

Where is the most appropriate dividing point by which we should define a solar cycle?

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The beginning and end of a solar cycle is typically marked at the point where the sunspot number takes a minimum value. It has been shown, however, that the sunspot number or its decreasing rate a few years before the solar minimum is well correlated with the maximum sunspot number of the succeeding cycle (Yoshida and Yamagishi, 2010). It has also been noted that the azimuthally averaged radial magnetic field at the surface of the sun during the late stage of a solar cycle is highly predictive of the amplitude of solar activity for the succeeding cycle (Cameron and Schussler, 2007). These observations appear to indicate that the succeeding solar cycle may in fact start a few years prior to the point at which the sunspot number reaches its minimum value.

The amplitude of a solar cycle is usually represented by the maximum value of the sunspot number in the cycle. If the pattern of the change in the sunspot number through a cycle remains constant, no problem is presented in taking the maximum sunspot number as representative of the amplitude of cycles. Given however that the pattern does differ noticeably between cycles, the average of the sunspot number over a cycle becomes a more appropriate index in the evaluation of the activity of solar cycles.

In this paper it is shown that the highest correlation between the average and maximum values of the sunspot number in a cycle is obtained when the cycle is marked off at a point three years before the solar minimum. The correlation between the sunspot number at the marking-off point and the average through the cycle is similarly shown to be highest at this same point three years prior to the minimum. These facts are concordant with previous findings that show that the sunspot number which correlates most strongly with the succeeding maximum sunspot number is not the minimum value itself, nor the values at one, two, four, five years before the minimum, but the value three years before the sunspot minimum. The physical meaning of these observations is discussed. Further, some interesting and intriguing features seen in the distribution and sequence of the average values of sunspot numbers of 23 solar cycles since the mid 18 century are shown.

Keywords: solar cycle, sunspot number, maximum value, minimum value, average value