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Interactive comment on "Positive trends in organic carbon storage in Swedish agricultural soils due to unexpected socio-economic drivers" *by* C. Poeplau et al.

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Replies to specific comments:

Reply to point 1: This is a very good point and we have rerun the t.tests for the county averages using weighted t.tests. As weighting factor we used the number of sampling points (of Inventory 1) in each county, which accounts for the agricultural area that is represented by each mean value. We have described that step in the statistics section. Since the weighing caused a strong increase in statistical significance, we also tested to use the square root of sampling points as a weighting factor. The result was the same. We added the following sentences in the statistics section: "To test the hypoth-

esis that the change in SOC concentration between two inventories for all of Sweden differs from zero, we calculated differences in arithmetic county means between two inventories and tested them against zero in a weighted one-sample Students' T-test. As a weighting factor we used the amount of sampling locations in each county (in Inventory I) to account for the different size and agricultural area of each county." We also changed the results section accordingly (p values of the t.tests were adjusted).

Reply to point 2: This is what we have done in Figure 4, where we present the overall country means as a function of time. The increasing trend becomes visible. The reviewer might agree that plotting several thousand points for each Inventory in one graph is not feasible. And regarding statistical tests: A more sophisticated integrative statistical approach would only be possible if the sampling points from Inventory 1 would have been resampled again and again. This was however not the case, so the possibilities of statistical analysis of such a dataset become somewhat "reduced". We have thought about this problem for quite some time, how we should best present the data and found that a comparison of county means would actually be the most detailed we could do. It gave us the chance to account for regional specific trends and conditions later on, since management data are also reported on this scale.

Reply to Minor points:

3999-9: How soil texture was determined? Soil samples or geospatial datasets

It was determined on each sample in Inventory 1. We added this information to the text: For pH and soil texture we used county-averaged measured values from the Inventories. In Materials and Methods we added that soil texture was determined on each sample in Inventory I.

4000-12, 4003-16: There is high correlation between ley area and C content/change in it, but that does not necessarily mean that ley area has really quantitatively caused the increase in soil. If there is 94MgCha (20cm) (Andren et al. 2008) in Swedish arable soils, 0.38% annual increase means about 0.35Mg increase in C per hectare.

In the manuscript there was reference showing that ley can results 0.52Mghayr higher increase in soil C compared to annual crops, so in that sense it looks like ley could really be potential driver for changes in soil C. Quantitative aspect could, however, be considered more closely in the manuscript.

When using the pedotransfer function reported by Kätterer et al. (2006) to estimate bulk density, the average SOC stock in the first Inventory was 66 Mg C ha-1 in 0-20 cm soil depth. The found annual increase of 0.38% would thus correspond to 0.25 Mg C ha-1. The proportion of ley and green fallow increased between 1991 and 2013 by 33%, so the expected change in SOC stock would be 0.17 Mg C ha-1, when the reported accumulation rate of Kätterer et al. (2013) (0.52 Mg ha-1) is considered. (Conant et al., 2001) reported an annual increase in SOC stock of 1 Mg C ha-1after cropland to grassland conversion, which would account for 0.33 Mg C ha-1. The calculated accumulation of 0.25 Mg C ha-1 is the exact mean of those two estimates. We conclude that attributing the increase in SOC to the increase in ley and green fallow area is reasonable.

4001-21: Are there areas of limestones in southern Sweden, that have naturally high pH and could be linked with observed SOC

This is true, and could be another reason for the observed coherency. We added the following sentence: “In addition to that, calcareous bedrock leads to high pH values in certain parts of Southern Sweden.” And also slightly adjusted the sentences before and after that.

4006-11: Can ley area in Sweden (regularly tilled, crop rotation) be considered to behave similarly as real grassland?

Yes. This is discussed in detail in Bolinder 1999, the paper we also cited.

4006-21: ESM vs. FD: Not exactly. e.g. soil compaction, adding manure. Maybe authors could add few words how FDmethod used in the study might impact results.

Which direction?

A change in soil bulk density leads to a change in depth of “horizons”, such as the plough layer. This might lead in certain circumstances to a sampling of the horizon below, when e.g. sampling depth is always 20 cm, but the plough layer depth was reduced to 18 cm due to compaction. However, in Swedish agricultural soils, the plough layer is mostly exceeding 23 cm, therefore the risk of sampling more than just the plough layer with a fixed depth of 20 cm is minimal. We added the following sentences: “Only in cases of severe compactions or heavy erosion, the fixed sampling depth of 20 cm would lead to a certain amount of subsoil added during the resampling. Most Swedish croplands are however ploughed to a depth of at least 23 cm.”

Technical corrections:

3992-23: Reference?

We now added Lal 2004.

3995-7: remove “as soon as possible”

We have done that accordingly.

Interactive comment on Biogeosciences Discuss., 12, 3991, 2015.