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The North-South asymmetry of solar activity: A signature of two coupled chaotic oscillators?

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The phase-coherent oscillatory dynamics on the 11-year frequency band (Schwabe cycle) is a common feature in all characteristic observables of solar activity. In this work, a wavelet-based framework [1,2] is applied for studying the mutual phase synchronicity of these oscillations. As a problem of specific scientific interest, the variability recorded on both solar hemispheres is systematically studied. It is demonstrated that time-varying phase shifts between the activity on Northern and Southern hemispheres provides a major contribution to the so-called North-South asymmetry (NSA). The presented results indicate that the NSA observations are consistent with the assumption of a different long-term phase diffusion of two weekly chaotic coupled oscillators, which evolve coherently in time. The obtained quantitative results on the variability of interhemispheric phase shifts are critically compared with the outcome of other studies using complementary methods of time series analysis [3]. The statistical reliability and implications of the derived long-term phase shift variability result are discussed. By using sophisticated methods for time series continuation and extrapolation [4], the recently hypothesised relationship between strong phase asynchrony of hemispheric variability and the occurrence of great minima of solar activity [5] is critically reexamined.

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