The volume scattering function (VSF), $\beta(\lambda, \Psi)$, describes the angular distribution of light scattered by a suspension of particles toward the direction Ψ $[rad]$ at a wavelength λ. It is defined as the radiant intensity, $dI(\Omega, \lambda)$ $[Wsr^{-1}\ nm^{-1}]$ (Ω [sr] being the solid angle), emanating at an angle Ψ from an infinitesimal volume element dV $[m^3]$ for a given incident irradiant intensity, $E(0, \lambda)$ $[Wm^2nm^{-1}]$:

$$\beta(\Psi) = \frac{1}{E(0, \lambda)} \frac{dI(\Omega, \lambda)}{dV} \, [m^{-1}sr^{-1}] \tag{1}$$

It is often assumed that scattering is azimuthally symmetric so that $\beta(\lambda, \Psi) = \beta(\lambda, \theta)$, where θ $[rad]$ is the angle between the initial direction of light propagation and that to which the light is scattered irrespective of azimuth. The assumption of azimuthal symmetry is valid for spherical particles or randomly oriented non-spherical particles. This assumption is most likely valid for the turbulent aquatic environment of interest here; it is assumed throughout this book.

A measure of the overall magnitude of the scattered light, without regard to its angular distribution, is given by the scattering coefficient, $b(\lambda)\,[m^{-1}]$, which is the integral of the VSF over all angles ($4\pi\,[sr]$):

$$b \equiv \int_0^{4\pi} \beta(\Psi) d\Omega = \int_0^{2\pi} \int_0^{\pi} \beta(\theta, \phi) \sin\theta d\theta d\phi = 2\pi \int_0^{\pi} \beta(\theta) \sin\theta d\theta \tag{2}$$

where $\phi\,[rad]$ is the azimuth angle. For compactness of notation we drop the λ notation though it is implied that all the IOPs, unless specified otherwise are function of the wavelength. Scattering is often described by the phase function, , which is the VSF normalised to the total scattering. It provides information on the shape of the VSF regardless of the intensity of the scattered light:

$$\tilde{\beta} \equiv \frac{\beta}{b} \tag{3}$$

Other parameters that define the scattered light include the backscattering coefficient,b_b , which is defined as the total light scattered in the hemisphere from which light has originated (i.e., scattered in the backward direction):

$$b_b \equiv \int_{2\pi}^{4\pi} \beta(\Psi) d\Omega = 2\pi \int_{\pi/2}^{\pi} \beta(\theta) \sin\theta d\theta \tag{4}$$

and the backscattering ratio, which is defined as

$$\tilde{b} \equiv \frac{b_b}{b} \tag{5}$$