

Review of SE-2013-63.

Title: Short-term spatio-temporal spring grassland fire effects on soil colour, organic matter and water repellency in Lithuania

Authors: P. Pereira, X. Úbeda, J. Mataix-Solera, D. Martin, M. Oliva, and A. Novara

### Detailed comments

Page 2121

- Line 2 You must add 1-2 lines stating why your research is necessary. Remove "first".
- Line 5 Were soil samples collected regular or randomly in the 400 m<sup>2</sup> plot? What depth?
- Lines 6-9 You need to say that you collected 250 soil samples before talking about "the 250 samples". Perhaps you mean that you assessed soil water repellency in fine earth (< 2 mm) and aggregate sieve fractions 2-1, 1-0.5, 0.5-0.25 and < 0.25 mm) from 250 soil samples.
- Line 9 You do not mention "WDPT" again, so remove the abbreviation.
- Line 10 At what depth colour changes were observed? If only at the surface, you cannot talk about incorporation of ash/charcoal.
- Line 13 Substitute "Soil water repellency (SWR)" with "SWR".
- Line 13... I suggest using "more severe SWR" than "higher SWR".
- Line 15 Substitute "aggregate fractions" with "aggregate sieve fractions". Substitute "the SWR" with "SWR".
- Line 16 Until 5 months after fire or during the first 5 months after fire? Not the same.
- Lines 16-17 Move "fractions" after "finer".
- Line 17 Reading only the abstract I find serious problems in this statement. Decreased severity of SWR cannot be attributed to leachability of organic compounds only because of the reasons you mention. If after a burn, I think that the composition of organic substances volatilized during burning and now coating aggregates must be homogeneous and probably there are not differences in leachability. Many other reasons may exist.
- Lines 19-21 Please, re-write this sentence.
- Lines 21-23 Of course. Any consideration about other factors (fire severity, temperature or previous wettability).
- Line 23 Substitute "repellent" with "hydrophobic" (water-repellent, in any case).

Page 2122

- Line 8 If very recent, climate change effects on fire regimes and role in boreal ecosystems are difficult to outline. Delete "recent". May be you mean recent land-use changes and fire suppression policies, but not "recent climate change". Re-write, for example: "However, climate change, recent land-use changes and fire suppression policies may have important implications on the fire regime, fire severity and the role of fire in boreal environments".
- Lines 10-13 I have serious concerns about boreal grassland decline in absence of fire. Is the distribution of boreal grassland and forest conditioned only by fire or are other agents playing their own role? I have deeply read Bond et al. (2005) and have not found a statement to strongly support this, except in a wide sense or for tropical forests and some other ecosystems. In fact, they wrote that fire-dependent ecosystems such as grasslands or savannas are of much greater

extent in tropics and southern hemisphere than the temperate and boreal areas. And more:

*“The third major fire-prone biome, boreal forests, are often dominated by fire-adapted trees with serotinous cones that release seeds only after crown fires (Johnson, 1992; Keeley & Zedler, 1998). However, by our measure of fire dependence, the dominance of the gymnosperm tree growth form does not depend on burning according to the simulations. If fire dependence were measured by changes in species composition, rather than broad functional type, large areas of boreal forest (and other ecosystems?) might be considered ‘fire-dependent’”.*

It is nonsense to suppose the regression of boreal grasslands in absence of fire, when boreal forests are strongly fire-dependent. In addition, Schindler and Lee (2010, DOI: 10.1016/j.biocon.2010.04.003) suggested that increased fire risk is expected in boreal ecosystems under climate warming. So, I suggest deleting this lines.

Line 15 Re-write: “on soil properties from boreal grassland ecosystems (Pereira et al., 2013a, c)”.

Line 16 Move this statement to the beginning of the paragraph.

Line 17 Remove “the” before “studies”

Re-write: “grassland soils”

Line 25 The effect of fire on moisture is strong but ephemeral. I suggest substituting with “water holding capacity” or “water balance”.

