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Earth System Dynamics Discussions

Interactive comment on "Inter-annual and seasonal trends of vegetation condition in the Upper Blue Nile (Abbay) basin: dual scale time series analysis" *by* E. Teferi et al.

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The authors wish to thank the reviewer #2 who took the time to review our research paper in detail. The critical parts of the paper were revised and the paper is now clearer and more consistent. We agreed with almost all the comments of reviewers and reworked the paper based on the comments and suggestions. We hope to get invited to submit the revised version. We feel the paper has benefited from the comments and appreciate the suggestions. Please see below details of how and where we added the required information, or why we did not agree with a specific comment.

Comment #1: The authors performed an elaborate analysis of vegetation-activity

trends in the Upper Blue Nile basin. Their manuscript represents serious research efforts and contributes to a better understanding of vegetation dynamics in the region. As such, their work fits within the scope of ESD. I do, however, have some critical remarks about their methodology and I suggest to revise the work flow and the manuscript accordingly. General comments: The 1982-2006 GIMMS data is not state-of-the-art (as mentioned on P174 L17). The team of Pinzon and Tucker released version 3g of their dataset, spanning 1982 until 2012. The processing chain changed to better facilitate trend analysis. I was surprised to see how much this affected trends in some regions and I thus recommend to ask for this newest dataset and to redo your trend analyses. Please find the paper on the dataset here: http://www.mdpi.com/2072-4292/6/8/6929.

Response to comment #1: When we carry out this research the updated GIMMS NDVI dataset (GIMMS3g) covering from 1981 to 2012 was not available online. We have also requested the concerned body through email, but there was no ease of accessibility of the data set. Thus, the GIMMSg NDVI data set was used. This time we are aware that the new data set has been released online in 2014. Given the results obtained from our research, we will continue to use the new data set in the future.

Comment #2: I have concerns about the use and interpretation of the HANTS output. The Fourier components themselves should not be interpreted as land-surface phenology (LSP) metrics, as opposed to what the manuscript suggests on P182 ff. In the Methods, the description is correct: the time series is decomposed into various harmonic functions, each described by a phase and amplitude. Component 0 represents the mean NDVI but component 1 and higher hardly represent biophysical processes. A change in one of these components cannot be interpreted as a phenological change but the sum of all components should be analysed for changing LSP metrics using common methodologies to derive them (e.g. following http://dx.doi.org/10.1111/j.1365-2486.2009.01910.x or others). I suggest to update the seasonality analysis accordingly.

Response to comment #2: Seasonal trend analysis, the method described in this manuscript, is an attempt to describe seasonal curves in their totality rather than to identify specific events along their development, and especially, to detect trends in their transformation. The amplitudes and phases are not intended to function as phenological measurements, but rather, to serve as efficient shape parameters for the description of the character and dynamics of seasonal curves. However, it should be recognized that there is some correspondence between the harmonic shape parameters and traditional phenological measurements (Eastman et al., 2013).

Comment# 3: I find the description of some off-the-shelf methodologies (HANTS, LM, MK) rather long. Concise descriptions with references to corresponding literature would suffice. Their parameterization, on the other hand, is not always clear (e.g. BFAST).

Response to comment #3: We have tried to make their description short in the revised version.

Comment# 4: What is the incentive for reducing the temporal resolution of the data (P177 L5)? How was the monthly mean calculated for MODIS data and why the mean instead of the maximum value, like in the compositing technique of the source data? Was the information in GIMMS and MODIS quality flags regarded before aggregation?

Response to comment #4: The bi-monthly composites usually show strong serial autocorrelation and aggregating into monthly observations reduces the effect of serial autocorrelation. Besides, it was necessary to work on monthly composites, in order to match the temporal resolution of the AVHRR NDVI product with global monthly climatic observations, which is to be studied in the near future. In order to get a representative NDVI value for a specific month, the average of the bi-monthly products would be reasonable than taking the maximum of the bi-monthly products. Other studies have also used monthly average (Zeng et al., 2013; Buermann et al., 2013). The numerous gaps created as a result of frequent cloud cover in the daily AVHRR record have already removed during the derivation of 15-day GIMMS NDVI product using Maximum Value Compositing (MVC) technique. The authors assume that the remaining errors in

MVC processed NDVI causing low NDVI values are further cleaned using (Harmonic Analysis of NDVI Time Series) HANTS. Therefore, temporal aggregation by arithmetic mean could be advantageous in having a representative monthly NDVI by considering the greenness of the two bi-monthly NDVI. This is true particularly when there is a significant NDVI difference between two bi-monthly NDVI products. Yes, the quality flags were considered before any further processing.

