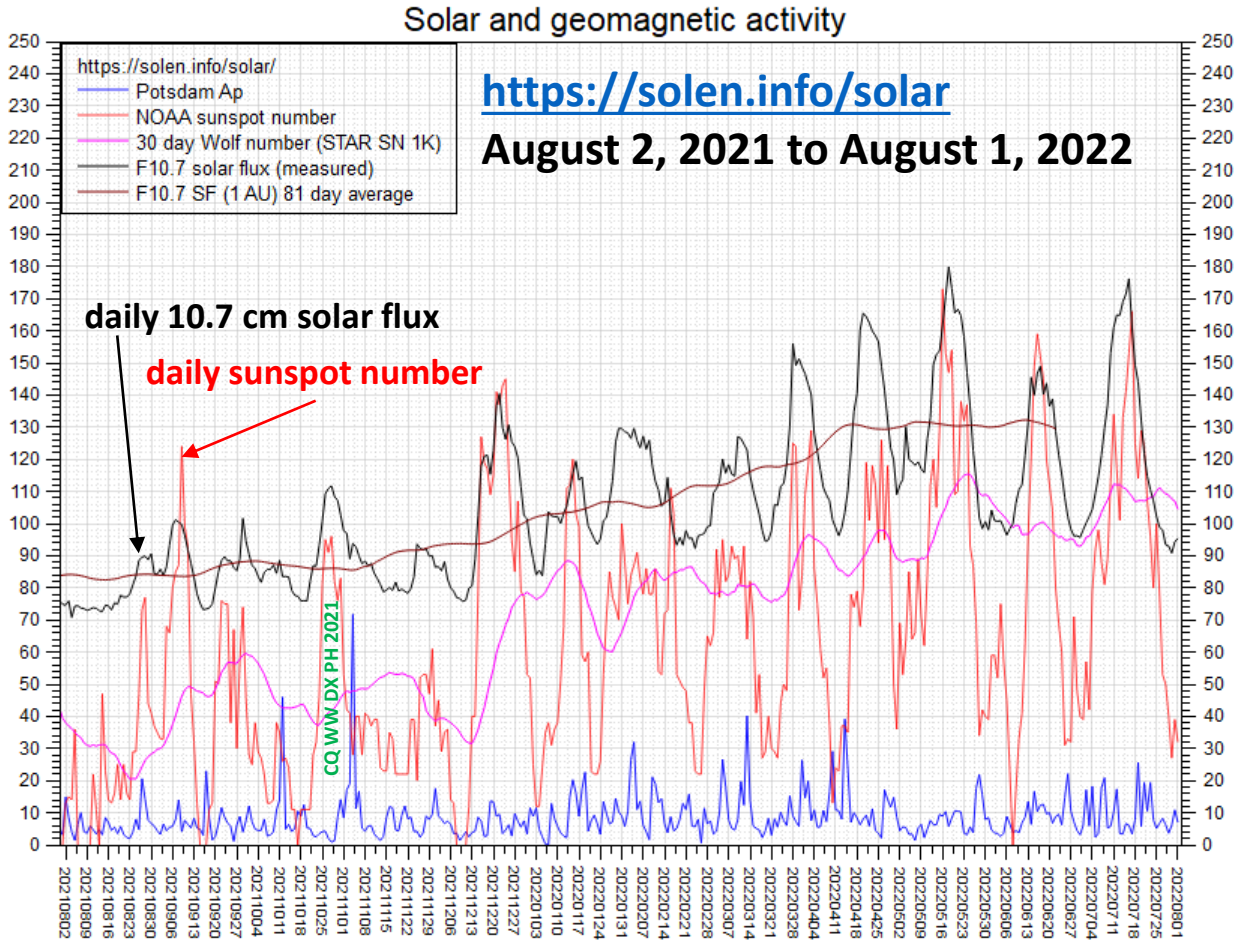


MF and HF Propagation

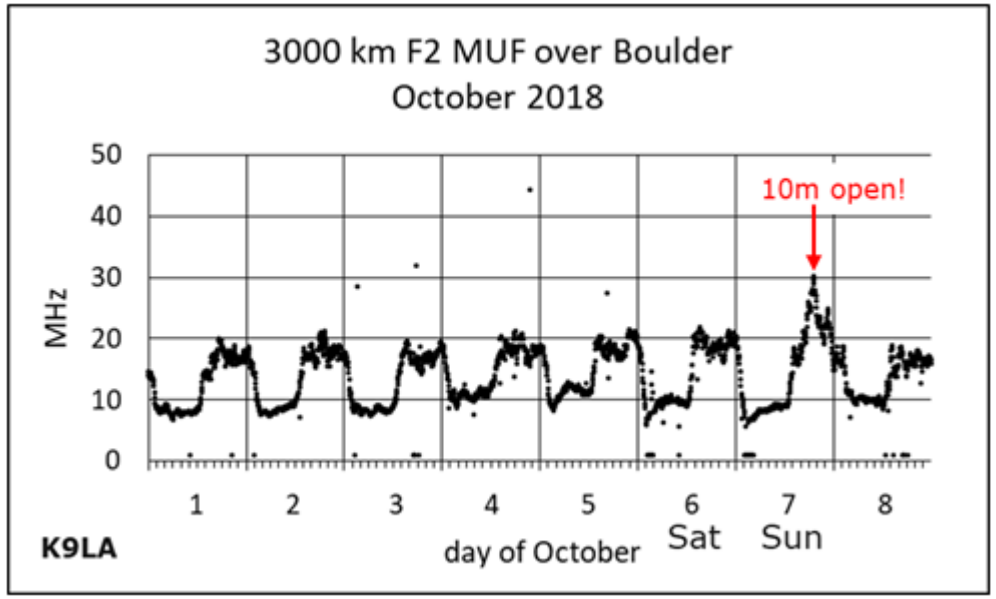
- 160m, 80m and 60m
  - Should be good at night unless there are thunderstorms
    - Might help to have a ‘receive’ antenna to minimize noise – small loop
- 40m and 30m
  - Should be good during the day for shorter distance QSOs
  - Should be good at night for longer distance QSOs
- 20m and 17m
  - Should be good during the day
  - Enough sunspots yet for nighttime?
- 15m, 12m and 10m
  - Mostly north-south paths in the daytime
