

Response to Report#1 (Referee # 2)

Response to reviewer comments

Overall, I am pleased with the reviews and the manuscript has improved. There are still some grammatical and edits errors throughout which is why I strongly encourage the authors to do a thorough reading of the manuscript to prevent such errors. Nevertheless, I believe it to be ready for publication after all (minor) comments below have been addressed.

Lines 23-24: "to assess impacts on a majority heterotrophic system" sounds somewhat awkward, please check the grammar

L23-24 Rephrased.

Line 28: resulted in "A" statistically...

L28 Corrected.

Line 39: you refer to the IPCC but cite the UNFCCC, maybe add the IPCC reference as well?

L38-39 Reference added.

Line 58: I believe a preprint is available for this reference (see:

<https://doi.org/10.70212/cdrxiv.2026517.v1>)

L59 Reference updated.

Line 60: or decreasing the natural CaCO₃ dissolution (see the additionality problem by Bach, 2024)

L62 Reference added.

Line 64: please check the equation, the "2" is before the "+" while it should be after

L66 Corrected.

Line 85: "at a range Ω s" is not grammatically correct, please review

L88 Rephrased.

Line 104: I believe the section should be rephrased "Materials and Methods" as per the journal guidelines

L106 Changed.

Line 108: water is repeated, maybe consider "with water collected from ~1 m depth"

L110 Corrected.

Line 120: experiments conducted "IN" 5 L

L122 Corrected.

Line 141 and throughout: this might be an edit for the typesetting team but in the text, HCO_3^- appears to be written in a different font every now and then?

L143 HCO_3^- has been written with equation text (HCO_3^-) in the word document to ensure the negative ionic charge will appear above the three.

Lines 147-148: here again, equations are wrong with "2" being placed before the "+ HCO_3^- ".

Please have a thorough read of the manuscript to pick these small yet important issues

L149-150 Corrected.

Lines 162-164: This is a very important point. I am concerned by the calculations here and this should be addressed to be considered for publication. The calculations provided do not yield the targeted TA increases. Let's assume 5L as per line 120 (maybe 6L is filled to the brim but it does not change the outcome significantly) and easy assumption for water density and conversion. 30 mL of a 0.94 M NaOH solution corresponds to a total alkalinity of 28.2 mmol ($0.94 \text{ M} = 0.94 \text{ mol kg}^{-1} \sim 0.94 \text{ mol L}^{-1} = 0.94 \text{ mmol mL}^{-1}$, hence 30 mL of that is $30 \times 0.94 = 28.2 \text{ mmol}$). Adding such amount to 5L (or 6L) leads to a total alkalinity increase of 5.64 mmol L⁻¹ (or 4.7 assuming 6L). This is not 500 $\mu\text{mol kg}^{-1}$ but rather 5,000. It is also the case for CaCl₂ and NaHCO₃. CaCl₂ does not add alkalinity, only NaHCO₃. Again, with the same assumptions, 30 mL of 0.12 M NaHCO₃ yields 3.6 mmol which is, once in 5L, 720 $\mu\text{mol kg}^{-1}$ (or 600 if in 6L). The CaO is a bit closer to targeted values with, given that CaO accounts for 2 TA, 640 μM (533 μM if in 6L) and 1,152 μM (960 μM if in 6L). If the calculations provided by the authors in lines 162-164 are correct, then the actual targeted value needs to be discussed somewhere and the discussion edited accordingly as it may have implications for the data interpretation.

