

Responses to reviewers comments on the revised manuscript

Reviewer #1 comments	Response
C-01: Line 25: In the abstract add uncertainty associated to the number listed (flux).	Done
C-02: Line 58: "The North Atlantic is a relatively well observed region of the ocean". Lauvset et al (2016) reference is for a climatology. For pCO ₂ , TALK and DIC surface observations in the North Atlantic maybe refer to Takahashi et al (2009), Bakker et al (2016) and Reverdin et al (2018) for recent observation synthesis in this region (see comment from reviewer 2).	Advice taken
C-03: Line 205: typo: carrbonic.	Corrected
C-04: Line 301: typo: and and continued...	Corrected
C-05: Figure 5a and 6: there is no data in January (correct ?).	Correct, yes
C-06: Table 2, Figure 6 and text: for TCO ₂ /S and TALK/S ratios specify units (e.g. $\mu\text{mol.kg}^{-1}/\text{psu}$).	Added $\mu\text{mol kg}^{-1} \text{psu}^{-1}$ to Table 2 and to Figure 6 legends.
C-07: Figure 6: Red horizontal lines for Atlantic Waters specified in the legend but not seen in figures.	The red Atlantic Water benchmark lines are in a, b and c but the value 35.13 was above the scale in d). Figure 6d has been redraw with S scale 30-36 and a red benchmark line.
C-08: For a reader not familiar with this topic, would it be nice to show also TCO ₂ and TALK data (not only the ratio with S; maybe add plots of TCO ₂ and TALK data in sup mat).	These plots are intended for another ms on Polar Water. Can be added to sup. mat. if editor requests so.
C-09: Line 390: Reference to Figure 6e ?	Corrected
C-10: Line 395: "Representative annual long term TCO ₂ /S and ALK/S means would be more realistic but are not available". Would that be possible to get this information from GLODAP in this region or using TCO ₂ and TALK climatological fields (Takahashi et al 2014; Broullon et al 2019, 2020), although this might not change the results.	GLODAP TCO ₂ and ALK data for Atlantic Water south of Iceland and north of 60°N is mostly for the summer months. Sentence left unchanged.
C-11: Line 399: reference to Table 1 or 2 ?	Table 2, corrected.

C-12: Line 402: Like in the submitted manuscript there is confusion here: "Polar waters having an increasingly higher alkalinity/salinity and alkalinity/TCO2 ratios". The ratio TCO2/ALK in Polar water is higher than in Atlantic (Table 2). Please rephrase.	Sentence simplified by removing Alk/TCO2 ratio.
C-13: Lines 410 and 448: Typo: Arcipelago	Both corrected
C-14: Line 434: Not clear to see in Figure S3 that pCO2 unchanged for the ratio 0.85. Could this be clarified ?	Figure S3 legend has been edited to clarify this.
C-15: Line 445: Not sure how you derive the value of 34.8 10**12 mol CO2/yr and 0.058 PgC/yr. I suspect a typo here: maybe this is 4.8 10**12 mol CO2/yr (as correctly listed in the supplement).	Typo corrected
C-16: Line 445: The effect of excess alkalinity of 0.058 PgC/yr is a number that could be recalled in the abstract. Would it be possible to associate an uncertainty for this number ?	Number has been added to the abstract. We argue that this number may be a minimum. There are too many poorly quantified variations (e.g. seasonal) and processes (e.g. ice formation and melting) for assessing uncertainty.
C-17: Line 457: Typo: thTCO2/Alk	Corrected
C-18: Figure S3: legend: typo: contours in in....	Corrected

Reviewer #2 comments	Response
I. 49-51: end of sentence to rewrite	I am sorry, but cannot see what is suggested here.
I; 142: rewrite 'to 5 stations' as 'with 5 stations'	Done
I. 147: remove ', two years'	Done
I. 163: change 'so were also calibrated...(as 'the standards... measurements were similarly calibrated'	Done
I. 191: 'we use discrete samples of pCO2 and TCO2, and calculated...'	Done, sentence edited
I. 226: I would still have liked what is the percentage of missing data that had to be filled with Mauna Loa values.	The ICE records do not extend over all years of the long term observations. Mauna Loa data were used for 1983-1992 and

<p>I. 300: 'undersaturation'</p> <p>I. 338 'which confirms...'</p> <p>I. 465: 'western Arctic Ocean' (western is a little bit vague ... does it refer to the European Arctic?)</p> <p>I. 477: carried</p> <p>I. 498: 'technical'</p> <p>Supplementary material: Figure S3, the caption title should include the mention that it is plotted at $t=5^{\circ}\text{C}$ and $S=35$ (then, it does not need to be mentioned in the next sentence for the red square)</p>	<p>2010-2012. (Mace Head begins 1991).</p> <p>Corrected</p> <p>Done</p> <p>The wording is in the title of the Ouyang et al. reference. Clearly not European Arctic.</p> <p>Corrected</p> <p>Corrected</p> <p>Done. Figure S3 legend has been edited. Also in response to Ref #1 C-14 .</p>
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