Long-Term Datasets for the Understanding of Solar and Stellar Magnetic Cycles
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Search for Correlation between Solar Flare Count and Mean Solar Magnetic Field

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Abstract. An investigation for search of correlation between the daily observations of mean magnetic field and daily flare count number in different class is studied here. The daily observations for mean magnetic field presented here are taken by Wilcox Solar observatory and daily flare count in different X-ray class is provided by National Centers For Environmental Information.

Keywords. Sun: flares, Sun: magnetic fields

1. Introduction

The perturbations in magnetic field are root cause of solar activity and hence space weather. The solar flares are a sudden release of large amount of magnetic energy in few seconds Somov, B. (2004), Tandberg-Hanssen & Emslie(2009), Shibata & Magara (2011), Fletcher et. al. (2011). The studies K. Kusano *et al.*(2012), Shibata & Magara (2011) reveal the dependence of flare occurrence on the structure and evolution of of local magnetic field over a small temporal scales. The daily solar mean magnetic field show periodic behaviour with longer periods of 11 years, and other periods of 1-2 years, 80-200 days, and 13-26 days as anlysed by Boberg et. al. (2002). The daily number of solar X-Class flares also show periodic behaviour with periodicities of occurence in different class in the range of 3 months to 400 months as studied by Gao & Xu (2016A) The periodicity of flare occurence also varies from cycle to cycle Gao & Xu (2016B). Here in this study we plan to analyze existance any correlation between the evolution of daily mean magetic field and daily flare count in different x-ray class.

2. Overview

The data presented here is taken from Wilcox solar observatory. The Wilcox observatory observes the daily mean magnetic field using Babcock type magnetograph Babcock (1953) since 1975 Scherrer *et al.* (1977) using Zeeman spliting in Fe I line at 5250 $\mathring{A}$. The data for solar flare numbers can be downloaded from web site of National Geophysical Data Center (NGDC) https://www.ngdc.noaa.gov/stp/space-weather/solar-data/solar-features/solar-flares/x-rays/goes/xrs/. The mean magnetic field have some breakes which are interpolated using spline interpolation. The date for which flare count is unavialable we have taken it as zero. We have used Pearson method

$$r = \frac{N\sum XY - (\sum X \sum Y)}{\sqrt{[N\sum x^2 - (\sum x)^2][N\sum y^2 - (\sum y)^2]}} \tag{2.1}$$

to calculate the correlation coefficient between the daily solar mean magnetic field and solar flare count in different class. We have used the R software to calculate the parameters computationally.

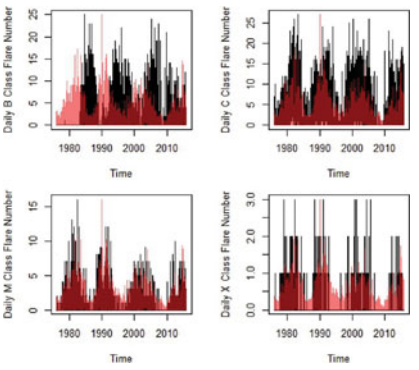

Figure 1. Temporal evolution of daily flare count in different class and overplotted absolute value of magnetic field

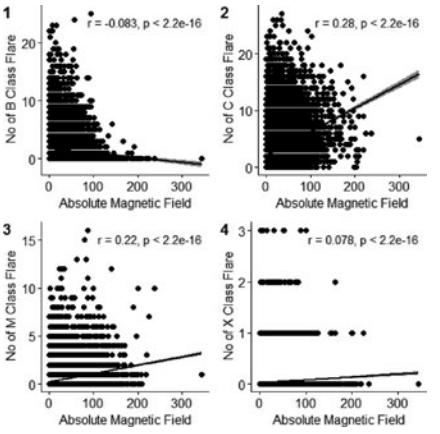

Figure 2. Cross correlation between evolution of magnetic field and flare count

3. Results and Conclusion

The figure 1 represents of evolution of daily flare count in X-ray classes. From top right to bottom left the evolution of daily count of flare is shown for class B, class C, class M and class X respectively. We have over-plotted the temporal variation of absolute value of magnetic field in red color. On x-axis time is plotted and on y-axis we have plotted flare count. The absolute value of magnetic field is scaled according to Y-axis. The figure shows that evolution of class B flare and magnetic field are in opposite phase, the class C, the class M and class X flare are in phase with magnetic field. The maximum daily count of no of class X flare is 3, for class M its 15, for class C flare and class B flare its 25. Figure 2 shows correlation coefficient between daily mean magentic field evolution and flare count for class B, class C, class M and class X in Panel 1, 2 3 and 4 respectively. The figures show very loose negative correlation between daily mean magnetic field and class B for other classes its positive. The values of r suggest an existance of strong or loose correlation between daily mean magnetic field and daily flare count in different class. The low r value and p-value can be atrributed to large sample size. We conlude that a more detailed and piece wise analysis is required for understanding the nature of correlation between daily mean magnetic field value and flare count.

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