Atmos. Chem. Phys. Discuss., 10, C6571–C6576, 2010
www.atmos-chem-phys-discuss.net/10/C6571/2010/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global fire emissions and the contribution of deforestation, savanna, forest, agricultural, and peat fires (1997–2009)" *by* G. R. van der Werf et al.

Anonymous Referee #1

Received and published: 18 August 2010

Review

G.R. van der Werf et al., 2010

Global fire emissions and the contribution of deforestation, savanna, forest, agricultural, and peat fires (1997-2009)

The manuscript by van der Werf et al. (2010) introduces calculated fire emissions for the time period 1997-2009 following a similar approach as used by van der Werf et al. (2006) utilizing improved satellite-derived estimates of burned area, fire activity, and plant productivity in conjunction with an improved version of the CASA biogeochemical model. For the first time the contribution of different fire sources (e.g. deforestation,

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savanna, forest, agricultural fires) is accounted for in a satellite based product. The manuscript is concise and very well written and together with the supplementary material provides substantial information on the single data products used for the analyses. It builds an excellent reference for the newly developed fire emission product.

The work is an important contribution and will be of substantial interest to the community. It is well suited for publication in ACP.

I have some comments that the authors may wish to address in a revised manuscript:

General comments:

1. The authors might want to refer in the abstract to GFED (Global Fire Emission Database). The previously published GDEDv2 has been widely applied in the modeling community. To clearly distinguish between the updated and improved GFED version (GFEDv3) introduced here and previous versions, GFEDv3 should be named in the abstract and also be clearly introduced and referred to as GFEDv3 throughout the manuscript.

2. I do not understand how the deforestation contribution is accounted for: The authors state that they combine burned area and active fire detections as a proxy for the area cleared by fire in deforestation regions. Therefore, the burned area is separated into burned area in wooded and in herbaceous. The cleared area is the product of wooded burned area and fire persistence.

- How is fire persistence defined in this context?

- What active fire detection product is used?

- How does this compare to the approach used in Giglio et al., 2006 for which a correction factor of 3.2 for burned area was defined in regions classified as deforestation areas (high fire persistence and tree cover)?; Is this correction factor not longer applied in Giglio et al., 2010?

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- Does the burned area distributed with the GFEDv3 dataset include this “correction”

- The additional data layers used to derive the breakdown of fire emissions into different sources are certainly of interest for the users of GFEDv3 and it would be desirable to include them in the distribution of the GFEDv3 dataset.

3. The authors state that the fraction of tree cover used to divide the burned area into wooded and herbaceous is based on the satellite observed VCF (vegetation continuous field) for the year 2004. For years other than 2004, the fraction tree cover was corrected by the cleared fraction.

- How is this done? The fractional tree cover is already needed to estimate the cleared fraction in the first place. - CASA also needs VCF to separate herbaceous and wooded vegetation. Is this the corrected VCF?

Specific comments:

Page 16154, Line 24: Why are the woodland fires not mentioned in the title?

Page 16162, Line 9: “2.3.1. Burned area and active fires” In this paragraph it is not clear to what extent the burned area dataset from Giglio et al. (2010), including also information on the distribution of burned area within the grid cell across different vegetation types and the distribution of burned area as function of fractional tree cover, was modified in this study, e.g. the use of a monthly climatology instead of active fire pixels for the partitioning for the pre-MODIS era.

Page 16163, Line 17: Were the MOD15 data available for the period 2000 – 2009?

Page 16164, Line 10: Is M(m,i) the monthly mean fAPAR value for the time period 2001-2008 ?

Page 16166, Line 14: Fig.4 is really helpful for the reader to understand the partitioning, maybe this could be referenced earlier.

Page 16166, Line 21: Do you mean wooded with forested?

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Page 16169, Line 22: “Fire emissions from trees that occurred in grid cells containing evergreen broadleaf forest but outside the humid tropics forest domain were here included as deforestation (or degradation) emissions to separate them from deforestation and degradation fires within the humid tropical forest biome, and to be able to assign them a different emission factor.” I do not understand this sentence. From Fig. 4 I conclude that there is one “deforestation and degradation” category only, or is this still separated in humid tropics and not humid tropics? The numbers given for deforestation fires throughout the manuscript do they refer to the total or humid tropics only?

