

Review of the manuscript: “ **Toward a possible next geomagnetic transition**”  
by A. De Santis et al.

In this paper different curves are fitted to estimates of the South Atlantic Anomaly (SAA) surface area (at Earth surface) made for different epochs. These curves are then extrapolated and the authors deduce that the core will reach a critical point of its evolution around 2034, entering then an irreversible process that may lead to a reversal or an excursion of polarity. Similar techniques are used for the global mean sea level (GSL), reaching also some critical point. I will not comment on the latter result, as I am not a specialist of these types of data.

The paper in my view presents several weaknesses and therefore is not publishable in a scientific journal. Outside the questionable extrapolation process, I think there are at least two major issues that the authors should address:

1- It is not discussed in the paper in what the variation of the surface included in the 32 00 nT isoline, at the surface of the Earth, characterizes the state of the core. This surface area can increase, or decrease, for numerous reasons such as a general decrease of the observed magnetic field strength without an increase of the magnetic field complexity, or by a simple decrease of the dipole field or finally an increase of the field complexity without decrease of the dipole field strength. Numerous other mechanisms can probably be defined that would lead to a change of the surface of the area, however none of these mechanisms give any information on the state of the core, the strength of the magnetic field inside the core, or the vigor of the convection in the liquid outer core. The authors should therefore demonstrate that the surface of the SAA, as defined by the area included in the 32 000 nT isoline, is a relevant indicator for the state of the core.

2- One of the important steps in the work presented is fitting functions of times (described in section 2) to the estimated area of the SAA. For this fit to be acceptable a proper estimation of the level of error in these area estimates has to be done. This in turn can lead to an estimation of the accuracy of the extrapolated curves. Data error estimates are not presented in the paper even if this is an essential piece of information that needs to be described in order to assess the validity of the final results.

In my view, defining an accurate error budget for the area of the SAA is not possible. Not only one has to find what is the accuracy of the Gauss coefficients (That is, may be, possible for GUFM but probably not for the IGRF/DGRF), but also one has to estimate what are the contributions of the unknown small scales of the magnetic field. One also has to estimate what effect has on the SAA area the regularization process applied for deriving magnetic field models from geomagnetic data. From Fig 1 it is clear that the fit to the area estimated from the IGRF/DGRF 2005, 2010 is not particularly good, whereas these two models are probably the two most accurate models of the whole IGRF/DGRF series.

I am here reporting two first obvious remarks, but the choice of the fitting functions, the stability of the extrapolation process and the link to the GSL also need to be discussed.

Detailed comments:

1- page 5120 ,Line 15: The sentence is unclear. The magnetic field strength of a dipole is the weakest at the dipole equator. I assume that in the second sentence of the paragraph, the authors refer to a field that is more complex than a pure dipole. This should be stated.

2- Page 5121, Line 5: The South Atlantic anomaly is a depression of the geomagnetic field **strength** at the Earth surface. Please add "strength".

3-Page 5121 Line 10. Sentence starting with " In practice,..." is unclear and probably need rewriting. What is the link of a magnetic monopole with a vortex in the liquid outer core?