  - Should see good improvement this coming fall/winter
    - More east-west paths likely
  - Watch for sporadic E on 10m and 6m right now and in December

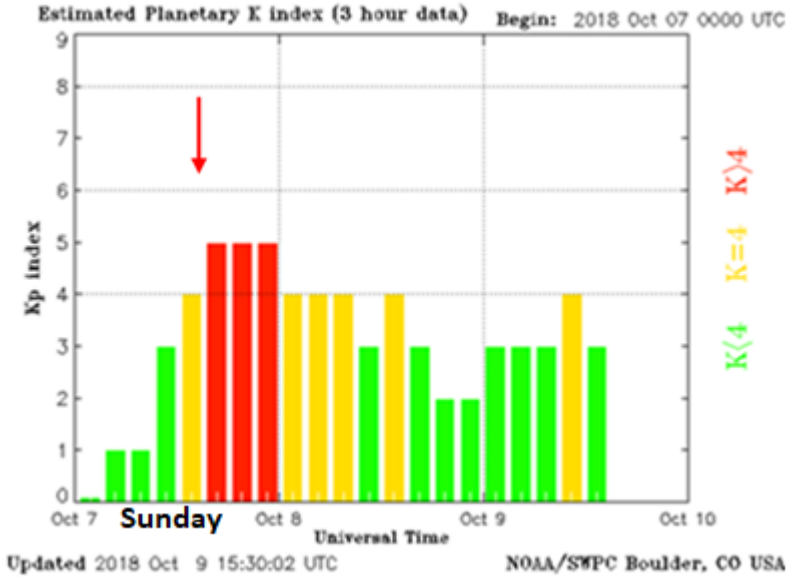
Short-Term Propagation Opportunities

- To reiterate, we still have a way to go before 15m, 12m and 10m will be open daily on a worldwide basis via the F2 region
- In the meantime, keep an eye on the daily sunspot number and the daily 10.7 cm solar flux
  - When they spike up, can give us short-term openings on these higher HF bands
  - Note CQ WW DX PH 2021 contest



