Reviewer 1: Comments and Author Response

The manuscript titled, "Low Cobalt Inventories in the Amundsen and Ross Seas Driven by High Demand for Labile Cobalt Uptake Among Native Phytoplankton Communities" written by Rebecca J. Chmiel and coauthors, describes how dissolved cobalt concentrations in the Ross Sea were much lower in the 2017-2018 season compared to two previous expeditions a decade earlier. The differences in these observations were explored by examining dissolved cobalt (dCo), zinc and cadmium uptake rates, as well as dCo vs. phosphate relationships to gain insights into processes acting on the dCo pool. Overall, I really enjoyed reading this manuscript and thought it was very thought-provoking and thorough.

Most of my comments below are very minor and driven primarily by interest. My only more general question for the authors was whether they had explored potential differences in the water masses sampled during the CICLOPS and CORSACS expeditions, which may impact the deep dCo concentrations. For example, if the expeditions both appeared to sample Circumpolar Deep Water (CDW) and Antarctic Bottom Water (AABW) equally well, then that would strengthen the argument that the dCo inventory differences are primarily driven by differences in Co uptake by the phytoplankton community rather than changes in the water masses over the Amundsen shelf or in the Ross Sea.

> [Authors' Response] A comparison of the water masses sampled during all 3 expeditions presented in this paper would be an asset to its overall conclusion. We have added a figure in the appendix (Fig. A2) to compare the hydrography and water mass classification of the samples used to show differences in the deep dCo inventory, and included a sentence in Sect. 4.3 that reads: "Since a plot of temperature vs. salinity shows largely overlapping hydrography among the three expeditions in the Ross Sea (Fig. A2), the observed difference in dCo inventories is unlikely to be due to differences in the distributions of the water masses sampled."

Perhaps related to this, I was also wondering if the authors have any evidence that the potential for Mn-oxidation might have changed over the 2007-2018 time period, perhaps due to a change in temperature? It seems like Mn-oxidation is low to non-existent in this region, but perhaps it would be something to think about for future work in this area and might have a significant impact on Co scavenging.

> [Authors' Response] While an examination of changing Mn-oxidation rates over time is certainly intriguing, it falls outside the scope of this study. An in-depth examination of Mn speciation and Mn oxidation on the CICLOPS expedition is presented in Oldham et al., 2021, where the authors do compare observed Mn concentration and speciation to previous studies, including the 2006 McMurdo Sound fieldwork discussed here.

In general, I thought this was an excellent paper and it will be an exciting contribution to the field. Below are some additional very minor more specific comments.

Specific comments

Figure 1: Can you perhaps note broadly on this figure where the CORSACS cruises were? I realize it might clutter the figure to have all of the stations, but maybe just an outline of the regions that those cruises sampled?

> [Authors' Response] I believe it does clutter Figure 1 to add the historical CORSACS and McMurdo Sound data. Instead, I have added Figure A1 to a new Appendix A, which maps the CORSACS-1, CORSACS-2, and McMurdo sound data onto the original maps for the CORSACS data to show how they overlap.

Figure 4 and 7: How were the regression outliers selected?

> [Authors' Response] In Figure 4, the one outlier in dZn concentration was selected by hand as a datapoint that did not fit the otherwise smooth dZn profiles analyzed, although the outlier was retained as shown in case this high signature is a true feature at this depth.
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> In Figure 7, outliers were selected by hand when including them in the linear regression substantially decreased its R^2 value. Often, this was due to upper ocean samples at some stations sharing similar properties as the deep ocean samples (for example, the Ross Sea dZn vs. dPO_4^{3-} subplot). We did our best to select depth thresholds that best described the data by region, but combining multiple stations in one regional graph will always be tricky since not all stations in a region share the same hydrography.
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> To clarify how the outliers were selected, a sentence in the legend of Figure 7 has been modified to read: "Regression outliers were selected by hand when including them in the linear regression substantially decreased its R^2 value; outliers are marked with an 'x'."

Figure 6: I thought it was interesting that the CICLOPS expedition shows more of a scavenging signal for dCo compared to the CORSACS expedition. Any thoughts on why there might be those differences?

> [Authors' Response] Although dCo profiles for some stations on CICLOPS show a decreased dCo concentration in the mesopelagic, as we would expect with a scavenging signal (Fig. 2 Station 22, for example), the trend of lower dCo with respect to dPO_4^{3-} is not visible in the dCo vs. dPO_4^{3-} plot (Fig. 6b), indicating that this decrease may not be attributable to scavenging.

Figure 9: I really like this figure, the trends are very clear and it is really interesting.

> [Authors' Response] Thank you!

Line 731-736: Perhaps split this into multiple sentences.

> [Authors' Response] This change has been made. The passage now reads: "When ρZn and ρCd was normalized to ρCo (ρM : ρCo; Fig. 5), deviations from these order-of-

magnitude trends were observed. In particular, at Stations 4 and 11 in the Amundsen Sea and Station 22 in Terra Nova Bay, ρZn and ρCd stoichiometry relative to ρCo tended to decrease towards the surface in the upper 50 m, while the opposite trend appeared to occur at Station 57 in the late summer."

Figure 12: Is it possible to also plot an average of the dCo in the deep and surface box over time on top of the evolution of the pools? I thought it would be interesting to see if this dCo loss is a steady decrease or not, based on this model. It appears to be steady based on the trends in the deep and surface, but seeing the average plotted on top of this might be interesting.

[Authors' Response] An average dCo concentration for each austral summer year could be plotted over this figure, but I would argue it is not necessary. The model presented is linear and has been set to show a loss of 10 pM in the deep ocean over a 12-year period. I suspect adding an average rate of loss trendline would both clutter the figure and imply that the rate of loss was a calculated outcome of the model, instead of an input parameter.