Manuscript "Vegetation dynamics and responses to climate anomalies in East Africa"

1. Overall appreciation

This paper presents a spatiotemporal study of trends in and interactions between terrestrial vegetation in different East African ecosystems (represented by LAI) and climate variability (mainly represented by a form precipitation anomalies, SPEI). Quantitative metrics are extracted through (i) the estimation of temporal trends within time series of the individual variables, (ii) a lagged-response model the interaction between them, and (iii) a spatial analysis of the responses in terms of environmental variables. The results are interpreted in terms of earlier documented regional cases.

Overall, from a technical point of view, this work consists of solid data processing and statistical analysis methods for gridded time series. Applied methodologies are well-described and the choices for particular approaches and techniques are generally sufficiently justified, but it does not aim methodological advancement by comparative evaluation of methods, quantitative validation or development of novel techniques. However, from a thematic (environmental) angle, it lacks prior hypotheses on the environmental mechanisms that are underlying to the time series models being tested in the absence of hypotheses the results are presented in a very descriptive way and lack interpretation and synthesis. Only towards the end of the paper, some hints as to the environmental processes at work are suggested and are inductively constructed from sets of positive and negative regression coefficients, where these coefficients are treated as data rather than parameters to evaluate and interpret models.

Therefore, the article in its current form does not fully qualify either as a methodological novelty, nor does it present conclusive thematic insights into the role of climate variability in the recent evolution of ecosystems and managed land use systems. I recommend it to be reworked towards either of these directions: A) a systematic evaluation of a new methodology to extract environmental metrics from spatiotemporal data with a thematic case study on East Africa or B) an in-depth thematic study on the variability of climate conditions in East Africa and the mechanistic effects on a different range of ecosystems, modulated by human management. I feel it has most potential for option A, but that would require a stronger emphasis on the novelty of your sequence of extraction methods, and a way to quantitatively evaluate how these methods perform compared to baseline methods or studies.

2. Specific comments per section in the manuscript

Introduction

P1.L23-P2.L3: In this paragraph, the two-way interaction between terrestrial vegetation and climate dynamics is suggested by a series of statements that mention the one-way effects as well as the notion of interaction. On P2.L19-24 some of this information is repeated, which is redundant. It is also not concluded towards which effect will particularly be investigated,

although the remainder of the study uses one-way effect of climate on vegetation as a working hypothesis.

P2.L26-31: Some (numerically) detailed figures are given on land use conversions, but it is not clear why this is relevant, as the anthropogenic factor is only approximated as an environmental factor by the Human Footprint Index.

Data

P2.L11-14: Why are the time series smoothed? The 'superfluous values' argument is not clear. What is the rationale behind Maximum Value Composition? For NDVI, it is known that most atmospheric disturbance effects pose a negative bias on the NDVI, is this also the case for LAI?

P2.L25-P3.L3: What does the grouping of LC mean in terms of ecosystem stratification? For example, why are 'shrub-barren mosaic' and 'shrubs-grasses mosaic' in different groups, each with their tree-rich variant?

P3.L4-6: The description of the Human Footprint Index is insufficient: it is not clear what these data represent and what their role is in the analysis.

Methods

P4.L3-4: "The resultant per-pixel anomalies for each dataset were then averaged to obtain region-wide average time series". Are per-pixel anomalies z-scores or absolute deviations from the 30y-mean? In both cases, is it meaningful to average per-pixel anomalies? It seems to make more sense to differencing/z-scoring after averaging.

P7.L23: Why specifically a 12-year window?

P7.L30-31. Water balance should be described in the data section.

P8.L1-2: "Local effects are analysed per land cover type" What is the definition of 'local' here? The 6 grouped land cover strata still represent vaste areas.

Results

P8.L6-11: There is a serious issue with reporting annual change rates of 0.004 LAI units and 0.035°C. Although these may come out of the trend models as statistically different from zero, the effect sizes must also be interpreted the light of numerical precision and physical meaning. I do not believe LAI is measured with a 0.001 precision or temperature resampled to 8 km can be more precise than 0.1°. With proper rounding, the annual trend magnitudes are effectively zero!

P8.24-P9.21: The results are very descriptive, in terms of 'numbers' and 'proportions' of pixels that have either positive or negative values. I think if these observations are synthesized to effects playing in particular, meaningful ecoregions, they would be a lot more readable. Also,

the categories of break models (reverse, decreasing with positive break, etc.) lack a clear link to the environmental processes they represent. What is the difference between 'increase with negative break' and 'increase to decrease' in LAI for a savannah grassland ecosystem and what is the role of climate variability in year-to-year differences in greening of savannah?

P10.L1-21: Some of these descriptions illustrate the statement in 'Overall appreciation' that some hints to possible mechanisms are induced from statistical parameters, e.g., L19-21: "Stronger positive trends in vegetation show a similar pattern compared to the LAI-SPEI correlation, implying widespread influence of precipitation on vegetation trends in the region" The question remains what 'influence' exactly means here? This reads like statistics with hypothesis.

P11.25-27: "lower sensitivity to human influence below 35% of the human footprint index": it is absolutely not clear what this threshold on this index precisely represents, or what can be concluded from the observation that drought resistance of vegetation appears to be lower where this index is below 35%.

Discussion + Conclusions

I think these sections requires more in-depth synthesis. Most of the interpretations are formulated as 'phenomenom X varies spatially / shows contrasting spatial patterns / show spatial heterogeneity' which does not provide the reader with insights on what climate-coupled changes have or have not occurred in these ecosystems. The conclusions section is only a brief summary of introduction, data and methods and does not touch the results or their interpretation.

P12.L18-19: "This increase in LAI could be attributed to increasing land cover transition to croplands"? Transition from which land cover?

P13.32-33: "The temporal changes in the vegetation response metric imply technological and ecological effects". What does this mean? Please clarify.

Figures

Figure 3: I am aware that it is not easy to represent many spatiotemporal dimensions and metrics on graphs. For panels (a) and (b), the legends should contain the actual values, rather than a numbering that refers to the figure caption text.

Figure 5: The caption does not contain sufficient information to understand the graphs and what they represent.

3. Textual suggestions

P3.L26-28: I think 'blended' here means 'added'? In that case, I would suggest to uses 'added'

P4.L15-17: There is a text issue with the numbering and listing of the classes. Text here says 6 classes, the numbering in text jumps from (iii) to (vi) and the legend of Figure 3 you have 8 classes.