

## ***Interactive comment on “Spatio-temporal vegetation dynamics and relationship with climate over East Africa” by John Musau et al.***

### **Anonymous Referee #1**

Received and published: 7 January 2017

This study investigates the trends in vegetation index (LAI) in East Africa for different land covers and assess vegetation-climate relationships/feedbacks by using lead/lag correlations for a 30-yr period, 1982-2011. The study shows majority of the region have a persistent land-cover type. Vegetation affected mainly by precipitation, and an increase in temperature brings additional stress.

The paper is suitable for HESS; however, the current presentation quality of the paper is not enough/good for publication!! It requires substantial revision. The author needs to improve readability. Especially writing, punctuation, and Figure 1 needs a revision. Discussion should be improved not only writing but also technical.

- Discussion should be better in writing. It is really hard to follow due to many sub-basins.

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- Capitalization, subject-verb agreement, typo, punctuation, and unity problems are common within the text. The text requires a thorough skim for usage of comma.

- Figure1 need to be improved a lot. To educate/make familiar with the region, you need to include mentioned locations in Results section should be given in the location map!

## MAJOR COMMENTS:

1. I recommend authors rework on Discussion part. Discussion is hard to follow. The study site is somewhat big, and there are many sub-basins (ecoregions) mentioned in the discussion. These sub-basins show different characteristics. I briefly concentrate on following statements:

- Water-limitation in vegetation dynamics, the region is mostly water-limited. So any increase (decrease) in precipitation cause increase (decrease) in LAI/vegetation productivity. It is good to mention quick response of grass/shrub to precipitation (you already did!).

- Tmax and Tmin may show asymmetric behavior/outcome. I state Tmax as a day-time temperature, and Tmin as a nighttime temperature. Increase in Tmax causes an additional stress on plants due to water limitation.

- Tmin also may affect similar Tmax. But in some places, Tmax or Tmin may be more effective! DTR and soil moisture relationship. Soil moisture also affects vegetation cover and productivity etc.

2. P8L3. It should be better to include a justification/physical basis that why did you select 1.00, 0.50, an 0.25 for lag1, lag2, and lag3, respectively for weighted averages. Or basically define: "we arbitrarily choose following . . . intuitively" etc.

3. P11.L29. 'Across the study period, stronger vegetation feedback was found with API than temperature'. Are there any recycling ratios reported in the hydrology literature for East Africa region for different ecosystems? I can sense the temperature and

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vegetation coupling as mentioned albedo change or energy partitioning; however, it will be better to include further justification for vegetation and precipitation coupling.

4. P13.L21-25. I highly recommend a trend analysis in annual precipitation for the study period (or longer depending on data availability) in the study site. A positive and sustained trend in LAI is a result of what? – A precipitation increase or land-cover change? How do you think that this is a sustainability of vegetation cover? I agree that land-cover type will not change, getting denser (enhanced LAI) but up to forever? Definitely, not. I am speculating vegetation benefits/responds wet era in climatic fluctuations. Similarly, as you reported (P14.L24-25) there is a decline in annual precipitation in Kenya so, LAI is decreasing. Until where? So, definitely, it will be good to include trend analysis to discuss these portion better.

5. P14.L19-22. "...the decline vegetation activity to a decrease in solar radiation and temperature as a result of cloud cover during the wet season" (Brando et al., 2010; Hilker et al., 2014; Hutyrá et al., 2007; Samanta et al., 2012).

-Firstly, the study site of all these citations is the Amazon Basin where receives much more precipitation than East Africa and most probably seasonally energy-limited. I am not sure how much applicable are your citations?

- Secondly, how much precipitation increase do you expect that there will be significant rise in cloudiness, and a significant reduction in incoming solar radiation?

6. P14.L23-23. If greenhouse gas emission causes an increase in ambient temperature, how the number of growing-season days are decreasing? It will be better briefly describe there: how Cook and Vizy (2013) described growing season days in their paper.

