Response to reviewer 2

General Comments

1. I think that your discussion related to the uncertainties in fluxes from erosion, and how it would impact your results, is very interesting, and it would be good to highlight this with a sentence in the abstract.
2. I'm wondering about the validity of assuming that coastal erosion supplies no alkalinity? Are there some references that you could add to support this assumption?
3. You are estimating the effect of the uncertainties related to your erosion fluxes by scaling the change in the carbonate system linearly to the uncertainties in the fluxes. However, the carbonate system is not linear, so I am wondering about the validity of this approach?
4. You have not indicated any spinup time of the model. While the spinup time may be less important for the results in the surface ocean, it will have more impact in the deep (where the volume turnover is longer), and especially the results in section 3.2.2. Could you comment on that maybe in the description of the simulations, and potentially in the discussion?

Response: We thank the reviewer for their thoughtful and constructive comments. We have extracted the individual concerns raised in the general comments and address them point-by-point below; the replies to the remaining specific comments follow afterwards.

Erosion flux discussion in abstract We thank the reviewer for this suggestion. We agree that the uncertainty surrounding erosion flux should be mentioned in the abstract, and we have added a sentence summarising the issue and its effect on our results: "We further test how recently revised, lower estimates of erosion-derived inputs would affect our results, bringing the simulated Arctic CO_2 sink closer to observation-based estimates".

Alkalinity from coastal erosion The assumption that coastal erosion supplies negligible alkalinity indeed requires explicit justification, rather than simply being asserted. We have therefore substantially revised the relevant section of the manuscript (see the proposed text below).

To our knowledge, no spatially resolved, pan-Arctic estimate of the input of alkalinity from coastal erosion currently exists. The prevailing view in Arctic land–ocean carbon literature treats erosion as primarily a flux of organic matter (Lantuit et al., 2012; Wegner et al., 2015; Vonk et al., 2012; Fritz et al., 2017; Nielsen et al., 2022), with the inorganic component generally neglected. We acknowledge that this prevailing view may be partly a consequence of research priorities (Lantuit et al., 2012), in which case the assumption that erosion supplies little alkalinity is more of a provisional assumption than an evidenced result.

That said, recent work has begun to challenge this approximation. Scholz et al. (2025) present geochemical evidence from the southwestern Baltic Sea showing that fine-grained glacial till mobilised by coastal erosion undergoes rapid seafloor weathering, releasing approximately 4.89 meq of alkalinity per gram of till eroded. This mechanism is primarily driven by carbonate dissolution at the seafloor and could, in principle, operate on any till-rich coastline. The reviewer is therefore correct that this assumption requires defence. To this end, we have conducted a scoping calculation to provide an approximate estimate of the maximum potential magnitude of this process across the pan-Arctic.

To do so, we combined the Arctic Coastal Dynamics Database (ACD; Lantuit et al., 2012) with the Global Unconsolidated Sediments Map Database v1.0 (GUM; Börker et al., 2018) to identify Arctic coastal segments underlain by glacial till and compute the corresponding mineral mass flux from coastal erosion. Both datasets distribute their data as polygons. To extract the till-associated coastline, we converted the ACD polygons into boundary lines and intersected these with the GUM-Gt (= glacial till) polygons, buffered by 1 km. We then computed the flux as follows: flux = retreat rate × cliff height × (1 − ice fraction) × bulk density × clipped boundary length. The 1 km buffer is small enough to capture only the landward-facing boundary of each ACD polygon within a till area, meaning no perimeter-doubling correction is necessary. This procedure yields a pan-Arctic, till-derived bulk sediment flux of $\sim$55 Tg yr^{-1}.

We assessed the methodological uncertainty of this calculation using two alternative approaches. A 5 km buffer intersection (with a perimeter-doubling correction to account for the buffer reaching across ACD polygons to both sides) yields $\sim$103 Tg yr^{-1}. However, the 5 km buffer extends well beyond the till polygon edges, into adjacent non-till coastlines, which biases the result upwards. A naïve spatial join, attributing the full flux of any ACD polygon whose boundary intersects a GUM–Gt polygon, yields $\sim$146 Tg yr^{-1} as a loose upper bound, ignoring the patchiness of till coverage along long ACD segments. Therefore, the 1-km buffer intersection-based estimate is taken as our primary value, with the 103 and 146 Tg yr^{-1} estimates serving as sensitivity bounds.

