Attracting New Hams thru Radio Science
- and -
Cycle 24 and Related Issues

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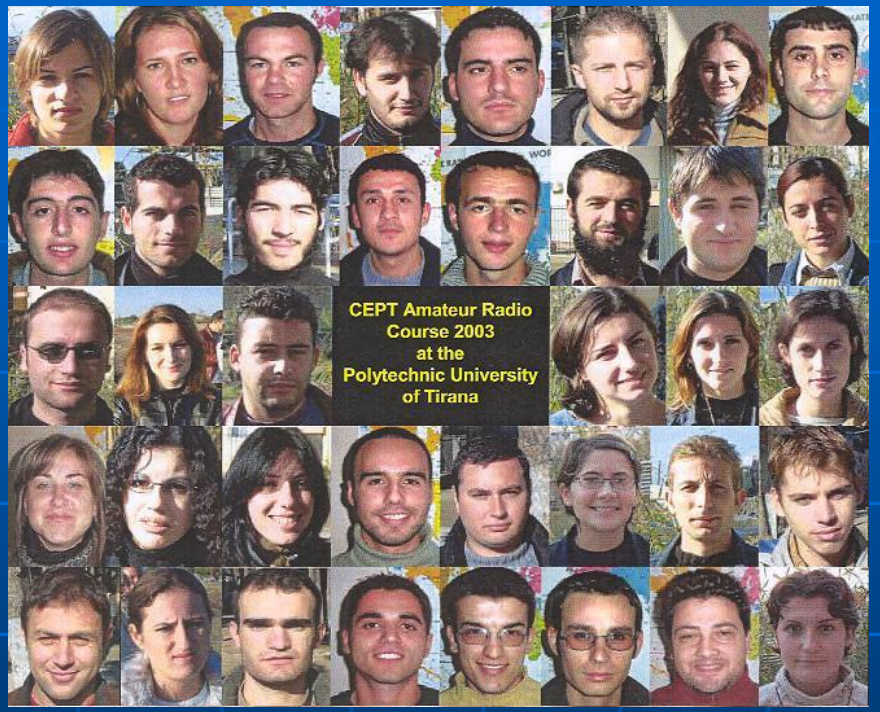
Two Topics

- Attracting new hams thru radio science
  - Our history in radio science
  - Radio science ideas for young techies, baby boomers and club projects
- Cycle 24 and related issues
  - Update on Cycle 24
  - Another Maunder Minimum?
  - Early predictions for Cycle 25
  - General band conditions
  - Comments about the Sun and climate

Attracting New Hams

- Going after young generation is necessary
  - Average age is over 50 nowadays
  - Average age in late 20s in the 1950s/1960s when huge amounts of us got into Amateur Radio as youngsters
- Good news/bad news – experience with Project Goodwill Albania (2003)



  - 4th and 5th year electronic engineering students at the Polytechnic University of Tirana
  - We taught CEPT criteria for Amateur Radio license
  - 39 new ZA licensees
  - But how many are active nowadays? Why not?

Attracting New Hams

- Let's not forget the older generation
  - May have more time for radio activities
  - Will likely have more money to spend on radio
- Many licensees are not active
  - Get them in a club
  - Get them more active

Ways to Attract New Blood

- Amateur Radio is very diverse
  - EmComm, moon bounce, traffic handling, contesting, DXing, rag chewing, fox hunting and many more
- How about appealing to them thru the “science of radio”?
  - Many ‘Big Bang Theory’ types out there
    - Both youngsters and us older guys and gals

Our History

- Amateur Radio has a rich history of involvement in the science of radio
- This started with the Radio Act of 1912
  - Moved operations to wavelengths shorter than 200 meters (frequencies greater than 1.5 MHz)
- These wavelengths were considered to be a wasteland – essentially line-of-sight
- But it inadvertently provided Amateurs new ground to cover and new discoveries to make
- And we certainly made discoveries and contributed to the science of radio!

Fading Tests in Summer 1920

- The Bureau of Standards realized the importance of understanding fading with respect to military and commercial applications
- Amateur radio operators teamed with Bureau of Standards personnel to collect data
- Reports published in the November and December 1920 QSTs

Trans-Atlantic QSOs

- Trans-Atlantic Sending Tests in December 1921 resulted in ~ 30 US Amateurs being heard in Europe
- First trans-Atlantic QSO between US and Europe occurred in November 1923
- All this on "useless" frequencies!

Trans-Equatorial Propagation

- XE1KE began working LUs on 50 MHz in August 1947 when conventional MUF too low
- During the International Geophysical Year (July 1, 1957 to December 31, 1958), the ARRL set up the Propagation Research Project to collect reports from Amateurs on possible 50 MHz and 144 MHZ ionospheric propagation
- Amateurs at the Radio Propagation Laboratory at Stanford University (W1VLH and W6QYT) analyzed the data
- 5B4WR's April 1963 QST article theorized on how TEP works – clumps of high electron density on either side of the geomagnetic equator

More Amateur Contributions

- Moonbounce
  - W4ERI at Evans Signal Laboratory (forerunner to the US Army Signal Corp)
- Long Delayed Echoes
  - W6QYT, W5LFM, WA6NIL at Stanford
- First propagation prediction program for PCs
  - K6GKU at Naval Ocean Systems Center

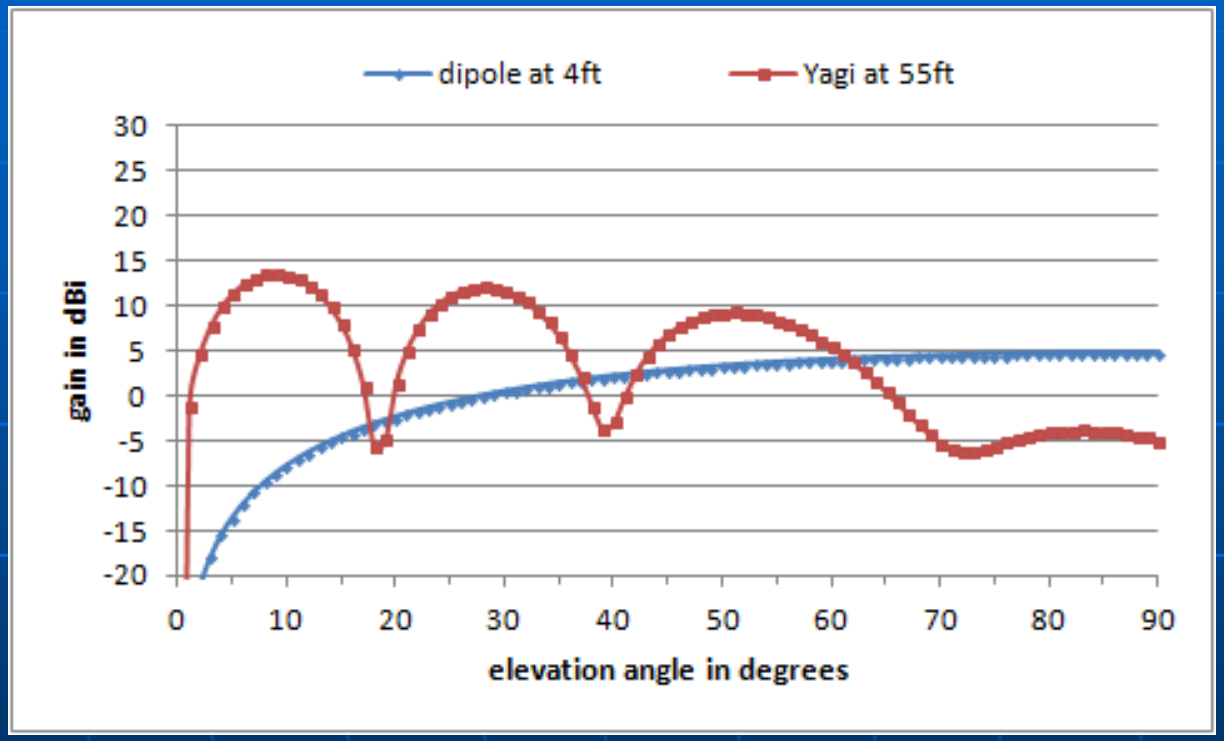
How Can We Contribute Today?

