Tipping cascades between conflict and cooperation in climate change

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Review comments second round

Editor comments: The reviewers provided considerable additional recommendations for further revising the manuscript. Particularly, please consider the balance between theoretical framework, literature review and Lake Chad case study raised by the reviewers.

Report #1: Submitted on 31 Jul 2024 by anonymous referee #3

Some of the authors are leading figures in the field. This lends them strong credibility within this non-double blind review process. In line with the authors' earlier publications, the article focuses on the crucial effort of utilizing complexity ontology for a more valid policy-guiding climate security nexus research.

However, I see some major issues with the article that should be addressed before seeing the manuscript fit for a more nuanced next revision round.

In particular, it is not always easy to follow the manuscript. I guess that this has several reasons:

1. The manuscript seems to be intended as review article. But it does too many things at once: It reviews existing literature on tipping point modelling and applies tipping point modelling to a case study of Lake Chad. Accordingly, there are passages that serve the one purpose but don't fit well with the other. This applies, for example, to sections 4.1 and 4.2. These are captivating reads for a history-informed review of social science modelling (Seriously, I read it with great interest!). But they are not helpful in preparing the reader for the Lake Chad case study. Given the page limits, it would help to develop this manuscript either into a theory-focused literature review (then drop the empirical case study) or into an empirical case study (then shorten the theory section into a serving section that provides only those aspects that are needed for the empirical part).

Response: Thank you for raising questions on context and content of the manuscript and giving advice to make it fit for publication. While the article over large parts is a review article on the linkages between climate conflict, tipping cascades and modeling, it is constrained by the limited and selected number of publications on this intersection and does not aim to review each of the large fields separately (climate, conflict, tipping, cascades, modeling) which would be too much for one review. Based on the review and related concepts we also aim to develop and demonstrate initial ideas and research pathways to integrate these concepts in a modelling framework and case study. At first glance this may appear much for one article but we think the purpose of reviews is not only to repeat what existing publications say, but also to develop ideas for integration and application following from the review, with possible insights for future research. In our view the social science modeling reviewed and described in Sections 4 and 5 introduces methods (such as the Richardson, VIABLE and bi-stable models) relevant to the title and topic of the paper, and are not limited to preparing the Lake Chad case study (Sect. 6 and Fig. 6) which is not meant to be the integrative highlight of the whole paper but an illustration of some of the concepts and methods, in particular the bi-stable model which is also applied in Sect. 5.2 and Fig.5. To address the reviewer's concerns and find a better balance we shortened the manuscript from 32 to slightly above 28 pages and the main text from 13,860 to 11,950 words (incl abstract), in particular in Sections 4.1, 4.2, 5.3 and 7, but keeping the empirical network tipping example in Sect. 5.2 and the Lake Chad case study in Sec. 6 with its model part 6.2 which was explained in more details (including the figure).

2. In the current form, the pursuit of two goals at once also results in a misbalance between an about 16 page-long theory section and an about 6 page-long application section. Within the empirical section it is confusing that further cases (Syria, South Asia) are discussed before the article turns to the actual case. Moreover, chapter 7 discusses "governance challenges" and political options. This is certainly important but follows somewhat isolated.

Response: In the previous manuscript we do not count everything until page 16 as theory, much is a review of literature on climate conflict and tipping cascades with references to empirical studies and regional cases ending on page 10. On page 11 we started with the 8-page model Sections 4 and 5 which in the revised paper are reduced to nearly 6 pages. We hope to have now a better balance of the different sections. We do not aim for an indepth case study which here serves as an illustration to the review and theory parts to demonstrate the relevance of the conceptual issues that could be extended in the future. Other cases where climate conflict and tipping are connected (Syria, South Asia) are moved from Sect. 6.1 to the hot spots Sect. 3.4 as a background to the later Lake Chad case, avoiding the streetlight effect. We significantly reduced Sect. 7 on "governance challenges" (together with parts of Sect. 3.5) which we find relevant to address options of positive and negative tipping between conflict and cooperation, which is a core issue of the whole paper and its title.

3. Some passages are not in plain English or difficult to understand. For example: What do the authors mean when they write "Whether climate stress drives a system from undesirable to favourable pathways, from conflict to cooperation, or from vicious or virtuous circles, pathways and opportunities for action consider enabling and constraining conditions."?

Response: Sorry if the language was not always clear and adequate to presenting the complex issues. We checked, revised and shortened the whole manuscript in terms of language and understanding, including the mentioned sentence.

