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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 #1 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: P170 Very short about seasonal trends in the abstract. Include more

results.

Response to comment #1: we have added some results about seasonal trends in the abstract section.

Comment #2: The introduction is generally very well written, however I lack some more background information regarding the seasonal trends. There is a long introduction regarding why to study inter-annual trends, but then there are just three sentences, to justify the intra-annual study.

Response to comment #2: we have included additional background information regarding the seasonal trends in the introduction section.

Comment #3: P173 L11 Remove frequent, as the MODIS NDVI product that you are using has a lower temporal resolution than GIMMS (16 vs 15 days).

Response to comment #3: We have replaced the term "frequent" with "repeated"

Comment #4: P173 L18 MODIS stands for Moderate resolution. So it is not fine scale. Fine scale these days have a few meters resolution, not 250 m.

Response to comment #4: We agree with your suggestion. Thank you for noticing it.

Comment #5: Sect 2.1 I would recommend to include a figure of the location of the Abbay basin within Africa including borders and perhaps the land use classification map. The different regions could be incorporated here as well. They were very hard to see on Fig 8.

Response to comment #5: We have inserted a map showing the location of study area.

Comment #6: P174 L5 Why is modelled evapotranspiration values interesting for this study? Remove. The text is already long as it is, and I recommend trying to shorten it down as much as possible.

Response to comment #6: We have removed that text.

Comment #7: Sect 2.1 Instead it would be interesting to know the types of species, if they are perennials or annuals. What is the typical crop that is grown in the region. These things affect the NDVI series a lot and are thereby relevant information, if you have it.

Response to comment #7: We have added sentences about the vegetation types and type of crops grown in the study area description section.

Comment #8: P174 L23 Why was this done? Why not run on bimonthly data? In the seasonal dynamics you miss a lot of information if you run on monthly instead of on bimonthly values. Already bimonthly composites have a low temporal resolution, but monthly are much worse and finding seasonal dynamics gets even more difficult. Especially in semi-arid environments with very short growing seasons.

Response to comment #8: We agree that the bi-monthly products are good for seasonal dynamics. However, 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.

Comment #9: P174 L24 If necessarily used, why arithmetic mean? Generally maximum values are used since errors tend to have a negative impact decreasing the NDVI value.

Response to comment #9: We do understand and share the Referee's concern about the use arithmetic mean in making monthly composites. 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.

Comment #10: Section 2.2.2 What kind of quality control data did you use for filtering of low quality MODIS NDVI data?

Response to comment #10: We extracted the information on clouds and generated masks of cloud cover for all time periods using the quality control flags in the MODIS file, in order to remove data lower quality, cloud contaminated pixels.

Comment #11: Section 2.2.3 There is no results presented which use the LULC dataset, I would include this in a figure in Section 2. 1. Instead. See comment above.

Response to comment #11: on P182-184 it was explained how the LULC data set was used in providing a basis for understanding the spatial distribution seasonal trends. We have moved description about land use and land cover to the section of study area description in the revised manuscript.

Comment #12: P175 L11 Use same pixel size as for the other data sets if presented

Response to comment #12: Yes, the LULC data set was resampled to match the resolution of the other spatial data sets.

Comment #13: P175 L17 The datasets are atmospherically corrected even before the MVC procedure and cloud issues should be rejected in the quality control. However there are several other issues (e.g. aerosols, haze, cloud shadows, atmospheric depth, water vapor, illumination variations, slope of the terrain, reflections from adjacent pixels and shadowing effects) affecting the NDVI values, and there is thereby many other reasons for smoothing the data.

Response to comment #13: Yes.

Comment #14: P175 L19 Most of these issues have a negative bias, which means that the fitting should be done to the upper part of the curve. Is this accounted for in the HANTS? Perhaps making an iterating process where the lower part is removed in the first iteration and in the coming iterations it is fitted more to the upper part. See (Jönsson and Eklundh, 2004). Jönsson, P., Eklundh, L., 2004. TIMESAT - a program for analysing time-series of satellite sensor data. Computers & Geosciences 30, 833-845.