- When you start looking into something, you may not know where it's going to end up
- Will you discover something to revolutionize Amateur Radio?
  - Maybe not
- Will you gain a better understanding of something that you can share with others?
  - Probably
- We'll look at three ideas
  - Measuring elevation angles
  - Monitoring the NCDXF beacons
  - Using weak-signal digital modes

Measuring Elevation Angles

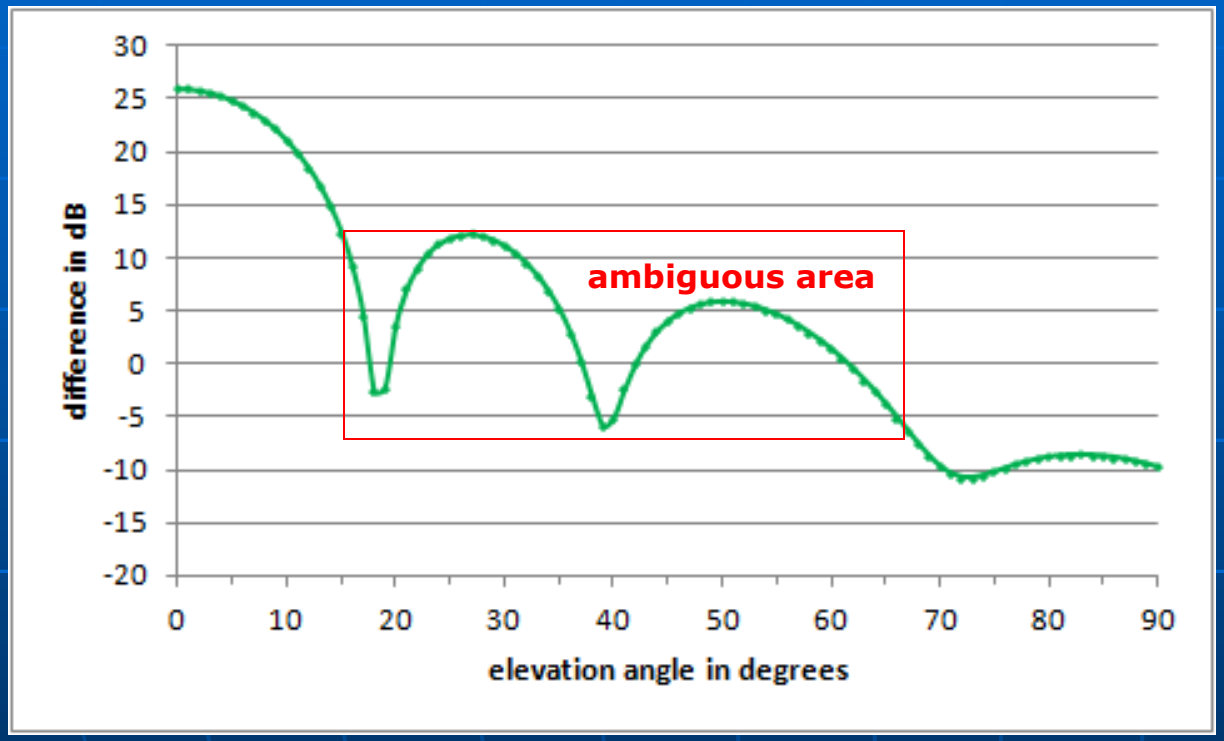
- What you'll learn
  - Understanding of how elevation angles vary throughout the day, throughout the year and throughout a solar cycle
- What you need
  - Antenna up high
  - Antenna down low
  - Calibrated S-meter

Antenna Patterns



- 10-Meter antennas
- High antenna has three major lobes and two major nulls
- Low antenna radiates the most energy straight up
- Orient tip-to-tip for minimum interaction

Take the Difference



- Take the difference between the high antenna and the low antenna to determine elevation angle
- Be aware of ambiguous area

Some Results

date	time (UTC)	station	55ft S-meter	4ft S-meter	difference (dB)	angle	comment
5-Jan-13	1548	VO1CAL	S9	S5	22	9	
	1750	A65BP	S4	S0	21	10	long path
	1820	K6RNK	S7	S3	25	5	
6-Jan-13	1334	IK6DTB	S3	nothing	-----	-----	
	1437	PA7MM	S7	S3	25	5	
	1442	G4ELJ	S5	S1	24	7	
	1445	EA8YV	S5	S1	24	7	
	1610	A45XR	S3	nothing	-----	-----	long path
12-Jan-13	1406	LA7GNA	S7	S3	25	5	
13-Jan-13	1340	OE6MBG	S5	S1	24	7	
	1347	DK2EE	S6	S3	20	11	
14-Jan-13	2250	VK2LAW	S5	S2	22	9	
17-Jan-13	1943	EA8YB	S9+5	S6	22	9	
	1944	VE1AWA	S9+5	S6	22	9	
	1947	RI1FJ	S5	S2	22	9	
	1958	ZL1BYZ	S6	S3	20	11	
20-Jan-13	1511	OE2013S	S6	S3	20	11	
	1513	G0FWX	S6	S3	20	11	
9-Feb-13	1552	N6WJN	S9+5	S6	22	9	

- If less than or equal to S3 on the high antenna, couldn't hear on the low antenna
- Lots of low elevation angles on 10-Meters
- Data for winter month - what about summer, fall and spring?

Monitoring NCDXF Beacons

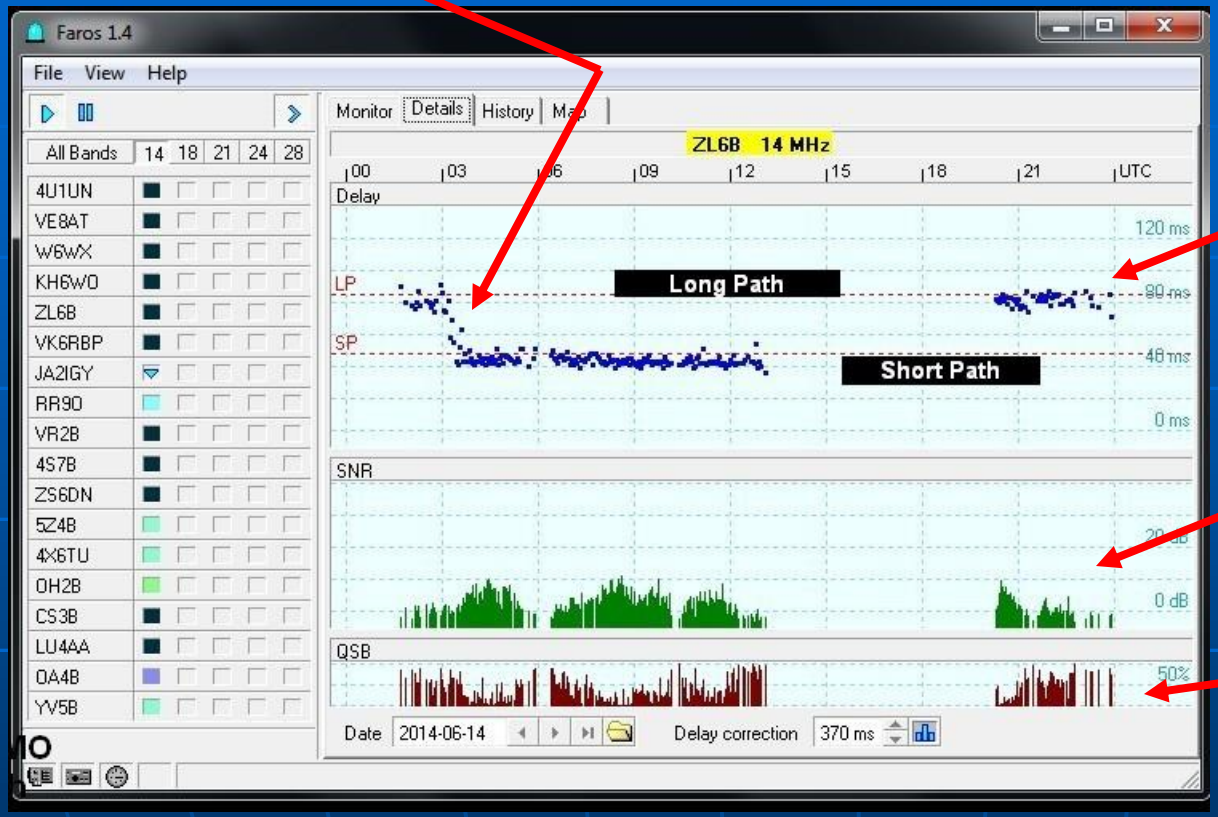
- What you'll learn
  - Short-term propagation trends on the higher HF bands
- What you need
  - Antenna(s) for the higher bands
    - 20m, 17m, 15m, 12m, 10m
  - Knowledge of beacon format
  - Faros beacon monitor software

