Optical properties of the "clearest" natural waters

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ABSTRACT: Optical measurements within both the visible and near ultraviolet (UV) parts of the spectrum (305-750 nm) were recently made in hyperoligotrophic waters in the South Pacific gyre (near Easter Island). The diffuse attenuation coefficients for downward irradiance, $K_d(\lambda)$, and the irradiance reflectances, $R(\lambda)$, as derived from hyperspectral (downward and upward) irradiance measurements, exhibit very uncommon values that reflect the exceptional clarity of this huge water body. The $K_d(\lambda)$ values observed in the UV domain are even below the absorption coefficients found in current literature for pure water. The $R(\lambda)$ values (beneath the surface) exhibit a maximum as high as 13% around 390 nm. From these apparent optical properties, the absorption and backscattering coefficients can be inferred by inversion and compared to those of (optically) pure seawater. The total absorption coefficient (a_{tot}) exhibits a flat minimum (~ 0.007 m^{-1}) around 410-420 nm, about twice that of pure water. At 310 nm, a_{tot} may be as low as 0.045 m^{-1}, i.e., half the value generally accepted for pure water. The particulate absorption is low compared to those of yellow substance and water and represents only ~15% of a_{tot} in the 305-420-nm domain. The backscattering coefficient is totally dominated by that of water molecules in the UV domain. Because direct laboratory determinations of pure water absorption in the UV domain are still scarce and contradictory, we determine a tentative upper bound limit for this elusive coefficient as it results from in situ measurements.

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