You repeat “organic matter” and “organic matter consumption”; “ash” and “ash nutrient input” (what is the first ash for?)

Line 27 I am not in full agreement with this statement. Read jumping the parentheses: “After fire, the degree of direct and indirect impacts on soils [...] have consequences for the complex spatio-temporal nutrient distribution and availability for plant recovery”. Plant recovery may be difficult, easy or even improved depending on the type of plants and strategies. I suggest re-writing this sentence and the following (in the next page).  
Check “have” (has?).

Page 2123

Lines 5-9 Delete “Fire can change soil colour.” And re-write: In fires of high severity, temperatures increase soil redness, especially at temperatures of 300–500 °C (Terefe et al., 2008) or above 600 °C (Ketterings and Bigham, 2000; Ulery and Graham, 1993), which is attributed to the destruction of the organic matter and increase in iron oxides such as hematite (Terefe et al., 2005). In contrast, low severity fires...”.

Line 10 Also in the soil surface and the surface of coarse particles.

Lines 11-14 It seems that all the knowledge on burned soils is about colour. Can you re-write the sentence?

Lines 14 ... The connexion between the sentence starting with “In addition...” and the first part of the paragraph is not clear. What were Eckmeier et al. studying?

Lines 20-21 Why? What do you want to use burned soil colour for? As an index of what?

Line 28 Not all SOM, but the major part. A small part remains as black carbon.

Lines 28-29 If all SOM is volatilized, it does not decrease considerably. It disappears.

Line 29 Only topography? What about rainfall? If rainfall is nor present or is too weak, SOM will not be eroded.

Also, in this case, “SOM” is not very accurate. I suggest “organic residues in the soil surface”.

Page 2124  
 Line 3 "It is" ...  
 Lines 3-5 This is not completely exact: depending on fire severity, burning can induce soil water repellency in previously wettable soils, or enhance it in some cases. But fires with severity high enough to induce SWR in wettable soils may have no effects when soil is water repellent previously to burn (see Doerr et al., 1998, for example).  
 Lines 8-10 Here and through the text. When you cite several references together, sometimes you have ordered them by date, in other cases alphabetically. Please, use homogenous criteria.  
 Line 24 Property loss? What does this mean? Soil properties?

Page 2125  
 Lines 3... The fire? I suggest: "In April 15<sup>th</sup> 2011, an area of XX ha near Vilnius (Lithuania) was affected by a wildfire. The burned area is located at coordinates 54°42'N and 25°08'E and elevation is 158 m.a.s.l."  
 Add the area: the difference between 20 and 25 ha is a considerable surface.  
 Line 5 "Fire severity was..."  
 Lines 6-7 "Three days after fire" ...  
 I suggest avoiding the use of "we".  
 Line 8 How many points? The number varies if you consider the sampling points are in the center of each cell of the grid or you include the borders.  
 Line 9 "... immediately after burning and 2, 5, 7 and 9 months later".  
 Lines 10-13 This information should be moved to the objectives. Perhaps some rewording is required.  
 Line 12 You mean the effects of low severity fires.  
 Line 20 What do these references support?  
 Line 21 Substitute "Soil organic matter" with "SOM content".  
 Line 23 "to remove".

Page 2126  
 Line 7 I suggest Doerr (1998), better than Mataix-Solera et al. (2013) for this.  
 Lines 10-13 Substitute "Water Drop Penetration Time" with "WDPT".  
 Doerr (1998) considered 3600-18000 and >18000 s classes. If you did not recorded WDPTs longer than 18000 s, tell us. If you only considered >3600 s as the final class, tell us (what is not "according to Doerr (1998)").  
 Line 15 What data?  
 You have just said that "data were considered normal and homogeneous at a  $p > 0.05$ " and then "Original data did not follow the normal distribution and heteroscedasticity". Re-write.  
 Line 17-18 Ok. Soil chroma was considered normally distributed after transformation. But is this really valid or is it an artifact? Correlation does not imply causation. It is used for description, but I do not think it can be used as just another soil variable.  
 I am absolutely not in agreement with treating soil chroma as a continuous variable. Chroma is not uniform for every hue at every value, and perhaps useful in this case if all observed colors were the same hue and value.  
 Line 19 Squared root transformation of what? SWR? Or is it WDPT?

