General comment:

This study uses bioassay experiments in the Weddell Sea and in the Amundsen Sea Polynya to study the effects of increasing Fe and temperature conditions on natural phytoplankton communities. Given the current predictions about upcoming changes in the Southern Ocean, it is critical to understand what effects these changes may have on natural communities. The manuscript is very well written, and this study is greatly strengthened by the extent of trace metal results reported (including both dissolved and particulate data).

However, several points could be improved. First, the differences in initial conditions could be discussed in more details (coastal vs offshore, difference in macronutrients, etc.). Further, the photophysiological results (Fv/Fm and more?) should be referred to more often to strengthen some statements. You could also add more information on the biological results that were briefly mentioned (e.g., Chl:C ratios) to confirm your hypothesis. The figures could also be improved with bigger panels and the statistically significant differences displayed to help result visualisation and interpretation. Finally, some typos need fixing throughout the manuscript (use of abbreviations and then not, some references to fix, some commas near period).

Below, I have provided line comments which I hope will help improve the manuscript.

Line comments

L68 This first long intro paragraph could be split for easier reading.

L71 fix ref

L105-107 This info could be removed from the introduction as you describe it well in your method.

L55-120 Considering how many times you speak of Mn in your results and discussion, I wonder if you should talk about it in your introduction and describe its essential roles in phytoplankton.

Figure 1: I think you are missing in your result and discussion a general description of your different sites. Both regions are separated but within them you present results from coastal and (almost?) offshore data? This may greatly impact your results too.

L137 what is 'PVDF'?

L143 ASP previously defined

L146 Why this difference in duration?

Table 1: could the depth profiles of each station be presented in SI so we can better visualize the different initial conditions?

L183 typo

L191 How were these light levels achieved in your experiment?

L245 Can you clarify if you expect your pTM measurements to include lithogenic material as well?

L248 at the end of the experiment?

L298 could you add info on the type of measurements (flash sequence etc…)

L303 Did you also rinse the cuvette with the (filtered) sample itself?

L307 Can measurements of the functional absorption cross section of PSII be derived from this instrument too?

Figure 3: it would be helpful to have the significant differences displayed on the figure.

Figure 4: please fix the x-axis label.

L594-596 You could also refer to Fv/Fm to support this statement.

L596 It is hard to visualize this trend because of the different scales in Figure S2. It would be good to refer to the lower Si initial conditions at W1 compared to A1 and A2. Also, the t0 of Figure S2 does not match your value in Table 1 for A1 and W2? Same for NOx of A1.

L610 How did you calculate the growth rates?

L642 are you referring to the 3 experiments? In your results I think you mentioned differences to the C and not the T.

L659 maybe I missed it, but you should also discuss that some bioassays have an increase in Chl in the control compared to t0 (A1, A2, W2) while W1 did not and why is that.

L661 you could also refer to your Fv/Fm results here.

L664 Could these results (Chl:POC) be presented in SI? So we can see the difference between treatments. Results of fluorescence per Chl may also be interesting in this context?

L666-669 Do you mean that in-situ phytoplankton were light-limited? It is expected which such low levels.

L671 Figure 2 still shows a great depletion of the added Fe by day 3. Do you think it is due to phytoplankton uptake or could be sorption? POC does not show any change but Chl does although with n=1. Do you think another parameter could have become limiting after day 3?

L674 these low light levels are comparable to this study: https://doi.org/10.1002/lol2.10366.

L676 Do you think you could have seen a response if the experiment lasted longer? With the initial combination of very low temperature, light and biomass at that station.

L677 Or maybe phytoplankton were just not Fe-limited at the A2 station, as supported by the high Fv/Fm. It is likely the cells were content with the slow growth rates and would only need more Fe if light levels were increased (refer to the paper mentioned in one of the previous comments + https://doi.org/10.1073/pnas.1810886116)

L686 Do you mean for A1 only? It is hard to visualize this treatment effect in Figure 4.

L696 Which figure are you referring to? I cannot see this in Figure 6.

L700 change in what?

L764 but POC results were not extensively described in this study.