Revisiting the carbon cycle

3/3 Additions, illustrations, responses to objections

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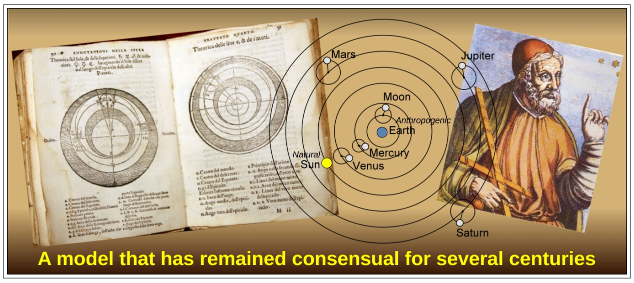
Within the span of a few decades, a simple hypothesis—that the rise in atmospheric CO2 is due **solely** to human emissions—has become widely accepted thanks to the political influence of the UN/IPCC. However, in 2025, a study titled "*Revisiting the Carbon Cycle*" called into question the carbon cycle model endorsed by the IPCC. In fact, in paragraph 6, the study proposes a model that competes with the IPCC's. This new model argues that the rise in atmospheric CO_2 is primarily determined by the surface temperature of the intertropical ocean (anthropogenic emissions are only a secondary factor). The model is presented here in three parts: Part 1 explains the reasons behind it, Part 2 provides a brief description. This Part 3 illustrates the changes in carbon flows according to this model and then addresses the main criticisms leveled against it.



A model that has remained consensual for several centuries

1. The MPO model summarized in a few figures

• The model presented in Section 6 of "*Revisiting the carbon cycle*" attributes changes in CO_2 to **M**ixed causes. Flows out of the atmosphere are assumed to be **P**roportional to the atmospheric CO_2 concentration, with the **O**cean being the dominant factor. This model is referred to here by the acronym **MPO**. We adopt the simplifications from IPCC AR6 Figure 5.12: a model with 3 compartments (Ocean, Atmosphere, Vegetation/Soils) and 5 carbon exchange flows with the atmosphere.

• Limiting the analysis to the **1980–2025** period, this article illustrates the various trends according to the MPO model. The 1980–2025 period allows us to use the four basic NOAA observatories (BRW, MLO, SMO, SPO) for atmospheric CO_2 concentrations rather than just MLO. Thus, we can rely exclusively on satellite-based temperature data (unlike in "*Revisiting the carbon cycle*"), which may result in slight differences in the estimates.

1.1 According to the MPO model, natural fluxes increase between 1980 and 2025

The figure below explains the notation used and shows the trends for the five fluxes (four natural fluxes + one anthropogenic flux).

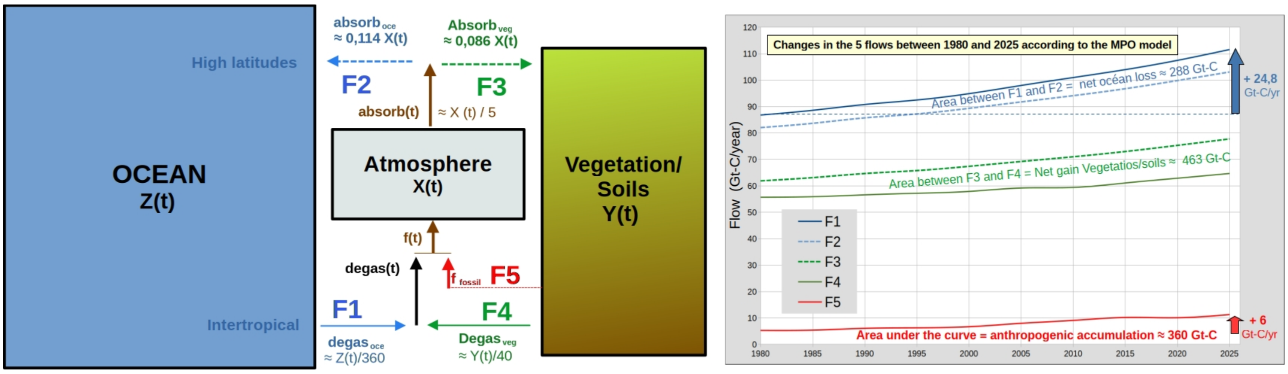


*Figure 1: On the left, a simplified diagram of the five carbon exchange fluxes with the atmosphere. The stocks of the three compartments are X(t), Y(t), Z(t). On the right, changes in the five fluxes between 1980 and 2025 according to the MPO model (**1 Gt-C → 3.7 Gt-CO2 → 0.47 ppm**).*

• According to the MPO model, flux 1 (F1 → ocean degassing) shows the greatest increase over 45 years. Between 1980 and 2025, flux 5 (F5 → anthropogenic emissions) increases by only **+6 Gt-C/year**, compared to **+24.8 Gt-C/year** for flux 1. According to the MPO model, the increases in X(t), F2, F3, and then Y(t) and F4 result from the concomitant increases in F1 and F5.

