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Common oscillatory modes in solar, geomagnetic and climate data and their interactions: Statistical problems and implications for solar-terrestrial relationships

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Recently, a number of researchers have observed cycles with periods in the range 7 - 8 years in various meteorological and climate records including land/sea surface temperature, sea-level pressure, precipitation and river runoff records, sea ice extent or tree rings. Palus and Novotna have proposed enhanced Monte Carlo Singular System Analysis (MC SSA) in which, in addition to the signal covariance structure, regularity and predictability of the SSA modes is quantified and tested; and were able to detect an oscillatory mode with a period 7.8 years in long-term monthly near-surface air temperature records from several European locations, as well as in the monthly NAO index (Nonlin. Proc. Geophys. 11, 2004, 721-729). In follow-up analyses they identified an oscillatory mode with approximately the same period in the monthly geomagnetic activity aa index (J. Atmos. Solar-Terrestrial Phys. 69, 2007, 2405-2415). In this paper we extent the enhanced MC SSA analysis to solar data. Considering different statistical properties of analysed data, we discuss the occurrence of common oscillatory modes in solar and geomagnetic activity and in climate variability, possible interactions and synchronization of these oscillatory modes and their implications for solar-terrestrial relations.

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