Set Up

- Beacon format at http://www.ncdxf.org/pages/beacons.html
  - 18 worldwide beacons
  - Ten second transmit time – in 3 minutes you can assess worldwide propagation on one HF band
- Faros beacon monitor software (free) http://www.dxatlas.com/faros
  - Uses delay to determine short path or long path
  - Measures SNR (signal-to-noise ratio)

What's happening here?

Some Results



- Short path vs long path
- SNR
- QSB

- ZL6B to K2MO on 20m
- June 14, 2014

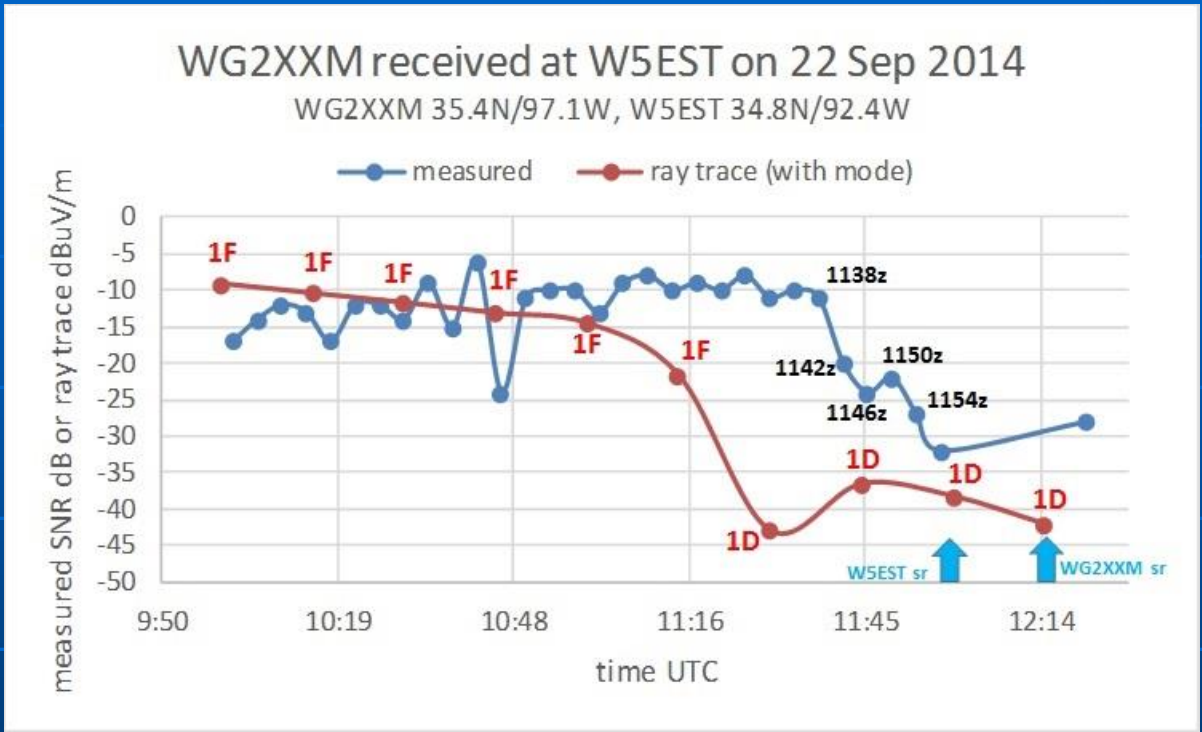
More Results

- Short-term openings not likely to be predicted by our propagation predictions
  - That's because our propagation predictions give monthly median results – don't capture short-term events

Using Weak-Signal Digital Modes

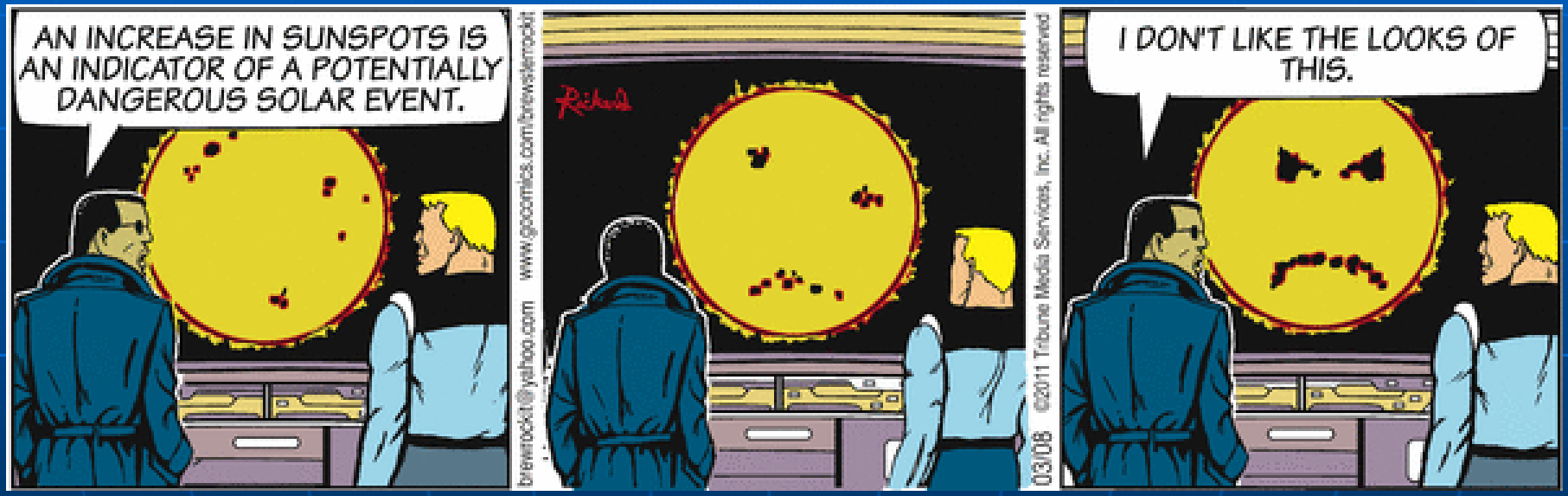
- What you'll learn
  - Propagation characteristics with signals that you can't hear with your ears
    - Low bands are a major opportunity
- What you need
  - Appropriate software
    - WSPR (weak signal propagation reporter)
      - http://www.wsprnet.org
  - Antenna for desired band

Results on 630m (476 KHz)

