The impact of human CO_2 on atmospheric CO_2 – Summary

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Introduction

This summary of Berry (2021) shows the main points without the math.

1. How CO2 flows out of the atmosphere.

The *Intergovernmental Panel on Climate Change* (IPCC) correctly assumes the outflow of CO_2 from the atmosphere is proportional to the CO_2 level divided by a time constant.

This time constant – that the IPCC calls "turnover time" and we call "e-time" – describes how fast CO_2 flows out of the atmosphere.

IPCC (2007, p. 948) defines "turnover time" equal to the first power of the carbon level divided by the outflow of carbon from the reservoir,

> "Turnover time (T) is the ratio of the mass M of a reservoir (e.g., a gaseous compound in the atmosphere) and the total rate of removal S from the reservoir: T = M / S. For each removal process, separate turnover times can be defined."

IPCC (2007, p. 948) says the turnover time (T) for natural CO_2 is about four years.

> *"Carbon dioxide* (CO_2) is an extreme example. Its turnover time is only about four years because of the rapid exchange between the atmosphere and the ocean and terrestrial biota."

IPCC's data for its natural carbon cycle (IPCC, 2013, p. 470-471) show the e-time for atmospheric CO_2 is 3.5 years, supporting IPCC's statement of "about four years."

Simple physics shows when outflow is proportional to the first power of level, natural and human carbon cycles are independent. So, we can calculate these carbon cycles independently and then add them up to get the total. We need only to calculate the human carbon cycle over time to see how human CO_2 changes atmospheric CO_2.

2. The first approximation conflicts with IPCC claims.

IPCC's data show the inflow of human CO_2 into the atmosphere is about 5% of the total CO_2 inflow and natural CO_2 is about 95%.

Since human and natural CO_2 molecules are identical, their e-times are identical. Therefore, to the first approximation, the composition of today's atmospheric CO_2 is about 5% human and 95% natural.

Yet, IPCC (2013, p. 467, Executive Summary) says,

> "With a very high level of confidence, the increase in CO_2 emissions from fossil fuel burning and those arising from land use change are the dominant cause of the observed increase in atmospheric CO_2 concentration."

IPCC (2013, pp. 470-471) assumes the natural CO_2 level remained at 280 ppm after 1750 and, therefore, human CO_2 caused all the CO_2 increase since 1750. This would make human CO_2 about 32% of 415 ppm as of 2020.

How can a 5% inflow cause 32% of the CO_2 level?

It can't. Even the IPCC realizes this problem. So, to support its claim that human CO_2 causes dangerous climate change, the IPCC incorrectly claims human CO_2 stays in the atmosphere longer than natural CO_2.

IPCC (2013, p. 469) incorrectly claims:

> "The removal of human-emitted CO_2 from the atmosphere by natural processes will take a few hundred thousand years (high confidence). … about 15 to 40% of emitted CO_2 will remain in the atmosphere longer than 1,000 years. This long time required … to remove anthropogenic CO_2 makes climate change caused by elevated CO_2 irreversible on human time scale."

This IPCC claim violates IPCC's own data-based e-time and ignores that human and natural CO_2 molecules are identical, and therefore their e-times are identical.

3. The second approximation proves the IPCC is wrong.

The first approximation considered only the atmosphere. The second approximation uses IPCC's four-reservoir carbon cycle model. The physics model, using outflow proportional to level and IPCC's e-times, replicates IPCC's natural carbon cycle, shown in Figure 1.

Then, this same model calculates a human carbon cycle compatible with IPCC's natural carbon cycle, using recursive, annual time steps from 1750 to 2020, shown Figure 2.

This compatible human carbon cycle shows human CO_2 has added only 33 ppm (8%) while nature has added 100 ppm (92%) to IPCC's 280 ppm level in 1750, as of 2020.

According to the scientific method, the physics model has proved IPCC's claim – that human CO_2 caused all the CO_2 increase above 280 ppm – is false.

Good high-school students can learn how the physics model works.

4. IPCC's natural carbon cycle

Figure 1 shows IPCC's natural carbon cycle at equilibrium with atmospheric CO_2 at 280 ppm (589 PgC). The boxes show reservoirs and arrows the flows between reservoirs.