Response to comment #14: In HANTS (Harmonic Analysis of NDVI Time Series) algorithm (Roerink et al., 2000; Verhoef et al., 1996) a curve fitting is applied iteratively, i.e. first a least squares curve is computed based on all data points, and next the observations are compared to the curve. Observations that are clearly below the curve are candidates for rejection due to atmospheric contamination, and the points that have the greatest negative deviation from the curve therefore are removed first. Next a new curve is computed based on the remaining points and the process is repeated. Pronounced negative outliers are removed by assigning a weight of zero to them, and a new curve is computed. This iteration eventually leads to a smooth curve that approaches the upper envelope over the data points.

Comment #15: Section 2.4 Why fit three different trends. The Median Theil Sen method is much more robust within time series analysis than OLS. Why fit an OLS at all? It is not recommended to use OLS within time series analysis and I would remove the OLS analysis completely. Then I would recommend to stick to use the Mann Kendell test for significance as it gets confusing when reporting all different kind of trends.

Response to comment #15: Now we have used only the Theil-Sen (Median) trend method. We have omitted the use of OLS throughout the revised manuscript.

Comment #16: P177 L25 –P178 L28 There is no reason for explaining what a OLS and a MK test is. These are things that can easily be found somewhere else for the

reader. Please remove. As mentioned above the text is already long as is.

Response to comment #16: We have removed sentences that can easily be found in literature.

Comment #17: P179 L 16 Why does disturbances shorter than 8 years not have an effect on the long term trends? MODIS time series is not more than 12 years; it must have a very big impact.

Response to comment #17: 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). The breakdown bound refers to the number of wild outliers that can be included in the series before they begin to affect the calculated trend. Thus, it can be assumed that any trend expressed has been present for at least about 29% of the length of the series (Neeti et al 2012; Eastman et al, 2009; Eastman et al 2013). Therefore, Theil-Sen slope calculated for AVHRR time series (26 years) rejects short-term interannual variability up to its breakdown bound of 29% of the length of the series (i.e. 0.29*26years = 8years). While the Theil-Sen slope calculated for MODIS time series (11 years) rejects short-term interannual variability up to its breakdown bound of 29% of the length of the series (i.e. 0.29*11years = 3 years).

Comment #18: P179 L20 Why is it necessary with a contextual Man Kendell? Is it not enough with a regular MK test?

Response to comment #18: Based on the priciple of spatial autocorrelation, if a location is truly experiencing a trend over time, it is reasonable to expect that neighboring locations will also be experiencing similar trends. By a similar logic, if an isolated location indicates a trend and none of its neighboring locations do, then it is reasonable to expect that the trend is spurious. Therefore, Contextual Man Kendell (CMK) trend test allows for a reduction in the detection of spurious trends and an amplification of confidence when consistent trends are present through adding contextual information.

CMK is a modified version of the Mann-Kendall test which is based on a principle that a pixel would not be expected to exhibit a radically different trend from neighboring pixels. A very detailed explanation about the main difference between CMK and MK is explained well in Neeti and Eastman (2011).

Comment #19: P180 L17 How was these regions of interest selected? And why did you not run BFAST for the entire region? This section needs a lot of clarifications. How did you parameterise the BFAST?

Response to comment #19: ROIs were selected for the time series analysis of exemplary different trend behaviour and trend changes. They were selected based on most prevalent classes of significant seasonal trends in GIMMS NDVI and MODIS NDVI. We couldn't run BFAST for the whole area because of the computational time it required.

Comment #20: P181 L 3 Why did you use two different methods in the trend break analysis. It is confusing, I would recommend to stick to one.

Response to comment #20: Our main change-point analysis technique is Pettitt test. Since Pettitt test doesn't show multiple trend breaks, we used BFAST just to show areas with more than one change points. The use of BFAST trend break analysis assisted identification of several change periods which might otherwise been overlooked through a commonly assumed fixed change trajectory analysis.

Comment #21: Change the Title 3.1 Course scale analysis. Why course and fine scale? Maybe use GIMMS and MODIS instead?

