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Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "Earthquake sequencing: Chimera states with Kuramoto model dynamics on directed graphs" *by* K. Vasudevan et al.

Anonymous Referee #1

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The paper entitled "Earthquake sequencing: Chimera states with Kuramoto model dynamics on directed graphs" by K. Vasudevan, M. Cavers, and A. Ware is to implement the Kuramoto model on the non-linear dynamics on a directed graph of a sequence of earthquakes. Directed graphs are derived from global seismicity data and they specified the conditions under which chimera states could occur.

The research question is relative interesting and the proposed model sounds reasonable. The physical background of the paper is based on the data related to earthquakes and to investigate chimera states. But what can we learn from chimera states?

Through out the paper, the authors used 7000 transition steps size. The integrating steps are not enough for large number of nodes (>5000). For example, the appearance of Fig. 4(a), 6(a) and 7(a) look like the transition instead of stationary states. Also in

the paper, there are two terms related to the original dynamics, consisting of the time delay and the phase lag. But the authors did not mention the values of these two terms.

In the following, I have some smaller points:

Line 16 on Page 2: What do you mean by "the Kuramoto model yields synchronization"?

Line 2 on Page 5: It would be better to change the word "propose" in " we propose a simple non-linear mathematical model, the Kuramoto model..." to the word "modify". As in the paper, the authors modified the Kuramoto model for the sequencing of global earthquake data.

Line 7 on Page 6: The authors focused on a stable solution. But in the following references, for example, Abrams and Strogatz, 2004, chimera states are not stable. That means nodes belong to the synchronized group are not fixed.

Line 13 on Page 6: The authors claimed that "We target our present study to defining a pulse-coupled or threshold-coupled oscillator model that would accommodate the existence of chimera states." But through out the paper, the authors did not mention the pulse-coupled or threshold-coupled oscillator model.

On Page 6: It would be good to introduce the literature, for example the authors' previous work on "the Kuramoto model with synthetic networks..", in the section of "Introduction".

Line 4 on Page 7: α indicates the phase lag. As claimed in other papers (e.g. Abrams et al. 2004 PRL or 2008 PRL), its value is crucial to determine the existence of chimera states. But the authors did not mention the selection of the value of α.

Line 1 on Page 8: the time delay is very crucial to determine the existence of chimera states. But the authors did not mention its selection.

Line 9 on Page 13: a mathematical problem. Suppose that substituting Eq. (6) into Eq.

(5), and then replace its coupling term by the real part of the order parameter, one can get the coupling term as $Kr\sin(\psi - \theta)/N$ instead of the last term of Eq. (8).

Line 23 on Page 15: The authors mentioned the time-delay term of Eq. (1) and listed some references. But none of these references considered the term of time delay.

Line 12 on Page 20: why is it the chaotic dynamics?

In Fig. 1, why the value of the color bar could be less than 0 (proportional to its occurring frequency)?

From Figs. 4 - 8, are the nodes' index of panel (a) and that of panel (b or c) the same?

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