Qualia

Study: Carbon buried in soil is only there temporarily

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Erosion can bury carbon in the soil, effectively storing it underground. But a new study in the journal *Proceedings of the National Academy of Sciences* demonstrates for the first time that this storage is only temporary.

Researchers say it is all about figuring out the global carbon cycle. In the new study, they estimate that approximately half of the carbon buried in the soil by erosion will be re-released into the atmosphere within the next 500 years - or possibly even faster, due to our warming planet.

I spoke to one of the authors, AAAS member Johan Six, a professor of plant sciences at UC Davis. He and co-author Kristof Van Oost, of the Universite Catholique de Louvain in Belgium, discussed why this important source of carbon emissions needs to be taken into account to understand global climate change past and future.

AAAS Member Central: Can you explain the concepts of carbon sources and carbon sinks, and how they relate to soil erosion?
Johan Six, AAAS member and a professor at University of California at Davis, and Kristof Van Oost, Universite Catholique de Louvain in Belgium: They are components of the biosphere that either take up CO_2 from the atmosphere (i.e., carbon sinks) or that release CO_2 into the atmosphere (i.e., carbon sources). The biggest carbon sinks in the biosphere are the oceans, but there are also significant carbon sinks in the terrestrial biosphere, such as forests and soils. In relation to erosion, it is evident that the disturbance of the soil by erosion leads to a release of CO_2 and is thereby a source. However, erosion is in two main ways also a carbon sink: 1) transported sediment and its associated carbon is buried in depositional sites where decomposition is slowed down; and 2) at the erosional sites, carbon depleted soils come to the surface and are consequently receiving more carbon input from growing plants than when in subsoil. Hence, they are increasing in soil carbon content. Balancing the carbon sink versus carbon source components of erosion leads to erosion being a net carbon sink.

AAASMC: In your recent study, how did you and co-authors calculate the amount of carbon emissions captured in soils and released to the atmosphere?
Six and Van Oost: We combined radiocarbon and optically stimulated luminescence (OSL) dating methods. Radiocarbon dating uses the naturally occurring radioisotope carbon-14 to estimate the age of organic materials, while OSL dating is a method for measuring doses from ionizing radiation. We looked at soil and sedimentary archives with more than 400 carbon inventories and depth distributions to reconstruct the movement of soil and carbon in the catchment. These data were grounded with baseline controls using reference sites experiencing typical land use change trajectories but with no erosion or deposition. By comparing these controls with measured amounts of carbon in soils throughout the catchment we could identify which soils had released carbon versus which ones had captured carbon.

AAASMC: What did you find? Were you surprised by the results?
Six and Van Oost: The major new finding is that the buried carbon by erosion is only a temporal carbon sink because we estimated that on the average 50% of the buried carbon is released over a period of 500 years. This result is not necessarily a surprise based on fundamental understanding of soil carbon dynamics, but our study is the first one to clearly show and, especially, quantify this.

AAASMC: How could climate change affect the rate of carbon release from the soil?
Six and Van Oost: Changes in precipitation and temperature directly affect the rate of decomposition of soil carbon. Hence, the predicted changes in precipitation amounts and patterns will affect the CO_2 flux from soils to atmosphere. Under climate change, an increase in temperature is generally expected, which will directly increase the soil carbon decomposition and hence the release of CO_2 from soil to the atmosphere.

AAASMC: Is there anything people can do to mitigate carbon release due to soil erosion?
Six and Van Oost: The major option is to prevent erosion by any means. Some of the agricultural management options that are effective in reducing erosion are: reduced tillage, cover cropping, terracing, contour cropping, and vegetation strips.

Related Links:

- Legacy of human-induced C erosion and burial on soil–atmosphere C exchange in *PNAS*
- UC Davis Agroecology Lab