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Interactive comment on "Precipitation-fire linkages in Indonesia (1997–2015)" *by* Thierry Fanin and Guido van der Werf

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Dear reviewer
We appreciate the comments on our draft. Please find a detailed response below with the reviewer's comments in italics.

Regards,

Thierry Fanin

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1   Specific comments

1. *Number of fires vs. area burnt. In many cases (e.g. l. 101-102 (Introduction)), the authors refer to the number of fires in a specific area only. Please note that in a peat/vegetation fire context, the area burnt (if available) may be more meaningful or at least a valuable addition to number of fires. In addition, stating the number of fires per unit area may also be helpful for comparing the different areas (e.g. in lines 236-244).*

   We agree with the reviewer. In general, active fires are to some degree the product of burned area and fuel consumption and thus more closely related to emissions than burned area. However, burned area observations may be more successful in peatlands if the emissions are too small to be detected by active fires. Given that the larger peat fires are in general detected by active fire observations and because from ATSR only active fire observations are available we focused on active fire detections. We now more clearly state this line of reasoning in the abstract.

2. *Matching GPCP and TRMM data, dry season definition. Why are only the 4 driest months of the year used for regression (l. 168)? Later it is stated that correlations were low for part of the region due to low variability of the dry month data. Was the regression performed with daily or monthly data? Please report in more detail. Later on, are lines 252-265 referring to the same dry period definition? If no, how was this period defined (daily vs. monthly, consecutive dry days vs. lowest sum of precipitation)?*

   We used the 4 driest months because of the different regional dry seasons (see Figure 4). We tried other time frames, from 1 to 5 months but a 4 month window yielded the highest correlations. We performed the regression using monthly data

C2

which is now more clearly stated in the methodology. Regarding the discussion part you are referring to, we used the 120 driest days based on daily data. The reason we choose a different approach is that to merge GPCP and TRMM, we needed a yearly consistent time period, while in this later discussion section we focus on specific years for which we can better use daily data. To avoid confusion, we followed you advice and modified the definition in the manuscript.

3. *Combining MODIS and ATSR data. Please add information on how this was achieved in a mathematical sense (linear regression?) How was it possible to compensate for lower ATSR sampling rates (l. 192-203).*

To compensate the lower ATSR sampling rate we multiplied the ATSR data with a monthly correction factor. To calculate this monthly correction factor we used the monthly total ATSR and MODIS active fire counts between 2001 and 2012. We then calculated the ratio at 1 degree spatial resolution, dividing MODIS by ATSR. This correction factor accounts for differences in sampling rates.

4. *Analysis of fire occurrence vs. rainfall thresholds/accumulation periods. In the Introduction, time frames for rainfall accumulation are duly described (l. 207-210). However, the methods for processing these data and combining them with active fires (Results l. 274-293, Fig. 8, Table 3) are not mentioned. More detailed information is needed here as well, as this part of the manuscript is currently not reproducible.*

We now more clearly state in the methodology how we combined active fire and rainfall (l. 225-226). We mentioned that we calculated the rainfall accumulation in each grid cell prior each active fire detected on time frames of 0, 7, 15, 30, 60, 90 and 120 days.

5. *Analysis of diurnal fire occurrence. This aspect is currently present but not*

well covered in the manuscript, i.e. the main analysis is focusing on night-time data, there are few references to other studies of diurnal fire activity and the sections dealing with this are rather weak. Additional 10:30 AM data from Terra would have been available but were not used and no attempt for a comparison to meteorological data (which would have to be diurnal as well) was reported. Consider either expanding or removing this aspect.

To achieve our relatively long time series we had to limit ourselves to night-time data simply because ATSR has only night-time data. If the diurnal cycle has changed over our time period this would have had an impact on the results. We prefer therefore to keep the discussion about the diurnal cycle to make the reader aware of this caveat.

6. *Links to ENSO and IOD. This is coming up somewhat surprisingly when Fig. 9 is first mentioned in l. 310 (Discussion) although it would be an interesting aspect if covered in more detail and in all appropriate sections of the manuscript.*

ENSO and IOD are explained in the introduction and then throughout all the discussion and conclusion. To answer the referee's comment, we now mention the use of ENSO and IOD data in the methodology section, citing where we collected the data (l. 235-236). We also mention the link between El Niño and the amount of active fires in the results section (l 246 – 253)

2 Technical corrections

1. *l. 53 and onwards: add a space between values and units (e.g. 117,000 km2)*
   Corrected

2. *l. 54 GFED4s This abbreviation has been explained in the abstract; please do so in the text as well.*
   Corrected

3. *l. 55 20kgC per m-2, change to: 20 kg C m-2*
   Corrected throughout the manuscript

4. *l. 61 represents, change to represent*
   Corrected

5. *l. 70-72 Is it possible to cite a reference confirming this?*
   Done

6. *l. 91-92 move 'region' in front of the brackets*
   Corrected

7. *l. 93 insert a comma after the 2nd citation*
   Corrected

8. *l. 98 change 'then' to 'at the time' or similar*
   Corrected

9. *l. 98 add 'However, : : :' before 'Fires do not solely occur: : :'*
   Corrected

10. *l. 99-100 Giglio (2010) is missing in the reference list*
    Corrected

11. *l. 117 Please clarify that you mean extinction of light and not extinction of fires.*
    Corrected

12. *l. 123-124 In this context, 1997-98 is not a fire event, but rather a fire season. Also applies to fire years.*
    Corrected

13. *l. 134 and further occurrences, also for tables: check if 'fig X' is the correct way to refer to figures.*
    We modified it to "figure". The abbreviation "fig" must only be used if it appears in running text.