• The area under a curve represents the carbon exchanged by the flux with the atmosphere between 1980 and 2025: 360 Gt-C for F5, 4,652 Gt-C for F1, 4,364 Gt-C for F2. The net gain from vegetation/soils (463 Gt-C with F3 > F4) and the net loss from the ocean (288 Gt-C with F1 > F2) are consistent with the measured trend in $\delta^{13}C$ between 1980 and 2025 (see Figures 5 and 6).

1.2 An analogy with a water tank

The analogy below offers an interpretation of the increases in the natural flows F2, F3, and F4.

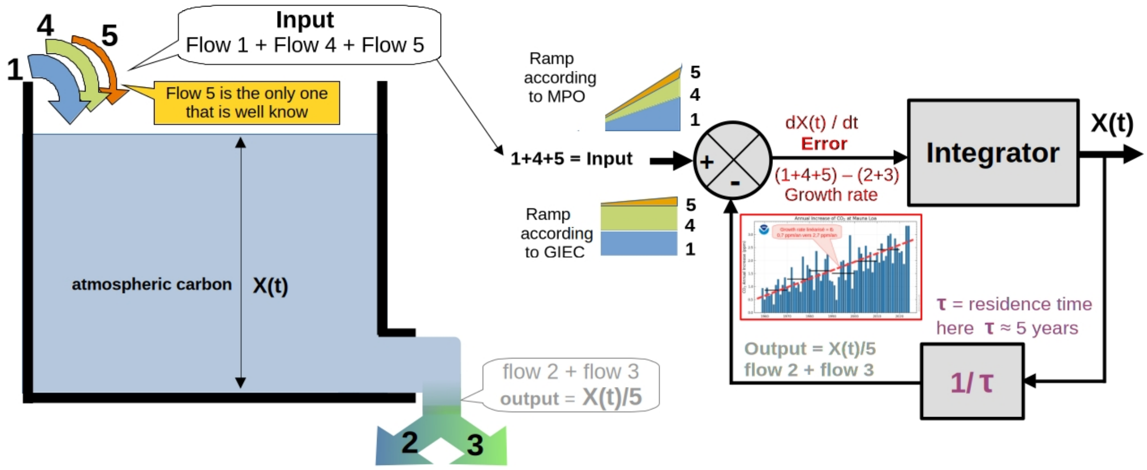


Figure 2: Analogy with a reservoir (left); Atmospheric model based on Fig. 14 from '[Revisiting the carbon cycle](#)', with the growth rate measured at Mauna Loa shown in the red box (right).

• The water level = X(t) in the reservoir determines the pressure, which controls the outflow = F2 + F3.
It is the difference between the inflow (1+4+5) and the outflow (2+3) that causes the annual change in X(t), i.e., growth rate = dX(t)/dt with dt = 1 year. Note that the **only** flux known to within ±5% is flux 5 (anthropogenic emissions).

• In linear control systems, an input/command that increases quasi-linearly is called a 'ramp'. According to the IPCC, the growth in the input (see the two ramps in the block diagram in Fig. 2) is caused **solely** by flow 5. But according to the MPO model, it is caused primarily by the natural flux F1, which drives the growth of F2 and F3 and, ultimately, the growth of F4.

• In the context of controlled systems and the MPO model, the annual growth can then be interpreted as a tracking error. Between 1980 and 2025, the increasing inputs (**the cause**) would never be offset by the outputs, which would increase as X(t)/5 (**the consequence**). The analogy with a reservoir aids understanding but remains imperfect, as the actual operation is less simple than the block diagram in Fig. 2.

2. Trends from 1980 to 2025 for 5 fluxes and 3 stocks

2.1 Illustrations of trends from 1980 to 2025 according to MPO

• The following figures illustrate the trends in the 5 fluxes, δ^{13}C, and the stocks X(t), Y(t), and Z(t) across the 3 compartments. The values for the Atmosphere compartment (CO_2 concentration and δ^{13}C) are derived from **measurements** (from multiple observatories). The values for flux 5 (anthropogenic emissions) are derived from CDIAC data and the BP Statistical Review.
All other values are estimated using MPO modeling and are therefore not based on observations.