MINOR COMMENTS:

P4.L19. "This area receives high and well distributed rainfall". This statement requires a qualitative number. I recommend giving a range of mean annual precipitation for the

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Lake Victoria ecoregion.

P10.L3. I prefer elucidating a bit better. "...indicating that most vegetation cover in the region is likely to maintain historical trends". My understanding is there is no climate change in the region that long-term climatic means prevail in the region for a while. So, the ecosystem is in steady-state condition. All of the site (excluding 0.2% of the study site) will keep their land-cover/vegetation.

P11.L8-10. Similar above. "...leading climatic variables indicate a possibility to predict vegetation dynamics using API,...". My understanding is this behavior shows persistence in climate. A few months leading climate variable, especially precipitation due to water limitation, is enough to forecast vegetation dynamics in advance as a result of persistence in climate.

P15. L26. It will be better to re-write this statement: "...by sparse vegetation mainly composed of grass and shrubs thus at the 8 km spatial resolution used in this study". I think you use 8 km spatial resolution due to the availability of the dataset. It will be better to rephrase.

MINOR POINTS:

P1.L17-18. Capitalization. From southern Ethiopia. ...through central Kenya into central Tanzania.

P1.L25. Verb. Terrestrial vegetation dependS on and affectS. ...

P1.L27. DELETE the comma after roughness. ...on surface roughness and albedo. ...

P1.L29. Typo. Lower case for monsoon. ...West African monsoon.

P2.L10. Insert a comma after regional. ...regional, and ...

P2.L20. Insert a comma after moisture. ...moisture, and they. ...

P2.L26. Insert 'the' before west. ...in THE West Africa region. As done on P3.L8.

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P3.L3. I do not think DTR should be capitalized! On the Sahelian diurnal temperature range...

P3.L14. Insert a comma after %. ...82.27%, respectively.

P3.L10. Insert a comma after Sudan. ...Sudan, and Uganda... Also in P4.L4 and P4.L5.

P3.L19-20. Rewrite, word order, move Africa Horn to the end of the sentence. My recommendation: ...and population density changes in the pastoral and agro-pastoral livelihoods zones in the Horn of Africa (East Africa).

P3.L20. Capitalization. ...the Greater Horn of Africa. ....

P3.L26. You can use 'spatiotemporal' for spatial temporal. Please check throughout the text to replace. P15.L19.

P4.L3-4. Lat/Long degree sign. ...bounded by 5.52°N and 11.76°S latitude, 28.8°W and 41.92°E longitude...

P4.L12. Delete 'covers'. The Sudanian ecoregion extends from ....

P4.L12. Capitalization and recommendation. ...and western Uganda.

P4.L17. Capitalization. ...and eastern Congo....

P4.L17. Capitalization. ...and eastern Rwanda...

P4.L21. Usage of 'data'. Make sure data used as either singular or plural. Data is a plural form of datum. Nowadays it is used singular or plural. But within the text, please ensure unity. Pay attention following: LAI data were... (P4.L21)

The GIMMS LAI3d data has been (P4.L28).....and has been .... (P4.L29)

The biweekly LAI data was... (P5.L1)

The precipitation data was ... (P5.L6)

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The data is . . . . (P5.L9)

Minimum and maximum temperature data was . . . . (P5.L25)

. . .LAI time series data were . . . . (P7.L1)

P5.L1. I think you should use lower case for 'Earth'. . .to correct earth observation data. . .

P5.L6. Capitalization and re-write the definition of the acronym. . .the Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) (Funk et al., 2015).

P5.L26. Correct acronym. . . .developed by Princeton University Terrestrial Hydrology Research Group for East Africa.

P6.L4. Capitalization and insert 'the' before university, and use lower case for land, cover, and classification. . .with THE University of Maryland global land cover classification scheme. . .

P6.L8. Insert the before Mann-Kendall. . . and THE Mann-Kendal. . .

