Response to Editor/Reviewer **21.10.2025**

Comment by referee:

Line 71. « However, on an annual cycle, sea ice does not serve as a net source or sink of these species to the underlying seawater. Instead, it serves as a mechanism for temporal and spatial redistribution, as these species are trapped during ice formation in autumn and winter, and subsequently released during ice melt – potentially at a different location due to drifting sea ice (Thomas et al., 2011) ".
This sentence was added during the review process. I'm not sure why. I understand the overall idea, but it is too simple and it ignores the transport of DIC and TA at depth during the brine expulsion and related deep water formation (Rysgaard et al. 2011; Crabeck O. et al. 2025; Moreau et al. 2016; Grimm et al. 2016), the fluxes of CO2 to the atmosphere that alter the DIC content (Geilfus et al. 2014; Nomura et al. 2013; 2014; 2018), or even sea ice remineralisation (Zhou et al. 2015) that transforms POC/DOC into DIC. I would remove that new sentence.

Thank you for the helpful comment. We agree that examining different timescales is important for understanding the dynamics involved. In response, we have added a sentence to clarify the seasonal timescale specifically. Rather than removing the original sentence, we felt a brief explanation would better address the concern and enhance the clarity of the introduction.

Changed to: "Additional seasonal processes modulating AT and CT include brine rejection and sinking of CO_2-rich brine (Rysgaard et al., 2011), air-ice CO_2 fluxes controlled by sea ice permeability (Geilfus et al., 2012), and bacterial respiration of dissolved organic carbon incorporated into sea ice (Zhou et al., 2016). However, over an annual cycle, sea ice does not serve as a net source or sink of these species to the underlying seawater. Instead, it functions as a mechanism for temporal and spatial redistribution, as these species are trapped during ice formation in autumn and winter, and subsequently released during ice melt, potentially at a different location due to drifting sea ice (Thomas et al., 2011)."