An Example of a Spike in the K Index





- 2018 California QSO Party
- No W6 stations heard on 10m in the Midwest on Saturday
- K index spiked up on Sunday – lots of W6 stations to work

The Digital Modes

Weak-Signal S/N Limits

fastest data transfer at the top, slowest at the bottom

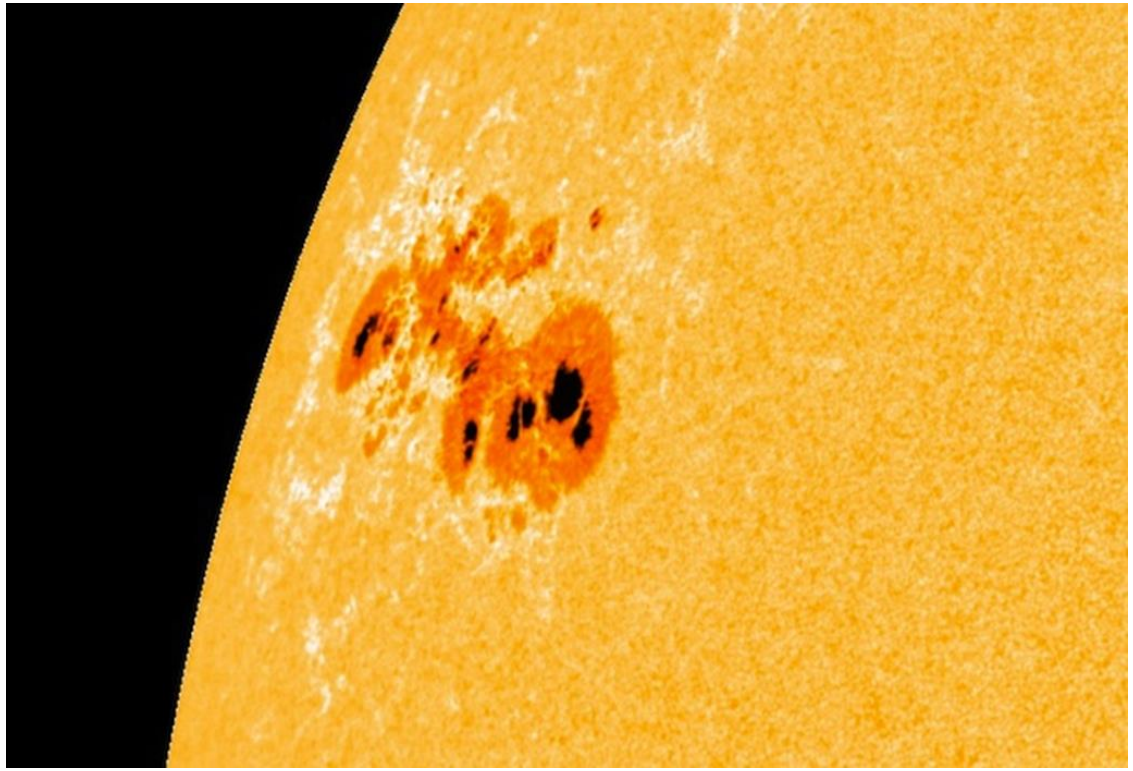
Mode	(B = 2500 Hz)
SSB	~+10 dB
MSK144	- 8
CW, “ear-and-brain”	-15
FT8	-21
JT4	-23
JT65	-25
JT9	-27
QRA64	-27
WSPR	-31

July 26 to Aug 2, 2022 (from Club Log data)