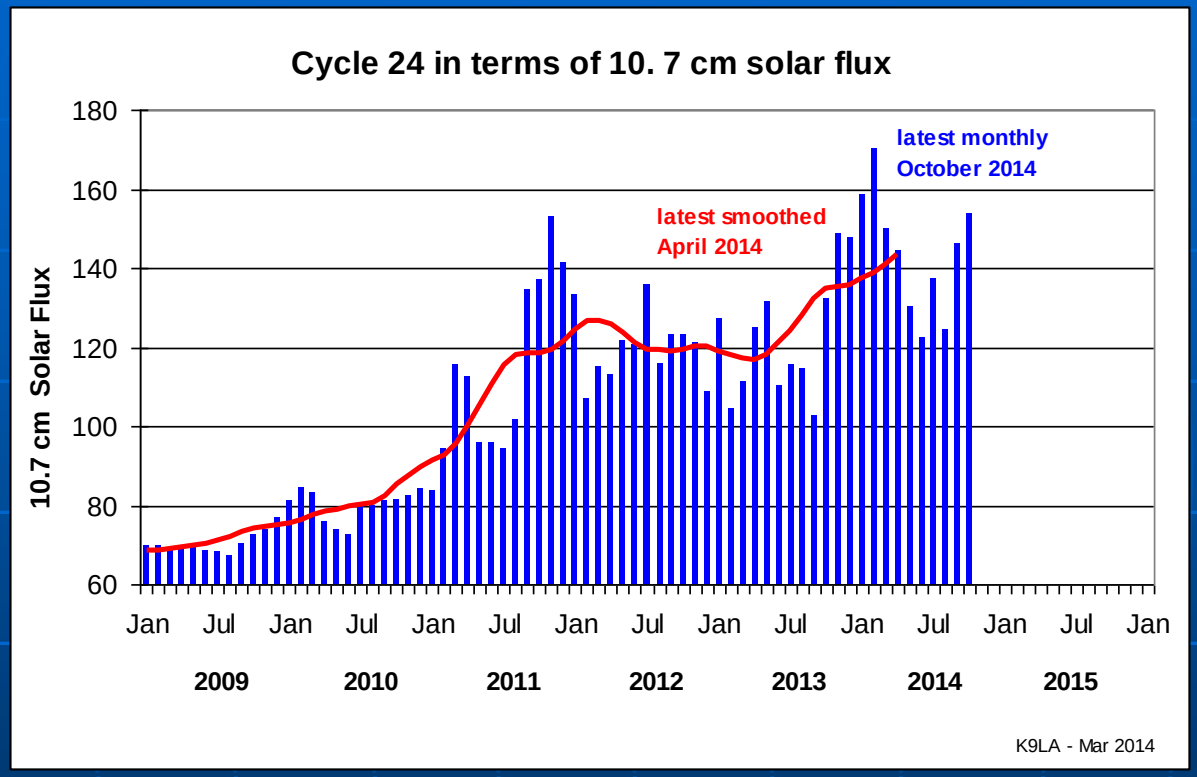


- Signal strength decrease before sunrise shows role of negative ions in the dark ionosphere
- Why the discrepancy between measured and modeled results?
  - A learning opportunity!

Now On To Cycle 24



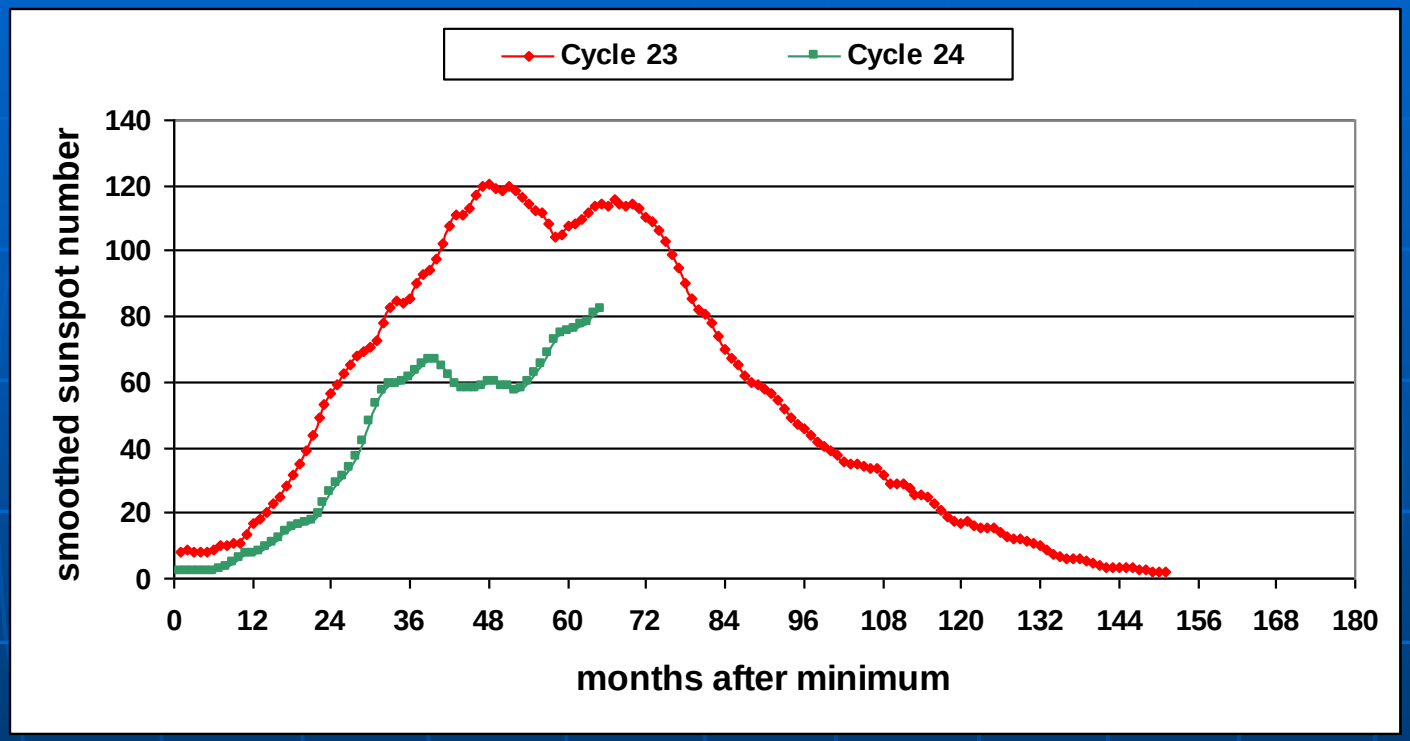
Cycle 24 Update



- Cycle 24 began in late 2008
- First peak after 3½ years
- Second peak after about 6 years – still in progress