Response to comment #21: we have used GIMMS and MODIS in place of course and fine scale throughout the revised manuscript.

Comment #22: P181 l 21 How do you know the OLS is over and underestimating? Again, why use OLS at all?

Response to comment #22: we have omitted the use of OLS in the revised manuscript

Comment #23: P182 L 5 Why is the linear better than non-linear just because there is a difference? Which linear test do you mean the Theil Sen or the OLS?

Response to comment #23: The spatial distribution of a difference map (i.e. when subtracting the LM and MK test output values) will reveal any regions where a linear trend test (Theil Sen) does not describe NDVI trends equally well as that of MK test. This type of techniques has been used successfully by Fensholt et al (2012).

Comment #24: If you find a method which is more robust than the other I would stick to that one and only present the result from this method. It is not very clearly written as it is now. If the scope of the paper is to investigate methods, sure than you can present all these different methods, but this is not the aim of this paper, and I would thereby suggest to remove these parts and focus on the best methods.

Response to comment #24: we have now stuck to the robust linear trend estimator (Theil Sen).

Comment #25: P182 L11 What is the LM test, I assume the linear regression, but it has never been described?

Response to comment #25: LM test is linear model test.

Comment #26: P182 L 16 Describe better what these different parameters describe, preferably already in the method section. It was described later, but it is too late and should already be described the first time they are mentioned.

Response to comment #26: we have now described the parameters (A0, A1, A2, Phase 1, and Phase 2) better in the method section.

Comment #27: P182 L 27 No, if there would be an earlier start of green-up which increases length of growing season, you would see a change in the phase. A change in mean NDVI but with no other changes would simply mean a shift upwards. Which also seem to be the case in Fig. 4a?

Response to comment #27: Yes, we agree. We have removed that statement. Thank you for noticing that error.

Comment #28: P 184 L10 incorrectly written. Class 4 is the class without an increase in length of growing season and it is found in shrublands, hence the shrublands have a longer growing season. Something is wrong here. Besides, it is only class2 and class 5 that has a change in the phase. A longer growing season would require a phase change. The amplitude just indicates larger maximum values and lower minimum values, but no change in the length.

Response to comment #28: we have removed the statement in the revised version of the manuscript.

Comment #29: P 184 L 25 'It is beyond the capacity', change to scope

Response to comment #29: we have now changed to "It is beyond the scope. . .."

Comment #30: P 184 L 25-P185 L16 This is not results, it is discussion and should hence be moved.

Response to comment #30: we have moved the sentences to the discussion part.

Comment #31: P 184 L 18 I assume that the ROI# are not the same thing as the classes in the seasonal trends. Again, why is not the entire area investigated using BFAST? As it is now, it is very unclear why these 8 regions were chosen and what makes them interesting.

Response to comment #31: The ROIs are chosen based on the most prevalent sig. seasonal trend classes. The ROIs for the analysis of inter-annual and seasonal trend are the same.

Comment #32: Sect Trend breaks in the seasonality parameters. This is not clearly described in the method section how this was done. Clarify. How is this analysis done?

Response to comment #32: We have modified the description of the trend break anal-

ysis of seasonality parameters in the method section.

Comment #33: P185 L 21 Why is it interesting to make a break point analysis for the Amplitude 0? It is the same thing as the mean NDVI, and should thereby not differ very much to the NDVI time series. The other parameters though, they are the ones that show the real dynamics in seasonality. Why is the other parameters not presented, and analysed properly?

Response to comment #33: We do understand the concern of the referee. However, given that Amplitude 0 (A0) is one of the shape parameter, it definitely determines the seasonal cycle. Since Amplitude 0 (A0) represents overall greenness, the break point analysis of A0 will tell us the year when significant change in overall greenness occurred. Besides, we have presented and analysed the main greenness parameters such as the break point analysis for Amplitude 1 (peak of annual greenness) and Phase 1 (timing of annual peak greenness).

