Earth System Dynamics Discussions

Earth Syst. Dynam. Discuss., referee comment RC1
https://doi.org/10.5194/esd-2022-16-RC1, 2022

Comment on esd-2022-16

Anonymous Referee #1

Referee comment on "Governing change: a dynamical systems approach to understanding the stability of environmental governance" by Nusrat Molla et al., Earth Syst. Dynam. Discuss., https://doi.org/10.5194/esd-2022-16-RC1, 2022

This manuscript provides a very interesting and innovative set of stylized modeling experiments to explore the stability of governance structures in environmental systems. The evaluation of system stability across thousands of governance structures using a generalized dynamic systems modeling approach is particularly novel and insightful. The manuscript is well written and organized. I'd suggest the authors address the following comments to further improve the manuscript:

1. The modeling approach necessarily deals with a stylized, abstracted representation of environmental governance systems. While there is some attempt to draw analogies between the mathematical abstraction and real-world systems in the introductory text, such analogies are largely excluded from the description of the model itself, the results, and the discussion/conclusion. I think the manuscript could be improved by providing examples of tangible aspects of real-world systems that the mathematical abstractions might represent (or using a single example, e.g., groundwater systems, and carrying it through the entire manuscript to aid readers with interpretability and bring the modeling formulation to life a bit more)

2. I'm not seeing where "stability" is clearly defined, both conceptually and mathematically. Perhaps I missed it. Regardless, a concise definition of the concept should be up front and center given the manuscript's focus.

3. While the effort to deploy thousands of structural variants of the environmental system is impressive and laudable, it seems to me that the revealed system dynamics still may be subject to higher-level structural assumptions regarding the nature of actor interactions. For example, NGOs are not directly tied to the state of the resource, whereas one might argue that NGOs are inversely (loss term rather than gain term) related to resource state (e.g., the tendency for environmental NGOs to emerge/grow as a particular environmental resource degrades). Likewise, actors could be viewed as operating within a nested structure (e.g., individual resource users interested in preservation of a resource

comprising an NGO). While I understand that such a stylized formulation cannot touch upon all of these elements, I think the advantages/disadvantages of the proposed formulation can be further interrogated in the discussion.

4. Given the modeling interest on actors' ability to influence policies or capacities of other actors, there might be some interesting and relevant connections with the power relations and sustainability transitions literature (see for example Avelino and Wittmayer, 2016). Perhaps this could be further explored in the introduction and/or discussion/conslusion.

5. The assumption of a Nash-equilibrium in actors' allocation of efforts is a strong one and receives very limited treatment in the manuscript. While I understand the adoption of the approach from a computational and conceptual standpoint, I think further elucidation of the implications and limitations of such an approach is warranted.

6. The abstract mentions a system's ability to "adapt to social and environmental change" and recover from "perturbations". Can the authors speak more to how perturbations of the system (in the form of either short-term shocks or gradual stressors factors) relates to the formulation? What exactly are the "perturbations in the variables controlled by the governance system" in this particular setup? And how does the concept of stability connect? I think a clearer defintion of stability (see comment above) and some added discussion could bring clarity to this.

Minor editorial comments:
Figure 1 - mismatch between F2,1,1 in the legend and F2,1,2 on the figure
Line 126 - "non-government" to "Non-government"
Line 138 - "them These" to "them. These..."
Figure 2 - Add "small system" and "large system" labels to the graphs (not just the captions) for readability