Evidence for large microbial-mediated losses of soil carbon under anthropogenic warming

Anthropogenic climate warming is expected to stimulate microbial decomposition of soil carbon, triggering losses from this large carbon store that accumulate in the atmosphere as CO_2. Yet there is still no consensus about whether this positive land carbon-climate feedback will equate to small or large net soil carbon losses to the atmosphere over the rest of this century. The lack of agreement about the magnitude of net soil carbon losses is a major source of uncertainty in projecting anthropogenic warming. The uncertainty is used to justify not factoring these indirectly human-caused emissions into national emission reduction targets intended to limit climate warming to 1.5 or 2ºC. However, even small fractional losses of soil carbon have the potential to undermine the efficacy of emission reduction targets (Figure 1).

A study published in *Nature Reviews Earth & Environment* reviews the evidence for the potential for anthropogenic warming to stimulate net emissions of soil carbon. **The authors conclude that uncertainty about the plausibility of large net soil carbon losses has been overstated.** They compile evidence that global soil carbon accumulates particularly at high latitudes, and that stocks are inversely correlated with mean annual temperature (Figure 1).

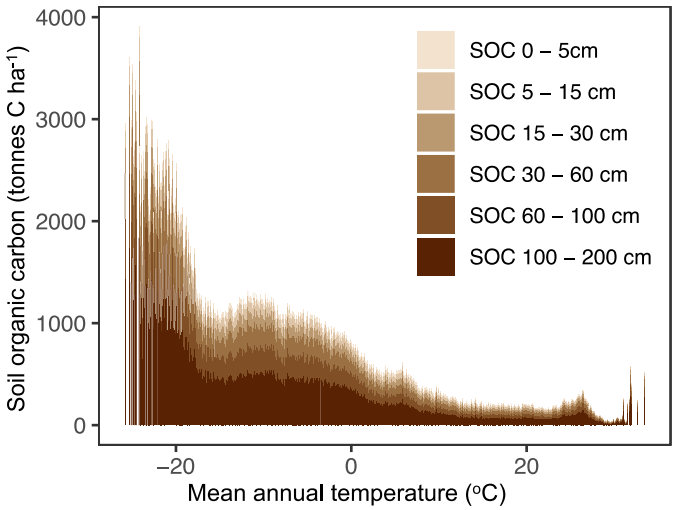

Figure 1. *Soil organic carbon stocks are negatively correlated with mean annual temperature at the global scale. At this scale, soils are the largest store of active carbon, representing 2,200 to 2,500 Pg carbon down to 1 m. Even if warming only stimulates the loss of a small fraction of this carbon, it will contribute substantially to the atmospheric CO_2 burden. Data shown are mean values per temperature value across 100,000 random mapped points. Cumulative values to 2-m depth of >2000 tonnes C ha^{-1} are likely an artefact of poor data on soil bulk density in organic-rich, high-latitude soils in global soil mapping products. Given the huge and vulnerable soil carbon stocks in these systems, high priority should be placed on reducing such data uncertainties.*

The authors reason that if colder conditions primarily drive global soil carbon accumulation (Figure 1), it seems highly plausible that anthropogenic warming in Arctic and Subarctic regions, where temperatures are increasing at about two times the global rate, will trigger large net soil carbon losses. **They argue that there is reasonable scientific confidence then that soil carbon losses caused by microbial-mediated decomposition under warming are likely to be of a magnitude relevant for emission negotiations.** Notably, low temperature regions store the largest soil carbon stocks and are also the most vulnerable areas to climate anthropogenic warming. Even without knowledge of the exact magnitude of losses, they assert that there is enough confidence in this carbon cycle-climate feedback to warrant more aggressive greenhouse gas emission reductions if we are to limit climate change to 1.5ºC by 2100.

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