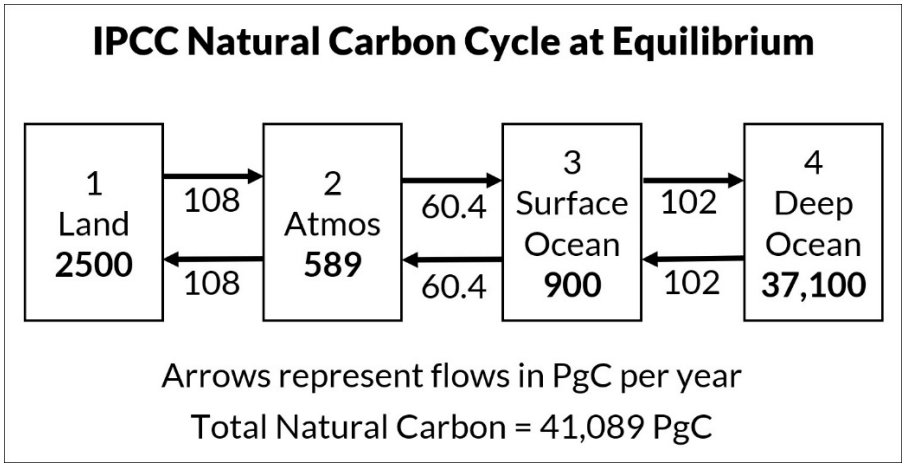

Figure 1. Levels and flows for IPCC's (2013) natural carbon cycle.

Figure 1 shows 1.4% of natural carbon is in the atmosphere and 90% is in the deep ocean. This is an equilibrium fingerprint that human carbon will approach.

5. Physics model applied to human carbon.

Figure 2 shows the physics carbon cycle model with IPCC's four reservoirs and six outflows, where the arrows are all positive numbers.

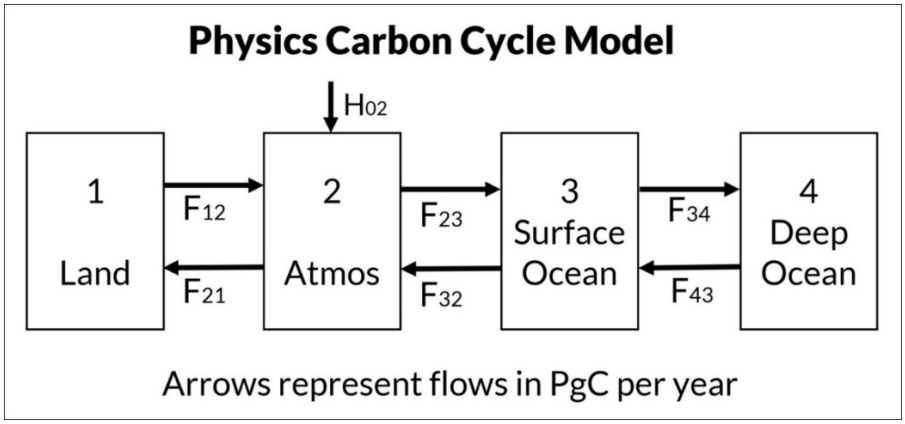

Figure 2. The human carbon cycle model uses the same physics as IPCC's natural carbon cycle but adds the annual inflow of human carbon.

Human carbon has added only one percent to the total carbon in the natural carbon cycle.

Figure 3 shows how the reservoir levels change with time for human carbon.

The purple dashed line shows the cumulative human carbon since 1750. The solid bold line shows the measured atmospheric carbon level *above* 280 ppmv.

Data alone prove natural CO_2 increased the CO_2 level above 280 ppm. The cumulative "New Human carbon added" before 1955 is less than measured "atmospheric carbon," making it impossible for human carbon to have caused all the CO_2 increase.

