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Different periodic behaviours of magnetic helicity flux in flaring and non-flaring AR cases

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We study the evolution of the normalized emerging, shearing and total magnetic helicity components for 14 flaring and 14 non-flaring active regions (ARs) using Spaceweather Helioseismic Magnetic Imager Active Region Patches vector magnetic field data (each of the selected AR contains the most complex δ-type spot). Wavelet analysis was performed for each AR. Then we looked for peaks in the periods appearing in the wavelet analysis, after which we performed statistical analyzes. The main findings of this study, (i) the Probability Density Function of peaks found in flaring and non-flaring ARs is that all of distributions of periods appear to be arranged in bands; (ii) from the correlation of the means of Gaussians obtained from Gaussian Mixture Model of ARs we can see that the emerging helicity component clearly becomes separate; (iii) the distributions of peaks before and after the flares changed in the flaring ARs. In all three cases it can be seen that the distribution of periods changes after the flare; (iv) if we see a δ-spot forming but we do not see that the periods in the emerging helicity would be shortened thereby no harmonic properties appear in it, then there is a good probability that flares will not occur; and (v) we can see that long periods (~20 hour) appear in the total and emerging helicity of flaring ARs, from which it can be concluded that if these periods appear we can expect flares.

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