Comment #34: P185 L14 Is the trend break for the phase 1997 the same across the entire class 2 area? Please clarify how this analysis was done.

Response to comment #34: The entire Class 2 represents areas with significant increases in Amplitude 0 and decrease in Phase 1 together and a significant decreasing shift of Phase 1 occurred at the year 1997 is the same for the entire Class 2 area. This was found to be linked to the local The change point analysis was performed using Pettitt test.

Comment #35: I would suggest to rewrite the results so that instead of presenting fine scale and course scale separately, present the Inter annual trends first, both MODIS and GIMMS, secondly the seasonal trends both products and finally the trend breaks, both scales. I think this would make the text much smoother and easier to read. Then you could compare results of the two. You should use the same method when analysing both data sets. As it is written now, the reader basically read the same results twice.

Response to comment #35: We have agreed with the comment and have changed the presentation of the result accordingly.

Comment #36: Why is the analysis so different for GIMMS and for MODIS. I would use the same analysis for both products. As it is now, it is very hard to understand why you use different methods for the different data sets.

Response to comment #36: we have followed similar method of analysis for both GIMMS and MODIS NDVI data. Theil-Sen and MK tests were carried out on both data sets. BFAST and Pettitt tests were also carried out on both data sets.

Comment #37: P 186 L 5 Figure 7a shows: (Fig 7b) remove a and place in the end: (Fig 7 a, b)

Response to comment #37: we have corrected that accordingly.

Comment #38: Whys is table 4 and 5 only presented for MODIS and not for GIMMS as well?

Response to comment #38: The purpose of making Table 4 and Table 5 is to link human activities in different sub-basins with the extent of the vegetation trend observed. Most of the human activities are local processes; they can be identified in a relatively higher spatial resolution. On the other hand, the spatial resolution of the GIMMS NDVI data is 8 km (some of the sub-basins cover few pixels of the GIMMS). Hence, the impact of local processes or human activities cannot be easily detected within 8 km resolution.

Comment #39: Why different titles in the subsection describing results of GIMMS and MODIS? It makes the text harder to follow. It feels like it is two different authors doing the GIMMS and the MODIS sections, and using completely different vocabulary. This makes it very hard to compare the analysis for the two different products. Try to be consistent and use the same words and analysis throughout the study.

Response to comment #39: please refer to response #35 and #36

Comment #40: Whys is the seasonal trends investigated in classes for GIMMS but in regions of interest for MODIS? ROI is not used until the trend break analysis for GIMMS. It gets complicated for the reader to follow when different methods are used. Under the method section ROI is not used until the trend break analysis. Please clarify. I would suggest using trend break analysis for the entire area instead of for ROIs.

Response to comment #40: The ROIs represent classes of the most prevalent significant seasonal trends for both GIMMS and MODIS. For example in Figure 8, most prevalent classes of significant seasonal trends are represented by 8 ROI. The computational time required for the trend break analysis of the whole area is very high. Thus, we chose to run BFAST on ROIs.

Comment #41: P187 L2 How can it be about 207? There are 5 different parameters with either a positive, no, or a negative trend. There is not 207 different possibilities?

Response to comment #41: In order to categorize the seasonal trends, the trend significance for each of the five shape parameters was classified into three categories: significantly increasing at the $p < 0.01$ level, significantly decreasing at the $p < 0.01$ level, and not significant. All combinations of these significance categories over the five shape parameter trends thus yield a total of $3^5 = 243$ seasonal trend classes. Of these, only 207 classes were obtained. In other words, permutation is performed, where n is the number of things to choose from, and we choose r of them (nr) (Repetition allowed, order matters).

Comment #42: P188 L18 Is the sampled areas the same as the ROIs?

Response to comment #42: The ROIs for GIMMS (Fig. 5) and MODIS (Fig. 10) are not the same, as the ROIs were selected based on the most prevalent sig. seasonal trend classes.

Comment #43: P188 L20 What is the seasonal component?

Response to comment #43: The seasonal component is the variation in the NDVI

data at or near the seasonal frequency. This is already described in the change point analysis section of the methods.