Of this flux, the silt+clay fraction (i.e. the size class relevant to the seafloor weathering mechanism of Scholz et al., 2025), is approximately 30–70% (Cao et al., 2015; Haldorsen, 1981; Vorren, 1977), giving $\sim$16–38 Tg yr^{-1} of fine-grained till. Applying the yield of 4.89 meq g^{-1} from Scholz et al. (2025) gives an estimated pan-Arctic alkalinity flux of $\sim$0.08–0.19 Teq yr^{-1}, or $\sim$5–11% of the pan-Arctic riverine alkalinity flux of 1.76 Teq yr^{-1}.

This estimate has significant uncertainty, largely due to regional variability in till mineralogy. Tills derived from carbonate-rich sources may yield alkalinity at rates comparable to those of Scholz et al. (2025)'s Baltic till. In contrast, tills from purely crystalline sources are likely to yield substantially less, as aluminosilicate weathering is largely cancelled out by reverse weathering (Scholz et al., 2025). Additional shelf-process variables, including rates of organic matter degradation, sediment resuspension and seasonal hypoxia, further modulate the realised yield in ways that cannot be constrained by the Kiel Bight observations at the pan-Arctic scale (Scholz et al., 2025). We therefore consider the range of $\sim$0.08–0.19 Teq yr^{-1} to be an upper bound on the alkalinity flux from till-derived coastal erosion.

We compare this with the co-delivered organic carbon flux. Carbonate dissolution adds 1 eq alkalinity and 0.5 mol DIC per equivalent, resulting in a net [TA-DIC] gain of $\sim$0.5 mol per equivalent of alkalinity. In contrast, aerobic OC degradation adds 1 mol DIC per mol C without compensating alkalinity. The upper-bound alkalinity flux therefore corresponds to an increase in [TA-DIC] of $\sim$0.04–0.09 Tmol yr^{-1}, while the OC degradation term (1.28 Tmol C yr^{-1}) corresponds to a decrease in [TA-DIC] of up to $\sim$1.28 Tmol yr^{-1}, approximately 14–30 times larger in magnitude (and of opposite sign). As the effect of organic carbon thus dominates, and as any prescribed alkalinity flux would be rather arbitrary given the large uncertainties, we believe that simplifying coastal erosion to deliver no alkalinity is justifiable.

We now provide explicit justification in the main text: "Coastal erosion of glacial deposits can release alkalinity into seawater through the rapid weathering of fine-grained glacial till on the seafloor, primarily via carbonate dissolution (Scholz et al., 2025). This process has recently been quantified by Scholz et al. (2025) in the Kiel Bight (Baltic Sea), but it has yet to be measured in the Arctic Ocean. To place an upper bound on the potential alkalinity flux derived from coastal erosion on a pan-Arctic scale, we applied the alkalinity yield of 4.89 meq g^{-1} obtained in the Kiel Bight (Scholz et al., 2025) to an estimate of the pan-Arctic fine-grained glacial till flux. We obtained this till flux estimate by combining the Arctic Coastal Dynamics Database (ACD; Lantuit et al., 2012) with the Global Unconsolidated Sediments Map Database (GUM; Börker et al., 2018) through spatial intersection, yielding an erosion-derived pan-Arctic alkalinity flux of about 0.08–0.19 Teq yr^{-1}. This flux corresponds to approximately 5–11% of the riverine alkalinity flux (1.76 Teq yr^{-1}; Table 1) and would have an effect on [TA-DIC] that is 14–30 times smaller than that produced by the co-delivered organic carbon flux from erosion upon degradation (1.28 Tmol C yr^{-1}; Table 1), disregarding CO_2 outgassing. The range of 0.08–0.19 Teq yr^{-1} is likely an upper bound. The Kiel Bight yield reflects a particular sedimentary and biogeochemical setting that may not be representative of the Arctic as a whole. The carbonate content of glacial tills depends on the type of bedrock crossed by the parent ice sheet, while the realised weathering yield depends on local rates of organic matter degradation, sediment resuspension and seasonal hypoxia. Therefore, the pan-Arctic per-gram alkalinity yield cannot simply be constrained by observations from the Baltic Sea (Scholz et al., 2025). Given the substantial uncertainties associated with the alkalinity flux and its modest magnitude relative to the co-delivered organic carbon term, we neglect any potential erosion-derived alkalinity flux in our simulations".

