

Interactive comment on “Toward a possible next geomagnetic transition?” by A. De Santis et al.

Anonymous Referee #2

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Dear Editor,

I have reviewed the discussion paper “Toward a possible next geomagnetic transition?” by De Santis et al. for the journal Natural Hazards and Earth System Sciences (NHES) and found it an interesting, original and well-written paper. The study is related to an important global natural hazard associated with the geomagnetic field, i.e., the South Atlantic Magnetic Anomaly. The authors utilize a modern concept of complex systems theory (the discrete scale invariance) to forecast an important extreme event, i.e., a possible reversal or excursion of polarity of the geomagnetic field.

Self-similar systems are characterized by continuous scale invariance and, in response, the existence of power laws. However, a significant number of systems exhibit discrete scale invariance (DSI) which in turn leads to log-periodic corrections to scaling that decorate the pure power law. A number of studies have proposed spatial and/or

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temporal log-periodic behavior in ruptures, seismicity, ground-water, bronchial trees, financial systems, and models (for a review see Malamud et al., Nonlinear Processes Geophysics 2005). Additionally, Balasis et al. (Geophysical Research Letters 2011) found that the time series of the geomagnetic activity index Dst, which is associated with magnetic storms, exhibit DSI. They showed that by using the Dst index the derived energy dissipation rate prior to a magnetic storm displays log-periodic oscillations on top of the leading-order power law form. The latter was used for the determination of the time of occurrence of an approaching magnetic storm. In this context, the application of the log-periodic approach by De Santis et al. to the geomagnetic field data of the South Atlantic Magnetic Anomaly is absolutely meaningful and has a physical basis.

The study is very timely with respect to the expected launch of ESA's Swarm magnetic field mission (November 2013). The new data from the multi-satellite Swarm mission are expected to advance the geomagnetic field models and therefore the accuracy of the IGRF model that the study uses for forecasting this extreme geomagnetic event, and thus will enable De Santis et al. (or other researchers that will be given the opportunity to read and informed by this paper after being published as a regular NHES paper) to estimate even more accurately the critical point in a few years follow-up study.

Another highlight of this discussion paper is that these results demonstrate the principle of universality in the behavior of different complex systems around their global instability, as the same equations are shown to hold for earthquakes (e.g., Sornette and Sammis, 1995; Sornette, 2006) and geomagnetic excursions (this study). Therefore, the publication of this NHES discussion paper as a regular NHES paper will be of interest and benefit not only geomagneticians but also for seismologists, geophysicists etc.

Therefore, I strongly recommend its publication in the journal NHES as it is.

Sincerely,

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Please also note the supplement to this comment:
<http://www.nat-hazards-earth-syst-sci-discuss.net/1/C1481/2013/nhessd-1-C1481-2013-supplement.pdf>

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 1, 5117, 2013.

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