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# *Interactive comment on* "Differences between coastal and open ocean distributions of $N_2O$ in the oxygen minimum zone off Peru" *by* A. Kock et al.

**Anonymous Referee #1**

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The manuscript by Kock and co-workers investigates the along- and cross-section distribution of nitrous oxide in the oxygen minimum zone off Peru, as well as it examines the typical relationship between excess N2O and apparent oxygen utilization. It seems that the authors have a very valuable database that deserves to be published. The data are trustworthy and the results were obtained over several cruises (6), covering an extensive area of ocean, and predominantly concentrated during the austral summer periods. For this reason the manuscript should stand up as an excellent scientific contribution. This study contributes to narrow the existing gap in knowledge related to N2O measurements in the underrepresented eastern tropical South Pacific, and shows the importance of evaluating coastal versus oceanic nitrous oxide distribution waters when attempting to analyze physical and biogeochemical processes causing that observed distribution. I understand that both levels and spatial distribution of N2O were



highly variable, and it is likely that these depended on fluctuating O2 threshold levels that were difficult to interpret. As a result this created inconclusive patterns. However, I found the manuscript to be written in a way that was difficult to follow and I was not able to reach the same conclusions highlighted by the authors. Therefore, in order for the manuscript to be published, I recommend that the authors clarify the following issues: Firstly, the title of the work is confusing. The authors should distinguish the difference between distribution in coastal and open waters. I also expect to see an oceanographic analysis of how the authors distinguish between coastal and oceanic region. Since this region is subjected to coastal upwelling the areas should be separated, taking into account, for example, of Rossby ratio. Additionally, it is important to consider the influence of the continental shelf and the related phenomena/mechanisms occurring within the study area as a result of the presence of the continental shelf. I feel that in order to interpret the observed results, the study lacks an analysis of distribution and mixing of water masses. For ejemple the presense of the emblematic equatorial subsurface water (ESSW) is omitted. Also, the study region is characterized by different zones (the occurrence of shelf and coastal upwelling), and by an intricate regional oceanography that is influenced by equatorial dynamics. The paper does not touch on any of these regional oceanographic aspects, nor aspects regarding the temporal variability of ENSO (El Niño, or coastal trapped wave of intraseasonal frequency), even though the sampling strategy considered different years. Despite the several years of analysis carried out for this study, part of the variability could be caused by temporal scales or by mesoscale phenomena previously described for the same study area. This can be clearly observed when the authors present the latitudinal distribution along 86 ° W (Fig. 2), temporary differences, for example, are observed (between cruise M77-4 and M90) that result in different spatial structures (for example see the peak of nitrite and maximum observed in nitrous oxide). Furthermore I am concerned with the explanation about the distribution and that it is "ventilation or re-ventilation" of the water; this is both discussed and concluded as a key issue. In truth, under the context in which it is referred to, I find that this term is not clear or is not correctly used. First the authors

should clarify precisely what they mean by the term “ventilation”, as it is not very obvious to myself, nor I believe to other Oceanographers; for example, coastal upwelling is properly not a ventilation process, on the contrary has the reverse effect as vertical advection dominates. Therefore, a thorough discussion of the regional oceanography is important. I think that there are many diapycnal mixing processes, as well as vertical and lateral advection, that is likely to cause the observed heterogeneity. I understand that the focus of the paper is not on these issues, but it should at the least include T-S diagrams analysis to give an idea of mixing processes among periods A further point to consider is that the biogeochemical processes which cause accumulation and consumption of N2O are not suitably addressed, and they even fail to consider the relationship between AOU and nitrite and nitrate (only AOU vs. N2O, Figure 5). This information could further benefit the interpretation process. The authors should also include the NO or N * index as part of figure 5. On analysing Figure 5, the coast and the open ocean are not very different, except for the fact that is seems there is even greater dispersal in the coastal zone. So, when the authors conclude that the coastal upwelling off the Peruvian shelf causes conditions that lead to the extreme accumulation of N2O, what would these conditions be? Are the authors referring to benthic processes? It also comes to mind the diagenesis of phosphorus in sediment and its effect on the nitrogen cycle. As a final point, I think there is a lot of good data but it is poorly worked, and I encourage the authors to improve this version.

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