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Observation of intermittency-induced critical dynamics in geomagnetic field time series prior to the intense magnetic storms of March, June and December 2015

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Criticality has been proposed as a suitable framework to study the nonlinear system of the Earth's magnetosphere. The magnetic field variations observed by the mid-latitude HellENIc GeoMagnetic Array (ENIGMA) with respect to the most intense magnetic storms (Dst < 150 nT) of the current solar cycle (i.e. 17 March, 23 June and 20 December 2015) are analyzed using the method of critical fluctuations (MCF). We show that the application of MCF to the ENIGMA time series reveals the existence of intermittency induced criticality in the range of 6 to 45 hours prior to the onset of these events. The results suggest that the underlying dynamical processes in the magnetosphere prior to intense magnetic storms present dynamics analogous to those of thermal systems undergoing second order phase transition.