Solar Topics and Propagation

Carl Luetzelschwab K9LA e-mail: k9la@arrl.net web site: https://k9la.us the Sun on April 16

anyone want to take a guess at the sunspot number for April 16?

Who Is K9LA?

- SWL in the late 1950s WPE9BQH
- WN9AVT in October 1961 been in 6 cycles
- BSEE 1969/MSEE 1972 Purdue University back when rainbows were black and white
- RF design engineer for Motorola (1974 – 1988) and Magnavox/Raytheon (1988-2013)
- Enjoy propagation, antennas, DXing, contesting, vintage rigs
- Wife is Vicky AE9YL her being a ham really helps
- ARRL Central Division Vice Director







Topics

- Cycle 24 update
- Current solar minimum
- Propagation at solar minimum
- Solar-Terrestrial data
- Take advantage of the digital modes
- Watch for short-term enhancements
- Cycle 25 predictions

Cycle 24 Update

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Cycle 24 Update



Why two peaks?
 How long will we be at solar minimum?

 It looks like we're near the bottom

- Spiky black curve is monthly mean data
- Smooth blue curve is smoothed data
 - Smoothed data heavily averaged to eliminate spikes
 - Smoothed data 6 months behind monthly mean data

Two Peaks



 Two peaks are due to asymmetry between the two solar hemispheres

 Not seen before in our history – the Sun appears to be in new territory for our observations

Current Solar Minimum

Minimums Between Cycles 18-19, 19-20, 20-21, 21-22, 22-23



My definition of solar minimum – when the smoothed sunspot number is below 20

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We became accustomed to short solar minimums – about 2 years

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Minimum Between Cycles 23-24



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Last solar minimum was almost 5 years!

The Current Solar Minimum



We appear to be tracking another long solar minimum
 Will the thick red curve start going up soon or will it continue at low sunspot numbers? the \$64K question

Our Last Solar Minimum

Solar Min Between Cycles 23 and 24

Sunspot Number



Solar cycles overlap – we see sunspots from both
 First new Cycle 24 sunspot emerged about 1 year before solar minimum

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The Current Solar Minimum

Cycle 24 and 25 Sunspots at Solar Minimum



1st official Cycle 25 sunspot in July 2019
 Cycle 25 sunspots on first 5 days of April
 No more sunspots in April from either Cycle

Propagation at Solar Minimum

What to Expect On the Bands

 160m, 80m, 60m, 40m and 30m should be open worldwide at night (pay special attention to sunrise and sunset)

 20m (and 17m to a somewhat lesser degree) should be open worldwide during the day and early evening

 Occasional openings on 15m, 12m and 10m mostly of a north-south nature to Carib, S Amer, C Amer and to VK/ZL thanks to the robust equatorial ionosphere

■ 6m F2 openings to the south possible on FT8 via Es/TEP

Other Comments

TINE (H)

NEAN LOCAL

 Don't forget Sporadic E on 6m and 10m during the summer (and December) should see more openings soon

- Take advantage of the digital modes
 - SNR advantage more later

 Watch for short-term enhancements more later Sporadic E - late morning and early evening

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Solar-Terrestrial Data

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NØNBH Solar-Terrestrial Data

Solar-Terrestrial Data Apr 2020 1410 GMT SFI:69 SN: К: @ SEM Rpt Ely. Aurora: 6 SW: **HF** Conditions Band Ni 80n-40n Goor 30n-20n 17n-15n 12n–10n Conditions VHF Aur Lat Aurora 6n EsFII 4n EsEU 2n EsEU EsNA EME Deg Solar Flare Prb MUF Geomag Field VR Sig Noise Lvl US Boulder NoRp Copyright Paul L Herrman 2012

 His web site <u>http://www.n0nbh.com</u> describes what all these mean

How do they apply to assessing propagation?