Comment #44: P188 L18 Why again using two different methods: Petitts and BFAST? And why use different methods for GIMMS and for MODIS?

Response to comment #44: Please see Response #20.

Comment #45: P189 L 19 What do you mean the reason for the burning is not clear? I assume it is a slash and burn agricultural technique is for clearing the area from shrubs and forest to create fields or natural fires.

Response to comment #45: It is difficult to point out the underlying cause for the burning. But from personal commination with different experts, I have come to know why pastoralists do the burning of shrublands and woodlands. In order to get a very good grass for the next season for their livestock, there is practice of burning the shrublands. There is almost no cultivation of crops in the area.

Comment #46: P190 L 4 Class 1 does only have a trend in mean NDVI, which is not describing a change in seasonality. This is not a seasonality term.

Response to comment #46: Please refer to Response #33

Comment #47: Please add References to the sentence P 190 L8.

Response to comment #47: by inserting reference we have changed the sentence to: "This result is consistent with a myriad of previous findings from both station observations(Menzel et al., 2006; Sparks et al., 2009) and satellite observations(Karlsen et al., 2007; Tucker et al., 2001; Zhou et al., 2001)."

Comment #48: Remove that it is beyond the capacity of this study. This is the discussion, so you should put your results into perspective.

Response to comment #48: We have corrected that.

Comment #49: P193 How is the trends in if you use the overlapping period for MODIS and GIMMS?

Response to comment #49: When we use the overlapping period, it becomes only 6 years data and we believe that the number of years for detecting reliable inter-annual trend need to be more than that.

Comment #50: Wang et al 2012, 'Impact of sensor degradation on the MODIS NDVI time series' (RSE) have shown a strong decreasing trend in the NDVI time-series of Terra. Could this explain the decreasing trend in the MODIS product?

Response to comment #50: This could be one of the reasons, but it needs further investigation. We have now included the above reference in the discussion section of the new manuscript.

Comment #51: P194 L10 Were there any trend breaks in the GIMMS series after 2000? Otherwise it is natural that there are no breaks in MODIS either.

Response to comment #51: No trend breaks was observed after 2000 in the GIMMS NDVI data series.

Comment #52: P194 L20 Why did the Petitts method show different results to BFAST? Again, I would recommend to stick to one mehtod, the one that you find most reliable and only present results from that analysis.

Response to comment #52: Please see Response #20

Tables and Figures

Comment #53: Table 1. Why minimum retained data points so different for GIMMS and MODIS?

Response to comment #53: If there are 24 data per year in GIMMS, we would like to retain a minimum of 2/3 of the original data (i.e. 24*2/3 = 16). For MODIS there 23 data per year, thus we would like to retain a minimum of 2/3 of the original data (i.e.

23*2/3 = 15).

Comment #54: Table 2 I would recommend only to present the Theil Sen and skip OLS, see above. Why is the no statistics of the MK method presented? Why are all slopes included? Is it not enough to present the statistically significant ones?

Response to comment #54: We have now omitted the use of OLS. Thus, only Theil-Sen slope is presented in Table 2 of the revised manuscript.

Comment #55: Table 3 What is the numbers within brackets? What does small sig. changes means?

Response to comment #55: In Table 3, pixels with significant changes in NDVI but of smaller sizes were detected. These are too small to be considered as most prevalent class and thus, we categorized these pixels and labeled them as “small sig. changes”.

Comment #56: Table 4 why is the percentage of the total interesting? Is it not enough with the % of sub-basin area?

Response to comment #56: Information on the percentage of sub-basin’s significant trend out of the total area of significant trend in the basin is useful for identification of sub-basin that is progressing and which one is degrading.

Comment #57: Mention in all table and figure captions if the analysis is based on MODIS or GIMMS.

Response to comment #57: we have done that in the revised version.

Comment #58: Table 4 and 5 can easily be combined

Response to comment #58: If we combine them, it is going to be difficult to read the table.

Comment #59: Table 5 should the slopes not be negative for the browning trends?