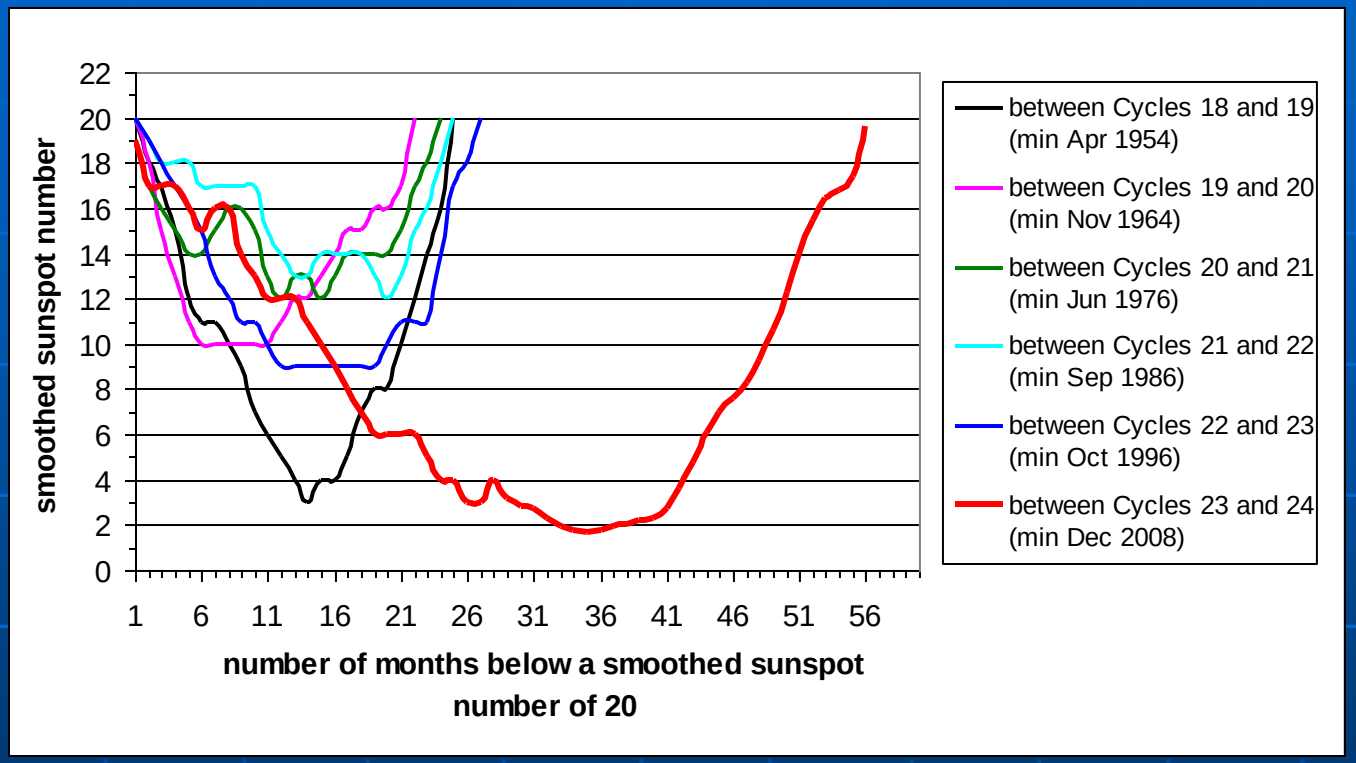
- We're still in the second peak
- Higher bands should be good this fall/winter

Cycle 24 vs Cycle 23



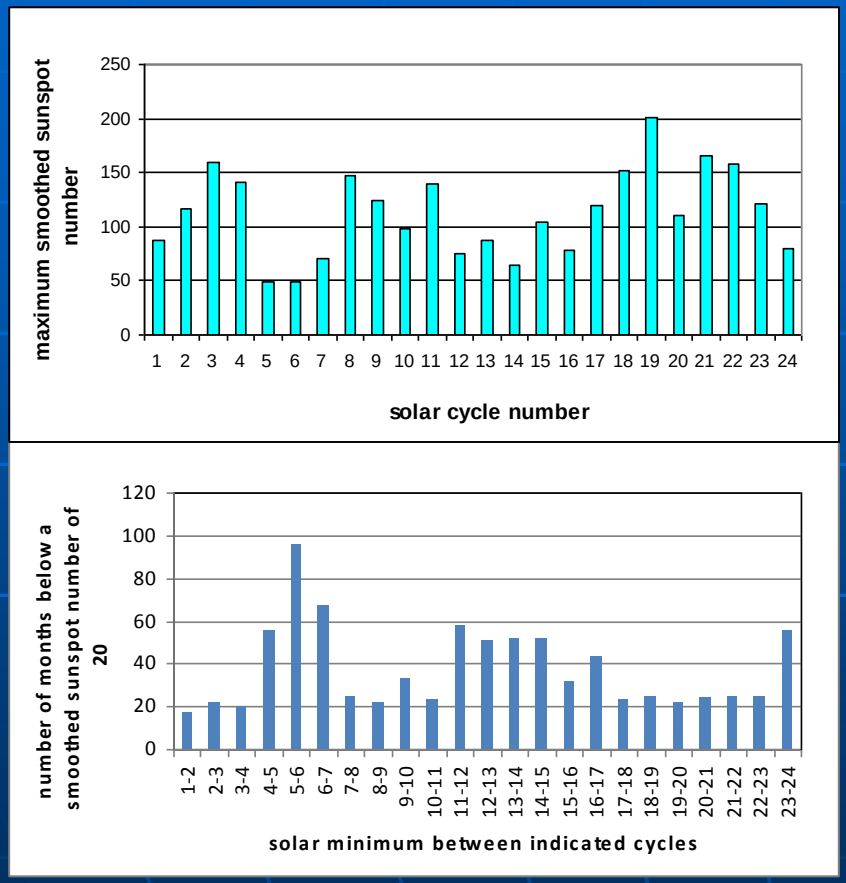
Will Cycle 24 have a similar long descent to minimum?

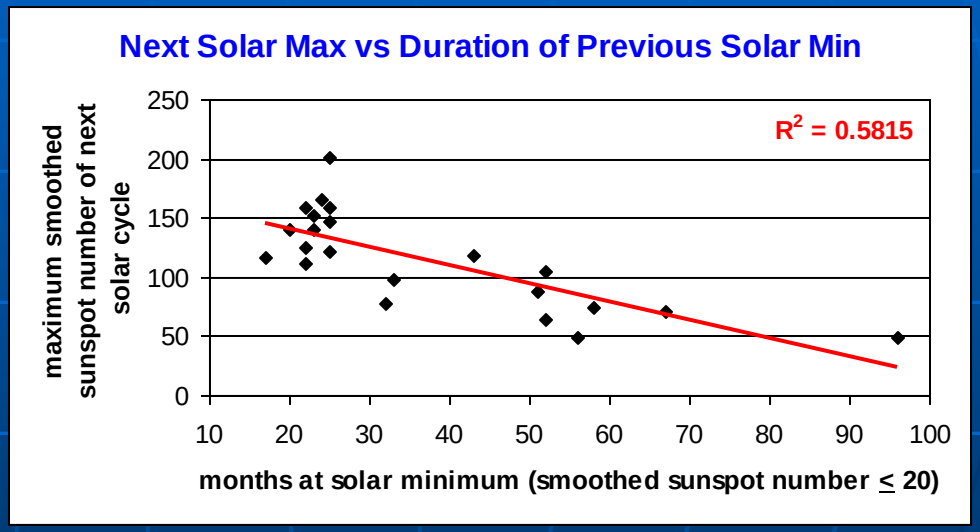
Speaking of Minimums . . .



- We were used to short minimums – about 2 years
- Then the minimum between Cycle 23 and 24 came along

