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Scattering phase function: the step-child of ocean optics

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What are inherent optical properties? The answer seems simple: absorption and scattering. Actually, this is the correct answer but only if one means by them the underlying optical processes. If the intended meaning is "absorption and scattering coefficients" the answer is wrong. Wrong because unlike absorption, scattering cannot be described by a single scalar. Scattering has angular distribution which normalized version is called the phase function.

Phase functions were never ignored but for several decades they were treated as the step-child of ocean optics: an average of three single wavelenght measurements of the San Diego harbor were used in radiative transfer calculations and when more variability was needed analytical phase functions created for diffuse galactic light were utilized. Only since about 2000, real progress started. Realistic analytical phase functions were created by Haltrin as well as by Fournier and Forand. New instruments were starting to be built. Two years later Mobley and colleges proposed a parametrization of Fournier-Forand functions using backscattering coefficients.

We show using Monte Carlo radiative transfer code that backscattering coefficient is not the only factor ruling the phase function shape. Reflectivity values calculated using "realistic" phase functions with identical backscattering ratios can differ by up to 10%. This is the motivation for proposing a new phase function parametrization, an improved version of one we have published in 2007. This spectral parametrization is based on Baltic phase function measurements in four wavelengths. The parameter used to choose the correct Fournier-Forand function is absorption. At this moment this is only a regional parametrization but with more data it can be improved to become a universal one. We challenge ocean optics researchers to use their measured phase function data to verify and improve our method. It is high time phase functions stopped to be treated as the step-child of ocean optics.