We thank the reviewer for her/his comments. Our response to your general and specific comments bellow.

Carbon sequestration in agroecosystems appears to be a significant way to offset some anthropogenic CO2 emissions, and no-till is generally considered an efficient and essential component for sequestering SOC. However, data comparing no-till and full tillage show large uncertainties, and not all studies found that SOC levels increased following a change in management to no-till. While there may be a significant change in C distribution in the soil profile, this does not necessarily translate into an increase in total SOC. Since the most important management factor appears to have a limited impact, the hypothesis of this study is generally in question. So the main question is what management practices are we talking about that would result in significant SOC storage. I am assuming that what we are seeing are the effects of potential natural land cover, not the effects of human land use.

This paper is not about the application of no-tillage to achieve additional carbon in the soils. No-tillage is only *one of the many* management practices available, which is also implemented in combination with other managements. One of the challenging things about any farm/soil management is that there is no perfect recipe that can be prescribed. Their effectiveness varies according to soil/environmental factors affecting each location, reason why spatial models like this one are so important. That is why the title of the first reference that you provide is "Climate and Soil characteristics Determine Where no-till Management can Store carbon in Soils and Mitigate Greenhouse Gas emissions". We will add that reference to our discussion.

In this regard, land use history is also a very important factor. This is probably the most difficult part of the equation. It is likely to have a greater influence compared to changes in analytical methods over time. A common problem with global studies and modeling is spatial resolution. Land use and its history often vary on very fine scales, which cannot be accounted for with low resolution spatial data.

We agree that land use history is very important and satellite imagery can detect that to different levels of details. Ideally we would like information at very detailed spatio-tempotal resolution to be able to detect large changes (e.g. forest $\rightarrow$ agriculture) but also smaller changes such as crop rotation. As far as we know, we are not there yet.

The product that we use (MODIS) has a spatial resolution of 250m and it *can* differentiate croplands from other categories. Of course, it could be missing borders between classes or small plots of land. There is extensive literature describing the use of MODIS products and we are happy to add a few references in the methods section.

One factor controlling SOC distribution is soil erosion. Countermeasures may well cause SOC to accumulate in the soil. Colluvial soil can also store a lot of SOC. Estimates put the resulting global storage at 78 Pg C. Such effects are not considered in this study because neither terrain characteristics, soil properties, nor parent material are accounted for in the models. That said, the results of the SHAP analysis become clearer at the 75th and 90th percentiles. This may indeed indicate some effect of management practices, but also the general potential to develop higher SOC levels in some terrain positions, as evidenced by the increase in importance of low elevations. Again, this may be an effect of small-scale (lower elevation) terrain and soil variability - rather than management practices.

Just for reference, the 78 Pg C you mention was estimated in a period between 6000 BC and 2015 AD (8015 years). This study is focused on a much shorter time scale. However, we acknowledge that erosion is a problem in agricultural production. For that reason, information about relief is important in SOC models. In this case, that effect is mitigated by the fact that the samples are distributed mostly in a narrow range of slope values ("flat areas") and part of it is already captured by the elevation covariate.

Regarding the SHAP values, there is a slight increase in the contribution of low elevations for Q75 but rather small compared with the large effect of temperature and precipitation.

All analyses and results are relatively worthless if they are not validated. And here, no validation of the hypothesis and no validation statistics for the modeling are presented. Therefore, the result is relatively meaningless.

As per response to RC2, We will add validation statistics and deviation from the percentiles derived from our bootstrapping routine.

This model includes well recognised factors that affect SOC. We acknowledge in the discussion that our model is not capable of identifying management practices since for that we would required very detailed management information at the global scale and enough soil information to cover all the possible combinations. Unfortunately, such level of information is not available to date, to the best of our knowledge. We also mention that in the discussion.

If I understand correctly, the global predictions are made based on cropland/pasture data only. The calculated SOC totals seem to be based on the global models. Here, however, at least the current forest areas would have to be removed, because otherwise the global storage capacity would be overestimated.

This is indeed a global model but forest areas are not included in any estimates. If this is related to figure 2 and 4, we do not mask the maps so it easier to see the global trends. We will add that comment to the corresponding captions.