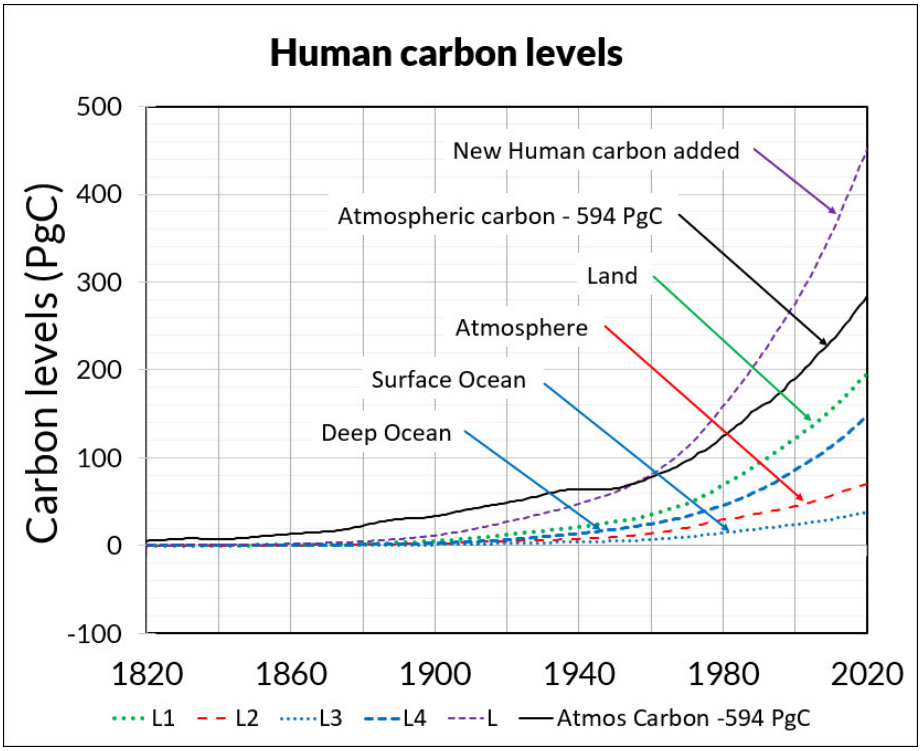

Figure 3. How human carbon levels change with time.

The red dashed line shows human CO_2 added to the atmosphere is much less than the "New Human carbon added" because the CO_2 e-time of 3.5 years lets CO_2 flow out of the atmosphere much faster than it can accumulate.

6. The Bern model uses IPCC's assumption.

Figure 4 compares the physics model with the Bern model.

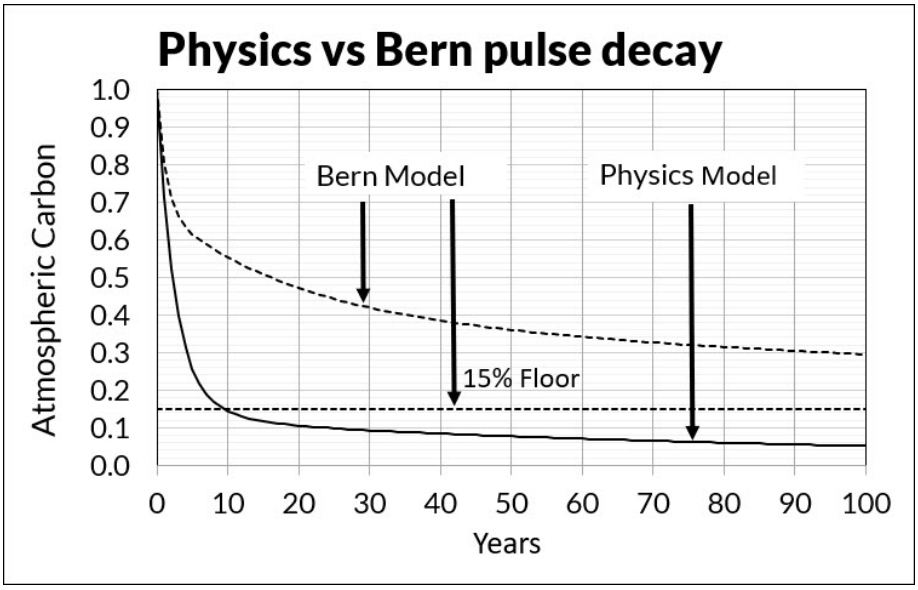

Figure 4. Pulse decay by the physics model and the Bern model.

The key difference between the Bern model and the physics model is the Bern model uses IPCC's invalid assumption that human CO_2 causes all the CO_2 increase while the physics model uses IPCC's e-time of 3.5 years.

7. Isotope data show CO_2 increase is natural.

Figure 5 shows

- ^{14}C data (black solid line) and its curve fit after 1970 (black dashed line).
- ^{14}C data relative to the $\delta^{14}C$ value in 1970 (blue sawtooth line) and its curve fit.
- $^{12}CO_2$ data in ppmv (red sawtooth line).