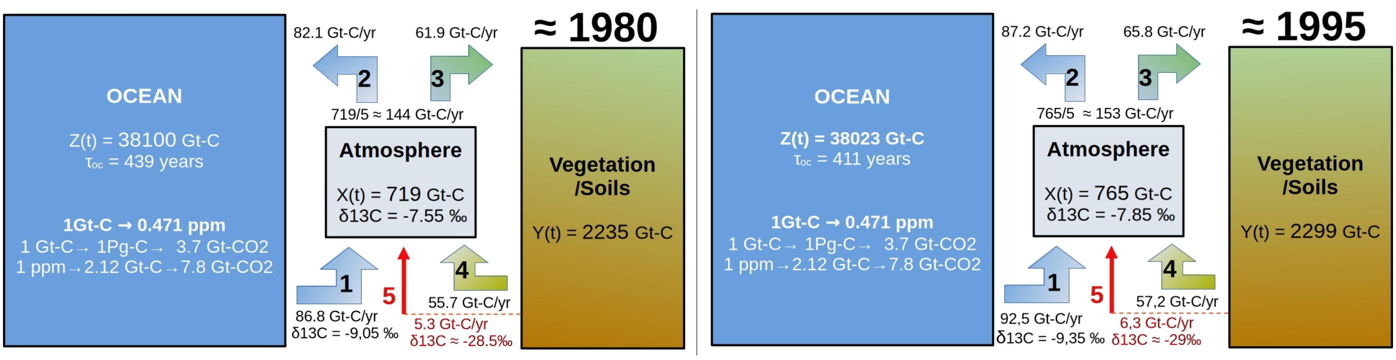


Figure 3a: MPO estimates of carbon stocks in the three compartments and of the five carbon exchange fluxes around 1980 and around 1995.

• For the figure illustrating the situation around 1995, the calculation of the estimates based on the MPO model is detailed below. Flows leaving the atmosphere correspond to 1/5 of X(t) = atmospheric stock: F2 + F3 = 765/5 = 153 Gt-C/year.
The flux F2 to the ocean is taken as 11.4% of the atmospheric stock: F2 = 765 * 0.114 = 87.2 Gt-C/year.
The flux F3 to Vegetation/Soils is taken as 8.6% of the atmospheric stock: F3 = 765 * 0.086 = 65.8 Gt-C/year.
It should be noted that this estimation procedure is largely consistent with the IPCC WG1 reports (Fig. 4 of 2/3).

• The stocks Z(t) in the ocean and Y(t) in Vegetation/Soils are derived from the previous year's values: each year Z(t) decreases by (F1 – F2) and Y(t) increases by (F3 – F4).

• The flux F4 is taken as approximately 1/40 of Y(t): F4 = 2299/40.3 = 57.2 Gt-C/year.
Oceanic degassing F1 depends on temperature via τ_{oc} → F1 = Z(t) / τ_{oc} = 38023 / 411 = 92.5 Gt-C/year.
For flux F1 (see Fig. 8 here), δ^{13}C is 1.5 ‰ lower than that of the atmosphere: -7.85 - 1.5 = -9.35 ‰.

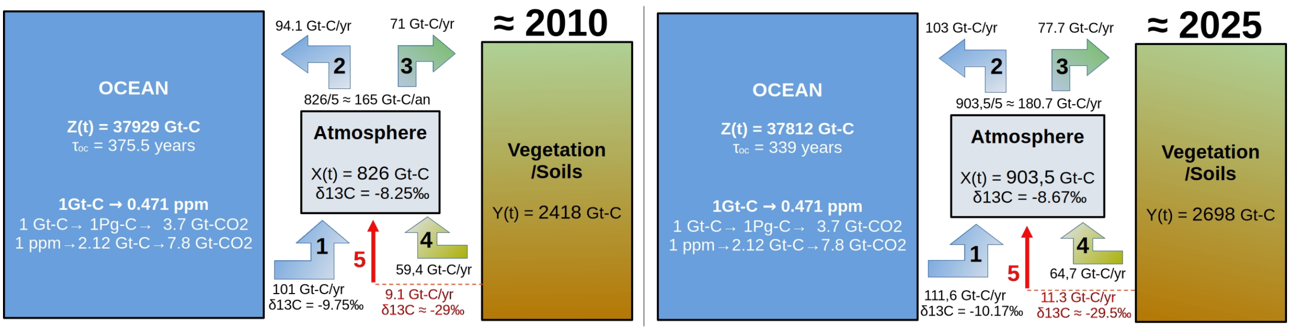


Figure 3b: MPO estimates of stocks in the three compartments and the five carbon exchange fluxes around 2010 and around 2025.

• The document Addendum.pdf details the method for estimating natural carbon exchanges using the MPO model.

• According to MPO, the 45 years of carbon exchange between the three compartments can be summarized as follows:
- The increase in ocean degassing (F1 increases by **+24.8** Gt-C/year between 1980 and 2025) caused an increase in X(t) and thus also in fluxes 2 and 3. The increase in flux 3 leads to an increase in Y(t), which in turn causes an increase in flux 4.
- The increase in anthropogenic flux F5 contributed more modestly to these increases (F5 increases by only **+6 Gt-C**/year between 1980 and 2025).

