A Statistical Test of Uniformity in Solar Cycle Indices

David H. Hathaway NASA/Marshall

Several indices are used to characterize the solar activity cycle. Key among these are: the International Sunspot Number, the Group Sunspot Number, Sunspot Area, and 10.7 cm Radio Flux. A valuable aspect of these indices is the length of the record – many decades and many (different) 11-year cycles. However, this valuable length-of-record attribute has an inherent problem in that it requires many different observers and observing systems. This can lead to non-uniformity in the datasets and subsequent erroneous conclusions about solar cycle behavior. The sunspot numbers are obtained by counting sunspot groups and individual sunspots on a daily basis. This suggests that the day-to-day and month-to-month variations in these numbers should follow Poisson Statistics and be proportional to the square-root of the sunspot numbers themselves. Examining the historical records of these indices indicates that this is indeed the case - even with Sunspot Area and 10.7 cm Radio Flux. The ratios of the RMS variations to the square-root of the indices themselves are relatively constant with little variation over the phase of each solar cycle or from small to large solar cycles. There are, however, important step-like changes in these ratios associated with changes in observer and/or observer system. Here we show how these variations can be used to construct more uniform datasets.