**2.2.3 Optical measurements**

**2.2.3.3 Apparent optical properties (AOPs) and other radiometric quantities**

~~Apparent optical properties (AOPs) measurements included light transmittance (~~*~~T~~*~~), photosynthetically available radiation (PAR), downward irradiance (~~*~~E~~*~~d) and the vertical diffuse attenuation coefficient for downward plane irradiance (~~*~~K~~*~~d). They are derived from measurements of radiometric quantities. Vertical profiles of radiometric quantities were collected during MALINA Leg2b using a Compact-Optical Profiling System (C-OPS) manufactured by Biospherical Instruments Inc. (San Diego, California)~~ and built with micro-radiometers (Morrow2010). The rationale for the development of this in-water profiling system is provided in Hooker2013 along with a detailed description of its design and operation, and further demonstration of its capability in deriving high-accuracy radiometric data close to the surface. This profiler provides high-resolution vertical profiles of the downward irradiance, Ed, and the upwelling radiance at nadir, Lu, in 19 spectral bands, as follows: 320, 340, 380, 395, 412, 443, 465, 490, 510, 532, 555, 560, 625, 665, 670, 683, 710, 780 nm and PAR. It also allowed an easy and unobstructed deployment of a reference radiometer using a telescoping mast (Hooker2010) for collection of the global solar irradiance, Ed(0+) or Es, and getting close to ice fields for specific casts. The processing of these data is based here on a well-established methodology (Smith1984). Further methodological details about the C-OPS and data processing can be found in optic-related papers of the MALINA cruise (Antoine2013, Hooker2013).

A multispectral fish-eye radiance camera (Antoine2013) was also deployed from the barge in order to measure underwater radiance distributions over full hemispheres and for the following six spectral bands (and bandwidths): 406 (15), 438 (24), 494 (20), 510 (10), 560 (25), and 628 (40) nm. The deployment used either a surface mode with the camera hanging from a floating frame and looking down just below the surface or a profiling mode where the two same cameras are mounted on a free-falling profiling frame and measure simultaneously the upwelling and downwelling underwater radiance distributions at various depths. The advantages listed above for the C-OPS measurements from the barge, e.g., avoidance of shading, also apply to the camera measurements.