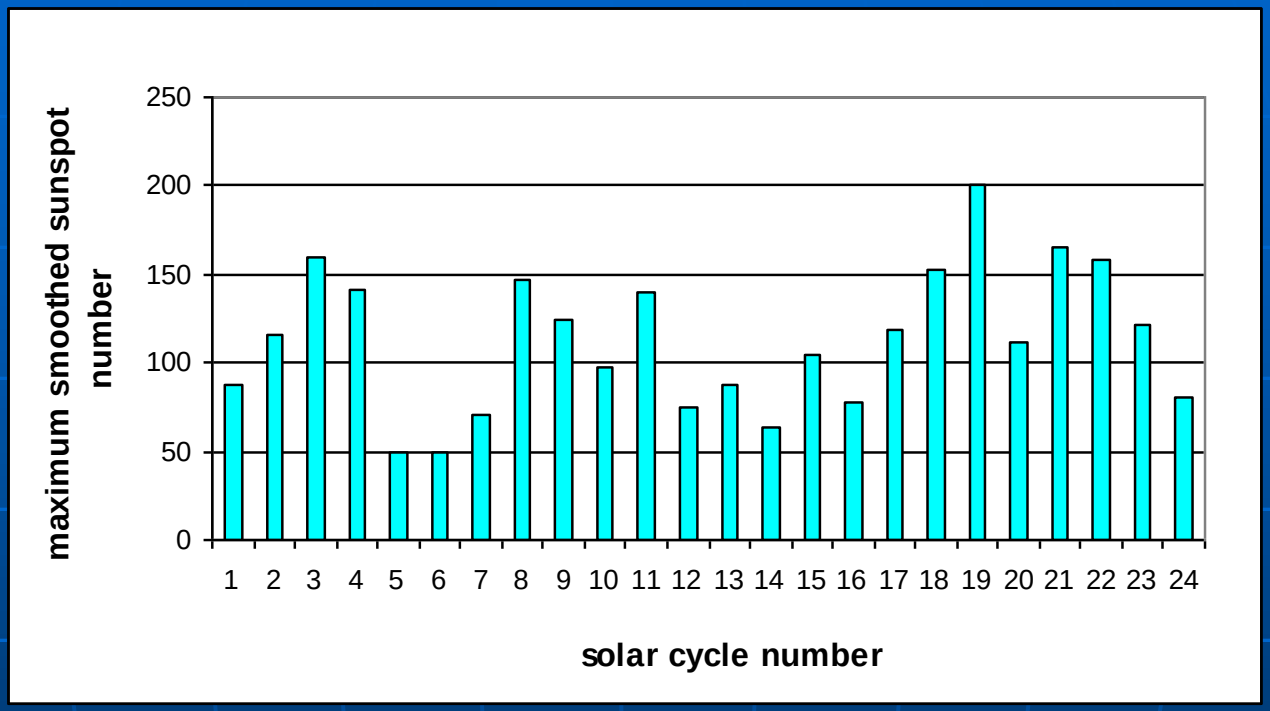
Length of Min vs Next Max





The longer the minimum, the smaller the next cycle

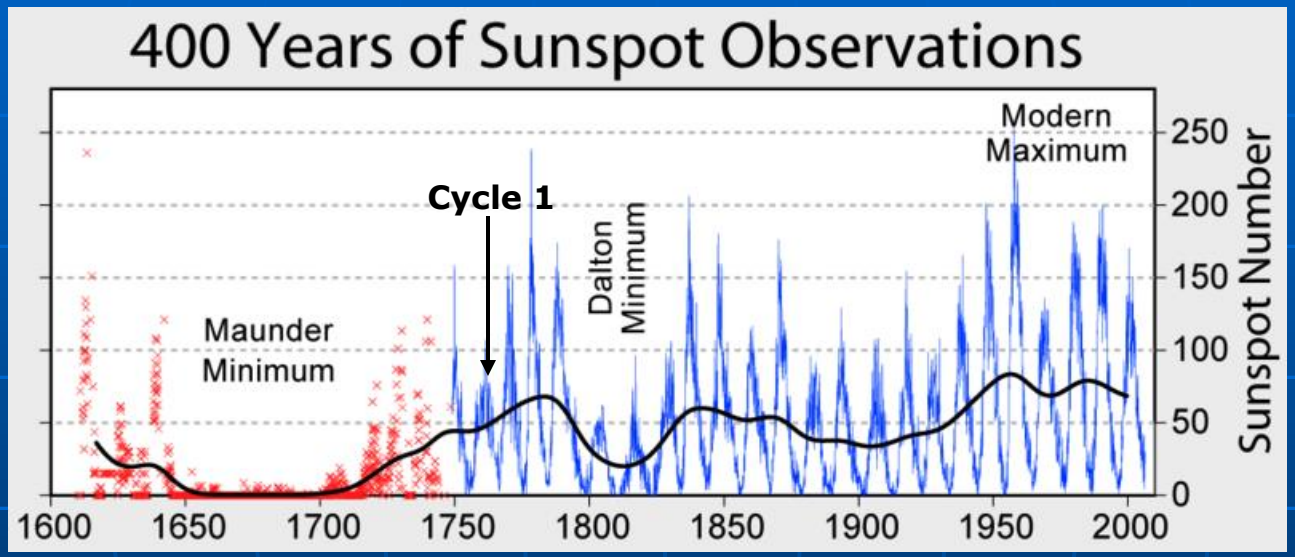
Recorded History



- Three periods of larger cycles
- Two periods of smaller cycles
- It looks like we're headed for a period of smaller cycles

How Small?

Another Maunder Minimum?



- Maunder min was a 70-year period of very few sunspots
- 1645-1715

MM Fueled By Magnetic Field Data

- July 2009 paper by W. Livingston and M. Penn
- Sunspots are visible when their magnetic field strength is $\geq$ 1500 gauss
- Extrapolating the linear trend line says no sunspots will be visible by the end of the decade (2020)
- Is this the signature of a Maunder Minimum?

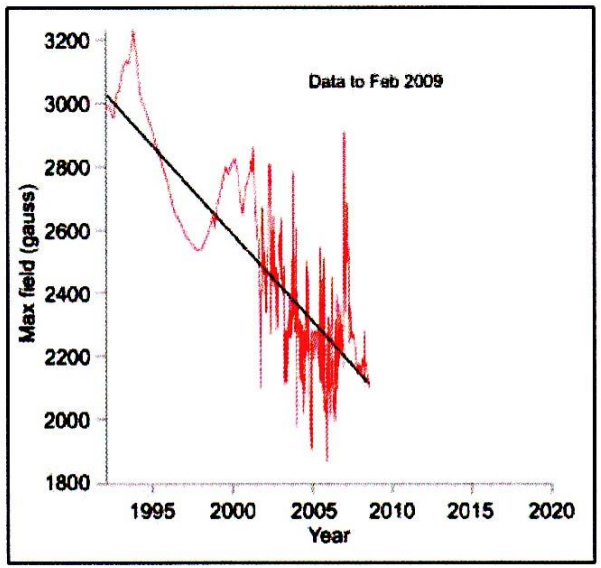
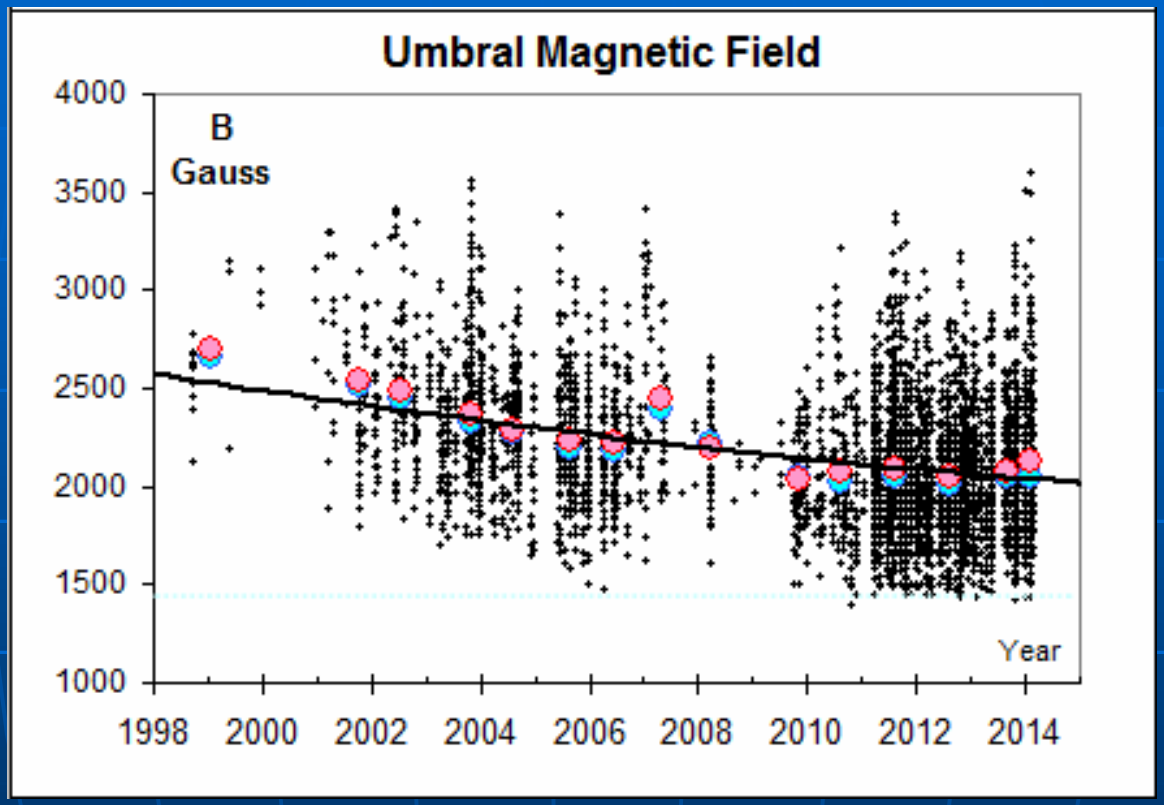


