

Interactive comment on “Short Commentary on Marine Productivity at Arctic Shelf Breaks: Upwelling, Advection and Vertical Mixing” by Achim Randelhoff and Arild Sundfjord

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[Below, please find: Your comments preceded by RC, “Reviewer Comment”, and our replies preceded by AR, “Author Reply”]

RC: The authors made good points on explaining the shelf-break upwelling is regional phenomena and there are other factors need to be considered, such as the wind stress, stratification, vertical mixing and advection. The authors proactively cautioned crowning the shelf-break upwelling as a universal paradigm over new ice depleting Arctic Ocean.

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1. Are the authors arguing a false impression? The self break upwelling itself is a regional phenomena. Did any of the papers that the authors refereed, Carmack and Chapman, 2003; Falk-Petersen et al., 2014; Wassmann et al., 2015; Våge et al., 2016; Haug et al., 2017), claimed that the shelf break upwelling is a “universal” phenomena?

AR: > Thank you very much for reviewing our paper. Below, find our replies to your general comments.

> To our knowledge none of these papers claimed that it is a “universal” phenomenon, and neither did we claim that they had done so. However, based on the available literature, there are multiple claims that (and investigations whether) shelf break upwelling all across the Arctic enhances productivity. Calling this a “paradigm”, a way of thinking, intends to say: Whenever someone talks about “Arctic shelf break” and “productivity”, many people appear to associate that with “upwelling” and next “increasing upwelling leading to increased productivity due to receding sea ice”.

RC: 2. The example that the authors gave, the Barents Sea, does not have favourable wind for the wind driven upwelling. Why the authors suggest that people will mistakenly think that the salinity front observed is a shelf break upwelling?

AR: > There are two issues here. To take your second point first, we are as puzzled as you are that this salinity front as such is sometimes considered to be due to shelf break upwelling. But it has happened and continues to do so; please see references given in the text (section “Upwelling in the Arctic”).

> We are happy that you agree with us on the general point that not every front at an Arctic shelf break is indicative of upwelling. This is a pretty basic point, and taken at face value, we assume few would defend it in all its generality. However, as complex as the underlying physics are, we have felt the need to clarify its most salient aspects as a basis for discussions of (the even more involved issue of) biological productivity. We believe our paper is helpful for two audiences: People interested mostly in the biology, perhaps with less familiarity with the underlying physics, and people who do know the

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physics but are looking into how this links to the biology.

> To your first point and eventually linking back to the point we were just making: The Barents Sea actually does (during wintertime, see our Figure 3) have winds that could, just based on alignment of the wind with the shelfbreak and coastline, drive upwelling if a number of additional factors are satisfied. What is dubious, however, is the link to biology, because, as we show based on available literature, nutrients are abundant in that region without any need for this wintertime upwelling. It is exactly the link to biology which is the focus of our paper, as we are not aware of any equally accessible, concise paper that lays out these kinds of processes.

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