Deterministic driving in avalanche models for solar flares

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Abstract:

Solar flares are one of the main drivers of space weather mainly because coronal mass ejections are linked to the most powerful flares. Lately, many research efforts have pointed to understanding and forecasting the most intense flares (Barnes et al, 2016 and Leka et al, 2019).

Since being used for the first time by Lu and Hamilton in 1985 avalanche models of solar flares have been successful in reproducing the main statistical observational features of solar flares. Moreover some authors have argued that they could represent a new approach for large (typically X-class) solar flares predictions based on simple and computationally inexpensive simulations (Strugarek & Charbonneau, 2014).

Solar flares forecasting could be achieved by studying the main characteristics of waiting times statistics. In this work we developed a 2D avalanche model for solar flares inspired in the Lu & Hamilton cellular automaton but with a modification: in this case we used a used a deterministically driver.

We studied the avalanche exponents for this model and calculated three alternative definitions of waiting time as introduced by Sanchez in 2002. Preliminary results suggest that the statistical behaviour depends on the waiting time definition with the traditional waiting time definition being the less useful for flare forecasting. Further studies are under way to validate our results.

References:

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