Frequency analysis of SHARP data series prior to solar flare activity

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In this paper, we differentiate the magnetic field properties of active regions associated with solar flares. We used the data from the Geostationary Orbital Environmental Satellite (GOES) to identify C, M, and X class flares that occurred from 2010 to 2016. For each flare, we obtained the magnetic field information of the relevant active region from the Space-weather HMI Active Region Patches (SHARP) data series produced by the Joint Science Operations Center for the Solar Dynamics Observatory (SDO). We used the 12-minute cadence measurements from the SHARP data series as signals separated into two time periods relative to the time T of the peak flare activity: (1) from T-24h to T-12h and (2) T-12h to T. Fourier transform was applied to the signals created by each time period for each SHARP parameter. Comparing the intensities of the Fourier transform of the two time periods, the change in the intensities at each frequencies shows noticeable differences between each flare class. Across all frequencies, the change in intensity is highest for X-class flares with respect to the characteristic twist parameter (MEANALP), horizontal gradient of vertical magnetic field (MEANGBZ), and current helicity (MEANJZH) of SHARP regions. M-class flares have higher change in intensity compared to C-class flares in terms of the mean horizontal gradient of the total magnetic field (MEANGBT), vertical magnetic field (MEANGBZ), and photospheric excess magnetic energy density (MEANPOT). This treatment of SHARP data series as signals allows us to further understand the behavior of active regions prior to the release of flares and associate them with the flux strength of the flare.