Under-Reported "Old" Carbon is Not the Source of Increases in Atmospheric CO_2

Introduction

A recent paper published in the Journal Nature by Dean et al. provides an interesting and compelling argument that a significant source of atmospheric CO_2 has been underestimated by carbon budget models. The study, *Old carbon routed from land to the atmosphere by global river systems* looks at the origin of the CO_2 released by river water into the atmosphere and concludes that the amount of ancient (millennia old) CO_2 is higher than has been used in the current carbon cycle models.

This "leakage" of ancient carbon, found in soil, sediments, and geological stores, is reported to be comparable in magnitude to the net exchange of carbon between land and the atmosphere. The findings also suggest that plants and shallow soil layers may be removing more CO_2 than previously thought, but this is offset by the release of old carbon from rivers.

A recent interpretation of this paper and its use of carbon isotopes called into question the well-established connection between human CO_2 emissions and the 50% increase in atmospheric CO_2. Here, we re-establish the validity and linkage of $^{13}C/^{12}C$ isotopic ratio to human emissions of CO_2 from the burning of fossil fuels.

Fluvial (River) Discharge of CO_2

The release of CO_2 locked up in older sediments largely is incorporated in the CO_2 and isotopic carbon balances of millennia ago and only changed in the past when the natural sources or sinks changed. These releases are not a new source of CO_2 in the atmosphere, as these releases have been occurring for many millions of years and are as old as the water, land and plants are on this planet. The same kind of more or less continuous natural emissions can be seen in volcanic emissions or natural coal seam fires which have gone on for millennia.

The authors made a mistake by attributing all CO_2 river discharge to the human influence, by conflating the total discharge/year with the *net* increase of CO_2, caused by fossil emissions. The real attribution may be from some 50% increase of CO_2 pressure in the atmosphere (pCO_2), leading to a 50% increase of dissolved CO_2 by river waters and 50% extra CO_2 released again in the atmosphere. In other words, release of increasing CO_2 was directly offset by the increased absorption by the same waterways, so there was no net increase in atmospheric CO_2.

A second important finding in the report is that there is likely an underreporting in carbon budgets of removal of atmospheric CO_2 by ecosystems. The importance of this fact was emphasized by the authors who stated, "This budget adjustment suggests that the decadal-aged biosphere is storing more anthropogenic carbon than previously suggested…." The primary author stated, "we do know plants and trees must be taking up more carbon from the atmosphere today to account for this unrecognized release of old carbon."

Increased Erosion Leading to Increasing CO2 Fluvial Release

The authors surmise that increasing erosion (perturbation) is leading to more CO_2 supply because of climate change. "Anthropogenic climate change may increase CO_2 supply to rivers as soils warm and/or get wetter and microbial respiration increases." The authors provided no evidence to support this claim and admit that "Whether or not anthropogenic perturbation has increased the leak of old carbon to the atmosphere through rivers that we observe here remains a notable knowledge gap." In other words, they have nothing to support the claim of increasing erosion due to climate change.

According to Professor Dean, "Our findings show some of this old carbon, as well as ancient carbon from rocks, is leaking sideways into rivers and making its way back to the atmosphere. We don't yet know how humans are affecting this flow of ancient carbon…" He continues, "we do know plants and trees must be taking up more carbon from the atmosphere today to account for this unrecognized release of old carbon."

In order for river-sourced CO2 to have significantly influenced atmospheric CO_2 concentration, an incredibly huge increase in erosion and river flow would be required, beginning slowly in the 1800s, increasing into the 20th century and escalating quickly over the last 70 years. Simply put, the increase in atmospheric CO_2 by 150 ppm by increased erosion and river output is not geologically possible in the timeframe of decades or hundreds of years.

Isotopic Evidence Supports Linkage Between Human Emissions and Rising Atmospheric CO2

The international research team studied more than 700 river reaches from 26 different countries across the world. They took detailed radiocarbon measurements of carbon dioxide and methane from the rivers. By comparing the levels of carbon-14 in the river samples with a standard reference for modern atmospheric CO_2, the team was able to date the river carbon.

Concerning the main isotopic changes: there is very little change in the $^{13}C/^{12}C$ ratio (expressed as $\delta^{13}C$) in the past 800,000 years as seen in ice cores at -6.4 +/- 0.4‰ $\delta^{13}C$, up to about 1850. After 1850 there is an enormous drop in $\delta^{13}C$, down to below -8‰. Recently confirmed by a similar drop of $\delta^{13}C$ in the ocean surface layer as measured in coralline sponges over the past 600 years.

Compared to the human introduction of nowadays 10 PgC/year of ^{14}C-free CO_2 in the atmosphere, the paper's alleged extra release from the increase of 50% extra ^{14}C-free CO_2 from rivers, indirectly caused by our use of fossil fuels, gets around 0.6 PgC/year or about 6% of the direct human contribution of ^{14}C-free CO_2 to the atmosphere. One may see the extra CO_2 release of rivers as indirectly caused by humans, thus for the ^{14}C decrease (expressed as $\Delta^{14}C$), that acts as a fortifying factor or positive feedback for our fossil fuel emissions.

No figures were given for $\delta^{13}C$ of the rivers CO_2 involved. As most of the dissolved old CO_2 is from carbonate rocks, that gives near zero ‰ $\delta^{13}C$ in river water and about -6.5‰ $\delta^{13}C$ when released in the atmosphere, which is slight negative feedback, compared to human emissions. We recommend a more detailed investigation.

Because the observed drop of $\delta^{13}C$ in the atmosphere is only 1/3 of what can be expected if all human CO_2 remained in the atmosphere, the new finding only confirms a small increase in replacing of fossil fuel CO_2 in the atmosphere by CO_2 from other reservoirs, mainly the oceans and vegetation.

Summary

That river-sourced CO_2 from ancient sediments has been overlooked by carbon models used by the IPCC and government sources is an important scientific issue that should be investigated further. However, both the carbon isotope data and the geologic record strongly support that human emissions of CO_2 are the primary source of the approximately 50% increase in atmospheric CO_2 since the beginning of the Industrial Revolution.

Ferdinand Engelbeen
David Burton
Renee Hannon
Ganapathy Shanmugam
Gregory Wrightstone

Authors of the CO2 Coalition investigation of the carbon cycle:
Human Contribution to Atmospheric CO2
https://co2coalition.org/wp-content/uploads/2024/12/Human-Contribution-to-Atmospheric-CO2-digital-compressed.pdf

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