Nonlin. Processes Geophys. Discuss., 1, C767–C768, 2015
www.nonlin-processes-geophys-discuss.net/1/C767/2015/

Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "Transient behavior in the Lorenz model" *by* S. Kravtsov et al.

Anonymous Referee #2

Received and published: 9 January 2015

The manuscript intends to report, in a concise way, on the transient behaviour displayed by the Lorenz model. My overall evaluation is that this manuscript does not deserve publication since it does not contain significant results. Moreover, the mathematical treatment is misleading at crucial points concerning the structure of the Lorenz attractor and the concept of local Lyapunov exponent.

First of all, it looks like the authors do not know that the origin and its unstable manifold are the edge of the Lorenz attractor (see e.g. [1]). This means that the box they construct to bound the attractor is plain wrong.

The manuscript introduces, with no much justification, a sphere to initialize the trajectories. The "spiral belts" with long transients reported are simply the intersections with the stable manifold of the origin. The authors are apparently unaware that this manifold has already been studied in detail in several publications, see e.g. [2]. There are no

novel findings in the disparity of transients observed.

In the conclusions, it is claimed that "The properties of the transient behaviour in the Lorenz model discussed here [...] are likely to be typical for arbitrary equations exhibiting chaos". This claim does not hold since the attractors of many models (e.g. the Rössler model) do not have a saddle point on its edge, and this has a strong influence on the behaviour observed, as explained above. Results are absolutely particular for the Lorenz model.

Finally, the definition of local Lyapunov exponent introduced to make Fig. 2 is meaningless. The averaged maximal eigenvalue of the Jacobian matrix along a trajectory, does not give correct information of how much different initial conditions (may) diverge. Of course, some qualitative agreement with a well defined definition may arise, but this is basically accidental. I recommend the authors to read [3] or [4], if they want to use the notion of Lyapunov instability with the required mathematical rigor.

[1] J. Guckenheimer and P. Holmes, Nonlinear oscillations, dynamical systems, and bifurcations of vector fields, Springer-Verlag (1983).

[2] B. Krauskopf and H. M. Osinga, The Lorenz manifold as a collection of geodesic level sets, Nonlinearity 17, C1–C6 (2004).

[3] B. Legras and R. Vautard, in Proceedings of Seminar on Predictability, ECMWF Seminar Vol. 1, edited by T. Palmer ECMWF, Reading, UK, 1996, pp. 135–146.

[4] E. Kalnay, Atmospheric Modeling, Data Assimilation and Predictability, Cambridge University Press, Cambridge (2003).

Interactive comment on Nonlin. Processes Geophys. Discuss., 1, 1905, 2014.