Non-linearity of carbonate system We have now explicitly tested the carbonate-chemistry component of the linearity assumption using mocsy 2.0 at three representative Arctic background states: the Arctic shelf surface (avg.); a Laptev Sea surface point; and a Laptev Sea subsurface point at ∼24 metres. At each location, we imposed a series of DIC perturbations ranging from 0 to the full simulated, erosion-driven anomaly. The relationship between ΔDIC and $\Delta\Omega_{\mathrm{Ar}}$ is approximately linear, with minimal departures from linearity at the surface and less than 7% at depth at the revised-flux scaling factor of ×0.25 (Fig. 1). The carbonate-system response is mildly mildly nonlinear, such that linear downscaling slightly overestimates the magnitude of the residual erosion anomaly (i.e., our rescaled values are conservative with respect to the strength of the remaining acidification signal).

As stated in the main text, this rescaling is intended only as a first-order approximation. Given the substantial remaining uncertainty in the revised erosion flux estimates themselves (Vonk et al., 2025), which likely exceeds the error introduced by the linearity assumption, we consider linear scaling an appropriate approach for a first-order assessment of how a lower erosion flux would affect our results, under the assumption that a proportional change in the prescribed erosion flux leads to a proportional change in the local concentrations of DIC and nutrients within the model. The latter assumption is supported by Terhaar et al. (2021), who demonstrated the approximate linearity of net primary production relative to terrigenous nutrient inputs in the same simulations.

Spin-up As suggested by the reviewer, we have added an additional spin-up paragraph to Section 2.3, summarising the upstream spin-up procedure by Terhaar et al. (2019): "All simulations were initialised in 1990 from the spun-up model state produced by Terhaar et al. (2019). That spin-up was produced as follows. Initial fields were drawn from observational climatologies: temperature and salinity from (Barnier et al., 2006), oxygen and nutrients from the World Ocean Atlas 2001 (Conkright et al., 2002), and pre-industrial DIC and TA from the Global Ocean Data Analysis Project (GLODAP; Key et al., 2004), supplemented by a 3000-year