Mode	% Use	QSOs	Graph
FT8	64.99	477,978	
CW	16.45	121,015	
SSB	11.04	81,201	
FT4	6.63	48,746	
FM	0.22	1,614	
MFSK	0.21	1,523	
PSK	0.11	797	
RTTY	0.11	783	
DYNAMIC	0.08	613	
MSK144	0.05	351	
DIGITALVOICE	0.02	127	
JT65	0.02	111	
SSTV	0.01	71	
HELL	0.01	64	
AM	0.01	64	
FSK441	0.01	64	
DSTAR	0.01	61	
All other	0.04	272	

- Take advantage of the digital modes
- They made our last solar minimum the most active in history on the higher HF bands – and on 6m

Why Are Sunspots Important?



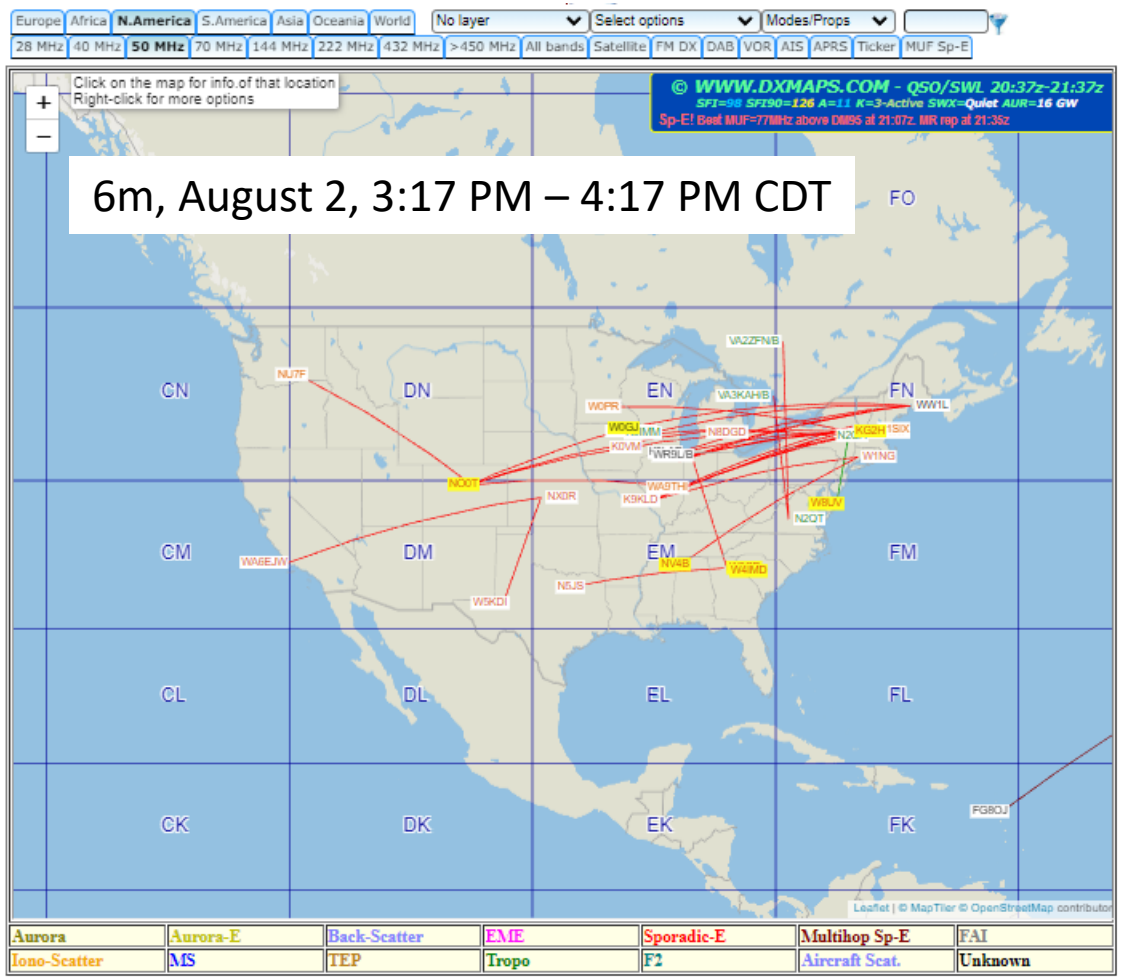
- The white area around a sunspot is called a plage (French for ‘beach’)
- These areas emit EUV radiation
- EUV radiation ionizes the atmosphere at F2 region altitudes
  - Sunspots themselves do not ionize anything (nor does 10.7 cm solar flux)
- F2 region is responsible for most of our long distance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

