Authors' response

Interactive comment on "Key drivers of pyrogenic carbon redistribution during a simulated rainfall event" by Severin-Luca Bellè et al.

Anonymous Referee #1

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In general, the study and manuscript is a worthy contribution to the field of investigation on the fate of pyrogenic carbon after forest fires due to exposure of heavy rain.

We are grateful and appreciate the positive feedback of the reviewer on our submitted manuscript and for the suggestions made to improve it.

The only part of the paper that I raise a question to in terms of validity is the assertion that PyC accelerated loss of SOC. The authors seem to contradict themselves by saying that SOC adsorbed to PyC and was lost along with the PyC, but at the same time state that the short time period < 1hr was probably not long enough for their to be any significant contact time and adsorption between SOC and PyC. They say that the loss of SOC was the same order of magnitude of PyC loss and therefore the two are linked. I failed to see the trend in the data and only select treatments were significant from the control, without any logic behind why. I would imagine if there were any interactive effects that it may be due to a fast dispersion of hydrophobic biooils from the PyC when the rain started which may have transferred hydrophobicity to the SOC. I think it is sufficient to be say that this is an area to further investigate without drawing any strong conclusions about causality.

We agree with the reviewer that based on the findings presented in the manuscript, no strong conclusions about causality between PyC and nSOC export can be drawn. We will have interpretations that are more conservative in section 4.2 about possible causalities between the two processes and clearly state that the data is highly variable and therefore conclusions about underlying processes need further investigations.

Here is what we propose for section 4.2 in the discussion:

By using $\delta^{13}C$-labelled PyC, we were able to show for the first time (to our knowledge) that the application of PyC to the soil surface and its subsequent redistribution affects the fate and redistribution of native SOC (nSOC). The changes in nSOC export by runoff and splash after application of PyC were in the same order of magnitude as the PyC flux after the rainfall event, but highly variable and the underlying processes are not fully clear and need further investigation (Fig. 5). These changes could be related to the sorption and stabilization of nSOC to PyC surfaces (Jiang et al., 2019; Singh et al., 2014), or the strong affinity of PyC to sorb to mineral surfaces, which can promote the mobilization of less effectively adsorbed nSOC through desorption (Jiang et al., 2016). However, it seems unlikely that these processes take place within minutes. Another possible explanation could be that PyC particles on the soil surface increase the soil hydrophobicity and lead to a longer contact time between water and nSOC, which may promote its export. However, it is still surprising that such a process would result in such a large export flux of nSOC. More specific experiments are needed to fully understand these processes.

For better clarity, we will further remove the statement "*loss of SOC was in the same order of magnitude than PyC"* in the abstract.

There was one other sentence which may need fixing as well on line 508 where maybe they mean that grass physically disintegrates quicker than wood. They had it the other way round.

In line 508, the cited reference (Spokas et al. 2014: 330-331) actually states that *"wood and high-lignin feedstocks appear to disintegrate into smaller particles more readily than the corresponding feedstocks with higher cellulose contents (e.g., manures, grasses, and corn stalks)"*. With this reference, we want to highlight that both grass- and wood-PyC can disintegrate and that therefore its mobility not only depend on feedstock, but also other factors causing the fragmentation. This is highlighted with our results, were we show that both grass- and wood-PyC can be highly mobile, and not only grass-PyC (even if we recovered much less of the grass-PyC due to dilution). We will rephrase the sentence, saying *"Spokas et al. (2014) further observed same or higher levels of fragmentation for wood-derived feedstocks (lignin-rich) compared to grass-derived feedstocks (cellulose-rich), depending on the experimental conditions applied."*