Relationship between spectral particulate attenuation and particle size distribution

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Introduction:

- Particle Size Distribution (PSD):

  Information about the ecological dynamics of marine water, particulate sedimentation fluxes and sediment transport;
- Beam attenuation coefficient (C):

  Quantify light propagation in the ocean and to study the concentration of the material affecting light propagation.

PSDs could be well approximated by a hyperbolic (Junge-like) distribution :

$$N(D) = N_0(D/D_0)^{-\xi}$$

- *N(D):* the number of particles with diameters between *D* and *D*+*dD* divided by *dD;*
- D_0: reference diameter;
- ξ: PSD slope varying between 3 and 5.

The particulate attenuation c_p:

$$c_p(\lambda) = c_p(\lambda_0)\, \lambda^{-\gamma}$$

The exponent of the particulate attenuation spectrum (γ) and the exponent of the PSD (ξ) are linearly by

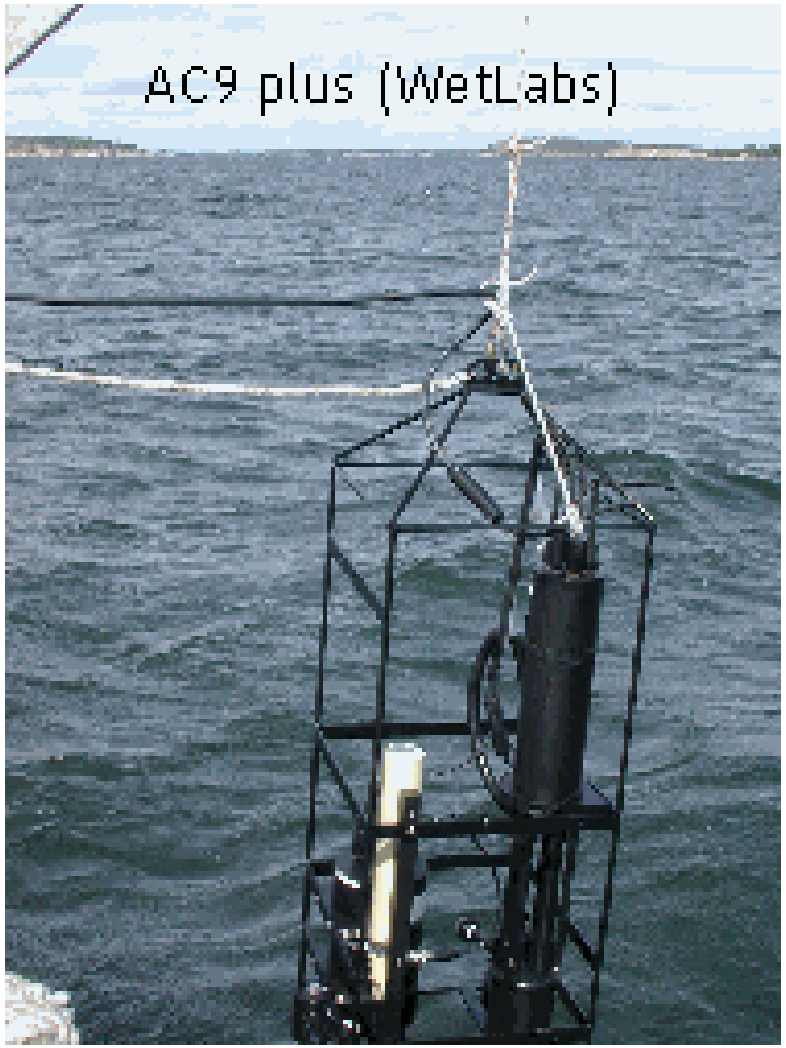
$$\gamma = \xi - 3$$

([Diehl and Haardt, 1980]);