Response to comment #59: Yes, the slopes for the browning trends are negative. We

have mentioned it in the caption of the table.

Comment #60: Table 6 What does ROI stands for? Make sure that all table and figure captions explain everything within the tables and figures so that you understand them without having to read the text. What are the different years within table 6. No explanations at all given. Many figures are very difficult to read, text must be larger so that you can see what it says.

Response to comment #60: We have improved the caption of Table 6. ROI stands for region of interest. A clearer explanation is given to every table in the revised version.

Comment #61: Figure 1. The legend is turned the wrong way. In captions write map of instead of spatial distribution of. . .

Response to comment #61: we have removed that map and a map of the study area is replaced.

Comment #62: Fig 2. If the MK trend is not linear, it does not make sense to compare the two slopes. It is two completely different parameters, why calculate the difference?

Response to comment #62: Please see Response #23

Comment #63: Legend figure 3, make boundary of the basin to line instead of rectangle. As it is now, it looks like it is the white area in the N part which you consider. What is this white area? In caption explain what the phase 1 is as well. Now amplitudes are described but not the phases. Be consistent.

Response to comment #63: We have done the correction.

Comment #64: Figure 4. I do not see a lengthening of the growing season in Fig a), the line is just moved upwards. There is only a lengthening of the growing season for class 2. Why is not class 5 shown? The figure caption is very blurry, shorten down and make more concise. Perhaps same scale on the y-axis?

Response to comment #64: We agree. But, if we consider day of left 80% point and

right 80% point, we see that there is a general increase in both the length of peak season and greenness. Class 5 is not shown because it is similar to Class 2. The figure caption has now become more concise in the revised version.

Comment #65: Figure 5 Why is not all ROI presented? Is each ROI one pixel or several? Describe clearer what St, Tt and et is.

Response to comment #65: Because of the limitation of space, we cannot display the trends of all ROIs. The location each ROI is already given in the caption. We have already described the symbols St, Tt and et, but their detailed explanations can be found in Verbesselt et al. (2010).

Comment #66: Fig 6 Again where is class5? What does mu1 and mu2 stand for? Is this the average parameters for the entire areas with the different classes?

Response to comment #66: Class 5 was not shown because of space limitation and it is similar to Class 2. In the caption of Fig. 6, mu1 and mu2 to refer the mean of the data series before and after the break-point, respectively.

Comment #67: Fig 7 Modis 250 m, not mm. I would recommend to filter the slopes so that all non-significant slopes are filtered out in fig c).

Response to comment #67: Thanks for the comment. We have corrected it.

Comment #68: Fig 8. Very hard to follow. Too much info in the same fig. I would recommend placing the name of the different regions and in an overall map in the study area section. By the way, why are borders just located in some figures but not all? Figure b and c, is very hard to get any information out of. I would rather recommend 5 sub-figures with trends of amplitude0, amplitude1, etc.

Response to comment #68: We have now placed borders of the different sub-basins in the study area map. Based on your comment, we have removed Fig. 8b and 8c. Borders of the sub-basins are shown when we feel they are useful to support the information on Table 4 and Table 5.

Comment #69: Figure 9 Again, why is the MODIS series investigated using ROI but not the GIMMS? Why not using classes as was done for GIMMS?

Response to comment #69: The ROIs are selected based on the most prevalent significant classes for both GIMMS and MODIS data.

Comment #70: Figure 10 and Figure 5. I do not see why BFAST captured breaks in Fig 5a, when no breaks were seen in Fig 10 a, b and c. For example 10 a, it looks like there is a strong decreasing trend in the seasonality after 2004, which was not captured by BFAST. Possibly, this could be explained by having a long moving window in BFAST. Can you please describe in the method section how you parameterised BFAST, as this is very important for assessing the reliability of the produced results?

Response to comment #70: Three breaks are observed in Fig. 5a. If we take the last break, it occurred before 2000 in GIMMS. In Fig. 10 the analysis is based on MODIS and the observed trend is decreasing without break point. In both GIMMS and MODIS monotonic trend is observed after 2000.

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