

Interactive comment on “Southern Ocean BGC-Argo Detect Under Ice Phytoplankton Growth Before Sea Ice Retreat” by Mark Hague and Marcello Vichi

Anonymous Referee #2

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General Comments:

The authors utilize BGC-Argo float data from the SOCCOM project deployed within the seasonal sea ice zone of the Southern Ocean to estimate the onset of phytoplankton growth in the spring. Large blooms are often observed at the receding ice edge in the Southern Ocean but the initiation of this growth is unclear. One hypothesis is that the ice melt stratifies the upper ocean providing preferential conditions for phytoplankton growth (release of nutrients from ice, increased light, shallow mixed layer depth). Here the authors argue that the initiation of growth begins before the onset of ice melt. They use both temperature and salinity data from the floats to estimate the timing of ice melt

C1

events and in nearly all the floats used in this study, the chl-a signal corresponding to phytoplankton growth, appears before ice melt. The leading hypothesis from this study is that light is the driving force for initiating growth even with >90% ice cover estimated from satellite data. There are many different kinds of sea ice and more light may penetrate through than previously thought. The authors also present a simple model with ice, no ice, and low light adaptation to further assess which driving factors of growth initiation most closely resembled the float data. It was found that the low light adaptation most closely fits the float data providing further support that low levels of light penetrating through the sea ice initiate phytoplankton growth prior to ice melt. I recommend publication of this manuscript with minor revisions listed below.

Specific Comments:

Line 15-21: more references needed

Line 52: define what the marginal ice zone is

Line 71: define date range used rather than all available floats because this will always be changing

In Methods: you need to discuss the sampling frequency of the floats as 10 days earlier on in the methods

Line 92: ice melting already occurred ***or the float moved out of an ice covered region*** (or the ice moved but may not have melted)

Line 173: list the standard nutrients rather than only saying ‘all standard nutrients’

Line 174: citation needed or source for the nutrient concentrations used

Line 179: How was MLD defined?

Line 199: Is it more correct to say Bio-Argo? Or is it BGC-Argo? Used both ways in manuscript

C2

Figure 5/6: Captions should be more stand alone and not just refer to the text. I recommend providing a little more detail in the captions.

Line 310: In the Briggs 2017 study a respiration signal was observed in oxygen and DIC inventories during the under ice period but switched to production prior to the estimated ice edge (see figures 4 and 6). There is no clear disagreement between these two studies just a different time-frame focus.

Line 312: Satellite data was also used in this study to estimate ice cover Discussion: Have you compared the MLD at the time of GI for each of the floats?

Technical Corrections:

Abstract: 0D model? Did you mean 0.5D as later referred to in the manuscript?

Line 142: change shown to show

Table 2: inconsistent letter case

All figures: the font is very small. I would recommend increasing all figure text font.

Figure 7: I recommend plotting all four subplots with same size axes. Only the bottom right plot has a larger x-axis.

Line 289: Add 'In' to start of sentence 'Figures 5 and 6...'

Line 370: Needs commas

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