2.2 Carbon balances for 1980–2025 based on the MPO model

• The table below shows the overall carbon balance for 45 years across the five carbon fluxes between 1980 and 2025.

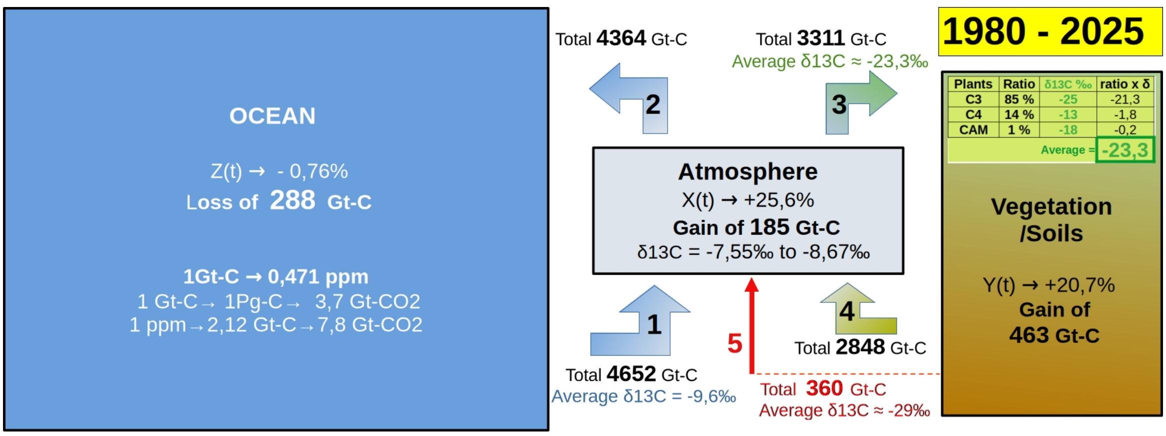


Figure 4: Cumulative totals of the five fluxes between 1980 and 2025 (areas under the curves in Fig. 1) and gains or losses in the three compartments.

• Between 1980 and 2025, the ocean would release 4,652 Gt-C in the intertropical zone but absorb 4,364 Gt-C in high latitudes. Over 45 years, the ocean would thus lose 4,652 – 4,364 = 288 Gt-C, or **only 0.76% of oceanic carbon**. According to MPO, the ocean is a **net source** of carbon relative to the atmosphere (contrary to the IPCC model but consistent with the measured trend in δ13C).

• Between 1980 and 2025, the atmospheric carbon stock increases from 718.7 Gt-C to 903.5 Gt-C, representing a net increase of ≈ **185 Gt-C**. Using the five cumulative values from Fig. 4, we detail below this net increase of 185 Gt-C in the atmosphere.

Balance sheet 1980-2025	Anthropogenic	Ocean	Vegetation /soils	**Net contribution**
Atmosphere **in** (Gt-C)	360	4652	2848	
Atmosphere **out** (Gt-C)		-4364	-3311	
Net (Gt-C)	**360**	**288**	**-463**	**185** Gt-C
δ13C (‰)	**-29**	**-9,6**	**-23,3**	**-13,0** ‰
Net x δ13C	-10440	-2756	10793	**-2404**

Figure 5a: The MPO model → Estimated net input to the atmosphere, 1980–2025 → 360 + 288 – 463 = ***185 Gt-C***
Based on the various $\delta^{13}C$ values, $\delta^{13}C$ is estimated for this net input → -10,440 – 2,756 + 10,793 = -2,404 and -2,404/185 ≈ ***-13.0‰.***
Koutsoyiannis 2024a, reports in Fig. 10 similar values for net contributions: -12.9‰ > $\delta^{13}C$ > -13.3‰.

2.3 The IPCC model appears to be inconsistent with $\delta^{13}C$ observations

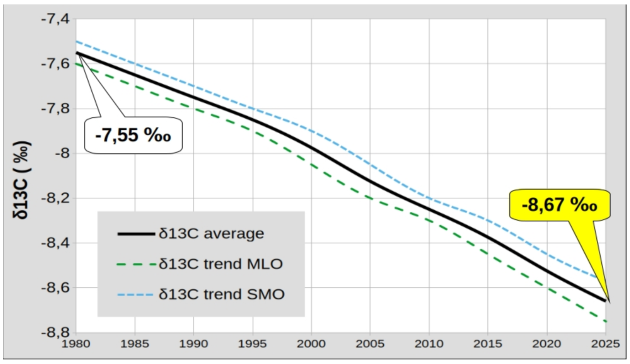
• According to the IPCC's assessment, between 1980 and 2025, anthropogenic emissions will release 360* Gt-C into the atmosphere, about half of which is expected to be absorbed equally by the ocean and vegetation/soils.

