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Comment

## ***Interactive comment on “Particles size distribution and carbon flux across the Arabian Sea Oxygen Minimum Zone” by F. Roullier et al.***

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The article by Rullier et al. (2013) on fluxes of large ( $> 100 \mu\text{m}$ ) particles and organic carbon across the Oxygen Minimum Zone (OMZ) of the Arabian Sea made on a NW to SE section in March 2010 stands out by the quantitative interpretation of in part novel measurements. It is an admirable open-sea effort on the small, 36 m long ship engaged in the Tara Oceans expeditions.

What is missing in the paper is to convey a sense for the effects on the fluxes of the variability of the data in the replicate casts, as well as of global coefficients (for example, as taken from Guidi et al., 2008, as cited), or of the unconvincing choice of 50 m for  $z_{\text{ref}}$  (Eq.7, p.19278). I do not want to suggest a full-fledged sensitivity analysis but I just ask to state what, for example, a change by 20% of the used values would mean.

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As to the write-up, please, state the date of the cruise on p.19274 and enter “inferred” on Line 5, p.19288, before “biogeochemical”. Also, were all the instruments, listed as “added” on top of p.19275, used on all 45 CTD casts and if not on how many? In the figures depicting profiles, the lettering of the axes is too small. In the caption of Fig. 11, state the depths of the two right-hand panels. What do the arrows in the right-hand panel of 11 A designate?

My principal comments address the vertical distribution of mesozooplankton and the treatment of fluxes. For the former, I add an early literature reference, while for the latter, I have substantive questions and suggestions.

1. Recall that the intermediate minimum of biomass as related to the O<sub>2</sub> minimum (Fig. 7, stas. 38-40) is present in the three major oceanic OMZs. In this paper, the increase of biomass in the lower OMZ is tentatively suggested as partly due to particles, which had been relatively little degraded or removed by grazers while settling through the overlying intense O<sub>2</sub> minimum (sect. 4.3), similarly to Wishner et al. (1998, as cited). Previously, Vinogradov and Voronina (1961/1962: 529 and Fig. 3) made a similar inference for food, settling from above but not utilized in the OMZ, as supporting higher biomass of mesozooplankton at depth.

2. In Fig. 11 the Martin model or curve does not fit the flux data well, neither near the surface nor if extrapolated to greater depth. Also, Line 20, p.19287 states that the model cannot be applied to sta. 37, yet the station is one out of two depicted in that figure. Why? And, is the station among the five included on Line 21?

Why use the Martin model at all? Because of its design, it will always fail when the depicted variable increases at depth. Also, its exponent is biologically or geochemically meaningless and cannot be experimentally verified. Instead I suggest plotting the data in Fig. 11 (perhaps the original raw numbers, rather than the plotted means?) and the fluxes or particle volumes at stas. 38 and 39, on double-log paper (see my attached figure exhumed from the Gray Literature). The differing slopes of regression lines in

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such plots reflect the shifting balance between (supply or growth) and (mortality or loss), both being the rates that we want to know for the mesopelagial - and in ecology in general. (Russian oceanographers used double-log plots 20-25 years before Martin et al., 1987, as cited.)

### Figure Caption

Logarithm of zooplankton biomass (mg wet weight  $m^{-3}$ ; < 0.38 mm mesh size) against logarithm of depth. Left panel, stations from the equatorial and western Arabian Sea; right panel, stations in the region of the strong OMZ of the Arabian Sea. Thin lines in right panel: regressions from left panel; thick line, drawn by hand through means for the OMZ. Data from Vinogradov (1962, table 1; 1970, table 20 [sta. 4630 at 3°N, 67°E; sta. 4684 is actually 4634]). Modified from Banse (1991).

Regarding the spelling in the headline of the paper, our consensus here is that it has to be Particle, but not particleS.

### References

Banse, K.: Issues related to vertical flux in the Arabian Sea, pp. 108-118 in U.S. JGOFS Planning Rept. 13, Arabian Sea Process Study (S.L. Smith, ed.), Woods Hole Oceanogr. Inst., Woods Hole, MA, 1991.

Vinogradov, M.E.: Quantitative distribution of deep-sea plankton in the northern section of the Indian Ocean, *Okeanologiya*, 2, 577-592, 1962 (In Russian).

Vinogradov, M.E.: Vertical Distribution of the Oceanic Zooplankton, Engl. transl. of the Russian original of 1968, *Israel Progr. Sci. Publ.* 5513, Jerusalem, 339 pp., 1970.

Vinogradov, M.E., and Voronina, N.M.: Influence of the oxygen deficit on the distribution of plankton in the Arabian Sea, *Okeanologiya*, 1, 670-678, 1961 (Engl. transl. in *Deep-Sea Res.*, 9, 523-530, 1962).

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Interactive comment on Biogeosciences Discuss., 10, 19271, 2013.

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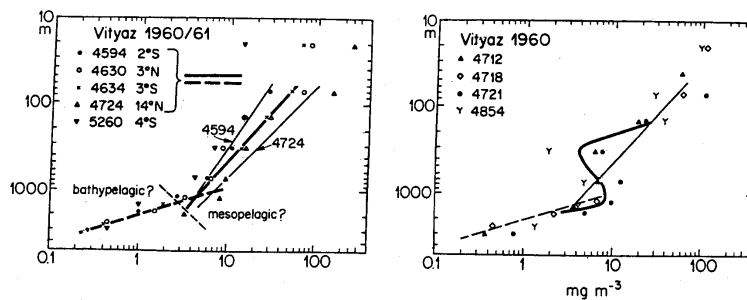
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Fig. 1.