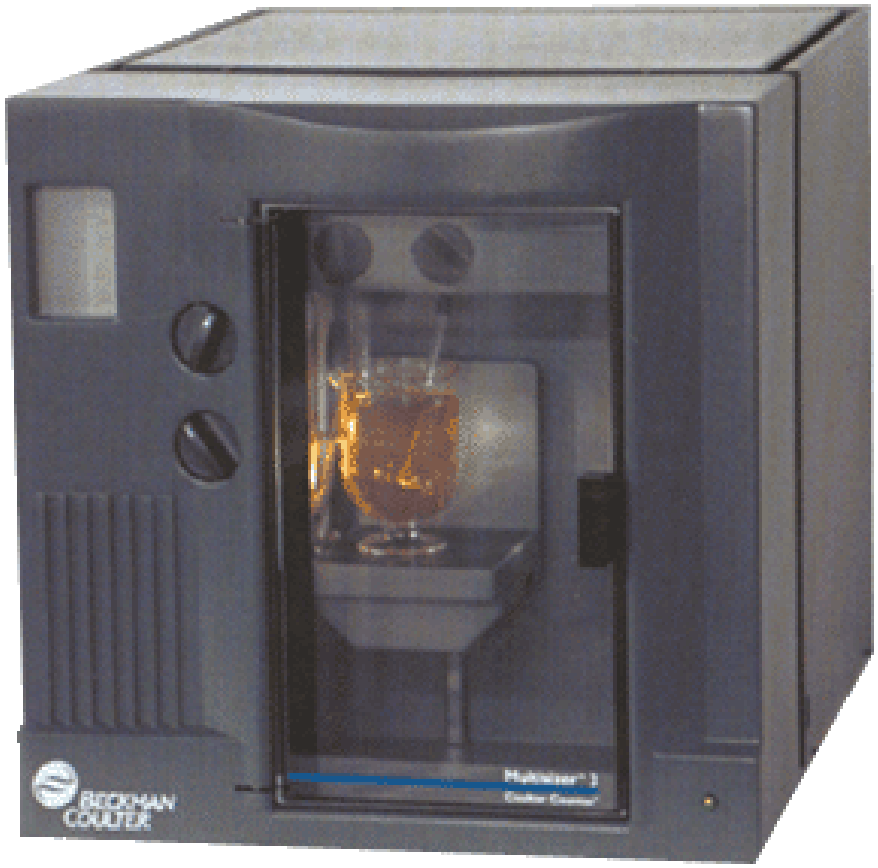
The main goal of this study is to test that relationship.