A Brief History of Solar Discoveries

- Over 2000 years ago - Chinese observed sunspots
- 1610 - Galileo invented the telescope
- 1843 - Schwabe credited with the discovery of the ~11 year cycle
- 1849 - Wolf developed a method to count sunspots
- 1902 - Kennelly (US) and Heaviside (U.K.) suggested independently that the Earth's upper atmosphere consisted of an electrically conductive region
- 1914 - Hale credited with the discovery of the ~22 year cycle
- 1924 - Appleton found conclusive evidence of an electrically conductive region by measuring the angle of arrival of radio waves from a nearby transmitter
- 1925 - Breit and Tuve demonstrated the existence of the ionosphere with the first ionosonde
- 1930 - Petit found a relationship between sunspots and EUV
- 1957-1958 - International Geophysical Year (IGY) made worldwide measurements of the ionosphere
- 1970s – first model of the ionosphere developed
- 1978 – first propagation prediction program for Amateur Radio operators (MINI-MUF)

What Are the Bands Doing Right Now?

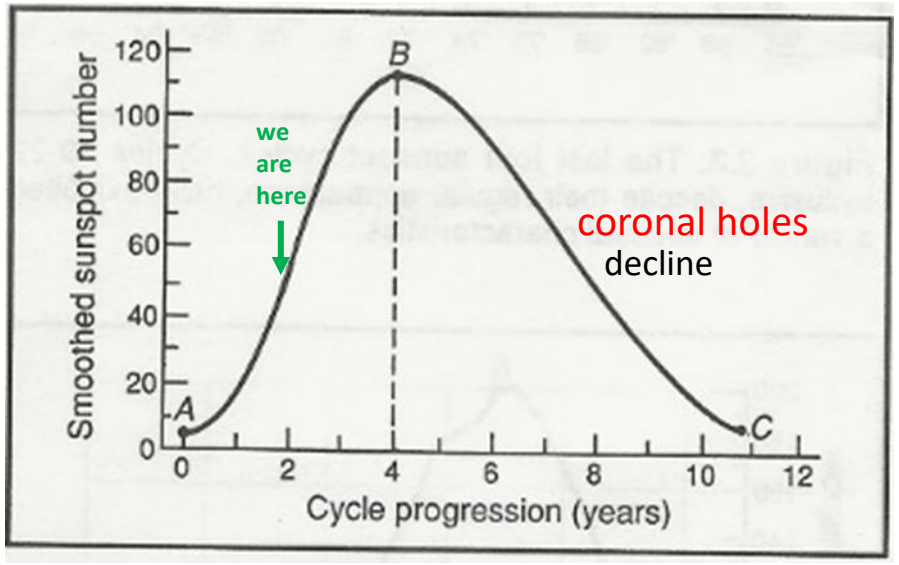
- Go to dxmaps.com
- Select a view
  - World, NA, Europe, . . .
- Select a band
  - 2200m to above 432 MHz
- Other methods
  - KC2G MUF map
    - https://prop.kc2g.com/
  - PSKReporter
    - https://pskreporter.info/pskmap.html
  - WSPRNet
    - https://www.wsprnet.org/drupal/
  - Reverse Beacon Network
    - http://www.reversebeacon.net/
  - IARU/NCDXF beacons
    - https://www.ncdxf.org/pages/beacons.html



When Do Disturbances Occur?