P7.L16. Capitalization. Capitalize Spearman. . . Spearman rho. . . Also in P7.L17.

P7.17. Punctuation. Separate independent clauses with a semicolon when using a conjunctive adverb such as hence, thus. . . semicolon + conjunctive adverb + comma

. . .non-linear; hence, the. . . . (P7.L17)

. . . .apart; hence, it is. . . (P13.L9)

. . .variability; thus, instantaneous . . . . (P14.L8)

. . . .limited; thus, vegetation. . . . (P14.L11)

. . . .cover; thus, our . . . . (P14.L19)

P7.L23. Typo. Notaro et al., 2008. . . Also correct the typo in P3.L6, P20.L6.

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P8.L2. Separate 'Upto' and insert a hyphen after 'three'. Up to three-month lag were used, ....

P8.L23. Verb. The GWR method and underlying principles ARE .... It may be also: The GWR method and underlying principles HAVE BEEN documented. ...

P8.L25. OLS. OLS introduced here firstly. Give the description of acronym here. It is given later on P9.L12.

P8.L26. Insert a space before 'denotes'.

P9.L3. Use lower case for where. ....where. ... also on P8.L26.

P9.L13. Ensure unity for AICc. Compare P9.L11.

P9.L21. Capitalization. Proper noun. Use upper case for national, park, and reserve. ....in Marsabit National Park and Reserve. ...

P9.L22. Capitalization. Another proper noun. ...Tsavo National Park.

P9.L24-25. Capitalization. ....in Selous Game Reserve and Ruaha National Park.

P10.L18. Capitalization. Use lower case for .....northern Tanzania. Similar to P4.L17.

P11.L10. Typo. ...EaSt Africa.

P12.L10. I recommend following for sigma2: , ...variance ( $\sigma^2$ ), .... (NOTE: 2 is superscript)

P12.L17. Replace 'Sigma2' with  $\sigma^2$ . (NOTE: 2s are superscript)

P12.L22. Word choice. ...during the long rainy season. ...

P13.L6. Plural. ....both the local and global regression ANALYSES. Also correct in P13.L7.

P13.L13. I recommend inserting 'lag' before '9': .... Up to lag 6 in model I and LAG 9 in model IV. ...

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P13.L21. Capitalization. Use lower case for 'northern'. In northern Uganda and. ....

P13.L26. Capitalization. Use lower case for 'southern'. ...from southern Ethiopia,...

P13.L27. Verb. The current analyses and results SUPPORT ....

P13.L28. Word choice. ...expansion of grassland and cropland....

P13.L32. Delete space before 'scale'. ....of large-scale. ....

P14.L6. Verb. The distribution of correlation between X and Y not only relateS....

P14.L26. Capitalization. Use lower case for 'century'. ...21st century..... 20th century....

P14.L28. Capitalization. Upper case for basin. ...Congo Basin.

P15.L1. Verb. Strong negative feedbackS ....correspond.... Or Strong negative feedback. ... correspondS.....

P15.L30. Typo. ...albeit its inherent...

P16.L5. Capitalization. ...by the CGIAR Research Program on Forests, Trees and Agroforestry....

FIGURE1. Improve location map.

- Insert latitude and longitude. Or make the spatial extension of two figures the same.
- Insert (a) and (b). Or modify the caption.
- Rwanda is missing on Figure1a.
- Increase font size in Figure1a bigger.
- Also you may include another figure shows elevation which has the similar extension Figure 1b.
- Following should be included in your location map: Selous Game Reserve, Ruaha

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National Park, Tsavo National Park, Marsabit National Park and Reserve, and forested areas in Turbi. If you want to specifically mention within the Results section, it should be included in your location map. You need to educate the reader.

- This is personal choice. I recommend 'arial' font type for clearness of location names.

Figure 2c, 2d are not cited in the text!

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-502, 2016.

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