Light scattering properties of marine particles in coastal and open ocean waters as related to the particle mass concentration

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Limnol. Oceanogr., 48(2), 2003, 843-859 | DOI: 10.4319/lo.2003.48.2.0843

ABSTRACT: Variations in the spectral scattering coefficient of marine particles [$b_p(\lambda)$] were measured at 241 locations in oceanic (case 1) and coastal (case 2) waters around Europe. The scattering coefficient at 555 nm normalized to the dry mass of particles [b^*_p (555)] was, on average, 1.0 and 0.5 $m^2 g^{-1}$ in case 1 and case 2 waters, respectively. Spectral variations in $b_p(\lambda)$ were, on average, small in all investigated waters. To understand the observed variations in particle scattering, we performed calculations based on the Mie theory with various values for the slope for the Junge-type size distribution, refractive index, and apparent density of particles (dry weight/wet volume). The latter two were varied according to the type of particles (organic versus mineral) and, for organic ones, as a function of the water content. The higher $b^*_p(555)$ values in case 1 waters are mainly due to the low apparent density, which results from the organic nature of particles and their elevated water content. In all investigated coastal regions, except for the Baltic Sea, the low $b^*_p(555)$ values can be explained by the dominant presence of mineral particles, characterized by a high density that counterbalances the effect of a higher refractive index. In the Baltic Sea, $b^*_p(555)$ was similar to values found in other coastal waters despite the fact that particles were dominantly organic, which may result from higher absorption relative to scattering. A smaller than expected increase of $b_p(\lambda)$ toward short wavelengths is attributed to significant absorption that increases toward the shorter wavelengths and reduces scattering, whether particles are living, detrital, or mineral. Our analyses suggest that the determination of b^*_p may be significantly sensitive to the porosity of the filter used to assess the dry mass of particles.