

Interactive comment on “Responses of soil physico-chemical properties to combustion: a space for time substitution study to infer how changes in climate are likely to affect response of topsoil to fires” by S. N. Araya et al.

Anonymous Referee #2

Received and published: 21 April 2016

This paper represents a detailed and thorough description of the physico-chemical properties of different experimentally burned soils taken from across a climosequence transect in Sierra Nevada. This study clearly represents a substantial body of work and such detailed observations will be of interest to the readership of SOIL. However, while I appreciate the amount of work that has gone into this study, I do have some concerns regarding (some of) the methodology and structuring of this paper (see comments below).

General comments

C1

Title and Introduction

The title does not well reflect the content of this paper. It does not seem appropriate to refer to this study as a space-for-time substitution study as there is no discussion of the vegetation or how it may change in the future (no context for the soils). Nor is there sufficient discussion for how the climate is projected to change fire regimes specifically in the study area. Surely it would be more valuable instead to have the words “climosequence” and “Sierra Nevada” in the title?

The introduction could benefit from being expanded to include the current vegetation (and soils) and current fire regimes (intensity, severity, frequency etc.) specifically of the Sierra Nevada study area, and how these may change with anticipated climate warming. This additional information would then provide better context and rationale for this study.

Use of term fire intensity

Page 1, line 22 (and throughout): Suggest the term “fire intensity” is removed throughout the paper. Fire intensity (as defined by Keeley, 2009; Int. J. Wildfire; v.18) is an energy flux, and has been shown to be only weakly correlated with maximum temperatures or heating duration. The intensity classes in this paper have been based on maximum surface temperatures reached in various wildfires (page 5, line 25) yet there is no discussion of the duration these temperatures were held at, and whether (or not) this compares to the 30 minute heating duration used in the muffle furnace experiments. Also, wildfires cannot be represented by a singular temperature (i.e. the muffle furnace) as the temperature varies widely both spatially and temporally (see Alexander 1982, Can. J. Bot. v.60; Finney et al., 2015, PNAS). It is therefore more appropriate to refer to furnace temperatures alone, not intensity, throughout this paper.

Materials and Methods

Please clarify how soil sieved at 2mm can represent actual topsoil in the field. Also,

C2

does this sieving and drying process change any of the intrinsic soil properties?

Use of a muffle furnace for combustion experiments As stated in the other referee comments, a muffle furnace does not fully capture the combustion process (only pyrolysis) that occurs during a wildfire and therefore the charcoals that are produced using this method should not be used to describe fire intensities (see comment above).

Discussion

Given the above comments on the use of charcoals produced in a muffle furnace to describe fire intensity, any subsequent interpretations of fire intensity should therefore be re-evaluated. The discussion section "4.2 climate change implications" could benefit from being expanded to discuss whether (and how) both the vegetation, and therefore soil, is expected to change in Sierra Nevada in the future in response to warming. If the rain-snow transition zone will move to higher altitudes, then will the treeline/ ecosystem boundaries in this climosequence also shift upwards? Vegetation is an important part of soil formation, yet other than in the study site and soil description section of the methods there is little to no discussion of the vegetation in this study area. This needs to be included in the text as fire behaviour is, in part, dependent on vegetation, so projected changes in vegetation first need to be discussed in order to comment on how the fire regimes in the study area may be altered in the future.

Specific comments

Check throughout: As several statistical tests have been used in this study where p values are given, or the term "significant" is used in the text, this should be followed by the statistical test used and the p value in brackets.

Page 2, line 3: what is the evidence for prescribed fires having temperatures <250°C? Is this soil temperature? Please provide a reference.

Page 2, line 5-6: there is no discussion of climate change scenarios or how fire intensity in this study area is anticipated to change in the future. Please remove this sentence

C3

or expand the discussion.

Page 2, line 25: insert reference for fires "maintaining the health of ecosystems"

Page 4, line 1-3: suggest the study aims are rephrased as it is not possible to scale up muffle furnace experiments to the field, let alone to predict effects of different fire intensities on soil.

