Nonlin. Processes Geophys. Discuss., 2, C481–C482, 2015
www.nonlin-processes-geophys-discuss.net/2/C481/2015/

Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "Brief Communication: Breeding vectors in the phase space reconstructed from time series data" *by* E. Lynch et al.

Anonymous Referee #2

Received and published: 12 October 2015

The authors present a purely data driven method to extract from a given time sieres dynamical information about the underlying dynamical system. To this extend they combine the bred vector method with the time delay embedding method to construct the phase space of the dynamical system. Within this reconstructed phase space pairs of nearby trajectories between a control and an initially nearby trajectory are piecewise followed over a specified time interval to measure the final separation distance. At this point the bred vector idea comes into play. After a rescaling of the final separation vector a local search in phase space for trajectories close to the final control phase space point shifted by the rescaled final separation vector of the previous iteration is initiated. After a proper identification to avoid points on the control trajectory, the next

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piecewise tracking is initiated. The growth rates at the end of each interval are the basic information derived from the analysis. The method is applied to the Lorenz 1963 L63 model. Three set ups are compared: (1) the standard breeding using the explicit L63, the proposed model, and an intermediate one where the time delay embedding is not used in favor of the original three dim L63 structure. The methods are compared by monitoring the local growth rates along the control trajectory and using positive large values as predictors for the regime shifts between the two leaves of the L63 attractor. With respect to this metric the new method performs reasonably well and the authors conclude that the new method provides a purely data-driven way to diagnose regime shifts for dynamical systems not well or not at all described by a set of equations.

In principle the paper is worth to be published in NPGP. It contains new information e.g. the proposed method and offers (some) help in interpreting the results. However, there is no clear conclusion or message especially with respect to data requirements and/or the dimensionality of the dynamics. The authors simply state that they ensured sufficient data density in three dimensions. But it would be worth to see how the contingency table statistics degrade when the actual data density is reduced. Although it is only a result for the idealized L63 it can give hints about the performance using real data. Another nice-to-know information would be on the frequency distribution (estimated probability density) of the calculated growth rates for the three test beds. This would again give more confidence into the new method than the simple thresholding of looking at large growth rates. So my major suggestion before publication of this paper is that the authors should provide a clear message to the reader and potential user: is it worth to apply the method to other types of (real) data because the method is generic or are the results specific to the chosen setup?

Interactive comment on Nonlin. Processes Geophys. Discuss., 2, 1301, 2015.