

Forecasting Future Solar Activity Trends - an indication to Solar Minima

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The Sun's activity rises and falls in an 11-year cycle. The ability to forecast these kinds of variable events is increasingly important because of radiation hazardous. Our technological infrastructure has reached at a point where solar activity and its prediction have become significant for space weather as well as for climate change. Our sun, the epicenter of all solar activities and associated phenomena plays a key role in the understanding of various solar parameters. On the other hand, if the Sun is moving into a new regime of lower activity, a period of uncertainty may make life hard for the forecaster. The different studies generally agree in predicting a period of low solar activity during the 21st century in spite of the fact that all these studies are based on single individual records of cosmogenic radio nuclides that contributes about 70% in the variability of solar activity and 30% can be attributed to climate effects. In continuation of prediction perspective, using the last 70 years (1947-2017) data of three solar parameters namely sunspot numbers, F10.7cm index and Lyman alpha index, we have predicted that the solar activity will further go down and there is an indication of another solar minima comparable to the Dalton minima but different in nature. To that end, we have applied the Hodrick Prescott filtering method to bifurcate each time series into cyclic and trend parts. The cyclic part of the each time series was used to analyze the persistence while the trend part was used as an input for future predictions. Further the cyclic component of each parameter was analyzed using rescaled range analysis and the value of Hurst exponent was obtained for sunspot numbers, F10.7cm index and Lyman alpha index as 0.90, 0.93 and 0.96 respectively. By using the simplex projection analysis on the values of amplitude and phase of the trend component of each time series we have reconstructed the future time series for solar cycles 25 and 26. When extrapolated further in time, the reconstructed series provided the maximum values of sunspot numbers as 89 ± 9 and 78 ± 7 ; maximum values of F10.7 cm index were 124 ± 11 and 118 ± 9 and Lyman alpha index were 4.61 ± 0.08 and 4.41 ± 0.08 respectively for solar cycles 25 and 26. We have also inferred that the solar cycle 25 will start in 2021 (January) and will last till the year 2031 (February) while the maxima of the cycle would reach around the year 2024 (February). Solar cycle 26 will be started in the year 2031 (March), will reach its maxima by the year 2036 (June) and will last till the year 2043 (February). We have also compared the activities of solar cycles 25 and 26 with solar cycles 5 and 6 (Dalton minima periods) and have observed that the other solar minima are underway but may be different in nature.