Page 6, line 24: please explain what a can is

Page 6, line 27-28: please rephrase this sentence. It is difficult to understand.

Page 7, line 7: please explain what a seven point measurement is.

Page 10, line 18-19: please clarify what is meant by kaolinite experiences loss at >550°C.

Page 12, line 30: add the temperature ranges of SOM combustion

Page 14, line 7: Please give a temperature range for "higher temperatures".

Page 15, line 23 and page 18, line 4-8: misuse of term "fire severity"

Page 16, line 6: please insert a reference for prescribed fires not contributing to soil C loss.

Page 18, line 18-23: suggest this paragraph is either re-phrased or removed. The rest of the paper refers to "fire intensity". There is no discussion of fire severity in this paper, or how different fire severities affect the physical properties of soil.

Technical and Typographical corrections

Page 1, Line 25: suggest change to "with increasing temperature"

Page 2, line 2: suggest rephrase to "occurred between 350°C and 450°C" to be more concise.

Page 2, line 15: wildland fire (one word)

C4

Page 2, line 18: please change “significant changes on global...” to “significant changes to global...”

Page 2, line 21-22: suggest re-phrase, this sentence is difficult to understand. Perhaps something like “. . . climate change are likely to affect topsoils in fire-prone ecosystems”?

Page 3, line 1-2: is this information relevant to this study?

Page 3, line 4: insert “the” (depends on the fire intensity)

Page 3, line 7: suggest change “of” to “such as”

Page 4, line 27-29: suggest shorten this sentence for clarity to, “. . . developed under similar granitic parent material and are located in landscapes of similar age, relief, slope and aspect (Trumbore et al., 1996) with significant. . .”

Page 6, line 21: The methods section needs to be written in past tense (please check throughout). Please change “four grams of soil is weighed into sieve” to “four grams of soil was weighed into a sieve”.

Page 6, line 22: please add the “the sample”

Page 6, line 23: please change to “Any soil passing through the sieves”

Page 7, line 8: replace “from” with “using”

Page 7, lines 11-12: add “a” “a fine powder”, “a ball-mill” (please check throughout the paper. There are many instances of this).

Page 7, line 15: replace “at step interval” with “with a step interval”

Page 7, line 20: replace “with” with “,”

Page 8, line 3: suggest change to “sieved <2mm soil samples were ground to a powder consistency using a ball-mill”

Page 8, line 5: how were the C and N values corrected?

C5

Page 8, line 16-17: suggest delete “with increase in heating temperature, all the soils exhibited a similar trend in color change” as this is repetition from the preceding sentence.

Page 8, line 18: delete “with” and change “in mid” to “at mid”

Page 10, line 20: suggest re-phrase perhaps to “Gibbsite was also not found in soils heated to >450°C”

Page 10, line 29: change to “soils. Yet, all soils became alkaline” for clarity.

Page 11, line 15: “ranged”. Also, could “less than 2%” and “over 7%” be more specific?

Page 11, line 19: Typo (p<0.05) described in text as insignificant.

Page 11, line 19,20: “The C:N ratio”, “their C:N ratios”

Page 11, line 21: perhaps simplify to: “in a similar pattern to the C concentration”

Page 11, line 24: “the loss”

Page 12, line 4: “The topsoil”

Page 12, line 25: the link of reddening soils and weathering is irrelevant for this study. Suggest rephrase to “is likely a result of oxidation and the transformation of iron oxides that occurs during combustion”

Page 12, line 28: “topsoil”

Page 13, line 1: suggest add period after soils and add “For example, Musick (1384m) soils, had the. . .”

Page 13, line 4-6: suggest re-phrase the sentence beginning “the influence. . .” as this is difficult to understand.

Page 13, line 13: “the main”

Page 13, line 22: “an increase”

C6

Page 13, line 24: “the aggregate”

Page 14, line 4: “an increase”

Page 14, line 5: “the removal”

Page 14, line 6: “the overall size”

Page 14, line 24: replace “to” with “with”

Page 14, line 27: “the start”

Page 14, line 28: “to this pH increase”

Page 18, line 17: suggest change “collapse of” to “disappearance of”

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