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Interactive comment on "Arable soil formation and erosion: a hillslope-based cosmogenicnuclide study in the United Kingdom" *by* Daniel L. Evans et al.

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Thank you for your comments on our manuscript. On behalf of my co-authors, I would like to respond to your suggestions as to how we could take this manuscript further.

(Please also refer to the PDF for equations set out below).

1a) Referee #1; C2, item 1: "If there is one place that the manuscript could be taken to the next level, it would be a more sophisticated mass and isotope balance approach to modelling hillslope soil production and transport. However, the authors are 100% transparent about the variables in their lifespan analyses, and their approach is ade-

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quate."

1b) Response to Referee #1; C2, item 1: The primary aim of the paper is to report soil formation data. The employment of these data in a first-order lifespan model is an important secondary aim and we accept that our model is currently relatively simple. To enact a more sophisticated isotope balance approach, however, we would need to execute further sampling campaigns for both sites and conduct further laboratory analyses. Whilst this is interesting work, we felt it fell beyond the scope of this paper. However, we are considering this for future work (as addressed below).

1c) Change in manuscript after Referee #1; C2, item 1: We argue that no change is necessary.

2a) Referee #1; C2, item 2: "Given that RFF has been actively farmed for over a century and a half, how do you reconcile a still extant A horizon? Do you think that tens of centimetres of soil have been lost in that time?"

2b) Response to Referee #1; C2, item 2: Soil has been redistributed downslope. This is demonstrated by the fact that the soils at the toeslope comprise, in part, of colluvium and further supported by the increased depth to the Bunter Pebble Bed at the toeslope as discussed on Page 16, line 7. Further isotopic work, particularly down the profile at the toeslope, would begin to explore this process in more detail but this is beyond the scope of this paper. There are two reasons for the survival of the extant Ap horizon. First, as soil is lost downslope, subsequent tillage operations incorporate former, unconsolidated soil from the B horizon into the Ap horizon. This leads to the dilution of the Ap horizon with the result that more of the initial Ap matrix survives than if there was no replacement. In Quine and Van Oost (2007), erosion rates are calculated from 137Cs data using the following equation: R_p= R_f (1- E/P)ˆts where Rf is the 137Cs fallout reference inventory, Rp is the 137Cs inventory at a point of interest, P is the cultivation layer depth, ts is the time between sampling and 1963, and E is the erosion rate. This equation can also be used to consider the survival of the Ap horizon,

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where Rf is the initial Ap matrix and Rp is the surviving Ap matrix. Using the data in Quine and Van Oost (2007), Ap survival is significant eve where erosion rates of 26 t ha-1 y-1 are experienced (57% after 50 years, and 32% after 100 years). Second, we would suggest that the continuous removal of organic carbon is balanced by the dynamic replacement of new carbon input. Previous research has shown that for both water-based and tillage-based soil redistribution, this dynamic replacement rate in the upper ploughed layer exceeds that of carbon mineralisation in the sub-plough layer. (Please refer to: Van Oost et al. (2005) doi: 10.1029/2005GB002471 and papers cited therein, particularly those from Harden et al.).

2c) Change in manuscript after Referee #1; C2, item 2: We suggest that the following addition is made on Page 5, line 22: "Despite being subject to arable practices for over 150 years, the presence of a 30 cm Ap horizon may be explained in part by the incorporation of organic carbon from the B horizon, and the dynamic replacement of new carbon into the plough layer, which exceeds the rate of carbon mineralisation in the sub-plough layer (Van Oost et al., 2005) although further isotopic work is required to verify this for RFF."

3a) Referee #1; C2, item 3: "Stratigraphic evidence or isotopic (Cs-137) evidence could yield some insight into the effect of the past 1.5 centuries of tillage."

3b) Response to Referee #1; C2, item 3: We agree, and we are actively pursuing this at another site.

3c) Change in manuscript after Referee #1; C2, item 3: We argue that no change is necessary. Please note that we have signalled the need for further isotopic work within the previous 'change in manuscript' (see 2c).

Please also note the supplement to this comment:
https://www.soil-discuss.net/soil-2019-8/soil-2019-8-AC1-supplement.pdf

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