Page 2127

- Line 9 Chroma has not relation with darkness.  
Here and through the text (Figure 1, for example). What do you mean with “Munsell chroma value”? I think you mean chroma. Avoid using “chroma value”, as “value” is another Munsell parameter.
- Lines 11-12 I am not in agreement. If you have not found statistically significant differences among average chromas from different months (all are “A”), you cannot say that it decreased with time.
- Line 5 Separate this section in one for colour and another for SOM content.
- Lines 12-14 Only one case and one-unit chroma variation? Again: isn’t this an artifact?
- Line 15 Substitute “SOM” with “SOM content”.
- Line 16 Substitute “Soil organic matter” with “SOM content”.
- Lines 16 ... What are the differences? Please, provide mean  $\pm$  SD values.
- Lines 19-21 What trends? There is no trend in the control plot (all groups are “A”). In the burned plot, SOM content first increases(B immediately after burning and 2 months later) and no further changes.
- Line 23 Substitute “The SWR” with “SWR (measured as the squared root of WDPT)”.
- Lines 23-25 and first Difference between treatments in the burned plot? What treatments were applied in the burned plot? Do you mean between dates? This is confusing.
- lines of I think you are talking about different treatments, but you mean control and next page. burned sites, which are not treatments. Keeping unburned is not a treatment you applied (neither burning, I hope so).  
Here and through the text, try to revise this.

Page 2128

- Line 4 “Sieve fractions”.
- Lines 6-7 You have not defined what “high SWR” is. You have defined WDPT classes (and later, you have used squared root of WDPT).  
Try to be more accurate. I think you write SWR in many cases, but you mean WDPT (or squared root of WDPT).
- Lines 5-8 Specify sieve fractions at each case. Sometimes you use only “finer fractions” and the reader does not know what fractions you mean. Do it as in lines 7 or 10, or simply cite the sieve fractions.
- Line 12 Delete one of the repeated “afters”.
- Lines 13-14 “Observed in the SWR finer fraction”?
- Line 17 Substitute “studied period” with “experimental period” (“studied” is repeated in the same sentence).
- Line 24 Not in “g”.
- Line 25 After or immediately after fire? “After” means all your experimental period.
- Lines 26-27 Not especially in the finer fraction. Why especially? It occurs in the two finer fractions. Can you say the composite samples were especially wettable?
- Line 28 You have not defined “wetable”.

Page 2129

- Line 3 Substitute “significant at a  $p < 0.05$ ” with “significant ( $p < 0.05$ )”.
- Lines 11-12 “Especially” repeated in a short time.
- Lines 2-8 Substitute “correlation between XX vs. YY” with “correlation between XX and YY”.  
What are the coefficients? Tell us, even if they are in tables.