4. The article's organization is not always intuitively obvious to the reader. For example, section 6.3 announces that the article will "demonstrate how in the Lake Chad case study meso-scale groups and communities can exhibit diverse and dynamic behaviours when under climate stressors" (line 794-795). Where is this demonstration? Is figure 7 the demonstration? I believe that figures alone are not a sufficient case discussion (adding to the more general point that this article should either develop into a theory-focused literature review or an empirical case study and, in the latter case, expand the empirical part).

Response: In addition to streamlining the manuscript, condensing some sections and strengthening connections between the parts, we included a few edits to better explain and integrate the Lake Chad case study. We have enhanced our detailed description relating to Fig. 6 (previously Fig. 7) and how it relates to the Lake Chad narrative, for which evidence of the main pathways is given in Sect. 6.1. In particular, we highlight how internal fragility of societies as well as external forcing by climate stressors, collectively enable transition from cooperation to conflict. We show two cascade pathways: (1) the tipping bias that drought can apply to fishing communities – forcing them away from the lake and lowering the barrier to social transition, and (2) the ensuing power vacuum draws in conflict actors and economies which raises the barrier for transition back to peace even when a wet season returns.

Moreover, a few other aspects:
5. A LOT of passages are insufficiently referenced and need referencing. For several other passages, more recent references exist. Moreover, at least one reference from the main text does not appear in the references list (Kavalski 2015) and another one is spelled differently in the main text and the references (Is it Shaik or Sheik Dahir?)
6. A more content-focused aspect on the impacts from climate change on Lake Chad: What do the authors make of the points raised by Selby and Daoust (10.1080/14650045.2021.2014821, pages 1288-1291) who doubt the claims that Lake Chad is shrinking and that this is due to climate change? Given that Selby and Daoust raise some serious doubts, good references

would be needed to justify the claims (lines 735pp) that lake Chad is indeed shrinking and that this is, if partially, a result of climate change. Moreover, the authors' position on what happens at Lake Chad becomes less clear given that they mention some expansion, rebounding and recovering of the Lake later on (lines 781pp).

Response to 5: While the text became shorter, we have included more recent references to an already long publication list, besides removing a few others (including some own work), besides making suggested corrections (Kavalski 2015, Sheik-Dahir). Although there could indeed be many more pulications on each of the individual topics (climate, conflict, tipping, cascades, modeling), we tried to limit the number to those that were instrumental to clarify the linkages and intersections between these fields of research.

Response to 6: We do not claim a continued shrinking of Lake Chad and thought we had already taken the doubts about climate-related water levels of Lake Chad into consideration referring to "some expansion, rebounding and recovering of the Lake later on". Our point is that the variability is a challenge which implies that a moving shoreline transversing the Lake's riparian countries is a stressor. To address the concern, we included the following reference and sentence: "Selby and Daoust (2022) find the policy discourse on conflict and security implications of climate change overstated, misleading, and out of line with scientific evidence."

Report #2 Submitted on 01 Aug 2024 by anonymous referee #2

The authors responded to all my comments satisfactorily. I only have two minor observations:

- It remains opaque to me why the authors included the sentence "Going beyond optimal decision-making models" at the beginning of Sect 4.2 and then talked about optimal decision-making in games. Or do the authors argue for considering game theoretic models as agent-based models?

Response: We are glad the reviewer is satisfied by our responses. We removed the sentence on "optimal decision-making models" and the connection between game theory and agent-based models.

- It is a pity that the tracked-changes version of the manuscript does not show deletions.

Response: Sorry for not showing deleted changes. We assumed that showing the revised parts in blue is sufficient. We will keep tracked changes in this version.

Report #3: Submitted on 06 Aug 2024 by anonymous referee #4

This is a thoughtful, detailed literature review of the approaches to conceptualize and measure tipping points in the Anthropocene (although this term is never mentioned). Such an article is timely and necessary in the current academic, political, and ecological climate and I recommend this paper published with minor revision. Several general comments and specific line edits are outlined in more detail below.

1. There is a concern about decoupling already vulnerable conditions that can easily escalate into a cycle of violence vs. actually assessing the thresholds of trigger points, which you also show expressed concern for on line 247. How to delineate between the two? Is it only places

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with the necessary preconditions (i.e. reliance on rainfed agriculture) it is possible to set such thresholds, or any place? How can these be made more context specific?