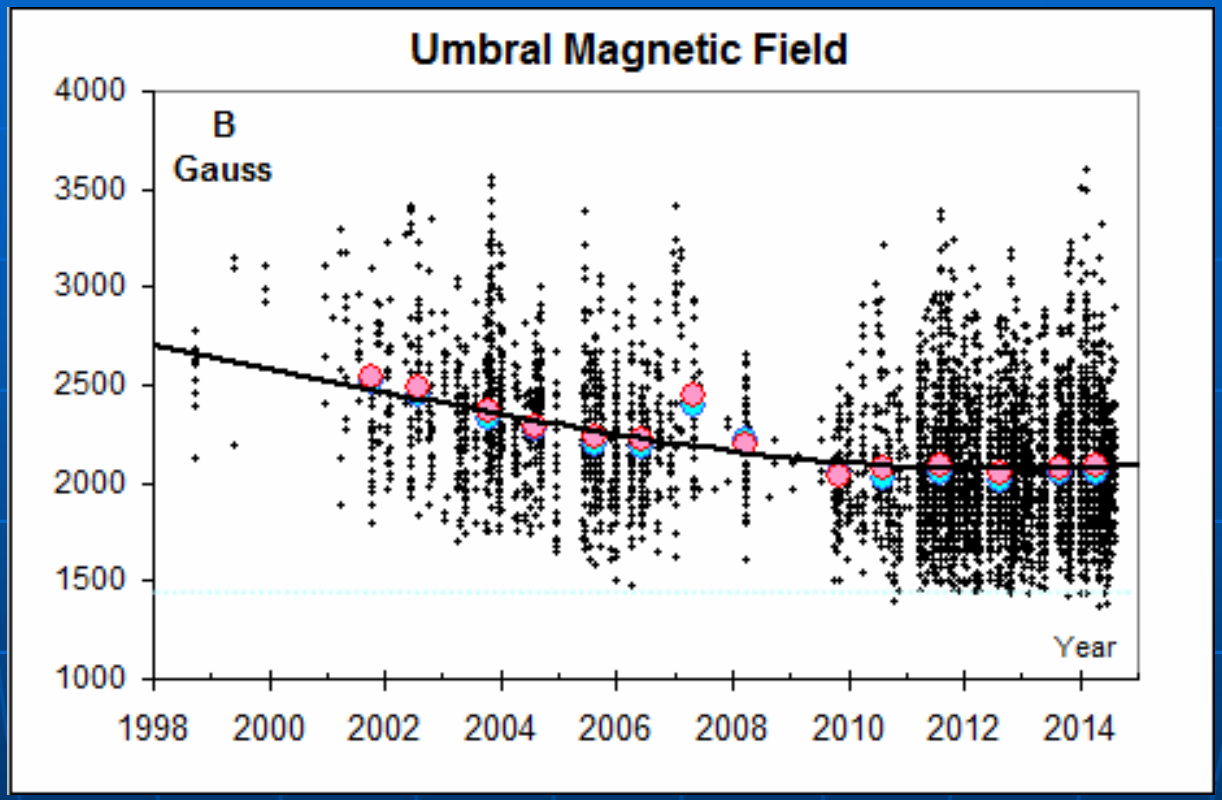
Fig. 3. The maximum sunspot field strength is plotted versus time, during the period from 1992 to February 2009; a 12-point running mean is shown, and a linear fit to the data is plotted. Apart from a few measurements, the linear trend has been seen to continue throughout this solar minimum.

Update Thru 2013



- Magnetic field strength still decreasing
- But it looks like it is starting to level off

Update Thru October 2014



- It sure looks like it's leveled off
- Suggests sunspots won't disappear

MM Conclusion – For Now!

- It's kind of looking like we'll just see an extended period of smaller cycles
- Not a period of few or no sunspots
- But we're going into uncharted territory for our lifetimes
  - The Sun will do whatever it wants!

What Bands? When?

- 160m, 80m, 40m are driven by absorption
  - These bands are best during night at solar min
- 15m, 12m, 10m are driven by MUF
  - These bands are best in daylight at solar max
- 30m, 20m, 17m are good throughout an entire solar cycle
  - Can withstand more absorption than 160/80/40m
  - Don’t need as high a MUF as 15/12/10m

What Bands? When?

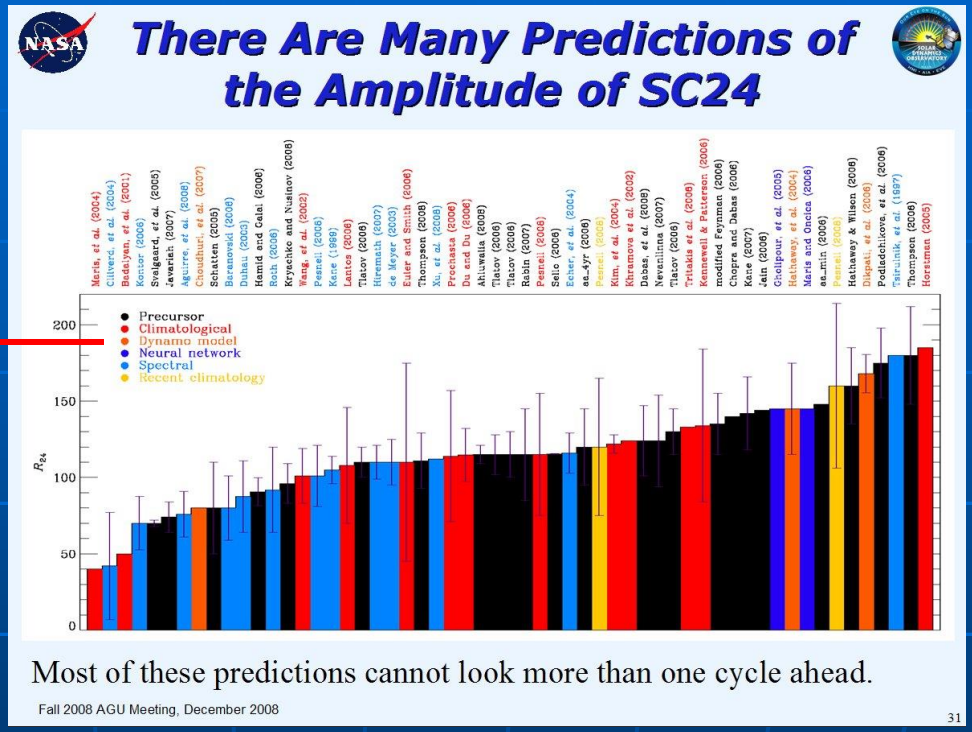
- Right now during 2nd peak of Cycle 24
  - 15m, 12m and 10m are best
  - 30m, 20m and 17m are good
  - 160m, 80m and 40m generally not considered good
    - But you can still work lots of DX around solar max
- Fall/winter of 2015/2016
  - 15m, 12m and 10m openings will decrease
  - 30m, 20m and 17m will be the best bands
  - 160m, 80m and 40m better
- Fall 2016 and onward
  - 15m, 12m and 10m will be mostly noise
  - 30m, 20m and 17m will still be good
  - 160m, 80m and 40m will also be good

