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Response to the discussion letter of Lassaletta and Aguilera "soil carbon sequestration is a climate stabilization wedge: Comments on Sommer and Bossio (2014)"

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We fully agree with Lassaletta and Aguilera (letter) that carbon sequestration in soils deserves "important attention from scientists, managers and policy makers" for a variety of reasons including for its role in climate change mitigation. With respect to mitigation, soil carbon sequestration can make a useful contribution over the medium term, which is no doubt important, even if modest, and the co-benefits of this sequestration would be very large. The main conclusion of our study was that there are limits to this mitigation contribution over time given the capacity of soils to absorb carbon and the difficulty of implementing improved soil management practices across wide areas.

Although it is rather a minor point in the larger discussion, these characteristics of potential carbon sequestration in soils mean that it does not well qualify as a 'wedge'. According to Pacala and Socolow (2004) "*a wedge represents an activity that reduces emissions to the atmosphere that starts at zero today and increases linearly until it accounts for 1 GtC/year of reduced carbon emissions in 50 years. It thus represents a cumulative total of 25 GtC of reduced emissions over 50 years*." Thus, as the name implies, a C-wedge is supposed to successively sequester increasing amounts of C (compare Fig. 1b in Pacala and Socolow, 2014). Our analysis clearly showed that this is not the case; neither the SOC sequestration nor the %-mitigation potential increase linearly (compare Fig. 3 in Sommer and Bossio, 2014). Unfortunately, Lassaletta and Aguilera (2014) do not provide any evidence for the contrary. Furthermore, even though our optimistic estimate surpasses a cumulative amount of 25 Gt C after 50 years, neither of our two scenarios reaches the threshold of 1GtC/yr sequestration in 50 years set up by Pacala and Socolow (2004) as second criteria for a wedge to qualify as such. We find no hints in their paper that the wedge criteria would allow for *either* 25 Gt in total *or* 1 GtC/yr 50 years from now. Therefore, in a strict sense SOC sequestration does not qualify as C-wedge.

Emission scenarios, such as the SRES-A2, published in 2000 have been updated recently by IPCC to Representative Concentration Pathways (RCPs) for its Fifth Assessment Report (IPCC, 2014). Notwithstanding, the SRES-A2 figures that we used, even though among the most pessimistic, have been close to observed data. For the year 2012 for instances, 34.5 Gt CO_2 were emitted into the atmosphere according to Oliver et al. (2013) while SRES-A2 scenario projections for this year were about 36 Gt CO_2. But even if the mitigation percentages changed slightly if other scenarios were used as a basis for comparison, that would not change the overall conclusions that a global effort to sequester C in soils would contribute little. We therefore agree with Lassaletta and Aguilera (2014) that more wedges –or better to call them mitigation practices – would have to be identified to balance increasing anthropogenic CO_2 emissions and that an intensification of mitigation practices in the next decades is crucial.

It is encouraging to read that CO_2-enhanced vegetation growth has already contributed significantly to lower the atmospheric CO_2 concentration (Shevliakova et al. 2013). On the other hand, a recent meta-analysis reviewing the impact of soil conserving practices, such as zero-tillage and surface residue retention, on SOC sequestration (Powlson et al. 2014) indicated that hopes were probably too high that these practices could contribute notably to mitigating climate change. Other authors (Pittelkow et al. 2014) stressed a potential yield penalty of zero-tillage systems and therefore argued that "the potential contribution of no-till to sustainable intensification of agriculture is more limited than often assumed". So, even if soil conserving practices contribute to the mitigation of climate

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change, there may be tradeoffs that limit the larger-scale adoption at a pace as we had assumed in our study.

However, despite all these potential obstacles that may limit a climate change mitigating impact of SOC sequestration, we nevertheless do strongly support development and large-scale implementation and adoption of agricultural management practices that stimulate carbon sequestration in soils. This because, on the one hand, every little bit helps, and effective climate change mitigation will most likely be the sum of many contributors, including soil organic carbon sequestration. On the other hand, increasing the amount of organic carbon in soils almost automatically increases soil fertility and thus our means to produce enough food for a rapidly growing global population (see also Malyon, 2014).

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