Review of Rixen et al 'Present, past and future of the OMZ in the northern Indian Ocean'

Rixen et al provide a review on the comparison of the two oxygen minimum zones in the northern Indian Ocean, located in the Bay of Bengal (BoB) and the Arabian Sea (AS). The two basins are compared from a oceanographic and biogeochemical point of view. This is obviously a challenge and I acknowledge that it is never an easy task to synthesize results from different disciplines and authors into a coherent piece of writing. To me the manuscript is a valuable contribution, however, it needs some more streamlining and integration of the different sections.

That said, I have some very general remarks, which I hope will help to streamline the manuscript:

I am not sure what is meant by hypoxic, in order to be able to stick with it may be helpful to define a range of oxygen concentrations you are referring to.

I am not quite sure what the aim of the study is, and what it specifically contributes as a stand-alone publication. From the title, I would expect to learn about potential expansion and intensification patterns of the two OMZs based on an assessment of past developments on geological timescales. This can, to a certain extent, be distilled out of the paper but I could imagine that if the authors take some effort and work through the paper once more, it would be more obvious. I also expected to learn about why those two basins behave so differently- there are different reasons given, including stratification, which is credible for a certain part of the BoB but not visible anymore in the offshore OMZ as presented by Bristow, further a ballasting effect by riverine particles present in the BoB and absent in the AS. The latter doesn't convince me, because it seems to be a coastal phenomenon only.

Regarding the different oxygen concentrations in the two basins, a steady state between physical oxygen supply and biological oxygen consumption is also given. The slightly higher oxygen concentrations in the BoB is suggested to promote a feedback between nitrate reduction and nitrite oxidation. This is based on Bristow et al mainly, which is one study with 5 stations during one time of the year. In order to strengthen your case, it may be beneficial to also consider Canfield et al. (2019) and Löscher et al. (2020), both of which propose alternative feedbacks possibly stabilizing the BoB's remaining oxygen traces. I understand that those studies may have come out after the presented paper was submitted and may have not been visible enough. Other results on OMZ oxygen production as suggested for other regions (Garcia-Robledo et al., 2017) may be worthwhile considering given the abundance of small unicellular cyanobacteria as described for the BoB. As for the assessment of deep time changes, reference to the work of Orsi et al. (2017) could be helpful.

In addition, but this indeed may go beyond the scope of the manuscript, a discussion on possibly changing monsoon intensities and atmospheric dust inputs could be interesting for a future assessment.

Right now, it is obvious that the sections have been written by different authors, with sections 1-3 needing a native speaker to improve the language. I understand that the first author coordinated the writing and I know that this is an ungrateful job. However, there needs to be some more coherence regarding the writing style, the level on which the different topics are presented, and again, some more integration of the different sections to improve the reading flow.

I also have some specific comments and suggestions:

Title: there is a comma missing between present and past.

l. 2 'is' should be changed to 'are'; 'it favors' should be changed to 'they favor'. I also do not quite understand the use of the (admittedly modern) expression 'ecosystem services'

l. 4: change 'which' to 'and its'

l. 8/10 past tense is used- is this because it refers to the geological past?

l. 25: 600 mio years is a bit short. Canfield, Lenton and Lyons give different ranges, but they are about 2.3-3.2 billion of years for the rise of oxygen.