Response: We appreciate the supportive words and included the term Anthropocene. Cycle of violence and thresholds of trigger points are connected as the first can be triggered by the second which is context and place dependent. What matters is the combinations of critical factors for climate change and conflict, and if one is missing the likelihood for the other is lower and may be sub-critical. Rainfed agriculture is a possible connector, being sensitive to climate change while conflict is sensitive to agricultural losses.

There is a conflation of chronic, climate change impacts versus short onset disasters. Surely these would generate differing triggers depending on if it's a short onset hurricane or flood versus a slow onset drought.

Response: Time and space matter in tipping processes and have a different scale in short-term events (hurricanes) and long-term events (droughts) which have a different dynamics of tipping and related cascades, where the former require responses on a shorter and smaller time scale while the latter need long-term adjustment over larger regions. A long term disaster acts as a general bias (e.g., an inclination to tip), whereas a short term disaster is more a push/force in one way. There is a short note on page 5

While the literature review is somewhat exhaustive, there seems to be a lack of identifying particular disciplines that focus on AGM. These studies seem to be political science dominated, but what are other disciples doing? Is there a need for interdisciplinary integration? Additionally, the first author's work is cited heavily and major works by other research groups from the climate-conflict literature in political ecology and geography are missing.

Response: The literature is meant to be interdisciplinary and not limited to political science. To balance the literature on climate and conflict we reduced those by the first author (who works in geography) and have included references from other authors and fields, including ecology where both system and agent models are popular.

The Lake Chad case study seems like a questionable example given the attention to issues of the 'streetlight' effect but additionally, could be expanded upon considerably. It is not completely clear the temporal scale of the fisherman moving out and leaving a political vacuum and needs considerably more explanation to be a convincing application of your framework. Researchers should be able to apply your VIABLE framework to other case studies.

Response: We had mentioned the streetlight effect before and besides Lake Chad shortly discuss climate-conflict cases in other regions (Syria, South Asia) in Sect.3.4. We have now clarified the expectations on what the case study should achieve. It is not meant to be an example of generalizing problems in climate-conflict interaction models, but rather to serve as an illustrative example on how different mechanisms and consequences can be reflected in the model(s) in Sect. 4 and 5. In Sect. 6, we explain: "*Following the climate-security discussion in Sect. 3, the review of tipping models in conflict and cooperation in Sect. 4 and the analysis of the transition dynamics in the bi-stable tipping model of Sect. 5, we now illustrate the conceptions and models for a regional example of a climate security hot spot familiar to many researchers, centred around the Lake Chad region. Translating qualitative narratives to quantitative networked tipping models introduced in Sect. 5, we show how different governance approaches (e.g., support vs. competition) and migration patterns can lead to an erosion or raising of barriers in conflict-cooperation transitions. The purpose is to show how narratives can map to models and not to develop a detailed or generalised Lake Chad climate-conflict scenario which is left to future research, e.g. implementing the VIABLE model.*"

Line edits:

Introduction: A bit reductionist, exaggerates the chaotic aspects of climate change without full discussion of alternative outcomes including peacebuilding and cooperation.

Response: In addition to introductory statements "to stabilize the Earth system and to develop forward-looking adaptation policies that prevent violent conflict and enable cooperation" we follow the reviewer by suggesting to "discuss alternative outcomes of positive tipping including peacebuilding and cooperation" which is then further discussed in Sect.3.5 and Sect. 7.

Section 2.2: elaborate more on social tipping points in general- i.e. consider including an example of political tipping points

Response: While social tipping points are shortly mentioned in Sec. 2.2 and 3.1 (with few references), examples of social-political tipping points are now given in Sect. 3.4 (hot spots in Syria, South Asia and Lake Chad, further discussed in Sect. 6).

Section 2.3: Turning points in history it could be argued are tipping points? Or are they different ? Be super clear in terminology

Response: We replaced "turning point" by "tipping point" to avoid alternative terms.

Section 6.1: Seems this section could be moved up earlier to section 2 to round out the literature review and show the authors are coming from the standpoint of climate change as a "risk multiplier" or mention this point earlier on.

Response: We moved other examples from previous Sect. 6.1 (Syria, South Asia and other hot spots) to Sect. 3.4 (not to Sect. 2) where they fit better as part of the literature review on climate change as a "risk multiplier" and hot spots, with reference to the Lake Chad case study in Sec. 6.