Editorial comments:

The manuscript still needs at least a minor revision before publication. Please see the reviewers comment regarding the methods used in section 4.6. I look forward to seeing a revised version of the manuscript. Thanks

Response:

Thank you, Editor. We have now revised our methodology in section 3.9 based on editor's feedback. The methodology the reviewer is describing is in **section 3.9**.

Please see our response below.

Reviewer's comments:

The authors have addressed my concerns in section 3.2. However for section 4.6, if I understand correctly, the authors are comparing the correlation of a length of 12 month data for a dry/wet year to the correlation of a length of 12 mo * 30yr data to inform drought and LAI response. I don't think the correlations are comparable because the correlation for the 1982-2011 include information on seasonality, interannual variability and even trend if ever exist while a correlation for a single year monthly data doesn't contain that much information and the difference between the two correlations cannot inform purely the impact from extreme events. Pan et al. 2015 is not comparing the correlation difference, but only looking at the anomaly of the variable relative to the long term mean. I don't think this section presents reasonable method/results but I do think the section and the question to be discussed is valuable and important for the paper. Please consider redesigning methods/metrics to evaluate drought and LAI response for the section.

Response:

We thank the reviewer for his time and efforts, whose comments have been used to improve the quality of the manuscript.

We have now revised the methodology as you have suggested.

In the current manuscript, we have compared the anomaly of the variables directly and also, added precipitation (This is now different from the previous method where we compared the correlations). The current methodology is fully adopted after previous study.

In addition, we also calculated the pattern correlation coefficient between the variables and inserted the values. Please see Section 3.9, Pages 25-26 for details. The revision is copied below.

3.9 Impacts of extreme events on LAI

The impacts of extreme events on LAI are shown in Fig. 10. The objective was to discuss the impacts and compound influences of extreme events on LAI during extreme hot/dry and wet years. Here, extreme events are the wet (2000, 2010, 2011) years - i.e. the periods with precipitation higher than normal; and the dry (1983, 1984, 1991) years which include the periods of very high dry spells. To achieve this, we used the anomaly of precipitation, SPEI *and LAI relative to the long-term mean. The anomaly was computed as a difference between a particular extreme dry or wet year and 30-year mean representing dry and wet conditions. The anomaly is the magnitude of impacts added by the extreme event in a particular year. The spatial pattern of the changes in LAI, SPEI and precipitation were then plotted. Our analyses follow Pan et al. (2015). Furthermore, we computed the pattern correlation coefficient between the LAI and climate variables for each extreme dry and wet year. The goal of this is to ascertain whether the sign of anomaly of the variables correspond in the same locations on two different maps. Note, although the SPEI is a drought index, it was also considered in a wet year because the impact of drought usually lasts beyond a dry year especially in semi-arid regions of southern Africa. In addition, hot temperature has an influence on the worsening of drought by causing water to evaporate from the soil. SPEI, as a drought index, considers temperature effects on moisture availability.*

We considered only observation i.e. CRU (precipitation and drought) and satellite-calculated LAI. The observed climate (CRU) data are not sub-monthly. Only the CRUJRA (reanalysis), which was used for model correlation, is sub-monthly. Model was not analyzed in this section because our goal was simply to examine the observed impacts (or influence) of an extreme event.

The spatial pattern of change of LAI and SPEI are mostly similar during extreme dry and wet years (Fig. 10). For example, in 1983 (a dry year), the negative anomaly of LAI in some parts of the region largely follows the negative anomaly of the SPEI, except in western and central parts. (Figs. 10A & 10B). In 1984, both variables show a strong positive anomaly over Madagascar, Swaziland and Kwazula Natal Province of South Africa (Figs. 10D & 10E). The pattern of change of both SPEI and LAI are also comparable during extreme wet year. In the wet year of 2000, the positive anomaly of SPEI that is observed in Nambia and South Africa is also evident for the LAI (Figs. 10J & 10K). In a like manner, both variables show negative anomaly over Malawi and Zambia. The strongest pattern (magnitudes) of change of the SPEI in the region is observed in the dry year of 1991 (Fig. 10H). However, the pattern of change of the LAI and SPEI are not similar over some regions in some periods. For instance, in 1991, while a negative anomaly of the SPEI is observed in northern Madagascar and central parts of southern Africa, LAI shows a positive anomaly (Figs. 10G and 10H). The opposite and decreasing relationship between the two variables in 1991 is also evident in the pattern correlation coefficient value of – 0.16 (Fig. 10H). The variation in anomaly in these parts and period may be due to the exertion of stronger influence by other factors such as residual soil moisture and precipitation (see Fig. 10I), with temperature having negligible impacts.

