Mediterranean Sea (Morel and André 1991; Bosc et al. 2004).

A buoy has been permanently deployed at the BOUSSOLE site since September 2003 and operates in a quasi-continuous mode, with data acquisition every 15 min night and day. This platform was specifically designed to optimize the measurement of radiometric quantities at two depths in the water column, nominally 4 m and 9 m, and at + 4.5 m above the surface (Antoine et al. 2008*b*), from which apparent optical properties (AOPs) and inherent optical properties (IOPs) are derived. Two sister buoys equipped with the same sets of instruments are swapped about every 6 months. Adequate measures have to be taken to minimize or eliminate bio-fouling, which is unavoidable with moored instruments. All instruments installed on the BOUSSOLE buoy are cleaned by divers every 2 weeks; in addition, copper tape is used on the instrument housings for transmissometers, copper rings on emission and reception windows of transmissometers, and copper faceplates for the backscattering meters. These practical measures have proven efficient in preventing bio-fouling. Possible contamination that would have developed in spite of these procedures is identified by comparison of the data collected before and after the cleaning operations, which allows elimination of possibly corrupted data. The BOUSSOLE site has been visited monthly since July 2001, during which time 0–400-m casts have been performed for acquisition of hydrological (conductivity–temperature–depth, CTD) data, complementary IOPs and AOPs, and water sampling for subsequent phytoplankton pigment analyses (high-performance liquid chromatography, HPLC) and particulate absorption measurements.

The PnB project began in August 1996 and consists of monthly sampling of physical, biological, chemical, and a comprehensive suite of optical measurements at seven stations spanning the Santa Barbara Channel (SBC; Fig. 1B). The SBC is an optically complex coastal site in which optical properties are affected by phytoplankton blooms, sediment plumes, and other episodic events, including mixing of various water masses (Toole and Siegel 2001; Otero and Siegel 2004; Kostadinov et al. 2007). There is a complex mix of cold water of relatively low salinity upwelled off Point Conception and warm, saltier Southern California Bight waters (Harms and Winant 1998). During the spring and early summer, upwelling introduces nutrient-rich water into the SBC, leading to blooms of phytoplankton. Finally, late-winter storms input sediment-laden waters into the SBC, mainly from the Santa Clara and Ventura Rivers (Otero and Siegel 2004). These intermingled influences lead to the pattern shown in Fig. 2B (the two shallow-water stations, Sta. 1 and Sta. 7, being excluded), with a rather seasonally stable mixed-layer depth (20–50 m) and average [Chl] of around 2 mg m^{-3}, with higher chlorophyll levels from April to July and lower values in the fall. Intense blooms are found within the SBC, usually in late spring (Toole and Siegel 2001; Otero and Siegel 2004). However, the timing of the spring blooms varies enough from year to year to smear out the mean annual cycle signal (Fig. 2B).

Table 1. Symbol definitions.

λ	Wavelength	nm
β	Volume scattering function	m^{-1} sr^{-1}
[Chl]	Chlorophyll concentration	mg m^{-3}
$a(\lambda)$	Total absorption coefficient	m^{-1}
$a_p(\lambda)$	Particulate absorption coefficient	m^{-1}
$b_b(\lambda)$	Total backscattering coefficient	m^{-1}
$b_{bp}(\lambda)$	Particulate backscattering coefficient	m^{-1}
$\tilde{b}_{bp}(\lambda)$	Particulate backscattering ratio: $b_{bp}(\lambda):b_p(\lambda)$	Dimensionless
$b_{bw}(\lambda)$	Pure water backscattering coefficient	m^{-1}
$c_p(\lambda)$	Particulate beam attenuation coefficient	m^{-1}
$c_p{}^*(\lambda)$	Chl-specific attenuation coefficient: $c_p(\lambda):\mathrm{Chl}$	m^2 mg^{-1}

Optical backscattering measurements—The volume scattering function at 140°, $\beta(140)$, is measured at BOUSSOLE using HOBIlabs® Hydroscat-2 backscattering meters (Maffione and Dana 1997) installed at the lower measurement depth of the buoy (~ 9 m) and equipped with filters at 442 and 555 nm (Table 2). Starting in October of 2007, HOBIlabs® Hydroscat-4 backscattering meters are used, with bands at 442, 488, 550, and 620 nm. These instruments are factory calibrated before and after each deployment following the method of Maffione and Dana (1997). Dark current measurements, performed on site with a neoprene cap covering the instrument windows, are typically $\sim 1 \times 10^{-5}$ m^{-1} sr^{-1} for λ = 555 nm and 2×10^{-6} m^{-1} sr^{-1} for λ = 442 nm. These numbers represent ~ 5% of $\beta(140)$ at λ = 555 nm and ~ 0.5% at λ = 442 nm. The time series used here is made of measurements from three instruments, starting with one instrument that was used until 09 June 2006 and from 22 February to 21 September 2007, a second one that was used from 10 June 2006 to 21 February 2007, and a third one that has been used since October 2007. Biases between successive deployments were removed to ensure coherency of the time series (only needed for λ = 442 nm), assuming the more reliable measurement is given by the newly calibrated and newly deployed instrument. The instruments operate at 1 Hz, so about 60 measurements are collected during each of the 1-min data collection sequences, conducted every 15 min. The median of these 60 measurements is used to derive a representative value for $\beta(140)$. The median of all these $\beta(140)$ values taken before 07:00 h and after 18:00 h provides the daily values used in this work. Possible diurnal variations are therefore ignored. These median values exclude measurements taken during daylight as a result of their higher noise levels. Although backscattering measurements started in September 2003, these measurements are more systematic after 2005, when the prevention of bio-fouling became more successful. Therefore, only data from 2006 and 2007 are used here.

b_{bp} is derived from $\beta(140)$ as follows (Maffione and Dana 1997; Boss and Pegau 2001):

$$b_{bp} = 2\pi\chi_p(\beta(140) - \beta_w(140)) \quad (4)$$

where χ_p = 1.13 (D. R. Dana and R. A. Maffione unpubl.)