L162-166 & L180 We have revised section 2.2 to clarify the discrepancy between the chosen target values and the actual measured values. Targets were chosen to compare to previously published studies. However, the exact concentrations of the stock solutions were back calculated based on TA and DIC samples that were taken during stock preparation and at the same time as when the bottles were all dosed in the field. The following table was added to Section 2.2

Target Treatment	Start Date	Stock Alkalinity (mol kg ⁻¹) and Dose (mL)	Predicted Δ Alk from starting Alk ($\mu\text{mol kg}^{-1}$) (n = 3)	Measured Δ Alk ($\mu\text{mol kg}^{-1}$) ($\pm$ error propagated)
CaCl ₂ + NaHCO ₃ (~ 500 $\mu\text{mol kg}^{-1}$)	06-24-24	0.100 M & 30 mL	474 $\pm$ 9	486 $\pm$ 11
	07-15-24	0.100 M & 28 mL	445 $\pm$ 2	441 $\pm$ 10
NaOH (~ 500 $\mu\text{mol kg}^{-1}$)	06-17-24	0.107 M & 30 mL	524 $\pm$ 1	520 $\pm$ 4
	07-22-24	0.094 M & 35 mL	532 $\pm$ 9	527 $\pm$ 11
CaO (~ 500 $\mu\text{mol kg}^{-1}$)	11-18-24	0.016 M & 100mL	509 $\pm$ 0	533 $\pm$ 18
	01-27-25	0.019 M & 100mL	616 $\pm$ 6	612 $\pm$ 13
CaO (~ 1000 $\mu\text{mol kg}^{-1}$)	11-04-24	0.018 M & 160mL	919 $\pm$ 2	923 $\pm$ 12

*Predicted error comes from the standard deviation of the seawater volume in n = 3 bottles. Measured error comes from the standard deviation of the replicate bottles and the error was propagated after values were corrected with a certified reference material (Dickson Seawater).

Line 169: does this drop in DIC correlate with missing TA? Could it be small CaCO₃ precipitation instead?

If we compare the predicted change in DIC and Alkalinity with the measured changes in DIC and Alkalinity on Day 0 in the treatment conditions, we see agreement within our measurement error (see table in next comment). Hence, we do not think the drop in DIC correlates with small CaCO₃ precipitation that may be below the instrument's detection limit but instead with the expected dilution from the CaO stock that had 84 $\mu\text{mol kg}^{-1}$ DIC in EXP 6 (11-04-24), 80 $\mu\text{mol kg}^{-1}$ DIC in EXP 7 (11-18-24), and 110 $\mu\text{mol kg}^{-1}$ DIC in EXP 8 (01-27-25).

Lines 172-176: here again, with the same calculations as above, DIC would change by 2.5-3 μM in 5-6 L with 1 mL, or by 5-6 μM in 5-6 L with 2 mL. Please review

L170-172 We have revised the text to state that all additions of the tracer only altered DIC by <5 $\mu\text{mol kg}^{-1}$, which can be seen if you compare the predicted ΔDIC from the stock alkalinity addition to the predicted ΔDIC from the tracer addition.

Target Alkalinity Treatment	Start Date	Predicted ΔDIC from the Alk addition ($\mu\text{mol kg}^{-1}$)	Predicted ΔDIC from the $\text{NaH}^{13}\text{CO}_3$ Tracer ($\mu\text{mol kg}^{-1}$)	Measured ΔDIC in Treatments relative to Control ($\mu\text{mol kg}^{-1}$) ($\pm$ error propagated)
CaCl₂ + NaHCO₃ (~500 $\mu\text{mol kg}^{-1}$)	06-24-24	473 $\pm$ 9	476 $\pm$ 8	489 $\pm$ 9
	07-15-24	442 $\pm$ 2	447 $\pm$ 2	440 $\pm$ 6
NaOH (~500 $\mu\text{mol kg}^{-1}$)	06-17-24	-10 $\pm$ 0	-8 $\pm$ 0	-8 $\pm$ 8
	07-22-24	-14 $\pm$ 0	-12 $\pm$ 0	-4 $\pm$ 10
CaO (~500 $\mu\text{mol kg}^{-1}$)	11-18-24	-36 $\pm$ 0	-34 $\pm$ 0	-40 $\pm$ 10
	01-27-25	-39 $\pm$ 0	-36 $\pm$ 0	-42 $\pm$ 14
CaO (~1000 $\mu\text{mol kg}^{-1}$)	11-04-24	-55 $\pm$ 0	-53 $\pm$ 0	-41 $\pm$ 5

*Predicted error comes from the standard deviation of the seawater volume in n = 3 bottles. Measured error comes from the standard deviation of the replicate bottles and the error was propagated after values were corrected with a certified reference material (Dickson Seawater).