* According to the *World Energie Outlook*, ~1,260 Gt-CO2, or ~343 Gt-C, but the IPCC adds approximately 5% for land-use change (*[LUC](LUC)*) → 343 * 1.05 ≈ 360 Gt-C.

Balance sheet 1980-2025	Anthropogenic	Ocean	Vegetation /soils	Net contribution
Atmosphere **in** (Gt-C)	360			
Atmosphere **out** (Gt-C)				
Net (Gt-C)	**360**	**-87,5**	**-87,5**	**185** Gt-C
δ13C (‰)	**-29**	**-9,6**	**-23,3**	**-40,9** ‰
Net x δ13C	-10440	837	2040	**-7563**
Min (‰)	*-31*	*-6,0*	*-20,0*	**-48,0** ‰
Net x δ13C	*-11160*	*525*	*1750*	-8885
Max (‰)	*-27*	*-12,0*	*-28,0*	**-33,6** ‰
Net x δ13C	*-9720*	*1050*	*2450*	-6220

Figure 5b: Estimate, based on the IPCC model, of the net input to the atmosphere from 1980 to 2025 → 360 – 87.5 – 87.5 = 185 Gt-C.
Based on the various $\delta^{13}C$ values, we estimate $\delta^{13}C$ for this net input → -10,440 + 837 + 2,040 = -7,563 and -7,563/185 ≈ -40.9‰.
In the lower section, we show that the IPCC's $\delta^{13}C$ for the net input remains far from -13‰ (-48‰ to -33.6‰), even for a wide range of $\delta^{13}C$ values.

• We verify below that a net input of 185 Gt-C with $\delta^{13}C$ = -13‰ (**mixed** net input → ocean + anthropogenic according to MPO) does indeed reproduce the value observed in 2025: $\delta^{13}C$ = -8.67‰. In contrast, the IPCC net input (185 Gt-C with $\delta^{13}C$ = -40.9‰) **does not** yield $\delta^{13}C$ = -8,67‰ in 2025.



	1980	Net mixed contribution	2025	
Gt-C	718.7	**185**	903.5	1
‰	**-7.55**	**-13,0**	**-8.67**	2
Gt-C x ‰	-5426	-2404	-7830	1x2

	1980	Net anthropogenic contribution	2025	
Gt-C	718.7	**185**	903.5	1
‰	**-7.55**	-40.9	**-14.38**	2
Gt-C x ‰	-5426	-7563	-12989	1x2

Figure 6: Left → trend (average of both hemispheres) measured for δ13C (see here).
Right → δ13C calculated for the atmosphere in 2025 according to MPO (mixed net flux) and according to the IPCC (anthropogenic net flux)

• The IPCC's thesis is incorrect, because a net input of 185 Gt-C that is **solely anthropogenic** (Fig. 5b → $\delta^{13}C$ between 48‰ and -33.6‰) implies for the atmosphere in 2025: -15.8 ‰ < $\delta^{13}C$ < -12.9 ‰, which is **incompatible** with $\delta^{13}C$ = -8,67‰.

2.4 The MPO model: a preliminary version consistent with observations

• Figure 4 shows that the Atmosphere (+185 Gt-C or +25.6%) and Vegetation/Soils (+463 Gt-C or +20.7%) compartments received net carbon inputs (1980–2025) from the ocean and anthropogenic emissions.
The figure below details the distribution (in Gt-C, in 2025, and according to the MPO model) of these two net inputs.

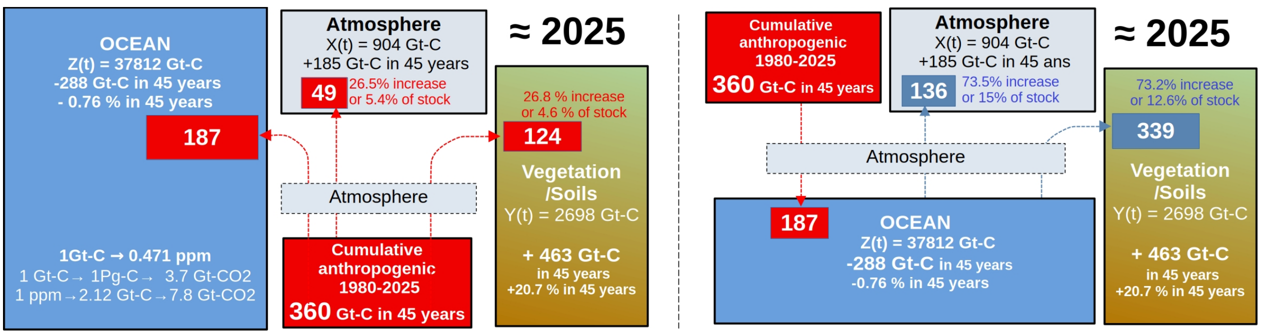


Figure 7: Where is the anthropogenic carbon (360 Gt-C) added (1980–2025) by flux 5 (on the left in Gt-C) located in 2025?
Where will the net oceanic carbon (1980–2025) contributed by flux 1 (right, in Gt-C) be located in 2025?