14. *l. 160-161 I would guess that $0.25_{is the final product spatial resolution and not the raingat}$*
    $Corrected$

15. *l. 170-173 Here you repeatedly report the results of a linear regression as 'correlation'. The correct term would be coefficient of determination.*
    Corrected throughout the manuscript

16. *l. 180 amount of fires: change to number of fires?*
    Corrected

17. *l. 185 change comma to semicolon or to 'where'*
    Corrected

18. *l. 186 2x 'use' in one sentence*
    Corrected

19. *l. 193-195 and elsewhere MODIS data is sometimes called MODIS, MODIS Terra or just Terra. Please harmonize; also applies to Aqua mentioned later on.*
    Corrected

20. *l. 209 Build-up of rain sounds inappropriate; how about accumulated precipitation, sum of rain or similar?*
    Corrected

21. *l. 215 Wetlands International (2015) is missing in reference list.*
    Corrected

22. *l. 220 and 223 Refer to parts a) and b) of Fig. 4 or include the area names in the figure for easier reference.*
    Corrected

23. *l. 230-231 Move the naming conventions to the Methods section.*
    Corrected

24. *l. 273 A reference to Fig. 7 is made, but as far as I understand Fig. 7 is not showing the data discussed here (120 driest days vs. monthly rainfall).*
    For better consistency between the manuscript and the figure we changed the average results explained previously to cumulated rainfall as shown in the figure.

25. *l. 274 Please add a comma after 'all regions studied'.*
    Corrected

26. *l. 310-311 The properties of the two El Niño years could also be mentioned in the introduction.*
    We added a sentence in the introduction

27. *l. 322-328 Are you sure the years and the reference to Fig. 6 are correct? Years 2005 and 2014 are not shown there and neither is northern Sumatra. If you meant to refer to Fig. 5, the 'monthly fires' line is much too compressed to observe any of the details reported here.*
    Yes the wrong figure was mentioned and corrected to Fig. 5. Following your recommendation, we moved the monthly data to the second y-axis for better clarity.

28. *l. 337 Do you mean Field and Shen (2008)?*
    Corrected

29. *l. 372-373 How do you define the start of the fire season and is it not related to the meteorological preconditions?*

C7

    We defined fire season as the period with most active fires in each regions, mentioned in the first paragraph in the results section and shown in figure 4.

30. *l. 376 Consider rephrasing to: ': : : there were more days with rainfall in 2015 than in 1997.' or similar.*
    Corrected

31. *References: some references (usually with URL addresses) have a different formatting/ font size (e.g. l. 421) and sometimes the doi is reported differently than for most other references (e.g. l. 446-447). There are some unusual symbols in my PDF version (l. 428 and 467), a comma is missing between doi and year in l. 462 and there is a blank in 'Nino' in l. 532.*
    We modified the doi, but difference in formatting or unusual symbols could not be found on our version.

3 Figures

1. *Tables 1-3 Please explain the area codes in the table caption or spell them out in the table.*
   Corrected

2. *Fig. 1 State what 'active fires' (number of fires detected?) means. What is the white area?*
   We corrected the definition of 'active fires' in the figure caption. The white areas are where no active fires have been detected and this is now explained in the caption.

3. *Fig. 2+3 Consider merging those two figures.*
   We decided not to merge these two figures because they represent two different parts of the methodology

4. *Fig. 4 Please consider writing the area name after a), b) etc. in each panel for easier reference. Also, consider if adding a legend and monthly mean temperatures may be helpful for the reader.*
We modified the area names and modified the colors of the y-axis labels to improve clarity. Finally, we have investigated monthly temperature but this adds very little with regard to explaining variability in fire activity.

5. *Fig. 5 The monthly fire detections are hardly visible in this figure. If this information is vital, consider a different arrangement of the panels or a different plotting technique. Please also add the area names directly in the panels.*
According to referee comments, we changed the monthly fire detection arrangement and added area names.

6. *Fig. 6 Data from 2006 does not seem to be mentioned in the manuscript. Is this intentional?*
Following your recommendation we extended the 2006 explanation (l. 268-269). Less text is dedicated to this year because of the lower fire activity that year. Yet, we decided to keep 2006 in this figure to show the reader the difference in fire and rainfall activity between weak and strong El Niño years.

7. *Fig. 7 Do you mean monthly sum of precipitation? – Creating averages would hardly be useful for this parameter.*
Corrected

8. *Fig. 8 Please consider reporting the years as 99, 00, 01 etc., if possible.*
We appreciate the suggestion and have tried but unfortunately that makes the figure hard to read. We do state in the caption how the numbers should be interpreted.

9. *Fig. 9 What is the data source for this figure? How is 'strongest fire activity' defined? Would it be useful to add sea surface temperature of the El Niño 3.4*

region and to show the years 1997 and 2015 that are discussed in the text in greater detail?
Following referee's advice, we added the data source for both dataset. Strong fire activity was defined as month with more than 5000 AF. Trying different possibility to present ENSO and IOD, we found that showing trends in El Niño or La Nina was more effective in passing the message.