



Long-term hindcast and forecast of solar activity variation based on the solar system resonance models

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The Schwabe frequency band of the Zurich sunspot record since 1749 is found to be made of three major cycles with periods of about 9.98, 10.9 and 11.86 years. The side frequencies appear to be closely related to the spring tidal period of Jupiter and Saturn (range between 9.5 and 10.5 years, and median 9.93 years) and to the tidal sidereal period of Jupiter (about 11.86 years). The central cycle may be associated to a quasi-11-year solar dynamo cycle that appears to be approximately synchronized to the average of the two planetary frequencies. A simplified harmonic constituent model based on the above two planetary tidal frequencies and on the exact dates of Jupiter and Saturn planetary tidal phases, plus a theoretically deduced 10.87-year central cycle reveals complex quasi-periodic interference/beat patterns. The major beat periods occur at about 115, 61 and 130 years (Gleissberg oscillation), plus a quasi-millennial large beat cycle around 983 years (Eddy Oscillation). A simple harmonic model based on the 9.98, 10.9 and 11.86 year oscillations hindcast reasonably well the known prolonged periods of low solar activity during the last millennium such as the Oort, Wolf, Sporer, Maunder and Dalton minima, as well as the seventeen 115-year long oscillations found in a detailed temperature reconstruction of the Northern Hemisphere covering the last 2000 years. The millennial three-frequency beat cycle hindcasts equivalent solar and climate cycles for 12,000 years. Finally, the harmonic model herein proposed reconstructs the prolonged solar minima that occurred during 1900–1920 and 1960–1980 and the secular solar maxima around 1870–1890, 1940–1950 and 1995–2005 and a secular upward trending during the 20th century: this modulated trending agrees well with some solar proxy model, with the ACRIM TSI satellite composite and with the global surface temperature modulation since 1850. The model forecasts a new prolonged grand solar minimum during 2020–2045, which would be produced by the minima of both the 61 and 115-year reconstructed cycles. The demonstrated geometrical synchronicity between solar and climate data patterns with the proposed solar/planetary harmonic model rebuts a major critique (by Smythe and Eddy, 1977) of the theory of planetary tidal influence on the Sun. Other discussions are added about the evidences of an influence of the resonances of the solar system on solar activity explaining also the Jose (159-185 year), the Seuss (200-220 year) and Hallstatt (2100-2500 year) oscillations.

References:

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