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Earth System Dynamics Discussions



# *Interactive comment on* "Interacting tipping elements increase risk of climate domino effects under global warming" *by* Nico Wunderling et al.

**Anonymous Referee #2**

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This paper presents an interesting extention of the Dekker et al. (2018) work on cascading tipping behavior by considering the possible cascading interactions of five potential tipping elements. The strenght of the paper is clearly the large-scale Monte Carlo approach such that the overall behavior of the dynamical system (1) is studied. A clear weakness of the paper is the connection to climate dynamics. I suggest that the authors try to rewrite the paper to strengthen the latter aspect; the comments below are intended to help with this.

1. Whereas one could justify (e.g. from conceptual models) that saddle-node bifurcations, underlying the individual dynamics term in (1), are relevant for the AMOC, ice sheets and Amazon rain forest, this does not hold for ENSO. Although this is mentioned in the paper (e.g. l63-64 and l75-78), there is no discussion on this issue. ENSO is also



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problematic because its behavior may not change substantially under climate change (e.g., in CMIP5 models (Kim et al., 2014).) The best way out is probably to omit ENSO from the list of tipping elements; the results will very likely still be interesting. If the authors want to keep ENSO, they should better justify the use of (1) for this tipping element.

2. The coupling between the tipping elements is too sketchy at the moment and requires more discussion and analysis. The coupling terms $s_{i,j}$ are now more or less 'guessed' but there are results of EMICs (e.g., Climber, Loveclim and modern variants) where such linear coupling coefficients could be estimated (e.g. from regression analysis). This would also shed more light on the part of the state vector ($x_i$ in (1)) where the coupling occurs (as now only sketched in Table 2). Dekker et al. (2018) have done this to establish the relation between the AMOC and ENSO (meridional Atlantic temperature difference and the equatorial wind stress). I realize that this is more work, but it would enhance the quality and possible impact of the paper significantly.

3. With ENSO removed and a better justification of the linear coupling from EMIC results (points 1 and 2 above), the interpretation of the results in Fig. 4-6 can be much improved. This in particular holds for the interesting result that the coupling destabilizes the reference climate state (as mentioned in the paper l268-270). Section 4 can then be substantially improved and it would be particularly helpful to the community if suggestions would be given on climate model experiments (even with EMICs) which could test the occurrence of this cascading behavior.

There are several more minor issues but as the paper probably is rewritten substantially with different results, I will not mention these here.

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