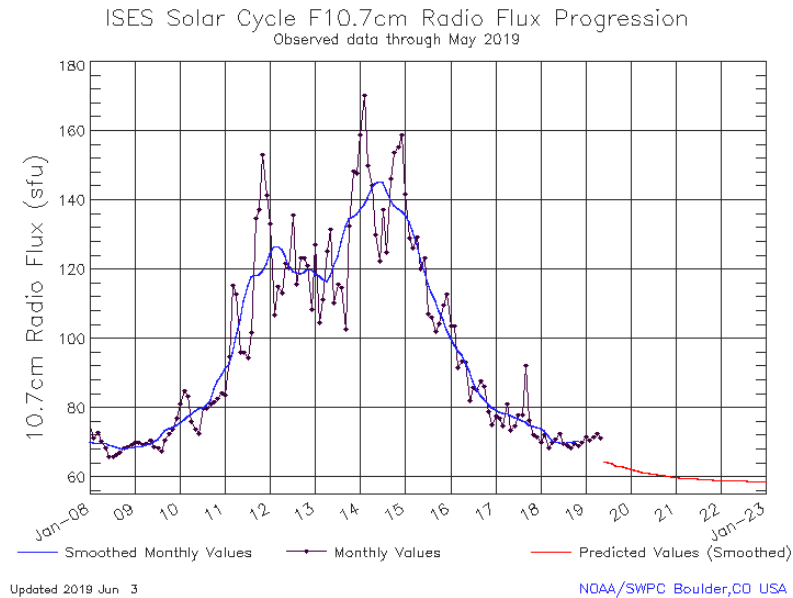


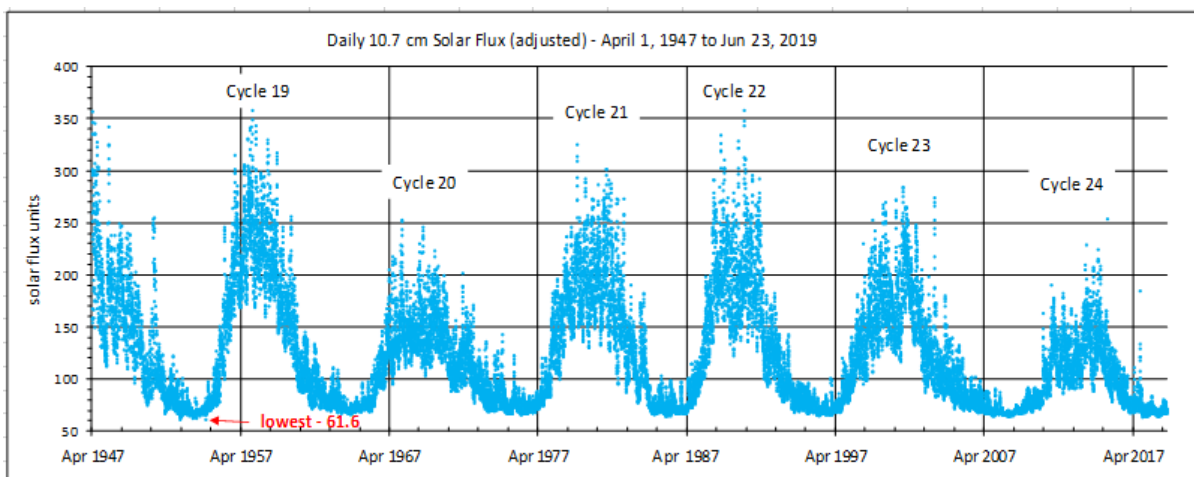
The SWPC's Prediction for 10.7 cm Solar Flux Carl Luetzelschwab K9LA July 2019

The Space Weather Prediction Center's prediction for 10.7 cm solar flux for the current solar minimum period (the red line in the plot below) at <https://www.swpc.noaa.gov/products/solar-cycle-progression> has raised some eyebrows due to the fact that the predicted value is below 60.



In fact, their lowest predicted value is 58.9 if you look at the detailed **Predict.txt** file at the above referenced web site. This low of a value seems to go against our historical observations.

So what is the lowest 10.7 cm solar flux that we have ever measured? That's not too hard to determine, as all we have to do is download the historical data and plot it. This is done in the plot below. This plot goes from the start of 10.7 cm solar flux measurements to June 23, 2019. The data is from <https://spaceweather.gc.ca/index-en.php>.

