

SOIL Discuss., author comment AC2
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Reply on RC2

Roisin O'Riordan et al.

Author comment on "The effects of sealing on urban soil carbon and nutrients" by Roisin O'Riordan et al., SOIL Discuss., <https://doi.org/10.5194/soil-2021-18-AC2>, 2021

General comments

We thank the reviewer for their comments and the time taken to read the manuscript and make these very useful suggestions which are gratefully appreciated. We address your comments individually below and hope to improve the paper as a result.

Response to specific comments:

- Thank you for mentioning this; it is an important point. Contamination would be very different between the greenspace and sealed soils, and the anthropogenic additions could themselves be considered a form of contamination. We will update the introduction to include a brief discussion of this.
- We agree that this is important. We will include further detail in the introduction on urban soil structure and spatial heterogeneity, and the reference you provide. We will also highlight how urban soils have rarely been studied to date.
- We will update this sentence to define ecosystem services, and to clarify the role that urban soil plays in providing them in urban areas.
- Thank you for highlighting this. We will update the map to show the location of Manchester within the UK, and will label the town of Rochdale to the north-east on a more detailed map.
- We will add further detail and update the text to the following:
 - (L. 89) All soils were sampled to a depth of 10 cm of available soil. In greenspaces, soils were sampled from open grassed areas where litter consisted of roots and dead grass leaves. The turf and root mat were removed and the soil was sampled down to 10 cm.
 - (L. 90) In sealed soils, imported construction materials consisted of limestone gravel or chips, construction rubble including brick or concrete, sharp sand, charcoal and ash. Profiles and horizons were not consistent across the sites due to the heterogeneous nature of soil sealing. In general, profiles consisted of a sealed surface, various layers of road or pavement foundation materials, and the soil underneath which was often a clay rich subsoil. The depth of construction materials varied from 30-110cm depth, but most samples were collected between 60-80cm depth, sampling the top 10cm of available soil under the construction materials.
 - (L. 92) At all sites two samples were collected, one using a metal bulk density core (6 cm diameter), and a second sample using a trowel for additional analyses using

fresh soil. Samples were collected in plastic bags and kept in a cool box while transported. Samples were then kept refrigerated and fresh soil analyses were undertaken within one week. Please could the reviewer expand on their comment on carbon analytics and plastic vessels?

- Regarding the soil sampling and urban soil categorization
 - Add a brief description of profile structures, horizons and a designation according to WRB to the different urban soil categories within section 2.3.1
 - In greenspaces, soils were sampled only to 10cm depth and the full profile was not excavated, thus description of the profile and horizons is not possible. For the sealed soils, horizons were not consistent across the various sites sampled, in part, due to anthropogenic disturbance. We acknowledge that further detail on these soils would be beneficial for the study of urban soils, however unfortunately, we are not able to provide all these additional details, for example the diagnostic criteria required by WRB, in this paper.
 - Define and name the type of artefacts (l. 101) found within the section 2.3.1 or later within the results
 - We will add the text: (L. 101) These artefacts appeared to be fragments of the materials used in the road or pavement construction (as described above) which had disintegrated and been mixed into the soil.
 - Figure 2 could be supplemented by specifying soil horizons according to FAO 2015, brief description or naming of the materials (especially for the sealing materials) and depth ranges.
 - More information will now be provided with additional text (please see 5.2) as well as the photographs and brief descriptions of the profiles in supplementary material.
 - Finally, it would be easier for the reader to get an impression if selected photos of the sampling sites and, if applicable, of the profile structure were summarized with a short description in an SI.
 - Thank you for this suggestion, we will include some photographs in supplementary information.
- We will clarify which samples were used for which analysis by adding the following text: Following drying to 70 °C, homogenising and sieving, subsamples were taken for analyses of total P, extractable OC and inorganic C. Further subsamples were then dried to 105 °C prior to CN analysis and loss on ignition. Bulk density cores were used to determine bulk density and soil moisture content. They were then used to measure the proportion of material >200 µm by sieving to determine soils with anthropogenic additions.
- We did not measure the proportion of artefacts in the soil. We will clarify this in the text with the following: Wet sieving was undertaken on subsamples of the sealed soils to distinguish between SU and SA soils. We used the proportion of material in the > 200 µm fraction to determine the level of anthropogenic additions and serve as a proxy for the proportion of artefacts. Soils with visible artefacts generally exhibited more than 40 % of subsample mass in the >200 µm fraction; thus, subsamples with more than 40 % mass in the >200 µm fraction were classed as SA soils, and those with less than 40 % in the >200 µm fraction were classed as SU soils.
- Determining the proportion of artefacts in the soil was not practical for this context as artefacts had disintegrated into very small fragments, hence why we chose an alternative approach. We will add further information on the type of artefacts (i.e. the construction materials) in both section 2.3.1 and this discussion point.
- Thank you for making this really interesting point. Indeed, it's hard to find a soil anywhere in the world that hasn't had some anthropogenic influence! We agree that many urban soils will have had some form of anthropogenic influence, whether that is direct additions to the soil or indirect such as atmospheric deposition. We will highlight this with additional text in the discussion section. This is something we hope to work on further in future studies.
- You are correct in that these were observations of some samples but were not captured

or measured across all samples, and therefore it is not possible to include them in the results, much as that would have been useful. We determined redoximorphic features as areas of grey, brown and orange, suggesting areas lacking in oxygen (grey) and those with oxygen (brown and orange) as described in Weil and Brady (2016) *The Nature and Properties of Soils*. We included this as a discussion point to give additional observations and background to the statements.

- Thank you for highlighting this. We will add further text to the conclusion to make suggestions for future work. These will focus on further study into the carbon in sealed soils, and whether anthropogenic additions might provide a long-term C store. We will also suggest gaining further understanding on anthropogenic influences on urban greenspace soils.

Response to technical corrections

- The term “wider urban C stocks” in l. 67 should be clarified.
 - We will update this text to: (L 67) To gain a clearer picture of how [sealed soils] contribute to C stocks across the wider urban area.
- Please add a reference for the statement on the population (l. 75).
 - We will add this reference: ONS (2021) Estimates of the population for the UK, England and Wales, Scotland and Northern Ireland.
- Please add a cross-reference to Figure 1 (“Fig. 1”) at the end of the sentence in l. 77.
 - We will add this reference to Figure 1.
- Please add the value range of distances between sealed and greenspace sites (l. 88).
 - The range of values will be added (0.25 m – 330 m).
- The term “technosols” should be written as “Technosols” (e.g., line 100, 247, 268) within the entire manuscript. I am not a native speaker myself, but I think this would be the correct spelling for a proper name.
 - We agree; we will update all instances of Technosols.
- Please give the information and specifications on the used pH probe in l. 123.
 - We will add this information.
- Please add a reference for the LOI procedure in l. 132.
 - We will add this reference: Heiri et al. (2001) Loss on ignition as a method for estimating organic and carbonate content in sediments: reproducibility and comparability of results.
- Please raise the 3 within (g/cm³) in the caption of Figure 3.
 - We will update this text.
- Regarding l. 277: Which type of minerals from concrete?
 - This refers to calcium minerals. We will add this text in.

We thank the reviewer again for their useful comments and suggestions. We hope that the changes discussed here will lead to a clearer and improved manuscript.