Biogeosciences Discuss., 5, S933–S937, 2008
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Biogeosciences Discussions

Interactive comment on "Contrasting distribution of aggregates >100 μm in the upper kilometre of the South-Eastern Pacific" *by* L. Guidi et al.

L. Guidi et al.

Received and published: 26 June 2008

General comments and responses:

Reviewer: This paper presents the results of an excellent study using excellent techniques with excellent results in an excellent place, but the paper is far from excellent and requires substantial revision. The major flaw is the authors' use of the flux numbers calculated from the aggregate abundances. They cite work by Alldredge and others to justify their assumption that sinking speed (and therefore flux) varies in proportion to aggregate size but the relationship from Alldredge and other authors is weak at best and certainly not capable of supporting the applications used here.

Authors: *The relationship used in this paper is not from Alldrege and Gotshalk (1988) but from an other study in press in Deep Sea Research Part I. Here we are using an*

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Interactive Discussion

Discussion Paper

extensive set of data with 118 flux measurements from sediment traps (model Technicap PPS5) both moored and drifting and concomitant profiles of aggregate abundance and size distributions.

The hypothesis is that the total mass flux (F) is the mass flux spectrum integrated over all particle sizes. Using diameter as a measure of particle size, then

$$F = \int_0^\infty n(d)m(d)w(d)dd \quad (1)$$

The mass (m) of a spherical particle is given by

$$m(d) = \alpha\, d^3 \quad (2)$$

where $\alpha = \pi \quad \rho/6$ *and* ρ *is its average density.*

Its settling rate (w) can be calculated using Stokes Law:

$$w(d) = \beta\, d^2 \quad (3)$$

where $\beta = g\,(\rho - \rho_0)(18\upsilon\rho_0)^{-1}$*, g is the gravitational acceleration,* ρ_0 *is the fluid density, and* υ *is the kinematic viscosity.*

If both w(d) and m(d) are given by power relationships, so is the combined quantity,

$$w \cdot m = A \cdot d^b \quad (4)$$

For the above case of constant density shown in Eqs 2 and 3the exponent b in the equation 4 is equal to 5.

If the aggregates size distribution and the values of A and b are known, then a mass flux can be calculated from size spectra using Eq. 1 and Eq. 4. The fluxes calculated this way can be compared to matching sediment trap values. Because we did not know

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the appropriate values of A and b, we used a minimization procedure to find those two values that provided the best fit between the two fluxes – sediment trap and particle size distribution-derived.

The procedure is explained in the paper in press in DSR I entitled: Relationship between particle size distribution and flux in the mesopelagic zone. Authors: Guidi et al. DOI:10.1016/j.dsr.2008.05.014.

Figure 2 in the above paper represents the mass flux estimation using the relationship described previously compared to the mass flux measurements using 118 sediment traps. We have combined data from different seasons and locations in order to find "global" values of A and b that could be used as a reference for any subsequent "local" analyses. However, our dataset does not indicate that the sample location plays an important role on A and b estimates: if it would be the case, clear outliers would appear on the Figure. This is not the case.

Reviewer: Further, there is no description of the sediment trap method so the reader has no basis for judging whether or not to accept these data as validation of the large particle flux estimates. The abstract states that "estimates of vertical flux rely on the sediment trap data but difficulties inherent in their design, limit the reliability of this information." This is true and well accepted so why do the authors later state that "When fitting the UVP data to the free-drifting trap data we assumed that the latter are correct" (Page 881)?

Authors: *Details on sediment traps design have been included in the revised text and th escientific responsible of sediment trap work is now one of the authors.*

Reviewer: Okay, having said that, it is important to note that these calculations are interesting and should be published, but the authors need to be more honest and consistent with their findings and assumptions. They should state clearly that the relationship between size and sinking speed flux is extremely tenuous and that the results derived from it are similarly questionable.

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Authors: *It is truth that the relationship between size and sinking speed flux is questionable. Based on results presented in this paper a relationship exists between aggregate size and aggregate flux even if there is some variability. The Biosope cruise crossed the South Pacific Ocean from very oligotrophic to highly productive waters. Our results illustrate this large variation in fluxes with high resolution when compared to sediment traps. We are confident that future calibrations of the in situ optical method used here will give more realistic flux estimations.*

Reviewer: They should also give more details on the "minimization" procedure used to fit the two fluxes and how this is used so that the plot in figure 6 is not entirely circular, comparing one set of data to another that was largely derived from it.

Authors: *The flux estimation is not derived from these sediment traps data but from a much larger set of data representing 118 comparisons between aggregate size and flux.*

We used the Matlab function fminsearch (The Mathworks, Inc., Natick, MA) to find the values of A and b of equation 4 that minimized the log-transformed differences (ΔF_c) between sediment trap and spectral-estimated fluxes:

$$\Delta F_c = \sum_i \left[\log\left(F_{T,i}\right) - \log\left(F_{E,i}\right)\right]^2 \tag{5}$$

where $F_{T,i}$ is the sediment trap flux value and $F_{E,i}$ the associated flux based on Eq. 1 for the ith observation. The logarithmic transformation was used to give equal weight to differences for small and large fluxes.

The minimization procedure yields only one pair of parameter values. We used a jackknife procedure to estimate the errors of the estimates. The minimization was performed on 1000 subsamples one third the size of the original data set and composed of data pairs selected randomly from the original data set.

Reviewer: There are other problems too:

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- lose the term "superficial." Yes, it can mean "relating to the surface," but the more common usage is "of little significance" or "oversimplified."
- not all of the terms in the equations are defined; this is critical (eg. A on page 877)

A (Constant for mass flux estimation calculated using the minimization procedure)

- the reference on the bottom of page 882 to figure 7 is probably for figure 5
- the two paragraphs on page 881 are largely redundant; this can be fixed by combining the two paragraphs
- miscellaneous typos

Authors: *All the remarks above were taken into consideration in the corrected m/s*

Interactive comment on Biogeosciences Discuss., 5, 871, 2008.