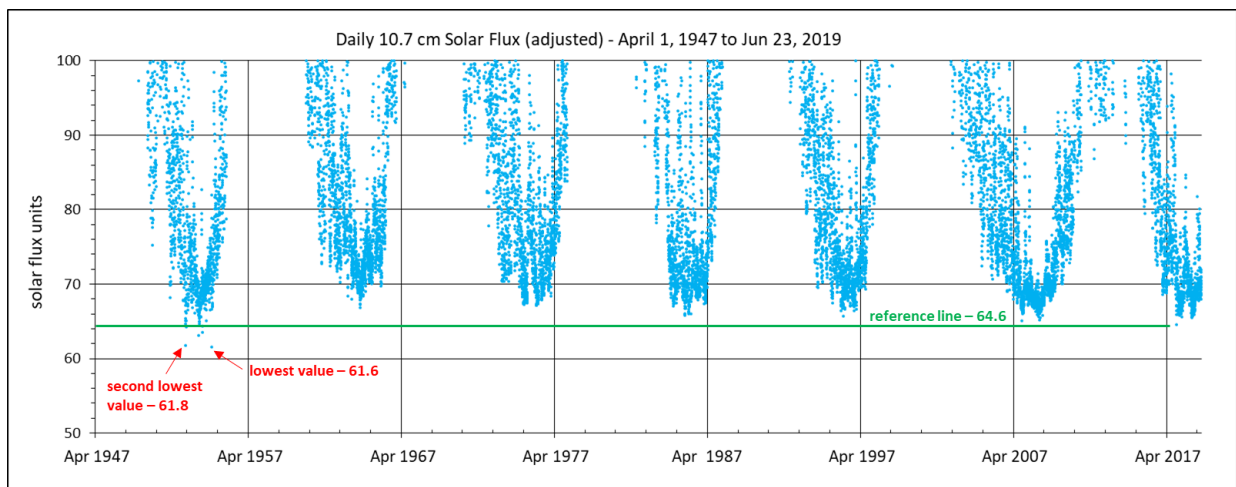


The lowest 10.7 cm solar that that we've recorded is 61.6 (the red arrow pointing to the blue data point) on November 3, 1954. The second lowest value is February 24, 1953 at 61.8. I believe these values are much lower than many people think could happen. It's certainly lower than I thought possible!

Note that these values are called the adjusted 10.7 cm solar flux. Since the orbit of the Earth around the Sun is not a perfect circle, the distance between the Earth and Sun varies throughout the year. The greatest distance is 94.5 million miles (in summer) and the least distance is 91.4 million miles (in winter). The 10.7 cm solar flux that is measured by our receivers on the ground is called the observed 10.7 cm solar flux. These observed values are converted to adjusted values by translating to the average distance between the Sun and Earth – 93 million miles. The difference between observed and adjusted can be up to about 1.7%. The adjusted values are what are reported.

Why were the values so low during the solar minimum period between Cycles 18 and 19? Of course the measurements could be in error. That's something with which we should always exercise caution. And I don't think there are any hidden 'fudge factors', but who knows. For now let's assume they are good values. What else could be a reason for such low values?

It could be that the solar minimum period between Cycles 18 and 19 was a bit deeper than all subsequent solar minimum periods. That's easy to determine. Let's restrict the range of the vertical axis in the previous plot to accentuate the solar minimum periods.



The solar minimum period between Cycles 18 and 19 had a number of values of 10.7 cm solar flux lower than any subsequent solar minimum period. That's easy to see by noting the green horizontal line – this line is referenced to the lowest 10.7 cm solar flux that occurred (so far) outside the minimum between Cycles 18 and 19, which was 64.6 during the present solar minimum on November 9, 2017.

My guess here is the SWPC believes the minimum period between Cycles 24 and 25 may even be a bit deeper than the minimum between Cycles 18 and 19. Is there anything to support this belief? Yes, there is. It's the paper by Shepherd, Zharkov and Zharkova [note 1] that predicts that

Cycle 25 will be 80% of Cycle 24 and Cycle 26 will be 40% of Cycle 24. The prediction from these authors comes from an analysis of the magnetic fields inside the Sun. They showed the presence of two principal components of the solar background magnetic field having opposite polarity. These waves are linked to solar dynamo waves that form in different layers of the solar interior. The tie-in to solar minimum is that a small cycle is historically preceded by a long, and perhaps deeper, solar minimum.

The authors analyzed the solar background magnetic fields in Cycles 21-23, and the bottom line is their belief that there will be a strong reduction of the solar background magnetic field in Cycles 25 and 26. The result will be a small Cycle 25 (slightly smaller than Cycle 24) and an even smaller Cycle 26 as noted in the previous paragraph.

How much should we believe the predictions by Shepherd, Zharkov and Zharkova? That's a tough question to answer. Although it's good to see a prediction based on the physics of the Sun, I don't know if we fully understand what's going on inside the Sun yet. Thus I think the best approach here is to take a "wait and see" attitude.

For those who want to dig deeper into this paper, you might want to visit the web site with the video that has Dr. Zharkova explaining their analysis. It is at the following url:

<https://www.sott.net/article/400195-Professor-Valentina-Zharkova-explains-and-confirms-why-a-Super-Grand-Solar-Minimum-is-upon-us>

Last minute update – the above three authors, plus another author, published a paper in June 2019 [note 2]. It's essentially a follow-on to the paper referenced in Note 1, but with more analysis and presentation of the Sun's interior magnetic fields. There aren't any specific predictions for Cycles 25 and 26 as in the 2014 paper. But the authors do conclude that we are in for a grand solar minimum similar to the Maunder Minimum (1645-1715) for the next three solar cycles (2020-2055) – which are Cycles 25, 26 and 27. Again, I think it's best to "wait and see".

Note 1 – Simon J. Shepherd, Sergei I. Zharkov and Valentina V. Zharkova; *Prediction of Solar Activity from Solar Background Magnetic Field Variations in Cycles 21-23*; **The Astrophysical Journal**, 795:46 (8pp); 2014 November 1

Note 2 – V.V. Zharkova, S.J. Shepherd, S.I. Zharkov, and E. Popova; *Oscillations of the baseline of solar magnetic field and solar irradiance on a millennial timescale*; **Scientific Reports in Nature**; <https://doi.org/10.1038/s41598-019-45584-3>, 24 June 2019