Seasonal variations in daily cycles of the beam attenuation coefficient

Pierre Gernez, David Antoine and Yannick Huot , ACRI-st, LOV, France
pierre.gernez@obs-vlfr.fr

ABSTRACT

A daily cycle[1] in the particulate beam attenuation coefficient (c_p) appears to be an ubiquitous feature in the world's oceans.

The goal of this study is to investigate the variability of the c_p daily variations under different seasons (Fig 1a).

Superimposed on seasonal variations, a daily c_p cycle is observed at all seasons (example Fig 1b). Its amplitude is about 20% in winter, reaches 80% during the bloom and decreases down to 10% in summer (Fig 2).

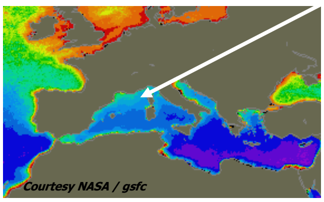
The time series of the daily c_p characteristics allows detailed observation of the bloom sequence. The bloom starts (ends) when the daytime increase (Ic_p) is greater (lower) than the night-time decrease (Dc_p). Moreover, the end of the bloom is anticipated by a parallel decrease in Ic_p and Dc_p.

An optimal irradiance (E_k) is determined from c_p measurements, using the specific particle production rate (r_0) versus the photosynthetically available irradiance (PAR) curve (Fig 3a).
E_k shows seasonal variability (Fig 3b).

DATA & METHODS

In the North Western Mediterranean Sea, at an oceanic site, the BOUSSOLE mooring allows continuous recording of the surface optical properties since September 2003 [2,3].

http://www.obs-vlfr.fr/Boussole/html/home/home.php

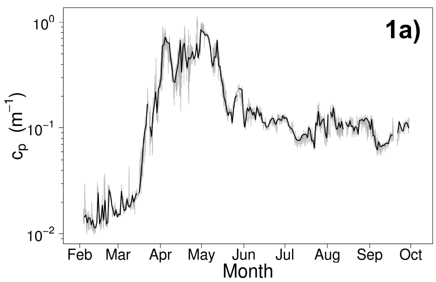


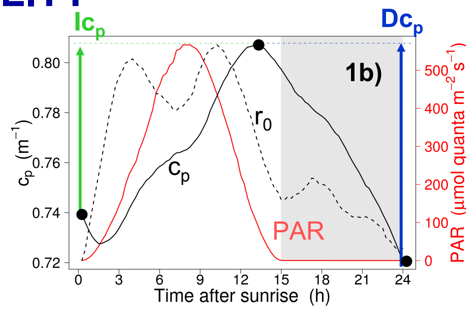
c_p is measured every 15 min at 660 nm. The specific particle production rate is defined by:

$$r_0 = 1/c_p \, dc_p / dt$$

Downward irradiance is measured at seven wavelengths. An approximate value of PAR is computed by discrete integration between 400 and 700 nm.

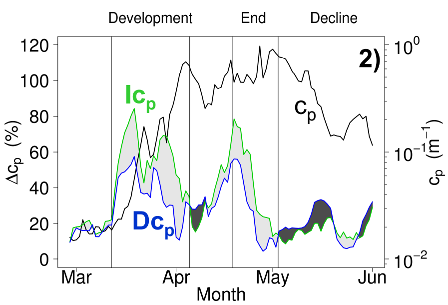
1.SCALES OF VARIABILITY





c_p presents a seasonal cycle in 2006 (Fig 1a). A daily cycle is generally observed. On this example, the 4th of May 2006 (Fig 1b), c_p increased by 10% between sunrise and sunset. The daytime variation of r_0 is maximum before noon and decreases in the afternoon. A similar shape has been observed for daytime variation in photosynthetic production [4].

2. BLOOM SEQUENCE



$Nc_p = Ic_p - Dc_p$ is filled in light grey when > 0 and in dark grey when < 0.

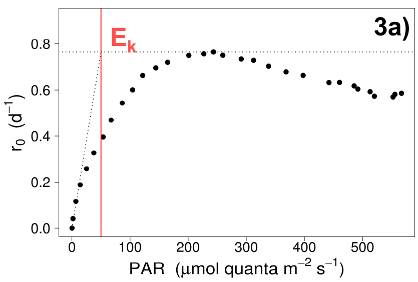
Bloom development:

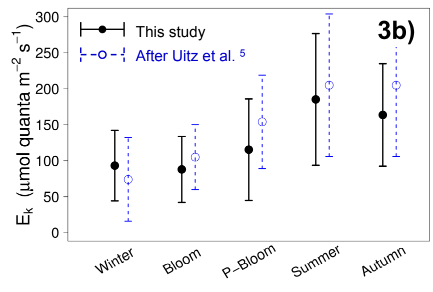
$Nc_p > 0$ and Ic_p and Dc_p are not correlated.

Bloom decline:

$Nc_p < 0$. The decline is anticipated by a parallel decrease in Ic_p and Dc_p.

3. SEASONAL VARIATION OF C_P DERIVED OPTIMAL IRRADIANCE





r_0 is plotted against PAR between sunrise and noon (Fig 3a), for the same example as in Fig 1b. The shape is similar to that of a photosynthesis versus irradiance curve. It is then possible to determine an optimal irradiance (E_k). When determined at different days of the year, E_k shows a seasonal variation (Fig 3b). It is consistent with global results computed in the surface layer [5].

ACKNOWLEDGEMENTS

This work uses data collected in the frame of the BOUSSOLE project, which is supported by the following agencies and institutions:

REFERENCES

1. Siegel et al. (1989), *Deep Sea Res.*, 36 (2), 211-222
2. Antoine et al. (2006), *NASA Tech. Memo.* 2006 - 214147
3. Antoine et al. (2007), *J. Atmos. Ocean. Technol.*, 25 (6), 968-989
4. Bruyant et al. (2005), *Limnol. Oceanogr.*, 50 (3), 850-863
5. Uitz et al. (2008), *Limnol. Oceanogr.*, 53 (2), 614-630