$\delta^{14}C$ is a measure of the ^{14}C / ^{12}C ratio. The natural level of $\delta^{14}C$ is zero.

Human CO_2 has no ^{14}C, so its $\delta^{14}C$ is -1000. If human CO_2 were 32% of the CO_2 in the atmosphere, it would dilute the natural $\delta^{14}C$ level from zero to -320.

Data show $\delta^{14}C$ has returned to its natural level of zero even as ^{12}C (red line) has increased, showing that natural CO_2 has dominated the increase in atmosphere CO_2.

The ^{14}C curve fit shows $^{14}CO_2$ e-time is 10.0 years (Hardy and Salby, 2021; Berry, 2021). The $^{12}CO_2$ e-time is smaller than the $^{14}CO_2$ e-time because the ^{14}C atom is heavier than the ^{12}C atom. This confirms that the e-time for $^{12}CO_2$ is less than 10.0 years.

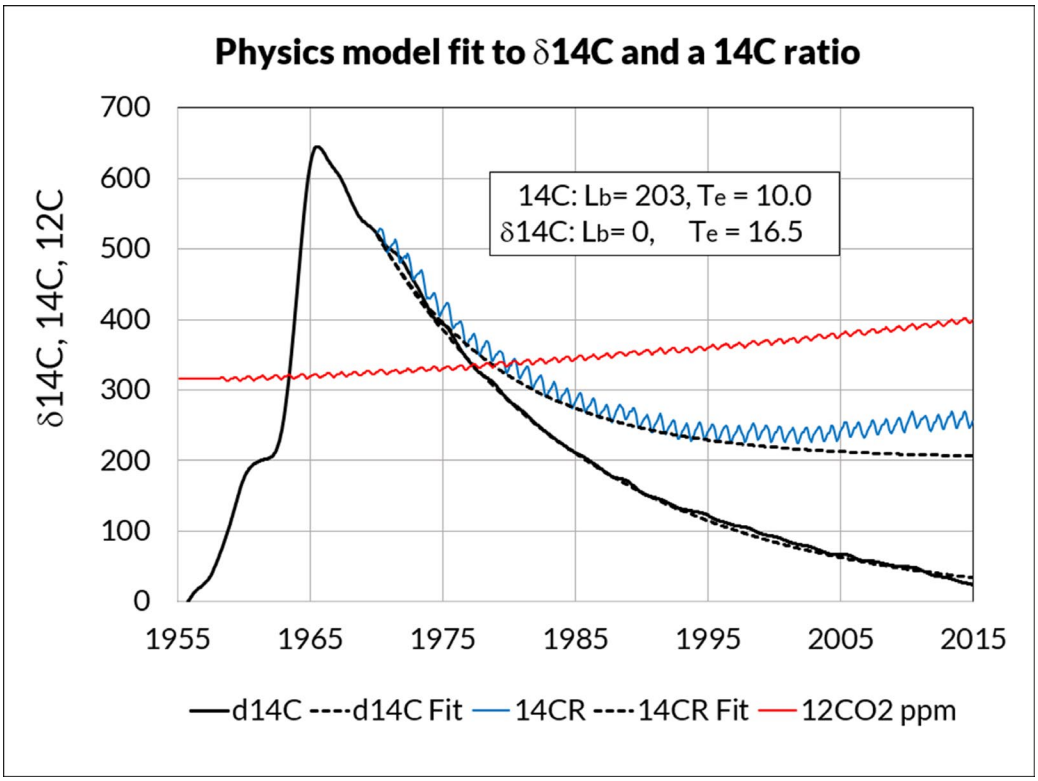

Figure 5. $\delta^{14}C$ data (black line) and its curve fit (black dashed line), relative ^{14}C (blue sawtooth line) and its curve fit (black dashed line), and $^{12}CO_2$ ppmv (red line).

Conclusions

The simple physics model – using IPCC's outflow proportional to level and e-times –proves natural CO_2 controls atmospheric CO_2. As of 2020, natural CO_2 has added about 100 ppm, and human CO_2 only 33 ppm, to IPCC's CO_2 level of 280 ppm in 1750.

References

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