

The manuscript by Nomura et al has improved significantly since initial submission, and I am satisfied with their responses to the majority of the points that I made on the original version. There are a small number of minor remaining issues, which I detail below. Once these have been addressed, I believe that this work will be suitable for publication in biogeosciences.

I think you (the authors) miss an opportunity to emphasise the importance of this work and the broader implications of these findings in the context of the profound changes in Arctic climate and sea ice that are underway. The original version had more of this emphasis, and in my first-round review I suggested strengthening these points to get the most of this work. Contrary to being strengthened, these statements were removed in the latest version; I suggest reinstating them and giving them more emphasis in the discussion and conclusions. The abstract could also be strengthened significantly by including the importance and implications there as well.

The grammatical points that I raised in my first review have been addressed to some extent, but there are still many points throughout the text where the definite/indefinite article (a/the) is used incorrectly or not used when it should be. There are a small number of places where singular/plural nouns and their following verbs are still incorrect, e.g. frost flower formation (line 116, 132), was/were. I am not sure whether this is something that the journal addresses upon acceptance, so will leave that to the Editor.

Specific comments:

In the abstract, you define “old” as several weeks, whilst throughout the rest of the manuscript it refers to >1 year (e.g. line 150). Perhaps “older” would be better in the abstract (line 42)

Line 89: should be underlying soil?

Line 119-120: This sentence would be better phrased as something like “A potential consequence of this might be an increased contribution of open ocean surface and/or thinner sea ice to the overall CO<sub>2</sub> fluxes of the Arctic Ocean”. It is more nuanced than what you had. This section sets the scene nicely for you to emphasise the importance and implications of your work, as suggested above.

Figure 2: I think one of your arrows is in the wrong place – please check

Table 2: I fully understand and sympathise with the challenges of polar fieldwork! Your addition is fine, but I would suggest using “logistical constraints” rather than “technical reason”.

Line 206: effect of snow and frost flowers?

Line 259-260: in the case of the VINDTA 3C, VINDTA stands for Versatile INstrument for the Determination of Total inorganic carbon and titration Alkalinity. Or in the case of the basic model, it stands for Versatile INstrument for the Determination of Titration Alkalinity.

Lines 262-267: What is the uncertainty on pCO<sub>2</sub> values arising from uncertainty in DIC and TA?

Line 323-324: Cite table 2

Line 378-380: this sentence is unclear. Does >5% mean when brine volume fraction increases by 5%, or when brine volume fraction is greater than 5%? If the latter, permeability increases by an order of magnitude compared to what? Please clarify.

Line 394-397: this still implies that your statement is true for most or all stations, and *especially* for F15, F16 and Y11. It is only true for those stations, so that should be made clear. In fact, there are more stations for which there is no significant difference (or even where Fice is slightly lower, Y12) than where Fice is higher. I understand that F15, F16 and Y11 show the effect that you want to describe, so in this sentence you should just remove “especially” and focus on describing those stations.

Line 400-402: I suggest stating that this is consistent with your findings

Line 420: this number requires a significant figure, and would tell your story much better if presented as 0.02

Line 430: “as compared to that in the atmosphere” not required as  $\Delta p\text{CO}_2$  incorporates atmosphere and ice.

Line 431-433: my comment at lines 262-267 is relevant here, and should be noted

Line 433: I suggest changing “in these conditions” to “at station F13”, for clarity.

Line 454: special should be spatial

Line 468: e.g. should be i.e.

Line 472: “magnitude for the” not required

Figure 6: in my opinion, you do not need to show temperature and temperature difference. It is temperature difference that is critical, so I would remove temperature itself to declutter the plot, as it doesn't add anything

Line 508: is  $r^2 > 0.7$  from linear regressions? Is a linear fit most appropriate here, or would you get a much better correlation from a different model? In either case, the model used should be stated.