Line 208: conditions should be plural

L215 Corrected.

Lines 240-241: one could also argue that DIC may have slightly changed due to sampling with a syringe

Yes, there could be small amounts of gases lost (CO_2 , O_2) when the bottles are opened for sampling and seawater is transferred to the syringe, but this would affect the controls and treatments in a similar manner. We attempted to minimize this as much as possible by collecting samples for O_2 and DIC first and from the bottom of the bottle, away from the gas exchange interface.

Line 254: pH does not have a unit

Units for $[\text{H}^+]$ in the CO2SYS program that is used to calculate pH on the Total Scale were previously included, these have now been removed to avoid confusion.

Line 315: "extremely low" is arguable, I would suggest only "low". Could also be "Short term impacts of alkalinity additions with high dilution" or something in those lines

L322 Changed.

Line 316: again, "extremely high" is subjective, I would rephrase

L323 Noted and corrected.

Lines 335-338: is that meant to be there or forgotten? It feels a bit awkward after the table and could be incorporated in the paragraph above

L332-334 These lines are supposed to be a caption for the table. Information about the control seawater condition was moved into the paragraph above.

Line 340: Table 3 could be moved below 3.1.2 as it fits with this paragraph rather than the previous one

L344 & L349-350 We have changed the headers in this section to more clearly separate the high dilution experiments from the other experiments.

Line 343: additions should be plural

L355 Changed.

Line 347: "Over the incubation PERIOD" or something similar

L359 Noted.

Line 362: conditions should be plural

L374 Noted.

Line 364: additions should be plural as you mention Ca^{2+} AND HCO_3^- . If you want to keep it singular, you might want to call it " $[\text{Ca}^{2+}] + [\text{HCO}_3^-]$ " addition or similar

L376 Noted.

Line 369: here additions should be plural as it refers to the NaOH addition and the $\text{Ca}^{2+} + \text{HCO}_3^-$ addition.

L381 Noted.

Line 373: usually, if pH on total scale is reported, it is labelled pHT with T as subscript

L385 Corrected.

Line 536: consider "MORE rapid changes"

L549 Suggestion accepted.

Lines 543-543: consider "SLIGHTLY higher" as the amount of Ca added is very little compared to the background, hence very little Ω change

L556 Suggestion accepted.

Lines 566-577: in this paragraph you should maybe consider Suitner et al., 2025 (<https://doi.org/10.5194/egusphere-2025-381>) which addresses temperature, salinity, surface area etc. for CaCO_3 precipitation.

L579-593 Thank you, suggestion accepted.

Line 582: I would rather rephrase as "did not have SOLID feedstock" as technically both solid and dissolved CaO are mineral base

L598 Corrected.

Line 585: maybe emphasize "DISSOLVED CaO additions"

L601 Noted.

Line 590: here Suitner et al., 2025 would be a good addition

L606 Suggestion accepted.

Line 594: again, for consistency, consider changing " $[\text{Ca}^{2+}]$ and $[\text{HCO}_3^-]$ Addition" to " $[\text{Ca}^{2+}] + [\text{HCO}_3^-]$ Addition". Also addition should be plural

L610 Corrected.

Line 601: same as above

Corrected.

Line 605: here it is perfect, keep this for consistency please

Noted.

Line 623: "say IF this is"

L639 Corrected.

Line 666. I believe the "," should be a "."

L682 Corrected.

Line 667: it should read "This in TURN"

L683 Corrected.

Line 675: rephrase as "POC sometimes increased or decreased"

L690 Corrected.

Line 677: remove "added"

Corrected.

We thank the reviewer for these thorough set of corrections and suggestions.