• Unlike the IPCC model (Fig. 6), the MPO model is consistent with modern observations (concentrations and $\delta^{13}C$) of atmospheric CO_2. The MPO model does not use the notions and concepts devised by the IPCC/UN, such as: airborne fraction, Bern function, adjustment time, and Revelle buffer factor.
Nevertheless, the very high uncertainties surrounding natural carbon exchanges make any modeling inherently risky. At best, we can hope to obtain a simplified representation of the carbon cycle on a timescale of a few decades.

• Among the avenues for improving the MPO model, which is still in its early stages, the following can be listed:

i) Carbon input from the lithosphere into the ocean may exist and may not be negligible (submarine volcanic activity, mantle degassing via hydrothermal vents on ocean ridges).
ii) The IPCC's carbon pools need to be revised → the atmosphere pool can be divided into the lower and upper atmosphere. Most carbon exchanges with the ocean and vegetation/soils occur in the lower atmosphere, with a residence time of

approximately 3 to 5 years. With the upper atmosphere, these exchanges are slower and the residence time is > 10 years, as suggested by post-1963 measurements of ^{14}C (nuclear tests).
iii) Flux F4, a function of Y(t), must also depend on temperature and biological activity.
iv) The flux F1, a function of Z(t) and the SSTi temperature, may also depend on biological activity at the surface of the intertropical ocean.
v) The ratios between X(t) and F2 or F3 (11.4% or 8.6%) may change over time.

3. Responses to Some Common Objections

• The MPO model uses a residence time of 5 years, meaning that each year, 1/5 of atmospheric carbon is sequestered by the Ocean and Vegetation/Soil compartments. **It should be noted that this assumption is largely consistent with the six WG1 reports of the IPCC** (Fig. 4, 2/3) .
One might nevertheless object that the residence time is not exactly 5 years. The figure below shows that the anthropogenic component (dXfossil/dt) in annual growth (dX(t)/dt) does indeed vary with residence time (4 to 6 years), but that this variation remains very small.

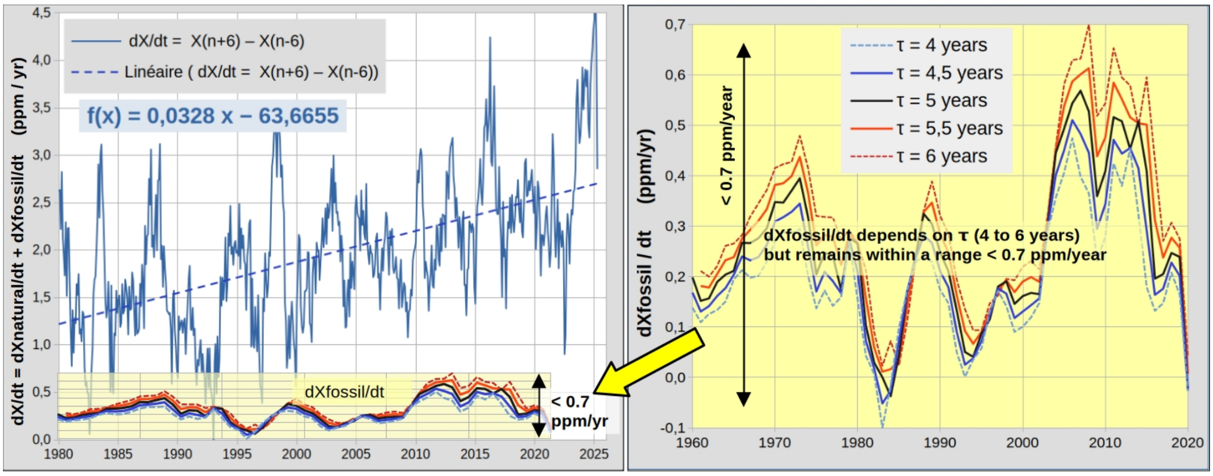


Figure 8a: Left: Atmospheric CO_2 growth = natural growth + anthropogenic growth → dX(t)/dt = dXnatural/dt + dXfossil/dt.
Right: The anthropogenic component of the growth (dXfossil/dt) depends on the residence time but remains within a range of ≤ ***0.7 ppm/year****.*

• Listed below are some common objections, refuted in §10 of '*Revisiting the Carbon Cycle*' or refuted in SCE articles. For responses to other objections, the reader may consult SCE_03/2025.