Methods: C_p

$$C_p = C_{pg} - C_g$$



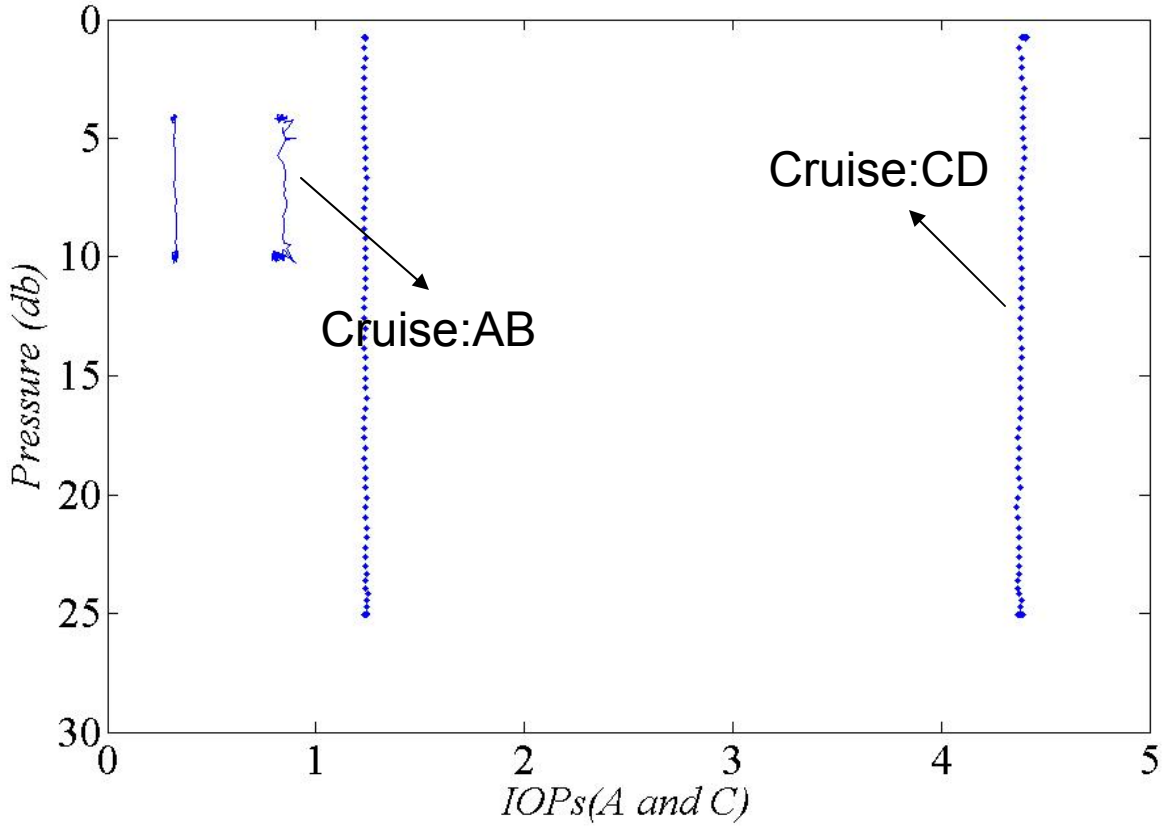
PSDs: Coulter Counter



3-10 *um* range used: avoid noise in the small size range (2<D<3*um*); the scarcity of particles >10 *um* made statistical very bad.

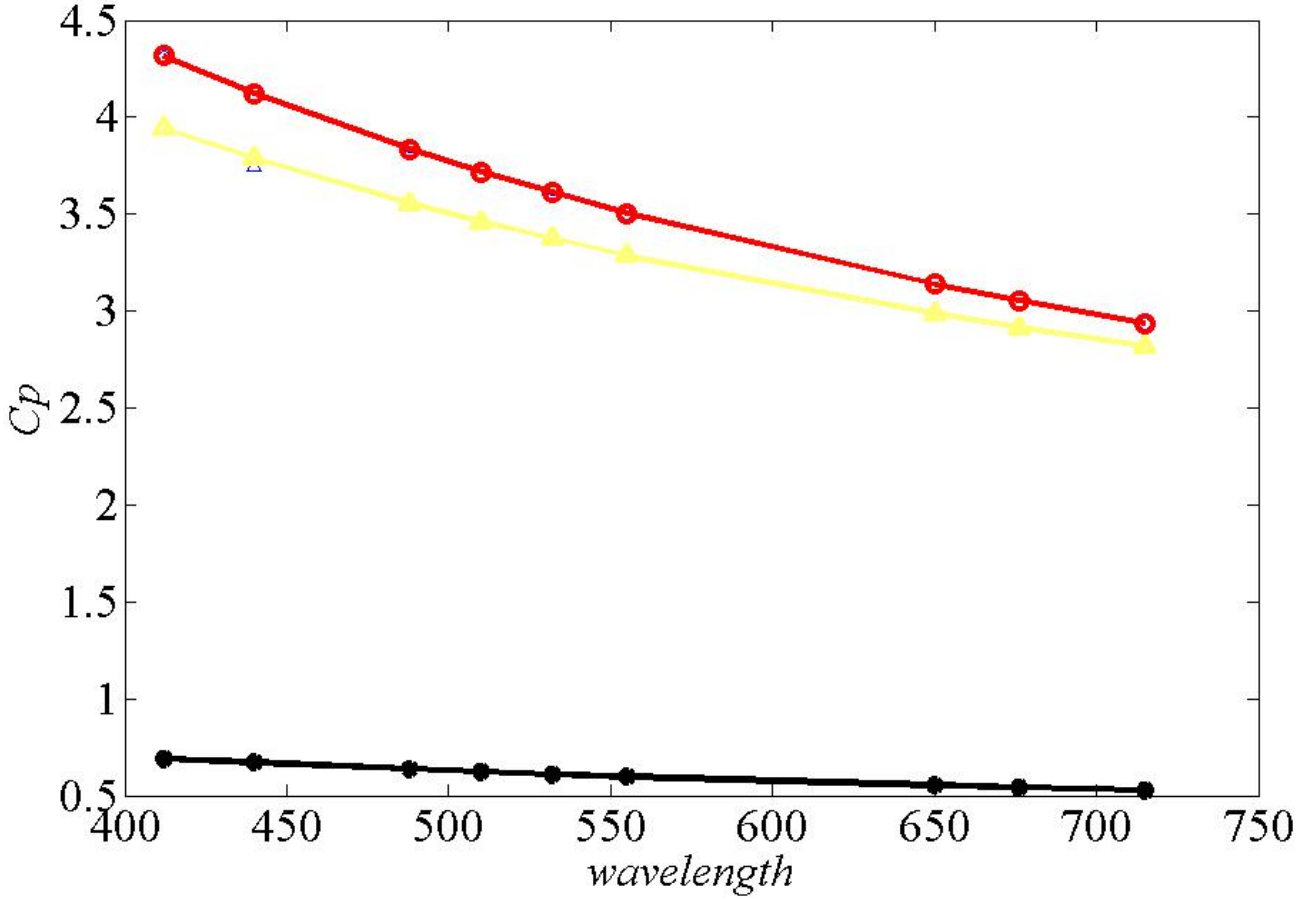
Results:

