The clustering of polarity reversals of the geomagnetic field: a constraint for geodynamo modelling

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Often in nature the temporal distribution of inhomogeneous stochastic point processes can be modelled as a realization of renewal Poisson processes with a variable rate. Here we investigate one of the classical examples, namely the temporal distribution of polarity reversals of the geomagnetic field. In spite of the commonly used underlying hypothesis, we show that this process strongly depart from a Poisson statistics, including variable rate Poisson statistics. The origin of this failure can be attributed to the presence of temporal clustering. We find that a Lévy statistics is able to reproduce paleomagnetic data, thus suggesting the presence of long-range correlations in the underlying dynamo process. Our results introduce a constraint for geodynamo modelling, and the probability tools we use can be viewed as a benchmark for further applications to various stochastic point processes.