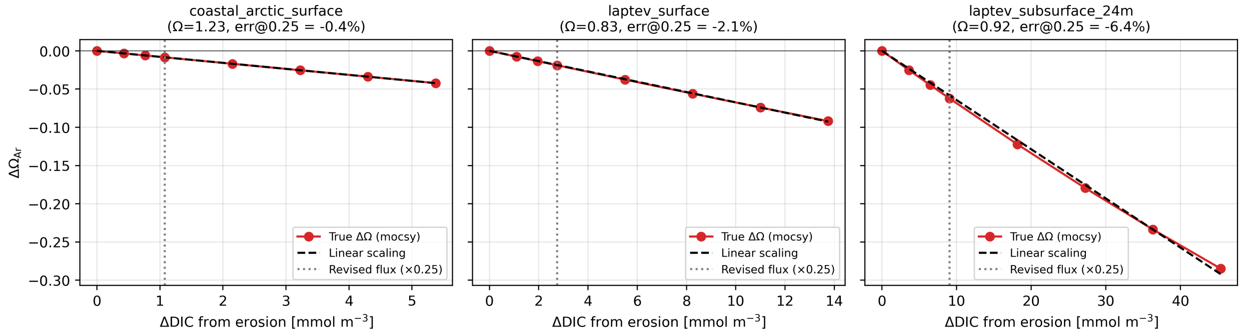

Figure 1: Test of the carbonate-chemistry component of the linearity assumption underlying the rescaling of erosion-driven $\Delta\Omega_{\mathrm{Ar}}$. Each panel shows the simulated relationship between an imposed DIC perturbation (ΔDIC) and the resulting change in $\Delta\Omega_{\mathrm{Ar}}$, computed with mocsy 2.0 at three representative Arctic background states: the area-averaged Arctic shelf surface, a Laptev Sea surface point (74.94°N, 119.95°E) and the corresponding subsurface point at ∼24 m. Background state values (T, S, TA, DIC, PO_4, Si) are taken from the no-erosion scenario averaged over 2005–2010. Red circles show the true $\Delta\Omega_{\mathrm{Ar}}$ response from mocsy under a closed-system assumption (no air–sea gas exchange), with TA held constant and DIC increased to mimic the DIC perturbation due to erosion inputs. The percentage error reported in each panel quantifies the departure of the linear extrapolation from the true mocsy response at the revised-flux scaling factor of ×0.25.

ORCA2–PISCES spin-up for DOC and iron (Terhaar et al., 2019). The model was first run for 50 years from rest in the lower-resolution ORCA05 configuration, then continued from 1870 with looped DRAKKAR forcing through 1957. In 1958, the ORCA05 fields were interpolated onto the ORCA025 grid used in this study and integrated forward to 2012, providing the 1990 state from which our simulations branch. The pre-1990 setup used the same model but without erosion inputs and with less accurate riverine inputs of carbon and nutrients (i.e., not based on observations and ignoring seasonality). The period from 1990 to 2004 therefore represents a transition between the two forcing sets. To minimize the influence of this transition, we only consider results from 2005 to 2010 (Terhaar et al., 2019)."

Regarding the depth dependence of spin-up effects, the reviewer is correct that spin-up effects scale with depth: the seasonal mixed layer adjusts within years, the upper halocline of the central Arctic Ocean basin within about 20 years (Kipp et al., 2019), and the deep Arctic basin only over centennial timescales (Schlosser et al., 1994). The strongest signals reported in Section 3.2.2 are located at 20–100 m depth on the Siberian shelves, where shelf water residence times are 1–6 years (Bauch et al., 2009; Schlosser et al., 1994); these depths are therefore well within the regime where the 15 years between the 1990 introduction of the new terrigenous forcing and the start of our analysis window in 2005 are sufficient for equilibration. We do not interpret anomalies below 100 m depth, and we have added a sentence to Section 2.3 noting that the spin-up duration limits the depth at which our anomalies should be interpreted as fully equilibrated. To further support this, we will provide supplementary figures showing the evolution of DIC and TA over 1990–2010 at several depth levels, demonstrating whether a new equilibrium has been reached following the introduction of the new terrigenous forcing; as has previously been shown for net primary production in Terhaar et al. (2021). These considerations and the corresponding figures will be added to Section 2.3 (or alternatively to section 4.3).

Comment 1

L6-7: "Riverine alkalinity generally mitigates acidification, whereas organic carbon from coastal erosion intensifies it." Consider changing to "Riverine input generally mitigates acidification, whereas input from coastal erosion intensifies it", because it is not only about the alkalinity and the organic carbon, it is about the combined effect of carbon and alkalinity in both fluxes.

Response:

It is correct that the net effect of each flux on acidification arises from the combined contribution of carbon, alkalinity, and nutrients. We have chosen to retain the original wording because it identifies the dominant component of each flux: rivers deliver substantial alkalinity (which mitigates acidification), while coastal erosion delivers predominantly organic carbon without alkalinity (which intensifies it). The effect of nutrients is then addressed separately in the following sentence. Naming the dominant component for each flux conveys the mechanism behind the net effect, which we believe is more informative for the reader than the more general formulation suggested. We hope the reviewer agrees this framing is justified.

Comment 2

L9: surface ocean → surface Arctic Ocean?

