Detection of Two Interacting Dynamo Waves in the Solar Cycles 21-23 with Principal Component Analysis of the Solar Background Magnetic Fields

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We present the PCA analysis of temporal variations of the solar background magnetic field obtained from Wilcox Solar Observatory in the cycles 21-23 and the sunspot magnetic fields obtained with SOHO MDI in the cycle 23. There are two principal components derived from the background magnetic field forming two off-phase waves of the opposite polarity travelling from the lower (below 40 degrees) latitudes of the opposite hemispheres towards the equator and then to the opposite hemisphere. The wave interaction occurs at different latitudes for different cycle around the maximums of the solar cycles creating the increased turbulence about a year prior and after the wave interaction time that may account for the double maximums observed as Gnevyshev and Ohl's law. The latitude of the two wave interaction seems to define the magnitude of the solar cycle being higher for higher latitudes and decreasing for the lower ones. The implications of the derived outcome on the solar cycle 24 appearance are discussed.

Keywords: solar activity; background magnetic field; sunspots, sunspot magnetic field; dynamo waves.

References

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