In their manuscript, Bertin et al. investigate the implications of including colored dissolved organic matter (CDOM), which can be photodegraded to dissolved inorganic carbon and thereby absorbs heat, for the heat budget and carbon cycle in the Southeastern Beaufort Sea. The methodologies are sound, with a model is established and validated for the investigated region, and a novel parametrization for CDOM and its main effects introduced (e.g. for light attenuation parametrization). The results show a significant effect on surface ocean temperature seasonally (+1.7°C), which in turn then has a significant effect for the regional carbon budget, with the CDOM warming effect causing a switch from a sink to a source for the region. The manuscript is well structured and streamlined, and I would recommend the article for publication with a few clarifications and minor revisions.

- The validation of including CDOM and arguments for explicitly representing CDOM (in the context of actually improving the model) can be strengthened. Figure D1 shows that biological productivity timings seem worse in the early season with CDOM effects (although the peak timing is then improved). It would also to be interesting to see if including CDOM generally improves model SST, and the biological productivity variables spatially. Would pCO2 data also be available? I think Figure D1 should be integrated and discussed in the main manuscript (or the observational timeseries integrated in the main figures).

- The study refers to colored dissolved organic matter, but what is actually represented in the model is only carbon. What are typical stoichiometries of CDOM and would representing the additional nutrient input have an effect on presented results?

- The study focusses solely on impacts of CDOM for heat budget and carbon dynamics, but I think it would be fitting to further discuss in more detail potential implications of POC and other particle effects. Would these feedbacks go in the same direction? I assume both of the fluxes of these compounds would also correlate with increased terrestrial DOM fluxesm since the processes leading to increases would be similar (coastal erosion, increased runoff, permafrost thaw etc.)

- I don't think the title really reflects the study that well, since the study only focusses on a specific region, and even then, I am not really convinced the phenology is actually improved (see above point). Maybe a more general title that represents the CDOM effects on regional heat budget and carbon dynamics would be more suitable.

Specific Comments

Abstract

L1 "Arctic warming affects land-to-ocean fluxes of organic matter, with significant impacts on coastal ecosystems and air-sea CO_2 fluxes."

I would already specify the specific processes (mobilization through permafrost thaw & coastal erosion?). I don't think terrestrial browning is really the correct statement here? Just state from terrestrial organic matter dynamics (?).

Methods

L93 *"degradation rate as DOC_{sr} (τ = 10 years)"* This would be a degradation time scale, no?

L105 *"After a sensitivity analysis (detailed in Appendix B), we set the ratio to 2% — re-partitioning Mackenzie River tDOC mass flux into 50%, 48%, and 2% DOC_{sl}, DOC_{sr}, and CDOM, respectively."* Are there CDOM contribution estimates from observations to compare to (Aarnos et al., 2018?)

Discussion

L347 *"however, ocean circulation and physics often shape the biogeochemical state without possible bio-geochemical feedbacks."* Unclear what is meant here.

L367 *"These results highlight that the coupling between CDOM and sea-ice have an important role in shaping phytoplankton phenology "* -> play the dominant role in shaping phytoplankton phenology?

L376 *"this work is presently underway."* I am not sure I would state this (and the statement will soon not be up to date soon, I guess).

Edits

L21 ‘‘resulting in" -> resulting from

L57 that govern *the* air-sea CO_2 flux