3.1 Objections Based on a Hasty Interpretation of Observations

• **a)** The main objection to the MPO model is as follows: a decrease in the average ocean pH would be sufficient to demonstrate that the ocean is a net carbon sink rather than a net source relative to the atmosphere.
This point is contested in the 4 pages of Section 8 of '*Revisiting the Carbon Cycle*': "*+1°K in T or +8 µmol/kg in DIC have about the same effect: +18 µatm in seawater partial pressure and –0.016 in pH*" (page 157).
The three remarks below also call for caution:

i) There may be a carbon input from the lithosphere into the ocean (submarine activity, hydrothermal vents on ocean ridges). **If this input* exceeds net degassing** (6.4 Gt-C/year → 288 Gt-C in 45 years), then oceanic pH decreases, **even if the ocean is a net source relative to the atmosphere** (here §5).
* A small input (currently unquantifiable due to a lack of measurements) ranging from 6.4 Gt-C/year to 10 Gt-C/year (anthropogenic flux) would be sufficient.

ii) Are the accuracy and sampling of pH measurements sufficient to confirm a decrease in average pH throughout the entire ocean? See SCE_06/2018.

iii) A decrease in pH can also result from a change in the physicochemical carbon balance in the ocean via an increase in SSTi (example below using the Alkalinity-Temperature-DIC simulator).

https://simpleserioussolvable.shinyapps.io/carbonate/

	Atmosphere	Alkalinity	Temperature	DIC	pH	Océan pCO2
Initial 1980	339 ppm	2300	28,0	2100	**7.817**	744
Final 2025	426 ppm	2280	28.8	2084	**7.799**	772
Delta	*87 ppm* *MLO measurements*	*-0.87%*	***+0,8°C*** *SSTi measurement*	***-0.76%*** *Fig 4 MPO model*	***-0.02*** ***The pH drops***	***744 > 339*** ***772 > 426*** ***The ocean dégasses***

Figure 8b: An example of conditions under which the pH decreases and the ocean degasses → DIC decreases by 0.76%: see simulator.

• **b)** Atmospheric CO_2 becomes depleted in ^{13}C.
Observations do indeed show a depletion, but it is too slow to be caused solely by anthropogenic emissions: see Fig. 6; also §7 of '*Revisiting the Carbon Cycle*' or §4 of SCE_03/25 as well as pages 22–24 in The Cause Of Earth's Climate Change Is The Sun.

• **c)** Atmospheric CO_2 is becoming depleted in ^{14}C.
Observations do indeed show a depletion, but this cannot be caused solely by anthropogenic emissions: see §11 of '*Revisiting the Carbon Cycle*' as well as § 5 of SCE_06/19.

3.2 Objections Based on Concepts Introduced by the IPCC/UN

a) 'Airborne Fraction': According to the IPCC/UN, approximately 44% of anthropogenic emissions remain in the atmosphere, whereas this is not the case for natural emissions.
In reality, the **equivalent** of approximately 1 to 4% of emissions—both natural and anthropogenic—remains in the atmosphere each year. See §10.4 in '*Revisiting the Carbon Cycle*' as well as Figures 2a and 2b in SCE_01/24.

b) ' Bern function: theory of a slow logarithmic response of CO_2 in the atmosphere.
These Bern functions contradict observations: see § 10.5 of '*Revisiting the Carbon Cycle*' as well as SCE_07/19.

c) 'Adjustment time' (50–200 years) or persistent stock of anthropogenic CO_2.
The concept of 'adjustment time' is questionable, especially in the absence of prior equilibrium. See Sections 10.6 and 10.7 of '*Revisiting the Carbon Cycle*' or Section 1.4.2 on page 35 of The Rational Climate e-Book or Section 3 of Koutsoyiannis 2024b.

d) 'Revelle factor' or 'Buffer factor', a "bottleneck" between the atmosphere and the ocean.
These concepts are inapplicable in the real world (where temperature is neither constant nor homogeneous): see §8 and §10.8 in *Revisiting the Carbon Cycle*' as well as The Rational Climate e-Book (pages 289–290).

• These four concepts introduced by the IPCC/UN ultimately appear to be ad hoc constructs.
They play a role comparable (in Ptolemy's system) to that of epicycles and deferents, those fanciful constructs that allowed for the maintenance of the dogma of exclusively circular motions around a central Earth.

3.3 Does the past shed light on the present?

During the Quaternary, glacial periods (≈ 90 ka, stunted vegetation) alternated with interglacial periods (≈ 15 ka, more abundant vegetation). Broadly speaking, during the various glacial-to-interglacial transitions, there is necessarily a transfer of carbon dioxide from the ocean to the vegetation/soil compartment as temperature and precipitation increase.
For example, during the last transition between -15 ka BP and -10 ka BP, we observe a simultaneous rise in sea level ≈ +120 m and **global average** temperature ≈ +5°C (but ≈ +9°C in Spitsbergen and northern Canada).
According to MPO, between 1980 and 2025, the same global phenomenon (transfer of carbon dioxide from the ocean to vegetation/soils) is occurring, but on a smaller scale (≈ +0.8 °C over half a century for the **global average** temperature).

