

***Interactive comment on* “The Wildland Fire Emission Inventory: emission estimates and an evaluation of uncertainty” by S. P. Urbanski et al.**

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The Wildland Fire Emission Inventory: emission estimates and an evaluation of uncertainty

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Response to comments by Anonymous Referee #2 We thank Referee #2 for the helpful comments. The referee’s comments have helped improve our manuscript. We describe our response to Referee #2 and propose specific changes to manuscript.

In the following text “R” refers to referee comments and “A” refers to the authors’ response.

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Referee #2 has organized comments into 3 groups, from most important (group 1) to least important (group 3).

Group 1 Comments

R1. This paper covers CONUS only, and the title should reflect that.

A1. We agree and propose changing the title to: “The Wildland Fire Emission Inventory: CONUS emission estimates and an evaluation of uncertainty”

R2. 23365-1 Just to be clear, you do not have a filter to exclude post-season prescribed burns, correct?

A2. That is correct. We have added the following sentence at 23365 – 6 to ensure this is clear to readers: “We did not develop a filter for post-season prescribed burns and such burns could be included in our assessment as false positive error.”

R3. 23365 A slope was estimated like this: The DB burned area data were purged of burn scars not matching an MTBS entry, and a filter was applied to exclude pre-season prescribed burning. After that, MTBS and DB areas were gridded to 25km and a regression slope was calculated. The DB burned area was corrected by this slope (decreased by 7%). This leaves me with lots of questions about the MODIS DB burned area used for the rest of the study. Is the pre-season prescribed burning filter applied to the whole 2003-2008 dataset? Is the MTBS exclusion applied? How does the MODIS DB total area compare to the MTBS total area, with and without the exclusions? Hopefully these questions can be answered without expanding the section too much. Your burned area uncertainty is based on an analysis at a scale of 25km, which is then used across all scales in the Monte Carlo analysis. This is imperfect, but probably OK, so long as it is not used for scales <10km. It does need to be stated upfront somewhere.

We address the referee’s above questions and comments in parts: R3. Is the pre-season prescribed burning filter applied to the whole 2003-2008 dataset? Is the MTBS

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exclusion applied?

A3. The pre-season prescribed burning filter and the MTBS exclusion were not applied to the whole 2003 – 2008 dataset. The pre-season prescribed burning filter and the MTBS exclusion were only used in the uncertainty assessment that identified the mean bias in the algorithm (7%) and quantified the error function of the MODIS burned area mapping (equation 2). As stated in the manuscript (23364 – 16), while our MODIS burned area mapping algorithm was designed for large wildfire events, it does detect and map fire events smaller than those mapped by the MTBS project (< 404 ha). Therefore it is possible that our MODIS burned area mapping algorithm may accurately map small fire events that are not included in the MTBS dataset and that these MODIS detected burned pixels would improperly contribute to our assessment as false positive error. The pre-season filter and MTBS exclusion are designed to minimize such false-positive error in the evaluation of the burned area mapping algorithm. At 23365-9 we have added the following text to clarify that pre-season filter & MTBS exclusion were used only for the uncertainty evaluation: “The MTBS proximity filter and the pre-season prescribed fire filter were only used in the burned area uncertainty evaluation which quantified the algorithm’s uncertainty function (Eq. 2) and corrected its mean bias (see below). The burned area in used in the emission inventory that is presented and discussed in Sections 3 – 5, included all MODIS based burned pixels as mapped with the algorithm as describe in Section 2.1.1.”

R4: How does the MODIS DB total area compare to the MTBS total area, with and without the exclusions?

A4: The burned are used in the uncertainty analysis was MTBS = 23,012 km², filtered MODIS = 22,027 km², and unfiltered MODIS = 24,084 km². At 23365-9 we have added the following text:

“The total burned area in the 11 subregions used in the uncertainty analysis was 23,012 km² for MTBS and 22,027 km² for the filtered MODIS data. Prior to filtering, the

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MODIS burned area was 24,084 km².” Also, related to this revision we also edited text as follows: At 23364-13 we changed “several” to “11”

R5. Your burned area uncertainty is based on an analysis at a scale of 25km, which is then used across all scales in the Monte Carlo analysis. This is imperfect, but probably OK, so long as it is not used for scales <10km. It does need to be stated upfront somewhere.

A5. We have added the following sentence at 23368-8: “We note that the burned area pdf was based on an analysis at a spatial scale of 25 km but is used across all scales ($\Delta x = 10$ km to $\Delta x = 200$ km) in the Monte Carlo analysis.”

Group 2 Comments

R6: Section 2.1 should stop after introducing the components: the information here on the burned area is better pushed to Section 2.1.1. It is especially confusing that you make statements about how you estimate burned area in Section 2.1 and reference Li et al. 2004, and not your own paper (Urbanski et al., RSE 2009)!

A6: We have removed the sentences describing the burned area mapping algorithm from Section 2.1. The removed text was merged into paragraph 2 of Section 2.1.1.

Specifically:

Beginning at 23355-14 we removed the following text: “The fire burned area is mapped using a MODIS-direct broadcast (DB) burn scar algorithm that combines active fire locations and single satellite scene burn scar detections (Li et al., 2004). The MODIS-DB algorithm provides rapid mapping of burned area and enables production of a regional emission inventory within 1 hr of the final (Aqua), local MODIS overpass.”