Cycle 25 Predictions

- 2010, Rigozo et al, Cycle 24 max ~113, Cycle 25 max ~132
  - The Cycle 24 prediction may be too high
  - Reduces confidence in Cycle 25 prediction
- 2009, De Jager and Duhau, Cycle 24 max 68 +/- 17
  - Pretty good prediction – so far!
  - After Cycle 24, a period of lower solar activity will start

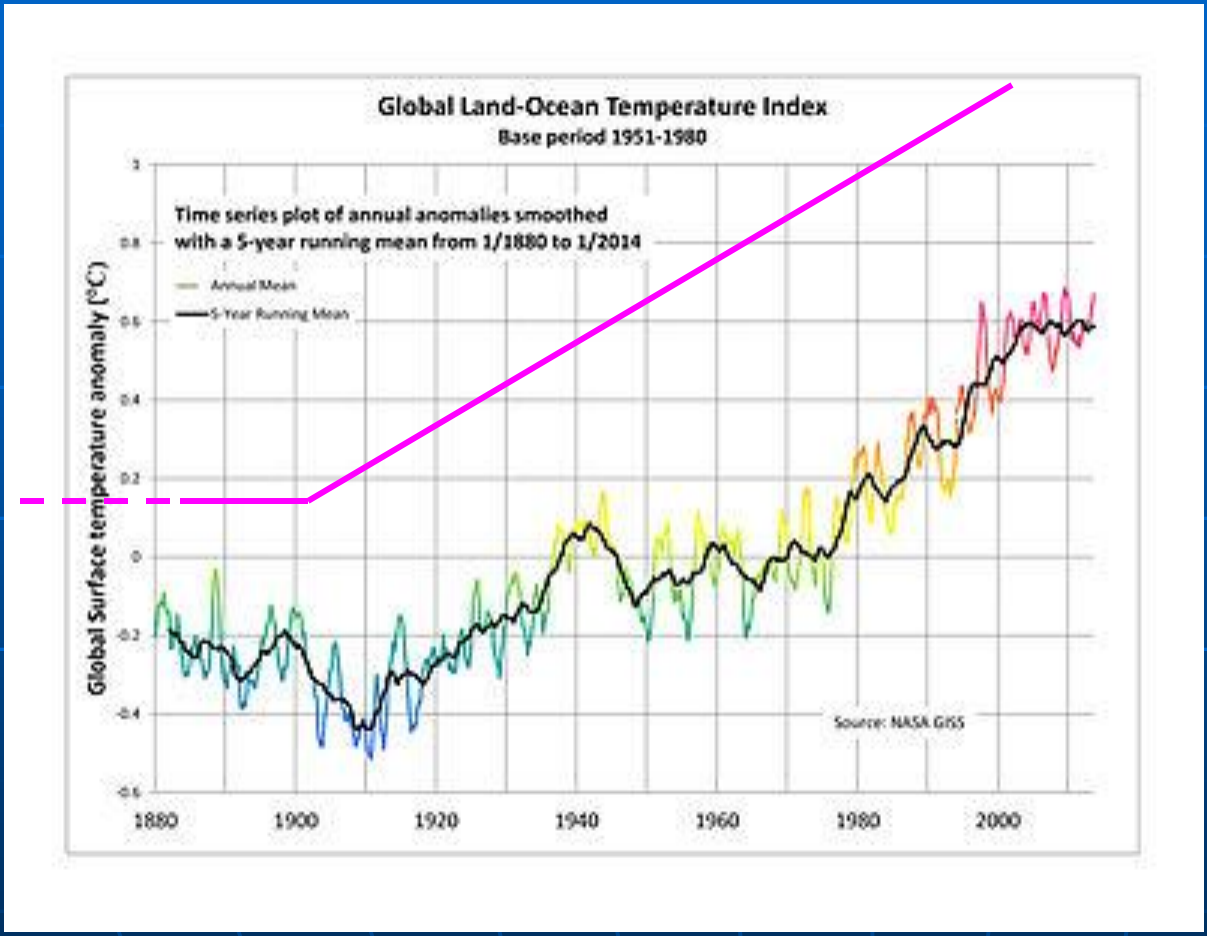
A Look Back – Cycle 24 Predictions

Precursor
Climatological
Dynamo model
Neural network
Spectral
Recent climatology



- Predicted smoothed sunspot numbers ranged from 40 to almost 200
- There are several scientists who will be "right"

The Famous ‘Hockey Stick’

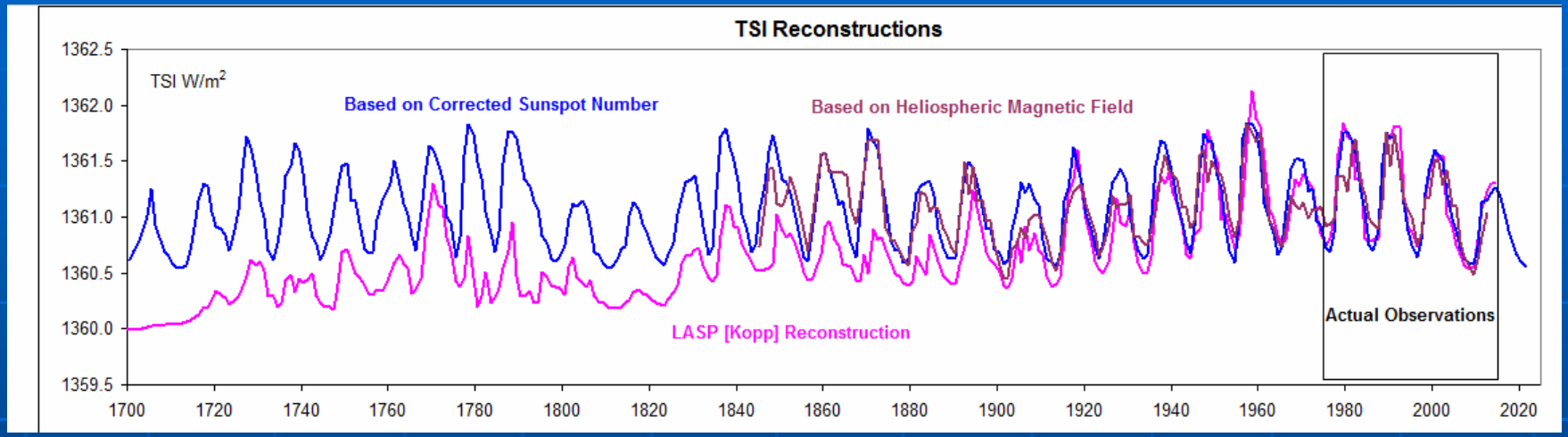


- About a 0.6°C rise since the 1950s
- Why is there a pause beginning around 2000?
  - Does it mean anything?

Temperature vs Sunspot Cycle

- Little Ice Age centered around the late 1600s
  - Coincident with the Maunder Minimum
- There appears to have been a Medieval Warming Period centered around 1050
  - From Carbon-14 data, Sun appears to have been more active back then
  - This warming period is in the 1990 IPCC report, but vanished in the 1996 report
- Does the Sun influence climate?

The Sun's Role in Climate



- The TSI (total solar irradiance) only varies by about 0.1%
  - TSI includes very short wavelengths (x-rays) to very long wavelengths (visible light)
- As I understand it, climate model assumes Sun is constant
- But that 0.1% sure changes the atmosphere – it makes the ionosphere – and the ionosphere varies thru a solar cycle
- Is there a climate mechanism for the Sun's radiation at wavelengths important for the ionosphere?

Summary

- Several ‘radio science’ ideas presented as a gateway into Amateur Radio and for club projects
  - Many other ideas available in other aspects of Amateur Radio
- We’re in the second peak of Cycle 24
  - It won’t last forever
  - Take advantage of good propagation on the higher bands now!
- Recent data suggests that we’re not headed into another Maunder Minimum
  - Just a period of small solar cycles
  - Dust off the low band gear