Comment# 5: The introduction gives a general overview of vegetation-activity studies but lacks a bit the problem statement for the study site: why is this basin of special interest?

Response to comment #5: We have added statements about why this basin of special interest.

Specific comments

Comment# 6: P178 L16 "For the median trend, the breakdown bound is approximately 29%" Please add a reference for this statement.

Response to comment #6: The median (Theil-Sen) slope is a robust statistic that is resistant to the impacts of outliers and it is known to have a breakdown bound of approximately 0.29 times the length of the series measured in time steps (Hoaglin et al. 2000, p. 160).

Comment# 7: P181 and P186 The terminology "coarser scale" (3.1) and "fine scale" (3.2) is ambiguous.

Response to comment #7: We have now used GIMMS and MODIS instead.

Comment# 8: P182 L26 and P190 L5 If _only_ Fourier component 0 changes, the shape of the curve remains unaffected and LSP metrics like start-of-season or length-of-season as defined by common extraction methodologies (e.g. %-amplitude threshold, max-increase, max-curvature) would not change. This renders the statements on P182 L26-L28 and P190 L5-7 incorrect or at least ambiguous.

Response to comment #8: we have corrected those statements

Comment# 9: P183 L8 "A decreasing phase angle means a shift to a later time of the year" This statement is correct but it does not necessarily affect the LSP metrics in the same way, because these are the result of the combined changes in various components. As mentioned in my second comment, I do not see the arguments for analyzing individual Fourier components instead of the additive harmonic function.

Response to comment #9: The Amplitude and Phase parameters are not intended as freestanding phenological measurements. Rather, they are shape parameters that can describe generalizations of seasonal curves in the nature of splines. The focus of this study is on trends of these parameters, which imply transformations of seasonal curves from one shape to another.

Comment #10: P184 L25 ff Change "capacity" to "scope". Furthermore, this paragraph (until P185 L12) is not very strong. The listed potential causes are very generic and trivial. It would help if the authors include a more site-specific analysis of potential drivers. This analysis, however, should be in the Discussion section and omitted from the Results.

Response to comment #10: We have corrected it as per the comment

Comment #11: P188 L16 "The trend break analysis ... was not able to detect trend breaks" I suggest rephrasing along the lines of "The trend-break analysis did not indicate significant trend breaks". This finding is, given the short time span (2001-2011) not strange. In the case of a trend break, the resulting segments would be short and the significance of the slope would likely be low due to the limited number of observations. The interpretation (L19 ff) of this monotonicity should be done with care and not be compared to monotonicity in the much longer GIMMS time series: a monotonic trend within the MODIS time span can have the same driver as one segment of equal length within the GIMMS time span.

Response to comment #11: We have rephrased the sentence. Thank you for the suggestions.

Comment #12: P189 L23 In line with some previous comments, I doubt if this figure of 59.5% reflects actual LSP changes.

Response to comment #12: Please see Response #2 and #9

Comment #13: P190 L18 "capacity" -> "scope"

Response to comment #13: we have changed that.

Comment #14: P190 L18 - P191 L7 There is some repetition here.

Response to comment #14: we have corrected that.

Comment #15: P195 L4 The final conclusion is a bit out of the blue given the earlier statement that it is beyond the scope of the study to interpret driving factors (P190 L18). I suggest to remove latter statement on the scope and to conclude that the findings were interpreted as being linked to human activities. In the same conclusion, are inter-annual trends meant instead of intra-annual trends?

Response to comment #15: We have corrected that accordingly. Thank you for noticing that error.

References

Eastman, J. R., Sangermano, F., Machado, E. A., Rogan, J., and Anyamba, A.: Global trends in seasonality of normalized difference vegetation index (NDVI), 1982–2011, Remote Sensing, 5, 4799-4818, 2013.

Hoaglin, D.C.; Mosteller, F.; Tukey, J.W.: Understanding Robust and Exploratory Data Analysis; Wiley: New York, NY, USA, 2000; Volume 3.

Interactive comment on Earth Syst. Dynam. Discuss., 6, 169, 2015.