Response:

Yes, this sentence refers to the *Arctic* surface ocean. We have added "Arctic" to the sentence.

Comment 3

L8-9: "Together, riverine and erosion-derived inputs account for about 20–40% of the seasonal variability in the saturation state of the surface ocean. This amplification of the natural seasonal cycle is primarily caused by an increase in the summertime maximum of the saturation state." → This is quite difficult to understand first time reading. Consider reformulating. May help with only changing seasonal variability to seasonal amplitude.

Response:

As suggested by the reviewer, we have changed the phrasing to: "Together, riverine and erosion-derived inputs account for about 20–40% of the seasonal amplitude of the saturation state in the Arctic surface ocean. This amplification is primarily driven by higher summertime saturation state values".

Comment 4

Section 1: very nicely written!

Response:

Thank you for this positive feedback.

Comment 5

L91-92: is there a reference for the low alkalinity input from erosion?

Response:

We discuss this in detail in our response to the reviewer's general comments, to which we kindly refer the reviewer. In summary, the literature generally treats erosion inputs as predominantly organic matter (Lantuit et al., 2012; Wegner et al., 2015; Vonk et al., 2012; Fritz et al., 2017; Nielsen et al., 2022), neglecting any potential inorganic fluxes. Recent work by Scholz et al. (2025), however, shows that the erosion of weatherable material can yield alkalinity through rapid seafloor weathering (mainly via carbonate dissolution). To assess the magnitude of this potential source of alkalinity for the pan-Arctic region, we combined data from the ACD and GUM databases and found that the alkalinity yield via this pathway is likely to be below ∼0.08–0.19 Teq yr^{-1}. Therefore, and given the substantial uncertainties attached to any potential estimate (especially on regional scale), we believe it is reasonable to assume that erosion is not supplying alkalinity.

Comment 6

L120: I would avoid using the word "please" in a scientific paper

Response:

We have removed the word "please" from the text.

Comment 7

L138-139: How did you distribute the input from the erosion, is it at the top surface layer?

Response:

Riverine and coastal erosion inputs were both distributed over the top two model layers. We have revised the text accordingly.

Comment 8

L143-145: How did you decide on this partitioning for the material coming from coastal erosion? Is some of this put into the particulate material pool?

Response:

Coastal erosion indeed predominantly delivers particulate organic carbon (DOC:POC of about 1:900; Tanski et al., 2016, already cited). Although PISCES contains two particulate organic matter pools (small and large POC) and a semi-labile DOC pool, we could unfortunately not add the erosion flux to POC or DOC due to PISCES' fixed marine C:N:P stoichiometry. Routing terrigenous organic matter into any of these pools would have forced it to marine stoichiometry, thereby distorting the terrigenous nutrient ratios that we specifically wanted to preserve. Additionally, POC is not advected by currents, meaning all input would remain directly at the coastline. To preserve the respective amounts of input and allow terrigenous nutrients and carbon to be advected by currents, we chose to route all carbon to DIC and all nutrients to their respective inorganic pools, accepting the assumption of instantaneous bioavailability for the sake of preserving terrigenous stoichiometry. Given that observation-based estimates indicate a very high (80±10%) bioavailability of freshly mobilised permafrost-derived organic matter from coastal erosion (Brüchert et al., 2018; Sánchez-García et al., 2011; Terhaar et al., 2021), we believe our option to be the best available choice. We will improve the description of our reasoning and the model's limitations.

Comment 9

L155: why didn't the simulations include erosion up to 1990? (earlier you wrote that the observational estimates go back to 1950)

Response:

The three ORCA025 simulations are computationally expensive, and we relied on an existing simulation with a long and complex spin-up procedure rather than starting from scratch. Given these constraints, we made a deliberate compromise between simulation length and computational cost, settling on 21-year simulations (1990–2010) that provide a 15-year transition period after the introduction of the new terrigenous forcing before our analysis window begins in 2005. This transition period is sufficient, given the residence times of Arctic shelf waters, as described in our response to the reviewer's general comments ('spin-up').

