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Comment on os-2021-45

I. Nicholas McCave (Referee)

Referee comment on "Distribution of suspended particulate matter at the equatorial transect in the Atlantic Ocean" by Vadim Sivkov and Ekaterina Bubnova, Ocean Sci. Discuss., <https://doi.org/10.5194/os-2021-45-RC1>, 2021

Review of Sivkov, V. And Bubnova, E., "Distribution of suspended particulate matter at the equatorial transect in the Atlantic Ocean" submitted to *Ocean Science*.

This interesting paper relies on a rare type of dataset, namely measurements of suspended particulate matter (SPM) volume by Coulter counter. It is based on a transect from about 10° north (E) to about 4° North (W) where 61 stations were occupied and 407 samples processed. This quasi synoptic view of the SPM distribution across the equatorial Atlantic reveals several features that are expected, namely high concentrations under the deep Western boundary currents, and one that is not. This is the presence of a column of high suspended sediment concentration over the Sierra Leone rise with a mid-depth maximum between about 1000 and 2000 m. There is a high concentration zone across much of the transect at around 1600 m which is at the same level as a CFC 11 anomaly displayed WOCE line A06, a correspondence that bears further investigation. There are numerous minor infelicities of English usage which I will be happy to transmit to the authors. More detailed comments follow below.

14-21: In the introduction the authors mention the seminal work of Biscaye and Eittrheim (1977) who ascribed thick bottom nepheloid layers (BNLs) to upward mixing of SPM, but they should also mention the lateral transfer arguments of Armi (1978) and McCave (1983), the 'separated mixed layer' model.

52-56: With so few regional measurements of particle volume by Coulter counter one might ask whether the data presented here are 'correct', i.e. whether contamination has been avoided. There is one other large-scale dataset which contains comparable values to those presented here, namely that of McCave (1983). The size range measured in the present study differs slightly from that of McCave but the range here extends somewhat further into the finest sizes at the expense of a cut-off of 20.7 μm versus 32 μm in McCave's data. So a strict comparison cannot be made. In that paper measurements of both particle volume and concentration by weight were presented and an apparent suspended particle density range was derived with values of 1.65 to 2.23 mg/mm^3 . The

present authors' ppm are cubic millimetres per litre. With values in the range of 0.01 to 0.08 ppm below the higher concentration surface layer the implied concentrations by weight are about 16 to 180 mg/L, in excellent accordance with suspended matter concentrations measured around the world, e.g. Brewer et al (1976) and the important synthesis of Gardner et al. (2018).

174-184: The authors point to an influence of Amazon River sediments being more important than concentrations at the African end of the transect. Nevertheless there is a marked high at the African end centred on about 800 m that the authors do not discuss and one wonders whether both might be due to internal wave activity on the upper slope.

225 et seq. The authors describe the high mid water concentrations extending down to the bottom over the Sierra Leone rise to the occurrence of aggregates ballasted with Aeolian dust. The concentration zone occurs 1000 km from the coast which is well beyond the zone of coastal upwelling-driven high productivity but does fall in the region of Sahara and Sahelian dust. The authors observe that this column of high concentration occurs under the Guinea dome, a permanent thermal upwelling dome with a cyclonic associated circulation. Other examples of high concentration columns are shown by Biscaye and Eittrheim over Bermuda rise and in the Argentine basin. It seems more likely that the authors observations are related to this circulation feature.

286-291: The intermediate nepheloid layer (INL) downstream of the 'dam' is similar to the INL demonstrated by Tucholke and Eittrheim (1974) deep western boundary current flows over the Puerto Rico Trench.

301-306: Lavelle (2012) has shown the effect of midocean ridges on accelerating currents along their flanks, currents which are likely to then lead to resuspension and generation of nepheloid layers.

310-346. It would be helpful to have a figure in which some of the size distributions were illustrated - cumulative number plots for example.

330-333: it is not clear how a large Brunt-Vaisala frequency in itself would lead to smoothing of a particle size distribution, but perhaps the authors wish to imply that there might be breaking internal wave-driven turbulence associated with frequency maxima that would promote aggregation.

Nick McCave

References (additional to those in the paper).

Armi, L., 1978. Mixing in the deep ocean – the importance of boundaries. *Oceanus*, 21(1), 14–19.

Brewer, P.G., Spencer, D.W., Biscaye, P.E., Hanley, A., Sachs, P.S., Smith, C.L., Kadar, S., Fredericks, J., 1976. The distribution of particulate matter in the Atlantic Ocean. *Earth Planet. Sci. Lett.*, 32, 393–402.

Lavelle, J. W. (2012), On the dynamics of current jets trapped to the flanks of mid-ocean ridges, *J. Geophys. Res.*, 117, C07002, doi:10.1029/2011JC007627.

Tucholke, B.E. & S.L. Eittreim, 1974. The western boundary undercurrent as a turbidity maximum over the Puerto Rico Trench. *J. geophys. Res.* 79, 4115-4118.