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Discussions
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Interactive comment on "Satellite observations of new phytoplankton blooms in the Maud Rise Polynya, Southern Ocean" *by* Babula Jena and Anilkumar Narayana Pillai

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Thank you so much for your constructive comments and suggestions that helped to improve the quality of the manuscript to a great extent.

Reviewer's suggestion 1: In this study, the authors present a phytoplankton bloom first known appearance on the Maud Rise polynya in the Southern Ocean. The authors used various remote sensing images from different broad bands (visible, microwaves,...) as well as modelling and insitu float data to support their approach which is appreciable.

Authors: Thank you so much for the appreciation.

Reviewer's suggestion 2: The appearance of the bloom is then discussed according to the bio-physical mechanism at its possible origin as well as in the context of the future under warming conditions. Overall, the work is of good scientific quality and the results are significant.

Authors: We are very much thankful for the appreciation.

Reviewer's suggestion 3: However, I would have liked the authors to go further into their analysis and discussions of the impact of light availability on the bloom. Indeed, it would have been interesting to compare the irradiance with known threshold in the literature, for example, in parallel of the SIC evolutions as it can have crucial impacts of the bloom and growth of phytoplankton.

Authors: As per your suggestion, we have included analysis of light and diffuse attenuation coefficient (Kd, m-1) for downwelling irradiance at 490nm. The bloom did not appear in September 2017 due to low light condition up to 12.6 Einstein m-2 day-1. The bloom was appeared in October-November 2017 under the influence of improved light condition up to 36.1 and 61.9 Einstein m-2 day-1, respectively for October and November (Table 2). PAR data was analyzed in parallel of the SIC evolutions (Figure S8 and Table 2). However, the sensitivity of light threshold value can be possible only in laboratory controlled condition experiment by considering various cultured groups/species of phytoplankton, which is beyond the scope of the study. We have used science quality remote sensing data, reanalysis, and Argo profiles for reporting the unprecedented phytoplankton bloom to what's possible with such a complex atmosphere-ocean-ice event. High diffuse attenuation coefficient (Kd, m-1) for downwelling irradiance observed up to 0.39 m-1 and 0.37 m-1 during October and November, respectively, which is an indicator of sediment resuspension and bloom condition.

Minor comments :

Reviewer's suggestion 4: line 33. replace a largest by the largest

Authors: Yes, we will replace. Thank you so much.

Reviewer's suggestion 5: Figure 1a. - There is too much information in figure 1a resulting as difficulties to see or understand what is displayed.

Authors: This is due to overlapping of dense ARGO locations and various bathymetric contours. We will surely bring more clarity by excluding few bathymetric contours.

Reviewer's suggestion 6: Figure 1. why is the latitude grid different in figure 1a compared to other Figure 1 panels ?

Authors: We kept the extent purposefully in figure 1a to show the readers about the proximity of Maud Rise to the Antarctica and surrounding seas.

Reviewer's suggestion 7: Figure 1b,c,d,e. the authors chose a criteria of chl-a>=0.8 (line 69). why display chl-a>=1 on the scale instead of 0.8 in these panels ?

Authors: The color bar indicates all values starting from 0.01 to 1. We have labeled 0.8 in the color bar (Figures 1b,c,d,e), so that it will become easy for the readers to follow.

Reviewer's suggestion 8: Figure 1. Would it be possible to also show the SIC extent?

Authors: Since the study region was fully covered by the sea-ice with a polynya on the Maud Rise, the sea-ice concentration (SIC) data found to be appropriate for the analysis. The SIC extent is more useful in the marginal ice zone. However, we have shown the extent of the polynya as dashed polygon in figure 1a. Thank you so much.

Reviewer's suggestion 9: Figure 2. same question as Figure 1 on the scale maximum displayed.

Authors: We will mark at 0.8 mg m-3 in the color bar (Figures 2), so that it will become easy for the readers to follow.

Reviewer's suggestion 10: Figure 2. Difficulties to distinguish the contours of the bathymetry in 2a and 2b.

Authors: Thank you so much. We will bring better clarity in bathymetric contours of figures 2a and 2b, by changing it to some different color.

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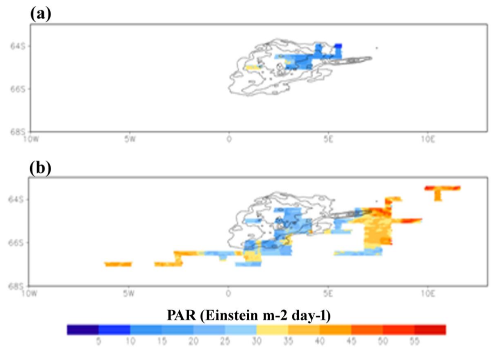

Figure S8. Monthly averaged values of photosynthetically available radiation during the appearance of polynya in (a) October and (b) November 2017.

Table 2. Net primary production and bio-optical parameters during the occurrence of Maud Rise polynya in October and November 2017. Values for November 2017 are given within brackets. NPP: Net primary production, Chl-*a*: Chlorophyll-*a*, Eu: Euphotic depth, PAR: Photosynthetically available radiation, SST: Sea surface temperature.

	Minimum	Maximum	Mean	Standard deviation
NPP (mg C m^{-2} day^{-1})	60.08 (101.43)	374.07 (415.08)	169.51 (208.44)	84.04 (50.90)
Chl-*a* (mg m^{-3})	0.07 (0.06)	3.48 (4.67)	0.29 (0.28)	0.26 (0.20)
Eu (m)	27.12 (8.35)	84.24 (109.56)	53.72 (56.90)	13.59 (12.49)
PAR (Einstein m^{-2} day^{-1})	6.27 (13.80)	36.10 (61.90)	17.79 (31.43)	6.86 (8.21)
Kd 490 (m^{-1})	0.03 (0.02)	0.39 (0.37)	0.06 (0.06)	0.03 (0.02)
SST (°C)	-1.80 (-1.80)	-1.25 (-1.31)	-1.67 (-1.65)	0.12 (0.14)

Fig. 1.

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Discussion paper