1. Optical Data:

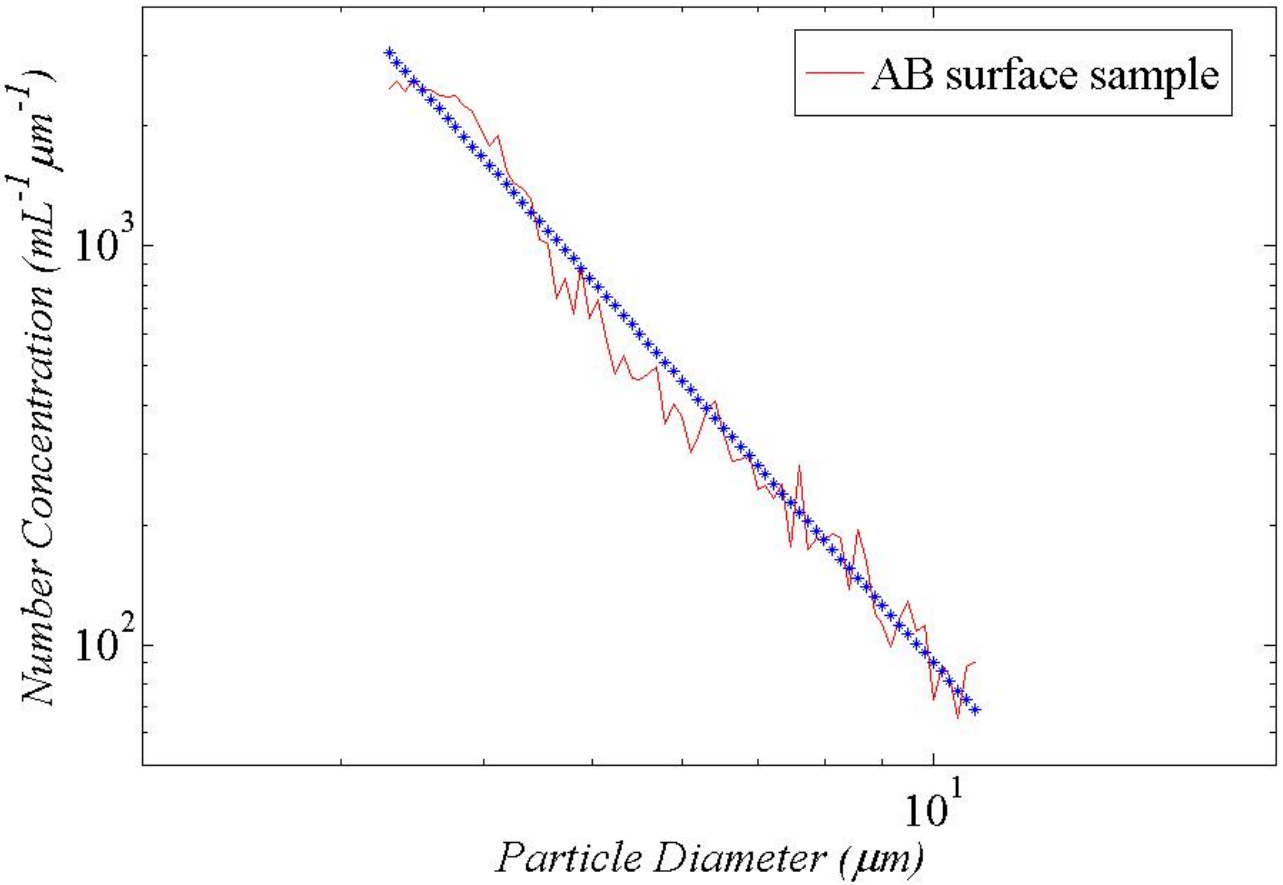


Super mixed water !!!

