

## ***Interactive comment on “High-resolution physical-biogeochemical structure of a filament and an eddy of upwelled water off Northwest Africa” by W.-J. von Appen et al.***

### **Anonymous Referee #2**

Received and published: 14 January 2020

Review of os-2019-108 High-resolution physical-biogeochemical structure of a filament and an eddy of upwelled water off Northwest Africa

This well-written manuscript focuses on a high-resolution ( $O(1\text{ km})$  horizontal,  $O(1\text{ m})$  vertical) transect offshore of the upwelling region of northwest Africa, utilizing a towed undulating vehicle. It is a diagnostic study of the physical and biogeochemical structure, along the transect in relation to remotely sensed observations of an upwelled offshore plume that intersects the transect, and mesoscale eddy features. The physical structure measured in situ includes the plume, and mesoscale and submesoscale eddies. The biogeochemical structure, in relation to the physical structure, is diagnosed to arise

C1

in various places from the nutrient enriched plume of upwelled water, symmetric instability, eddy trapping of water and subduction of low PV waters. Although the transect itself is well measured, the authors lack the observations (e.g., time series and across-transect gradients – except for remotely sensed data) to make definitive diagnoses of the observed physical-biogeochemical structures, with many uses of qualifying words and phrases such as “may”, “suggests that”, etc., in section 3.3 and onwards. However, they do make clear that 1-D dynamical and biogeochemical assumptions are very inadequate in this region, and by extension others like it, for analyzing water column profile data. They also illustrate the value of high resolution physical and biogeochemical data that towed undulating vehicles, such as the instrumented Triaxus-E can provide. For example, they show how the observations suggest that observed high nitrate values in a narrow section of the mixed layer are consistent with submesoscale eddies at the base of the mixed layer having symmetric instabilities injecting higher nutrient waters up into the mixed layer in a slantwise fashion. Such observations are very inefficient with traditional profiling instrument packages, which limits the collection of such highly resolved data sets over longer transects. The authors suggest that more highly resolved data sets like this need to be collected in eastern boundary upwelling regions to better understand/constrain atmospheric-ocean fluxes carbon dioxide.

I am puzzled by some of the information in the paragraph beginning on line 236. I think the authors are arguing that the + nitrate excess in the core of the anticyclone is due to 1) upwelled water with high nitrate, low DO (high AOU), and zero nitrate excess; 2) the residence time in the ML before the water is subducted in the eddy formation is  $\sim$  weeks; 3) the residence time is long enough for air-sea flux to raise DO (lower AOU), but too short for PP to lower nitrate and hence leads to + nitrate excess. I am not an expert on this subject but time scales of  $O(\text{weeks})$  seem long enough for PP to be significant. Further down in the manuscript it is mentioned that the phytoplankton doubling time is 1-2 days. Or am I misunderstanding the argument?

Minor comments Line 92. I suggest that “...we describe the used data.” be replaced

C2

with "...we describe the data used." or simply "...we describe the data."

Line 125. I am a little confused about the statement of identical gradients traversed in opposite directions by the saw tooth pattern. Is the idea that the vertical gradient is essentially the same in the downcast as the upcast?

Line 236. I suggest changing "...small scale aspects that could be resolved at much higher resolution than by traditional CTS casts ..." with "...small scale aspects that were resolved at much higher resolution than would have been by traditional CTS casts ..."

Line 419. Replace "lead" with "leads"

---

Interactive comment on Ocean Sci. Discuss., <https://doi.org/10.5194/os-2019-108>, 2019.