• If the increase in atmospheric CO_2 over the past few decades is indeed largely natural, then it must have occurred repeatedly during the Holocene (see Fig. 4.4). This hypothesis appears to be contradicted by the air microbubble proxy in ice core records (but this proxy is called into question here § 1.5.5.2 or there). On the other hand, the stomatal proxy (here or there) or direct measurements prior to 1957 (here) show that CO_2 levels > 350 ppm during the Holocene cannot be ruled out.
If these variations in atmospheric CO_2 during the Holocene do not lead to particularly alarming warming (here § 1.5.1.2), then **it is necessary to question the extreme projections put forward by the IPCC/UN**.

•These projections are based on the concepts of "radiative forcing" and the "greenhouse effect". They thus rely on questionable models promoted by a still-young science, largely supported by a political consensus. This support appears to be leading this recent discipline toward submission to models rather than to empirical observations.
Recent studies also suggest that the IPCC's central hypothesis—namely, that global warming is caused by anthropogenic CO2 emissions—is open to question.

4 Conclusions

• **The MPO model is guided by modern observations**: trends in δ13C (Figs. 5 and 6) and correlations (Fig. 6e of the 1/3). According to this model, all carbon exchange fluxes with the atmosphere increase between 1980 and 2025. This increase results primarily from the rise in intertropical ocean temperatures and, to a lesser extent, from anthropogenic fluxes.

• In Section 2.1 of this article, the MPO model is shown to be consistent with modern measurements (concentrations and $\delta^{13}C$) of atmospheric CO_2. It provides an estimate of natural fluxes (Addendum.pdf) and stocks between 1980 and 2025.

• In Section 2.2, various budgets (1980–2025) are presented that demonstrate the internal consistency of the MPO model. However, a model's consistency is not proof of its validity. Furthermore, uncertainties regarding natural fluxes call for caution: **at best, the MPO model is a simplification of the real world, valid for a few decades**.

• This model is a preliminary draft incorporating the IPCC's 3 compartments and 5 fluxes, but it is a draft guided by reliable modern measurements rather than by uncertain proxies. The central assumption (20% of atmospheric carbon is sequestered each year: 11.4% by the ocean and 8.6% by vegetation/soils) is largely consistent with the six IPCC WG1 reports (Fig. 4, 2/3).

• Section 3 addresses the main criticisms leveled at the MPO model. These often stem from hasty interpretations of observations or from the use of ad hoc concepts introduced by the IPCC.

• Section 10 of "*Revisiting the carbon cycle*" challenges these IPCC/UN concepts (which reinforce the anthropocentrism inherent in the IPCC's *role*). Indeed, the IPCC/UN presupposes a **central** human influence by adopting a static view of natural fluxes. According to this assumption, the only significant change would come from anthropogenic fluxes, while natural fluxes would remain virtually fixed and balanced.

• In the past, *deferents and epicycles* justified a millennia-old dogma: that of circular motions around a central Earth. Today, the concepts of *radiative forcing*' and '*airborne fraction*' are said to validate the IPCC/UN's 'settled' science. But these new epicycles are likely to run short → within a few COPs, a mischievous historian might well propose a more appropriate name for the IPCC: **I**nitiative **P**tolemy for **C**arbon **C**ondemnation.

Part 1 of the article outlines the reasons that led to the model (study of correlations and $\delta^{13}C$).
Part 2 of the article presents the model used in Figures 14 and 15 of Section 6 of 'Revisiting the carbon cycle'.

References

Revisiting the carbon cycle (C. Veyres, JC Maurin, P. Poyet, 2025)
(Quay et al., 2003, p.4-12) Fig. 8 https://doi.org/10.1029/2001GB001817
(Haverd et al,2019) Fig. 2 https://onlinelibrary.wiley.com/doi/pdfdirect/10.1111/gcb.14950
(Kouwenberg et al, 2005) Fig.3 Atmospheric CO_2 fluctuations during the last millennium

What Causes Increasing Greenhouse Gases? (Salby, Harde, 2022)
A Nobel Prize for Climate Models Errors (R. Clark, 2024)
Koutsoyiannis 2024a
Koutsoyiannis 2024b
Le château de carte du réchauffement anthropique (C. Veyres)
The Rational Climate e-Book (P. Poyet, 2022)
Les Alarmistes malades de la Presse (JC Maurin, 2026)

Addendum.pdf