- Line 6 Repeated “the correlations”. Re-word.
- Line 13 Substitute “as in the present one” with “as in our experiment”.
- Line 18 Soil colour or only chroma?
- Line 20 How can rainfall dissolve black ash (organic residues not completely burned) so reducing soil darkness with time? Leaching only affects soluble minerals. In any case, soil darkness/brightness is measured by Munsell value, not Munsell chroma.
- Lines 21-24 But you have not determined soil nutrients. So, this (true) statement is not necessary here.
- Page 2130
- Lines 1-2 Black colour does not increase temperature, sun radiation does. Re-write “decreases albedo facilitating the temperature rise during day hours”.
- Line 3 Remove the comma before “and”.
- Line 5 How does the black ash cover change microbial activity and diversity?  
Can you provide any data on the rainfall amount after fire? At least, explain if it was a rainy period.
- Line 7 Is this area the same study area in Pereira et al. (2013a)? In this case, you mean vegetation cover. If you only write “vegetation”, many other factors may be implicit (diversity, species composition, vegetation structure...).
- Line 10 Vegetation cover.
- Line 11 In Boreal grasslands, effects on biodiversity may vary with fire recurrence. Your assumption is valid only for low recurrence of fire.
- Lines 15, 17 and 20 SOM content.
- Pages 2130 and 2131 According to the measured acidity (pH 7.2, Table 1), I have serious concerns about if organic matter may be leached. Leaching only affects soluble organic substances, which lose solubility when pH increases. Leaching of organic compounds is negligible at pH 7.2. This is a key point of your work and needs much more explanations. Especially when leaching seems to affect more strongly certain sieve size fractions.  
Are you sure that leaching is the key here? It is a flat area, so there is no erosion risk. But changes in nutrient concentrations and increased root activity may affect (or be correlated with) microbial activity. What do you think? If soils were wettable before burning, I should assume that hydrophobicity is concentrated in volatilized and later condensed organic substances now covering the surface of aggregates.  
In my opinion, microbial activity may destroy hydrophobic substances coating aggregates in the burned soil with time, and the intensity of this effect may be conditioned by the size of aggregates, as relations S/V vary exponentially with aggregate size.
- Page 2132
- Line 6 Re-write: “that, in water-repellent soils, the finer fraction...”.
- Line 10 Delete the “>” signe.
- Line 15 “Measurement periods” do not exist in your experimental design. Substitute “measurement periods” with “sampling dates”.
- Line 25 Consider previous comments and remove or support this statement.

Page 2133

- Line 4 Only sand-sized aggregates? I suggest writing that fire may decrease the average aggregate size or decrease the proportion of sand-sized aggregates.
- Line 8 "Particle size".
- Lines 8-9 You are putting together particles and aggregates. The processes you are citing here are very different.  
Particle size may change after high temperatures by melting. In contrast, changes in aggregate stability increases the proportion of finer aggregates (as a consequence of fragmentation of coarser aggregates).  
In any case, discussion here about changes of particle and aggregate size is speculation, as you have not studied it.  
The important issue here: how do these processes (if present in your experiment) affected the properties you have studied?
- Line 16 SOM content.
- Lines 16-19 I'm not convinced.  
However, I think that a non-parametric statistical approach should have been more interesting.  
Have you determined WDPT in dark and white ash?
- Line 21-22 This citation concerns unburned soils.
- Line 26 Better use "water repellent" for soil and "hydrophobic" for substances.
- Table 1 The first row is separated by a line. Remove it.  
You have analyzed 25 samples. Can you provide  $\pm$  SD?  
"Silt loam" according to...? USDA?  
I suggest moving the notes at the foot to the head of table.
- Table 2 In the main text, you make no difference between WDPT classes more than wettable, low, strong and severe WR, with no reference to other classes (6-10 s, for example). I suggest grouping WDPT classes in wettable (< 6 s), low (6-60 s), strong (61-600 s) and sever WR (601-3600 s).
- Figures 1-3 A suggestion: colour figures increase citations. Don't ask me why, but it occurs.
- Figure 1 After fire or immediately after fire?  
If no significant differences are observed among chromas from different dates in control plots after ANOVA, post-hoc has no sense: remove all the "A"s in the control series.  
As in a previous comment: chroma or value?
- Figure 2 After fire or immediately after fire?  
If no significant differences are observed among SOM% from different dates in burned plots, remove all the "A"s in the burned series.  
Also, delete the "a" for dates 5, 7 and 9 months clusters.
- Figure 3 After fire or immediately after fire?  
Remove "a"s in 5, 7 and 9 months clusters.
- Figure 4 Is it separated because of formatting the SED manuscript? Please, check that figure has been provided complete.