CMEs and big solar flares

solar max

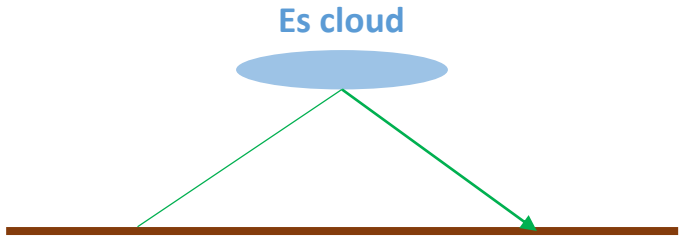


solar min

solar min

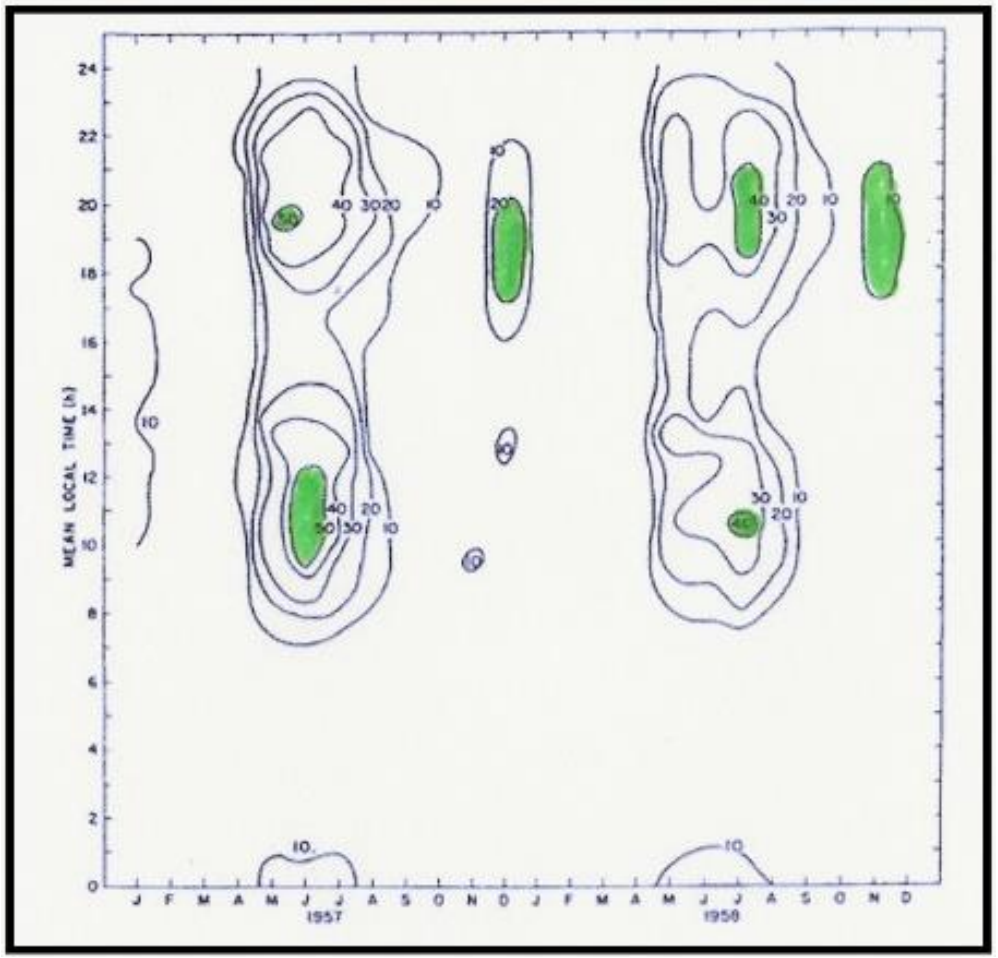
- We have to take the bad (CMEs and big solar flares) with the good (great propagation on the higher HF bands)
- CMEs most prevalent around solar max
  - Geomagnetic storms
- Big solar flares most prevalent around solar max
  - Solar radiation storms – polar cap
  - Radio blackouts – daylight side of Earth
- Coronal holes most prevalent during the decline of a solar cycle
- Quietest time is during the ascent of a solar cycle
  - Where we are right now