Fitted C_p Curves:



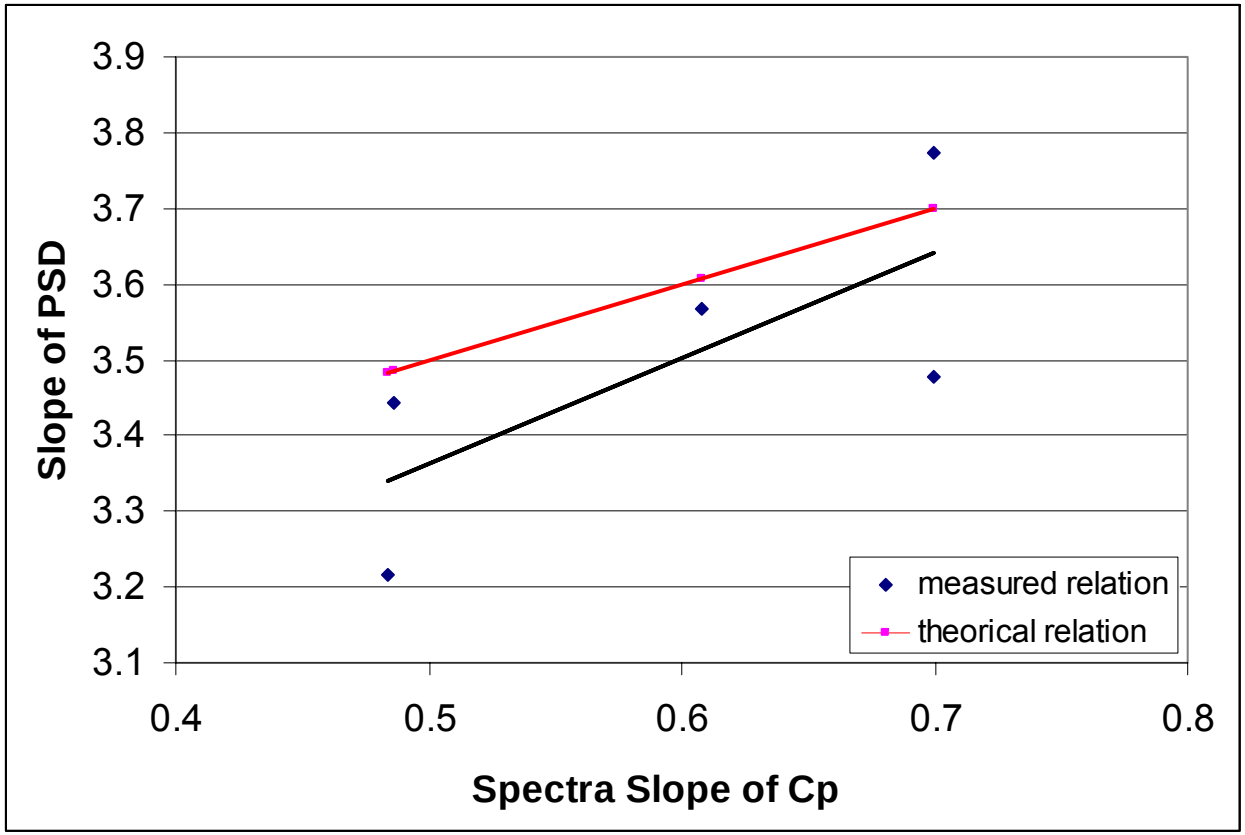
Fitted PSDs Curves:



Comparison: ξ for Two Different Particle Size Ranges and Spectral Slope γ

	Cp(440)	ξ for 2<D<10um	ξ for 3<D<10um	γ
AB surf	0.6575	7.8273	3.4445	0.4861
AB 10m	0.6575	9.8067	3.2151	0.484
CD stn1	3.7436	3.32	3.5679	0.608
CD stn2 surf	4.098	2.9453	3.7722	0.6998
CD stn2 10m	4.098	2.8565	3.4784	0.6998

Theoretical and measured relationship:



Conclusions:

- The shapes of the particulate attenuation spectra ($c_p(\lambda)$) were found to be well approximated by a power law with respect to wavelength;
- A single Junge exponent was found not to match very well the whole data from 2 to 10 *um*; a better fit was found when the size range was limited to $3 < D < 10$ *um;*
- The range of observed values of ξ and γ is relatively consistent with the linear relationship: $\gamma = \xi - 3$.