Page 16166, Line 27: “area weighted average of the previously and newly deforested fractions” Isn’t this the area weighted average of the single deforested fractions occurring in one grid cell?

Page 16170, Line 13: “Boreal forests were unique in that emissions included burning in forest, shrubland, and wood savanna classes.” This information is already stated above. Also the labeling in Fig. 4 (1-fraction grassland/cropland/barren” for the forest fraction in boreal regions is not really self explaining. The authors might want to add an explanation to the figure caption.

Page 16170, Line 20: “labeled them savanna fires” . . . it is actually savanna and grassland fires. This should be consistent throughout the manuscript.

Page 16171, Line 18: Organic soil layer burning. This needs some more explanation. How is this simulated in CASA? Are the areas in which the organic soil layer burns restricted to peat regions only? How are the peat regions outside the tropics defined? Is boreal soil layer burning reported as forest fire emissions and what emission factors are applied?

Page 16171, Line 21: “we set a minimum and maximum value.” of burning depth?

Page 16173, Line 2: 2.4.5. “Trace gas emissions” - It is not clear to me what the deforestation EF is based on. -“ . . . we used a dry matter content of $\sim$48% to translate

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calculated carbon to dry matter conditions." Is here only a single value used, or is this done biome specific with the values given in Tab. 5?

Page 16180, Line 10: "This analysis was confined to the tropics". This should be rephrased. The analysis of deforestation and peat fires were restricted to the tropics but fire emissions were assessed globally (the global emissions are also the reference for the "$\frac{1}{4}$ of all fire emissions might be net emissions" in the sentence before).

Page 16181, Line 11: "Fire emission were doubled to account for emissions other than fires, for example from the respiration of leftover plant materials ..." Does GFED3 not track the respiration of killed but not combusted material as done in van der Werf et al., 2003?

Page 16192, Line 23: "While our combustion completeness values as well as depth of burning in peatlands were scaled based on soil moisture conditions . . .." Is this scaling not applied for the depth of burning of organic soil layers?

Page 16196, Line 10: I had problems to find the biospheric fluxes (NPP and R_h) through the provided link.

Table 1: "VCF (2001 onwards)" from the text I understood that VCF for the year 2004 was applied.

Table4: The separation of combustion completeness into "burned" and "all" needs some further explanation.

Fig. 1: It should be mentioned in the caption that this is for the Amazon basin.

Fig2/Fig10/Fig12: The gray scale is hard to distinguish on my print out. A colored version would be easier to read.

Fig 4: This figure is really helpful. However, there are a some details I do not understand: what does the 0.5d stand for? Should this 0.5 deg ? "Organic soil: f(climate, FP)" - how is the fire persistence used here? (*) - the tropical "peat" class is not shown,

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but is based on the fraction of burned area detected in tropical peatlands and the tropics organic soil burning scheme" Isn't for the partitioning, explained in this figure, only the peat coverage used and not the "soil burning scheme". FTC is not introduced in the caption.

Fig. S2: "linear regression between MODIS fAPAR and AVHRR NDVI" is this identical to the GIMSS NDVI as stated in the main text?

Fig. S2: . . . and varied between 1-60% in the tropics . . ..

Technical corrections:

Page 16156, Line 20: "Schultz et al. (2002)" should be "Schultz (2002)"

Page 16165, Line 7: "2.4.1 Deforestations Rates" Here and throughout the manuscript the authors should clearly state that the deforestation source is only accounted for in the tropical regions.

Page 16172, Line 25: "burned between less" should be "burned less"

Page 16175, Line 13: ".. best estimates" should be "... best estimates."

Page 16176, Line 19: Reference Andreae et al., 2001 should be Andreae and Merlet (2001)

Page 16178, Line 3: "Cvs" should be "CV"

Page 16178, Line 15: "One factor that had a major impact on ..." That the uncertainty is higher before 2001 is already stated two sentences before.

Page 16179, Line 29: "BOAS" should be "Boreal Asia"

Page 16191, Line 25: "... indicate fuel loads of" should be replaced by " . . . indicate fuel consumption of"

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 16153, 2010.