 There are 'primary' parameters and 'secondary' parameters

 'Secondary' parameters are tied to the 'primary' parameters and I consider them redundant

 The 'primary' parameters that I consider important are SFI, SN, K and A

Solar-Terrestrial Data SN: SEM FIX: ora: 6 SW: 72.5Bz: HF Conditions Day Band Night Fair 80n-40n Goo 30n-20n 17n-15n 12n-10n VHF Conditions Aur Lat Aurora EsEU Eseu FsFII 2n Esna EME Deg Solar Flare Prb 105 MUF HS Geonag Field Sig Noise Lyl US Boulder NoRet Copyright Paul L Herrman 2012

SFI and SN

- Both indicate if the MUF (maximum useable frequency) is high enough for 15m thru 6m
- SFI is Solar Flux Index at 10.7 cm
 - ~65 (solar min) to ~300 (solar max)
 - Generally need ~85 for 15m, ~100 for 10m, ~150 for 6m

SN is Sunspot Number

- 0 (solar min) to ~200 (solar max)
- Generally need ~25 for 15m, ~50 for 10m, ~100 for 6m
- 304A (30.4nm) is 'secondary' parameter

K and A – Activity of Earth's Mag Field

SOTAL-LELLESTLIAT DATA							
11 Apr 2020 1410 GMT							
SFI:69 SN: 0							
A: 5 K: 1							
A-hay: 00 d a oru							
304H: 93.4 @ SEM							
Pth Fix: No Rpt							
Elc Fix: No Rpt							
Aurora: /n=							
Bz: 2.6 SW: 372.5							
HF Conditions							
Band Day Night							
80n-40n Fair Good							
30n-20n Poor Poor							
17n-15n Poor Poor							
12n-10n Poor Poor							
VHF Conditions							
Aur Lat No Report							
Aurora Band Closed							
6n EsEU Band Closed							
4n ESEU Band Closed							
2h ESEU Band Closed							
2h ESNH band Llosed							
EHE Deg Poor							
Solar Flare Prb 10%							
MUF							
MS 0 6 12 18 UTC							
MIN							
Geomag Field VR QUIET							
Sig Noise Lvl S0-S1							
Sig Noise Lvl S0-S1 MUF US Boulder NoRpt							

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- K is a 3-hour parameter
 - Logarithmic scale from 0 (quiet) to 9 (extremely disturbed)
- A is a daily parameter (avg of 8 K indices)
 - Linear scale from 0 (quiet) to 400 (extremely disturbed
- Geomagnetic storms generally result in lower F2 region ionization (lower MUF)
 - Tied to Coronal Mass Ejections (CMEs) around solar max and Coronal Holes (CHs) during a cycle's decline
 - We generally want low K and A
 - Subscript 'p' means 'planetary'

What We're Trying to Do

- Take very complicated processes in the atmosphere and derive simple generalities
- What we lose are short-term events
- Best way to assess propagation is to:
 - Listen what we used to do
 - Monitor various QSO reporting web sites

PacketCluster Networks

Settings	0	ountry	State	Bands	Users	DX
Spotter	Freq	DX	Tine	- 2.V		
KF7E	7822.8	BASAD	18482 19			
K4RUM	7886.5	PJ5/KG9N	18542 19 C	0		
KG1U	7885.9	HI3/KC1XX	11852 19	and the second se		
K2UR	7884.8	ZL 1NA/MM	11872 19 0	SX 7005.0		
NS2C	7884.8	2L1NA/HH	11132 19 u	p 1.1 GL Guys		
N8ZI	7884.8	ZL 1NA/IM	11222 19 u	p1		
NØFV	3547.0	DSSTOS	11352 19 -	14 - not hearing	well	
W1FU	3505.0	JA7BXS	11452 19 C	Q		
K6RF	7816.8	XU1X	11492 19 H	anoi Eddy		
RA1K	7816.8	XU1X	11572 19 L	PCW		
W40N-3	7816.8	XU1X	12812 19			
K4DY	14862.8	OK1MLP/P	12072 19 C	A TO2 O		
M4QN-3	7812.5	E29TGW	12142 19	a second s		
KASH	7816.0	XU1X	1218Z 19 U	p 1.5		
K4DY	14862.8	OK/OM2JU/P	1234Z 19 C	Q SOTA		
K8DSS	14018.5	LASZO/MM	12372 19			
W1JR	14025.0	388CF	12372 19 U	p 1		
K8DSS	14818.5	LASZ0/IM	1238Z 19 q	th		
K8DSS	14018.5	LASZO/HM	1238Z 19 n	r PYOF		
K8DSS	14819.8	YUSEEA	12432 19			
MOKGP	7010.0	HR5/F2JD	1247Z 19 C	Q		
K8DSS	7818.8	HR5/F2JD	12512 19	Statement and the second		
KP4AKB	7156.0	JA2CXY	12512 19 5	9 into North Amer:	ica	
K8DSS	7881.1	ZF2AN	12522 19			
KPAAKB	7156.0	JA2QXY	12522 19 c	orrected call		
MOKEP	7001.0	ZF2AN	1300Z 19 C	0 +1		
NAFZ	7818.8	HR5/F2JD	1320Z 19 C	Q		
VE2FK	14837.6	HB9ARF	1322Z 19 C	W.		
W4DOW	14881.9	SQ8IFG	13232 19			
WSZR	7826.3	KH2L	13242 19			
W4DOW	14881.9	DLSWF	13252 19			
WW9L	14843.2	L25R	13312 19			

