Analysis of Sun-Earth Connection Data with Methods of Nonlinear Dynamics

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We processed one of the indices of solar activity, Wolf number (Relative Sunspot Number), using the following data analysis methods: Fourier analysis, Wavelet analysis Hilbert-Huang analysis and Quantification Recurrence Analysis (RQA). Apart from that, a correlation analysis of the wolf number and the Aa index of geomagnetic activity has been conducted. Spectral analysis methods have found the well-known solar activity period of 11 years and longer periods as well. Compared to the Fourier and Wavelet analysis methods, the Hilbert-Huang Transform found quantitatively more and shorter periods. We investigated the dynamics of solar activity with several RQA measures. During solar activity, phase transitions have been observed that coincide with the minimum of activity. Analyzing the 21st century data, a new minimum has been observed, which will not be similar to the Maunder minimum.
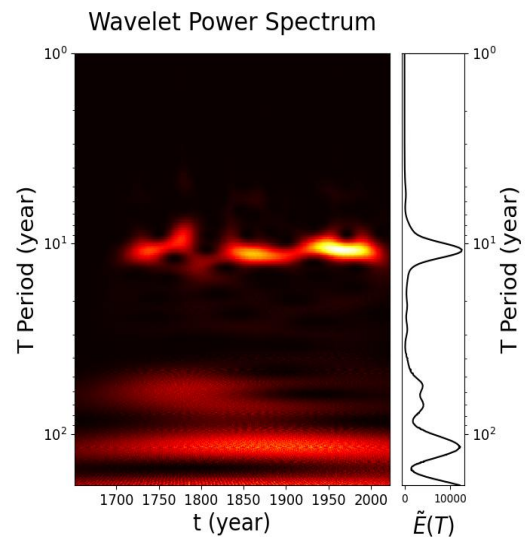

fig. 1: Wavelet power spectrum of wolf number. We can see that 11-year period isn't constant in time.

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