



North-south synchronization of dynamical processes at the Sun and the Earth

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A cross recurrence plot (CRP) analysis to study nonlinear interrelations and synchronization between time series has been applied to the solar activity and climatic variations at the Earth. Sunspots are remarkable features visible at the solar photosphere and display spatio-temporal patterns in the Northern and Southern Hemispheres of the Sun (Butterfly diagram). By using CRP tools we have analyzed long-term instrumental records of monthly averaged sunspot areas available for both hemispheres to find their complex relationships. It is found that synchronization exhibit quasi-regular behavior and can be associated with oscillations of North-South asymmetry of sunspot activity. We also considered North and South monthly averaged air surface temperature data to study synchronization and difference between climatic variations in the Northern and Southern Hemispheres of the Earth. As compared with the solar case, long-term temperature data are less synchronized than sunspot activity in both hemispheres. It is shown that temperature series exhibit near simultaneous phase transitions revealing their global origin. Interesting is that recurrent plots of sunspot numbers display near-synchronous phase transitions indirectly indicating evidence of solar activity impact on climate.