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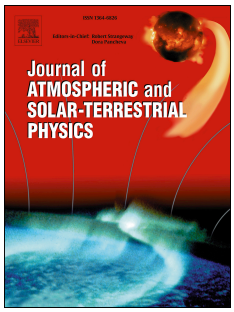

A deterministic model for forecasting long-term solar activity

Eleni Petrakou

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A deterministic model for forecasting long-term solar activity

Eleni Petrakou

Athens, Greece
(on leave from the Center for Axion and Precision Physics Research, Institute for Basic Science, Republic of Korea)

Abstract

A phenomenological model is presented for the quantitative description of individual solar cycles' features, such as onset, intensity, evolution, in terms of the number of M and X-class solar flares. The main elements of the model are the relative ecliptic motion of the planets Jupiter and Saturn, and its synergy with a quasi-periodic component of solar activity. Using as input the temporal distribution of flares during cycle 21, the general evolution of cycles 22-24 is reproduced in notable agreement with the observations, including the resurgence of activity in the last months of 2017, and further predictions are provided for cycle 25. This deterministic description could contribute to elucidating the responsible physical mechanisms and forecasting space weather.

Keywords: solar cycle, solar flares, forecasts

1. Introduction

Energetic solar events and the quasi-periodic variability in solar activity, known as the solar cycle, are widely attributed to the Sun's magnetic dynamo mechanism (Parker, 1955; for a recent review, Brun and Browning, 2017); however their modelling is still far from complete (e.g. Spruit, 2010; Brun and Browning, 2017) and no regulating factors have been established. Existing methods for the prediction of the timing and amplitude of solar cycles mainly

Email address: eleni@petrakou.net (Eleni Petrakou)