The reason erosion inputs do not extend back to 1950 is simply that the existing spin-up simulation with the standard version of PISCES, from which we branched our runs in 1990, did not include them. This existing simulation used outdated riverine inputs and no erosion inputs. Introducing erosion inputs earlier would have required branching the simulations earlier from the existing standard simulations, which was not feasible within this study given that the Arctic-specific changes were not a priority for most research groups using the computational time. We are currently preparing terrigenous forcing files covering 1850–2100 and plan to use them in future work to assess the temporal evolution of these inputs. We will clarify this reasoning in the revised manuscript.

Comment 10

Section 2.3: you have not written anything about the spinup of the model. How long is the spinup time? What fields was the model initialized from?

Response:

As suggested by the reviewer, we have added an additional spin-up paragraph to Section 2.3, summarising the upstream spin-up procedure by Terhaar et al. (2019): "All simulations were initialised in 1990 from the spun-up model state produced by Terhaar et al. (2019). That spin-up was produced as follows. Initial fields were drawn from observational climatologies: temperature and salinity from (Barnier et al., 2006), oxygen and nutrients from the World Ocean Atlas 2001 (Conkright et al., 2002), and pre-industrial DIC and TA from the Global Ocean Data Analysis Project (GLODAP; Key et al., 2004), supplemented by a 3000-year ORCA2–PISCES spin-up for DOC and iron (Terhaar et al., 2019). The model was first run for 50 years from rest in the lower-resolution ORCA05 configuration, then continued from 1870 with looped DRAKKAR forcing through 1957. In 1958, the ORCA05 fields were interpolated onto the ORCA025 grid used in this study and integrated forward to 2012, providing the 1990 state from which our simulations branch. The pre-1990 setup used the same model but without erosion inputs and with less accurate riverine inputs of carbon and nutrients (i.e., not based on observations and ignoring seasonality). The period from 1990 to 2004 therefore represents a transition between the two forcing sets. To minimize the influence of this transition, we only consider results from 2005 to 2010 (Terhaar et al., 2019)."

Comment 11

L211-213: Has the CO2 been generated on land, or in the freshwater?

Response:

The wording "generated on land" was indeed imprecise: riverine CO_2 originates from a combination of soil respiration in the catchment and in-stream respiration and photodegradation of organic matter during transit. We have rephrased the wording to: "River water often carries substantial

CO_2 generated in the catchment and during river transit [...]".

Comment 12

L211-213: Why is the plume becoming supersaturated when reaching seawater? Is it an effect of salinity?

Response:

The original wording incorrectly suggested that mixing with seawater generates supersaturation, when in fact the river water arrives at the coast already strongly supersaturated, and mixing acts to reduce its $p\mathrm{CO}_2$. We have revised the sentence to: "When this CO_2-rich freshwater mixes with seawater, the resulting surface plume remains supersaturated in $p\mathrm{CO}_2$ despite dilution, driving CO_2 outgassing to the atmosphere".

To clarify the underlying carbonate chemistry: as river water mixes with seawater, several processes act to lower the plume's pCO_2 relative to the river endmember:

1. Dilution with seawater reduces DIC toward seawater values, lowering pCO_2
2. Increasing salinity raises the dissociation constants K_1 and K_2, shifting DIC speciation away from dissolved CO_2 toward HCO_3^- and CO_3^{2-}, which further reduces $p\mathrm{CO}_2$.
3. Alkalinity addition from seawater (which typically has higher TA than river water) also reduces $p\mathrm{CO}_2$ by buffering the system.

The key point (which our original phrasing obscured) is that the plume remains supersaturated relative to the atmosphere (even though its $p\mathrm{CO}_2$ is lower than that of the river endmember), which is what drives the outgassing flux shown in Fig. S5.

Comment 13

Section 3.2.2: Would it be possible to see if the model simulations become more realistic when including both erosion and riverine input, by comparing to observations? I'm thinking that there should be vertical profiles of carbon system parameters from single cruises, but is possible that there are not enough observations for such a comparison.