I use VE7CC's software (free)
 Via telenet (not RF)

www.dxmaps.com



 6m on Wednesday from 2033-2049 UTC
 Looks like there were 3 E clouds

- Other maps
 - WSPRnet
 - PSK reporter
- IARU bcns

Take Advantage of the Digital Modes

QSO Duration vs Sensitivity

Mode	QSO time	S/N limit in 2500 Hz	Advantage over my ability to copy CW	* Based on ability to cop at -2 dB S/N 250 Hz banc
CW	~ 15 sec	-12 dB *		
JT65	~ 4 min	-25 dB	13 dB	
FT8	~ 1 min	-21 dB	9 dB	
FT4	~ 20 sec	-16 dB	4 dB	
Next mode?			K9LA	

Each new digital mode traded 'sensitivity' for speed to complete a QSO
FT8 took off in mid 2017 and leads the pack
Will there be another digital mode?
Any more trades will put us back to CW

width

Watch for Short-Term Enhancements

Propagation Predictions We <u>do not</u> have daily propagation predictions Today's ionosphere does not correlate well with today's sunspot number or 10.7 cm solar flux Why not? Because two other parameters modify the amount of ionization • Geomagnetic field activity we have a decent understanding of this https://www.swpc.noaa.gov/products/storm-timeempirical-ionospheric-correction • Events in the lower atmosphere coupling up to the ionosphere lots of research on-going in this area

Propagation Predictions

 It turns out that our predictions are statistical in nature over a month's time frame

Extremely short-term events are not captured
 A great example is the 2018 California QSO Party



2018 CA QSO Party – Oct 6,7



- No W6s in the Midwest on 10m on the 6th (Saturday)
- K index spiked up on the 7th (mid-day Sunday)
- Positive phase of this geomagnetic storm increased mid and low latitude ionization – 10m opened to W6 yay!
- Check the higher bands when the K index spikes up

Cycle 25 Predictions

What Does A Long Minimum Tell Us?

Next Solar Max vs Duration of Previous Solar Min



A long solar minimum <u>strongly suggests</u> the next cycle will be small

Cycle 25 Sunspots

Dec 2016, Nov 2018, May 2019, early July 2019
 All were small and of short duration – no AR (active region) numbers assigned
 A long duration Cycle 25 sunspot on July 8, 2019
 Assigned AR2744

 The first 'official' Cycle 25 sunspot



Cycle 25 is alive!



Cycle 25 Prediction

- NOAA/NASA Solar Cycle 25 International Panel
- Prediction on December 9, 2019
 - Solar minimum in April 2020 <u>+</u> 6 months

October 2019 to October 2020

 Peak in July 2025 <u>+</u> 8 months at a smoothed sunspot number of 115 (similar to Cycle 24)

Summary

It looks like this solar minimum will be a long one – minimum soon or a bit later?

- The low bands and 20m/17m will still offer worldwide DX QSOs at solar minimum
 - SFI and SN are proxies for true ionizing radiation
 - There's still enough EUV to keep 20m open

Don't forget sporadic E

 Look for occasional openings on 15m, 12m and 10m to the south and to VK/ZL at solar minimum

Due to day-to-day variability of the F2 region

Summary con't

- Be aware of short-term enhancements on the higher HF bands and on 160m when the K index spikes up
- Look for over-the-pole openings with more daylight up north
- The digital modes will make this solar minimum the most active in history on the higher bands – take advantage of them!

Cycle 25 is likely to be small – like Cycle 24

• But still watch for great 10m and 6m F2 openings around solar maximum in the fall and winter



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