Sporadic E Propagation

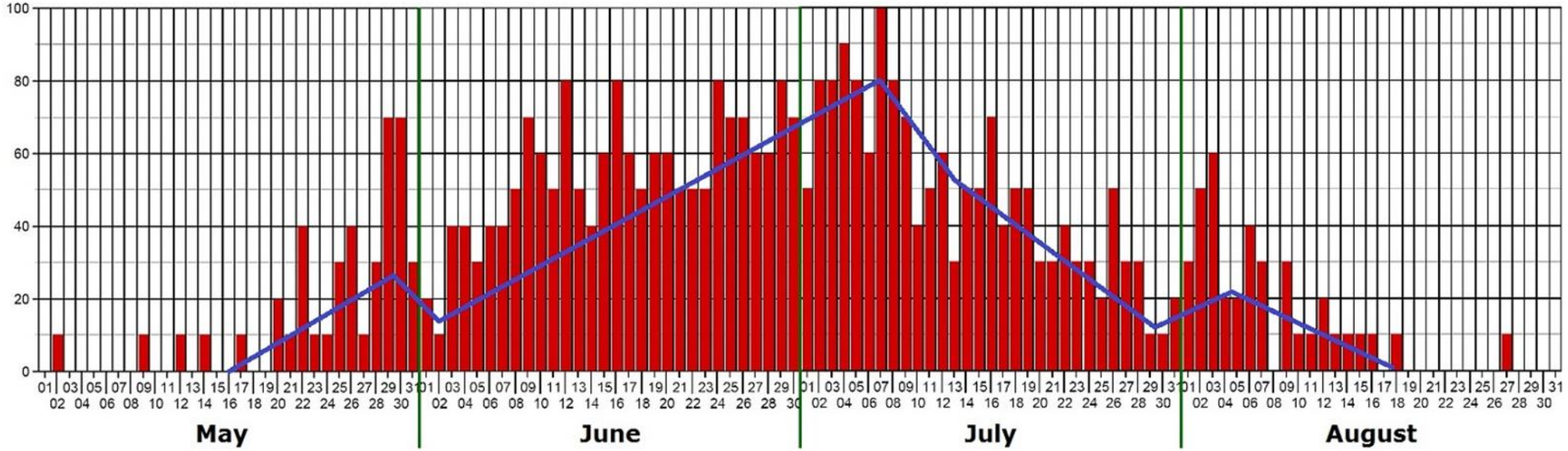


6-Meter Propagation (Short-Term)

- Sporadic-E (Es)
- Probability vs month and local time
  - Green areas are highest probability
- Best <u>summer</u> local times are
  - Late morning
  - Early evening
  - Always monitor in-between, too



VE3EN 6-Meter Es Data (Long-Term)



- 2004-2014 (11 years of data)
- Eastern-Western Europe to Eastern Half North America
  - USA 1/2/3/4/8/9 call areas + Canada VO1,VE1,VE2,VE3,VE9,VY2
- 5 or more contacts between multiple stations
- Y-axis is the % of the 11 years that QSOs were made
  - Early August has had 6m Es openings on about 3 of those 11 years

Summary

- Cycle 25 is in its ascent – solar maximum around 2025
- So far Cycle 25 kind of looks like another small-ish cycle
  - The next 6-12 months should pin things down better
  - Hopefully it will get up to an 'average' cycle (like Cycle 23)
- Even if it is a small cycle, solar maximum should offer worldwide propagation on a daily basis with modest power and modest antennas on the higher HF bands and on 6-meters in the fall/winter months
- The digital modes offer an advantage over CW and SSB
  - Can decode a signal farther down in the noise
    - How much farther down depends on which digital mode
  - This is a significant advantage on 10m and 6m
- Take advantage of the summer Es season on 10m and 6m – it's almost over
- There are tools on the internet to determine what the bands are doing right now – don't have to get deep into the SFI/SN/A, etc