At 23355-24 changed “MODIS-DB” to “MODIS-direct broadcast (DB)” At 23356-7 inserted the sentence: “The MODIS-DB algorithm provides rapid mapping of burned area and enables production of a regional emission inventory within 1 hr of the final (Aqua), local MODIS overpass.” At 23356-11 added the reference “Lin et al., 2004”

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The burned are mapping algorithm develop in Urbanski et al., 2009a built upon spectral tests for burn scar detection devised by Lin et al. 2004, therefore we believe it is appropriate to include this reference.

R7: 23372-4 “The pattern is similar, though not as extreme, at g10 km,1 d(k,t), 64% of total ECO arose from 10% of the elements. . .” may want to rewrite for clarity. I recommend comparing scales by similar percentages of emissions, rather than fractions of bins, e.g. 50%/90% of emissions from XX%/XX% of bins.

A7: We have modified the text as suggested by the reviewer. At 23372-2 we have changed the text to read: “At g25km,30d(k,t) 50%/90% of total ECO originated from 2%/18% of elements. The pattern is similar, though not as extreme, at g10km,1d(k,t), for which 50%/90% of total ECO arose from 5%/35% of the elements.”

R8: Figure 8. I think Figure 8 could be much more informative if structured with the Cumulative Distribution Function instead of the histogram. The CDF plot enables one to exactly extract numbers like “XX% of the total CO comes from XX% of the bins,” which can only be qualitatively inferred from the histogram plot.

A8. We have changed Figure 8 to a CDF as suggested by the reviewer. The new Figure 8 caption reads: “Figure 8. Cumulative Distribution Function of CO emitted by element. Panel (a) is for data aggregated to $\Delta x = 10$ km and $\Delta t = 1$ day. Panel (b) is for data aggregated to $\Delta x = 25$ km and $\Delta t = 30$ day.”

R9: 23373-23 “average pixel duff consumption” what is the “pixel” in this analysis? Do you just mean the average fraction of duff consumed?

A9: We mean the average fraction of duff consumed. The word “pixel” has been removed.

R10: 23371-25 Is this weighting of California fires toward October a result of the huge 2007 events, or is it a pattern repeated across years?

A10: No. Burned area, fuel consumption, and emissions were similar in 2007 and
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2003, while the values of these variables in 2006 & 2008 were about midway between the high years of 2003 & 2007 and the low years of 2004 & 2005. The October maximum is related the coincidence of critical live fuel moisture in chaparral shrubs (which is often reached by October) and the Santa Ana winds (which occur October – March) Ref: Dennison & Mortiz, Critical live fuel moisture in chaparral ecosystems: a threshold for fire activity and its relationship to antecedent precipitation, Int. J. Wildland Fire, 18, 1021-1027, 2009.

Group 3 Comments

R11: 23354-5 “may not be applicable” -> “may seriously misrepresent the relevant uncertainty”

A11: 23354-5 The text has been edited as suggested by the reviewer by replacing “may not be applicable” with “may seriously misrepresent the relevant uncertainty”

R12: Equation 1: k is location, t is time, i is species

A12: This is correct. We have clarified this by editing the text at 23355-8 as follows:

Change: “In Eq. 1 FLC is the product of the fuel loading (FL; kg-dry vegetation m⁻²) and combustion completeness (C, dimensionless). All of the variables have significant spatial and temporal variability; in the above formulation k is the location (grid index) and t is time.”

To: “In Eq. (1), k is location, t is time, i is species and FLC is the product of the fuel loading (FL; kg-dry vegetation m⁻²) and combustion completeness (C, dimensionless).”

R13: 23360-18 Harington typo

A13: Typo corrected

R14: 23360-21 UnitedStates typo

A14: Typo corrected

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R15: 23360-22 “avoids introducing additional uncertainty” Well, not exactly. Maybe “avoids introducing additional variability”

A15: changed “uncertainties” to “variability”

R16: 23364-27 “nearby” -> “near”

A16: changed “nearby” to “near”

R17: 23373-20 “COMSUME”

A17: 23373-20 changed “COMSUME” to “CONSUME”

R18: 23379-18 “emission model sensitivity to the mapping of fuel models.” This sentence is a bit clunky, I had to read it 3 times. Maybe just say “sensitivity to the mapping of fuel models”.

A18: Removed “emission model” as suggested and the sentence now reads “In both studies, the substitution employed the same the fuel loading model and fuel consumption algorithm, and thus provides information only on the sensitivity to the mapping of fuel models.”

R19: 22381-28 “Reducing the uncertainty in EFPM2.5 would reduce uEFPM2.5” I think here, and elsewhere in the rest of this paragraph, you mean uEPM2.5. Also “may significantly reduce uEFX,” I think you want to say “may significantly reduce uEX”

A19: The reviewer is correct. We have made the following changes: At 23381-28 changed “uEFPM2.5” to “uEPM2.5” At 23382-2 changed “uEFX” to “uEX”

R20: 23386-25 “Society of Range Manger”

A20: corrected to read “Society of Range Management”

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 23349, 2011.

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