Biogeosciences Discuss., 4, S2757–S2760, 2008
www.biogeosciences-discuss.net/4/S2757/2008/

Biogeosciences Discussions

Interactive comment on "Particle optical backscattering along a chlorophyll gradient in the upper layer of the eastern South Pacific Ocean" *by* Y. Huot et al.

Y. Huot et al.

Received and published: 11 March 2008

We thank Ms. Whitmire for her positive and helpful review.

This work had two main objectives. First, to study the relationship between the chlorophyll-a concentration and the particulate backscattering coefficient, particulate scattering coefficient, and the particulate backscattering ratio in oligotrophic and hyperoligotrophic waters (0.02 < [Chl] < 2 mg m^{-3}). Their second objective was to investigate the [co-]variability in the spectral behavior of the particulate backscattering and scattering coefficients, and by extension, the backscattering ratio. This work is extremely important because measurements of these parameters in Case-I waters with [Chl] of less than 0.15 mg m^{-3} have rarely been made, despite the fact *that these waters constitute greater than 90% of the surface ocean. The paper is thoughtful and well written, and I recommend that it be published without much revision.*

Specific comments and general thoughts

On Instrumentation and methods

There is likely to be active debate on the combined use of two different instruments to measure backward scattering in this work. It might seem incongruous to have used different processing methods and conversion factors (χ) for the ECO-BB3 and the Hydroscat instruments. In fact, different χ values are required because the ECO instruments measure the VSF at different backward angles than the Hydroscat instruments (117 degrees versus 140 degrees respectively). It's arguable whether or not fitting a power function to the Hydroscat data was necessary and/or justified, and a figure or statistics on how robust the fits were would go a long way toward justifying taking this approach (perhaps outside the scope of this paper, but certainly should have been included in Stramski et al., 2007). Despite these differences, studies continue to show that these instruments provide estimates of the backscattering coefficient that are within 10

We would like to emphasize that the Stramski et al. paper does include a justification for the use of a power fit. In section 2.3.2 of that paper is written: "Because bb(λ) is expected to be generally a smooth monotonic function of λ, especially in the absence of intense phytoplankton blooms, the use of final backscattering values from the spectral power fit has an advantage of smoothing out potential positive and negative uncertainties that may be present in the measured data at individual spectral channels (for example, calibration uncertainties or the influence of a large particle on a single sensor channel). The Stramski et al. paper further states that for the green band of interest to that study, the agreement between the measured and fitted values was, on average,

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3% for the BIOSOPE data set and within 0.5% for the ANTXXIII/1 data set. We believe that this information is clear and provides sufficient detail concerning the single waveband backscattering data utilized in the Stramski et al. paper, especially as this paper already includes a very comprehensive description of methodology. We now mention in our paper two statistics about the fitting procedure relevant to the other wavebands. The average difference between fitted and measured values of bb(λ) was <4% in each of the spectral channels utilized in this study. The average value for the coefficient of determination, R2, is 0.986 (st.dev. = 0.012, N = 112). Note that we carried out the complete analysis with and without the power fit and the difference were negligible. We kept the fitting procedures to be consistent with the work of Stramski et al. 2007 who had thoroughly investigated its use.

On the Results Figure 1 is remarkable, and seriously informs our understanding of the relationship between backscattering and chlorophyll in oligotrophic, Case-I waters. One could still debate what the primar y source of par ticulate backscattering is in these waters, whether it be the phytoplankton and heterotrophic 64258;agellates themselves or their co-var ying non-algal par ticles (detritus, colloids, etc.), but the tight relationship between chlorophyll and backscattering is an impor tant finding. If the source of the backscattering is not the micro- and nanoplankton, then the detrital and colloidal particles are so tightly coupled with the chlorophyll-containing particles that they seem to be functionally equivalent in terms of their contribution to the backscattering signal, i.e. they appear to be one in the same as far as satellites are concerned. This is ver y interesting, and should stimulate some lively conversations about the so-called 180;180;backscattering enigma.180;180; Would this tight relationship between backscattering and chlorophyll hold in areas where Aeolian inputs are more significant? How robust is this relationship in other central ocean gyres?
We made a preliminary attempt to look at other oceanic location with higher chlorophyll concentration to see if the relationships derived herein would hold.

This is now presented in Figure 2b and shows that the relationship derived on the BIOSOPE cruise track provide reasonable predictions of the backscattering in the Benguela upwelling and in the Bering Sea.

There is more work to be done in this area, but this paper is a fantastic start.
Technical corrections
Page 4573, line 4: typo remove "?" after (λ).
Corrected

Page 4574, line 5: 180;"which may reflect the true natural variability in oceanic waters. " I would be inclined to say "180;which likely reflects the true natural variability in oceanic waters."
Unchanged; the sentence represents better our idea with using "may".

Page 4585, line 10: reverse the order of "are" and "also" at the end of the line.
The text has been modified slightly in this section to improve readability.

Interactive comment on Biogeosciences Discuss., 4, 4571, 2007.

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