Supplementary Material:

2.2. Apparent optical property measurements: diffuse attenuation coefficients for downwelling irradiance and related variables

The average daily PAR irradiance for the SML was computed in accordance with Babin et al. (1996):

where $\bar{E}$d (PAR $^{-0}$), which represents the daily downwelling PAR irradiance just beneath the air-water interface, was derived from the measurement performed on deck after accounting for the loss of irradiance due to reflection from the water surface (Kirk, 2011; Morel and Maritorena, 2001), Z_{SML} is the depth of the SML determined using temperature differences, and $Z_{1\%}$ is the depth of euphotic layer.

2.3. Inherent optical properties and related variables

The partition of the chlorophyll-specific phytoplankton absorption coefficient in the absorption associated with photosynthetically active pigments [$a^*_{ph\text{-}psp}$ (λ)] and that associated with nonphotosynthetic (photoprotective) pigments [$a^*_{ph\text{-}ppc}$ (λ)] was calculated following the expressions proposed by Babin et al. (1996):

where F_{nps} (λ) represents the part of phytoplankton absorption attributed to photoprotective carotenoids, and a^*_i (λ) and C_i were previously defined in equation 5'. This approach is based on the actual a^*_{ph} spectrum and offers the advantage that the packaging effect is accounted for (Allali et al., 1997).

2.4.2. Pigment-based estimation of phytoplankton size classes

The diagnostic pigment analysis (DPA) was originally proposed by Vidussi et al. (2001), and refined by Uitz et al. (2006). The biomass proportions associated with each size class were computed following Uitz et al., (2006) as:

where DP is the sum of the weighted concentrations of all diagnostic pigments:

Then, the size index (*SI*) proposed by Bricaud et al. (2004) was used to assess the variations of the dominant size class of the phytoplankton communities as follows:

where 1, 5 and 50 μm are taken as a central diameter value of each size class (picophytoplankton, nanophytoplankton and microphytoplankton, respectively), which are weighted by the biomass proportion *F* of the corresponding class.

The numerical coefficients used in the above equations (from V to VIII) were computed by Uitz et al. (2006) using multiple regression analysis from a global ocean data set that encompasses Case 1 waters in different hydrological and trophic conditions. It should be noted that this method provides only approximate proportions, because we made strong assumptions when (i) ascribing a certain pigment to a given size class, and (ii) assigning a fixed mean diameter to each size class to compute *SI*. On occasions a given diagnostic pigment could be shared by different size classes or some taxonomic groups that harbour specific diagnostic pigments may vary in size (see Brewin et al., 2013 and references therein). Moreover, each of the three phytoplanktonic classes actually presents a rather large size range. Despite this, the approach of Uitz et al. (2006) has been used extensively in biological oceanographic research providing reliable results at regional (e.g., Kheireddine et al., 2018; Organelli et al., 2011; Wang et al., 2014) and large-scale assessments (e.g., Bricaud et al., 2004; Uitz et al., 2015). Besides, different works implemented this pigment-based method for the analysis of temporal variation in phytoplankton size fractions (e.g., Gernez et al., 2011; Mayot et al., 2017).

References

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