The influence of precipitation (as a standalone meteorological factor) on LAI during extreme events is limited. This is observed from the disparity in the spatial pattern of the LAI and precipitation over some regions and periods. For example, in 1984, the wide negative anomaly of precipitation that is shown over Zimbabwe, Mozambique and southern Madagascar is opposite to the LAI, which shows positive anomaly (Figs. 10D and 10F). The LAI anomaly is more similar to that of the SPEI (Fig. 10E). Also, in wet year of 2000, while precipitation shows preponderant increase over northeastern parts of southern Africa, there is a decrease in the LAI as is the case with SPEI (Figs. 10J – 10L). Nevertheless, precipitation plays a primary/major role in the pattern of change of LAI, as is observed over the most parts of the region during the years considered. Generally, the pattern correlation coefficient values *between the LAI and SPEI are higher than those between the LAI and precipitation in extreme dry and wet years.*

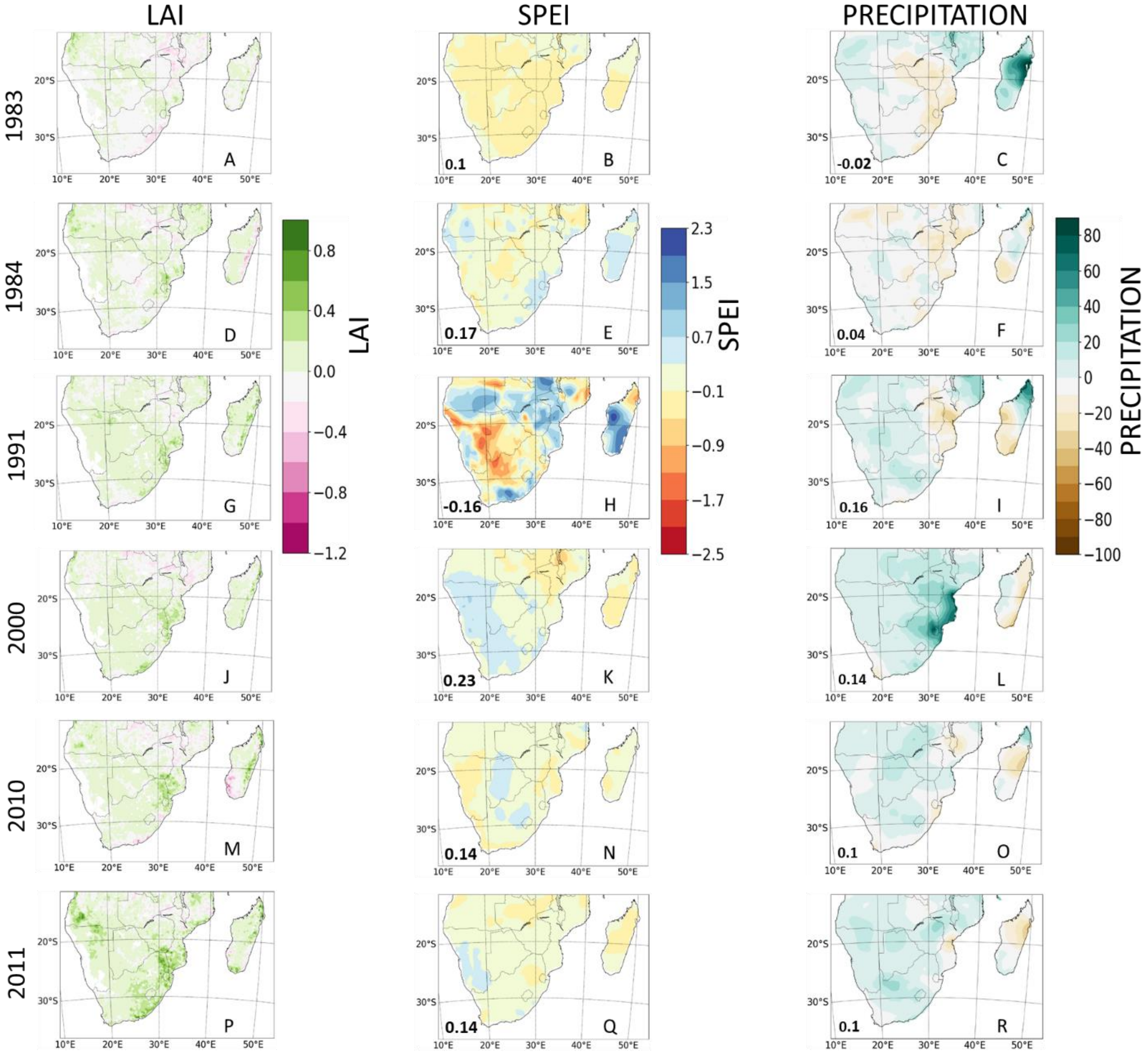

Figure 10. Spatial pattern changes in satellite-calculated LAI, observed SPEI and precipitation during extreme dry (1983, 1984, 1991) and wet (2000, 2010, 2011) years. For (A) – (I), the changes in LAI, SPEI and precipitation were calculated as a difference between the dry year and the 30-year mean, and for (J) – (R), changes in LAI, SPEI and precipitation were calculated as the difference between the wet year and the 30-year mean. White areas indicate no correlation. The inset numbers in the second column are the pattern correlation coefficient values between the LAI and SPEI for the extreme dry and wet years, while the values in the third column are the pattern correlation coefficient values between LAI and precipitation during the extreme dry and wet years.

References:

Pan, S., S. R. S. Dangal, B. Tao, J. Yang, and H. Tian. 2015. Recent patterns of terrestrial net primary production in Africa influenced by multiple environmental changes. Ecosystem Health and Sustainability 1(5):18. http://dx.doi.org/10.1890/EHS14-0027.1