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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.

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.

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.

Please also note the supplement to this comment:
https://bg.copernicus.org/preprints/bg-2020-361/bg-2020-361-RC1-supplement.pdf

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Key drivers of pyrogenic carbon redistribution during a simulated rainfall event

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Abstract. Pyrogenic carbon (PyC) is produced by the incomplete combustion of vegetation during wildfires and is a major and persistent pool of the global carbon (C) cycle. However, its redistribution in the landscape after fires remains largely unknown. Therefore, we conducted rainfall simulation experiments on 0.25-m² plots with two distinct Swiss forest soils (Cambisol (clay loam) and Luvisol (sandy silt)). We applied PyC produced from wood (*Picea abies*) labelled under FACE conditions and C4-grass (*Miscanthus sinensis*) to the soil surface to study PyC redistribution by runoff and splash, and the vertical mobility of PyC in a 10 cm unsaturated soil column based on the differences in $\delta^{13}C$ of soils and PyC. We assessed the effect of soil texture, slope angle and PyC characteristics (feedstock and particle size) on the mobility of PyC during 30 minutes of intense rainfall (102 mm h^{-1}). Our results highlight that PyC is highly mobile. Surface runoff transported between 0.2 to 36.0 % of the total added PyC. Erosion by splash further redistributed 10.3 to 25.3 % of the added PyC. Soil type had a substantial impact on the redistribution of PyC by both runoff and splash: on average, we recovered 10.5 % of the added PyC in runoff and splashed material for the clay-rich Cambisol and 61.3 % of the added PyC for the sandy silt Luvisol combined. PyC feedstock had a clear, but contrasting effect on PyC redistribution: relocation in the runoff and splashed material was greater for wood-PyC (43.4 % of total added PyC) than grass-PyC (28.4 %). However, more wood-PyC (11.5 %; fraction of organic C derived from the PyC) remained where it was initially applied compared to grass-PyC (7.4 %). The results further suggest that the effect of PyC characteristics on its mobility can be highly variable and depend not only on the material from which it was derived, but also on other factors (e.g. particle size, porosity, density). In particular, the mobility of PyC was almost twice as large for fine-grained PyC (< 63 µm) than for coarse PyC (63 µm – 2 mm). Vertical mobility of PyC up to 10 cm depth was greater in the clay-rich, well-aggregated Cambisol, but limited in the physically instable Luvisol, likely due to quick aggregate breakdown and surface sealing. The addition of PyC to the surface of the studied soils further induced changes in the export of native soil organic carbon (nSOC) in the same order of magnitude as the PyC flux after the 30 minutes rainfall event. Our study shows that large quantities of PyC can be redistributed by water erosion over short timescales, and

Fig. 1.