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A proportional hazard model for the estimation of ionosphere storm occurrence risk

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Severe Ionosphere magnetic storms are feared events for integrity and continuity of navigation systems such as EGNOS, the European SBAS (Satellite-Based Augmentation System) complementing GPS and an accurate modelling of this event probability is necessary. Our aim for the work presented in this paper is to give an estimation of the frequency of such extreme magnetic storms per time unit (year) throughout a solar cycle. Thus, we develop an innovative approach based on a proportional hazard model, inspired by the Cox model, with time dependent covariates. The number of storms during a cycle is supposed to be a non-homogeneous Poisson process. The intensity of this process could be expressed as the product of a baseline risk and a risk factor. Contrary to what is done in the Cox model, the baseline risk is one parameter of interest (and not a nuisance one), it is the intensity to estimate. As in Extreme Value Theory, all the high level events will be used to make estimation and the results will be extrapolated to the extreme level ones. After a precise description of the model, we present the estimation results and a model extension. A prediction for the current solar cycle (24th) is also proposed.

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