l. 27 ff I am not sure what this means? Are you suggesting those are the only habitats of anaerobic organisms? Because they are quite abundant throughout the marine water column on particles see e.g. (Ganesh et al., 2015;Ganesh et al., 2014). In addition, nitrate reduction to N2 can happen via anammox- in this case one could more or less claim those are anaerobic microbes. Denitrifiers are not anaerobic microbes, they are facultative and respire oxygen when possible.
l. 39 'of' is missing before 'oxygen'
l. 49 'expense'
l. 62 Here, a definition of hypoxic and anoxic would be helpful. Also, this way to abbreviate looks very awkward. Change to 'inhibit', 'prevent'
l. 66 'of' before 'anaerobic' is missing
l. 70 a reference to work by Schmidtko et al. (2017) and Keeling et al. (2010)is missing
l. 75'margins'
l. 77 Again, this needs a definition of hypoxia.
l. 85 ff a reference to Naqvi et al. (2010) is missing.
l. 166 How do the different primary producer communities look? How is the food web- wouldn't this also be important to make claims about export fluxes? Also, if we have a faster export, would the a more anoxic sediment or deeper water layer be expected?
This statement is also somewhat contradictory to the claim made based on Bristow et al, that a microbial feed back stabilizes the trace oxygen concentrations. I would suggest mentioning the reasons for the difference in OMZ intensity in a way that is less exclusive and so that they can complement each other. The way it is, it is confusing.
l. 174 this needs a reference
l. 174 ff The statement is unclear, I think you are talking about a sulfidic event when saying anoxia
l. 176 if this is an 'only report' why do you have three references?
l. 178 'don't seem to evolve every year'
l. 179 Who dies during those mass mortalities? Please replace ' in between' with 'occasionally'. How confident are we that those mass mortalities do not result from trace metal contaminations from the land?
L 183 'also' could be removed, sounds awkward.
l. 184 change 'were' to 'was'
l. 187 Actually, Bristow shows microaerobic processes to occur
l. 190 ff awkward sentence, please rephrase
l. 192 Please add an explanation what excess N_2 measurements are good for. I don't think a non-N cycle expert can possibly know that.
l. 199 'outcompetes'
l. 202 remove 'the', change 'rate implies' to 'rates may explain'
l. 204 ff, l. 206ff Please rephrase- awkward sentences.
l. 208 'Follow-up studies also reported'
l. 212 ff Schunck et al didn't report on periodic outbreaks but on a one-time event, another report from the same region would be Callbeck et al. (2018), both references combined may give some hint for a regular occurrence.
l. 215 this may also just be a result of the monitoring program. If no one went there to measure one wouldn't find it either.
l. 220 remove 'the' before 'biological'
l. 221 'This approach is based on'
l. 223 what does 'regarded' mean here? The water masses of interest?
l. 232 'approximately'

l. 238/ 239 I don't understand this statement.
l. 258 'isotope ratio'
l. 261 ff it would be helpful to explain which values are typical for denitrification and other processes
l. 262 change 'indicates to 'is located in'
l. 268 ff this statement doesn't make sense to me, the reference is also maybe not ideal.
l. 270 'SNM'
l 272 'suggests'
l. 273 ff What is the purpose of this statement?
l. 279 'within'
l. 280 'key factor'
l. 315 This could benefit from a reference
Generally, I was missing references to work on eddies in Atlantic OMZ waters and their relevance for oxygen budgets and biogeochemistry (Fiedler et al., 2016;Karstensen et al., 2017;Schütte et al., 2016), especially in lines 366 ff.
l. 391 remove 'the'
l. 392 what is meant by 'nitrogen'? N_2, organic or inorganic nitrogen species?
l. 392-405 this section would benefit from an explanation of what those values mean.
l. 397 remove 'the'
l. 407 the core has the lowest oxygen concentrations?
l. 419 this sentence seems to be missing something
l. 428 'an onset'
l. 422 ff, this part would benefit from observations by Orsi et al. (2017)
l. 429 ff I don't understand the purpose of this statement
l. 430, the abbreviation ICW is only explained in l. 439
l. 433 what does BP stad for?
l. 436'surfac- derived oxygen-rich water'
l. 448 Kiel Climate Model, introduce the abbreviation as you use it later on, also this needs a reference.
l. 454 explain what PISCES stands for
l 485 'the' before 'late'
l. 413 what does that mean that it is backward? Replace 'oxygen values' with 'oxygen concentrations or saturations' whatever is appropriate
l. 516 there are high resolution options including mesoscale dynamics in CMIP6
l. 519 Isn't it rather a general problem that there is no circulation model available?
L 579 ff this section is lengthy and could lead better to the point
L 612 'Arabian Sea'
L 721 what is and 'edge effect'?

References

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