Response:

We would have liked to provide such a figure, similar to the one in Terhaar et al. (2021). Unfortunately, as suggested by the reviewer, the number of observations in the Arctic is too small to give an accurate enough observation-based estimate of the current saturation states in the Arctic shelf seas and to allow to demonstrate such an improvement.

Comment 14

L461-531: These references may be useful here (first one touching on the effect of lability of terrestrial DOC on the spatial distribution of remineralization, second one uses a model with full stoichiometric variability, and discusses the effect of tDOC remineralization on pCO2, and the effect of tDOC on light attenuation):

Fransner, F., J.Nycander, C.-M.Mörth, C.Humborg, H. E.Markus Meier, R.Hordoir, E.Gustafsson, and B.Deutsch (2016), Tracing terrestrial DOC in the Baltic Sea—A 3-D model study, Global Biogeochem. Cycles, 30, 134–148, doi:10.1002/2014GB005078.

Fransner, F., Fransson, A., Humborg, C., Gustafsson, E., Tedesco, L., Hordoir, R., and Nycander, J.: Remineralization rate of terrestrial DOC as inferred from CO2 supersaturated coastal waters, Biogeosciences, 16, 863–879, https://doi.org/10.5194/bg-16-863-2019, 2019.

Response:

Thank you for bringing these references to our attention. They are indeed highly relevant to the section in question and support our points. We have included them as follows: "[...] While we cannot quantify the bias introduced here, the strength, spatial pattern and seasonality of terrigenous-driven acidification are all sensitive to assumptions about the lability of organic matter. The importance of resolving lability has also been demonstrated by Fransner et al. (2016), who showed in a subarctic setting that subjecting terrigenous DOC to either a single decay timescale (∼10 years applied to the whole pool) or to a labile–refractory partitioning (∼1 year applied to 80%) yields comparable total remineralisation, but different spatial distributions, with implications for coastal carbon cycling and air–sea CO_2 gas exchange" and "In addition, our model does not account for CDOM and its effect on light attenuation [...] Fransner et al. (2019) similarly showed, using a coupled hydrodynamical–biogeochemical model of the Baltic Sea, that a terrigenous DOC-dependent light attenuation, dampening primary production by up to 25% in the most affected regions, was required to reproduce observed CO_2 supersaturation in coastal waters [...]".

Barnier, B. et al. Impact of partial steps and momentum advection schemes in a global ocean circulation model at eddy permitting resolution. *Ocean Dyn.* **56**, 543–567 (2006). `http://dx.doi.org/10.1007/s10236-006-0082-1`

Bauch, D., Dmitrenko, I. A., Wegner, C. et al. Exchange of Laptev Sea and Arctic Ocean halocline waters in response to atmospheric forcing. *J. Geophys. Res.* **114**, C05008 (2009). `https://doi.org/10.1029/2008JC005062`

Börker, J., Hartmann, J., Amann, T. & Romero-Mujalli, G. Terrestrial sediments of the Earth: Development of a global unconsolidated sediments map database (GUM). *Geochemistry, Geophysics, Geosystems* **19**, 997-1024 (2018). `https://doi.org/10.1002/2017GC007273`

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Fransner, F., Nycander, J., Mörth, C.-M. et al. Tracing terrestrial DOC in the Baltic Sea—A 3-D model study. *Global Biogeochem. Cycles* **30**, 134–148 (2016). `https://doi.org/10.1002/2014GB005078`

Fransner, F., Fransson, A., Humborg, C. et al. Remineralization rate of terrestrial DOC as inferred from CO2 supersaturated coastal waters. *Biogeosciences* **16**, 863–879 (2019). `https://doi.org/10.5194/bg-16-863-2019`

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Kipp, L. E., Kadko, D. C., Pickart, R. S. et al. Shelf-basin interactions and water mass residence times in the Western Arctic Ocean: insights provided by radium isotopes. *Journal of Geophysical Research: Oceans* **124**, 3279–3297 (2019). `https://doi.org/10.1029/2019JC014988`

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