# PHYTOPLANKTON BLOOMING IN THE MEDITERRANEAN SEA AS SEEN BY SEAWIFS (1998-2003)

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**Abstract**
Assessments of SeaWiFS-derived (1998-2003) chlorophyll-like pigment concentration (Chl) were used to survey phytoplankton growth patterns in the Mediterranean Sea. The Chl average basin value, computed from yearly and monthly mean images, shows a decreasing trend, modulated by bimodal seasonal patterns, with maxima in late winter and minima in late summer. Chl anomalies, computed as the normalized difference between yearly/monthly means and corresponding climatology, become smaller with time over most of the basin. Both these elements point to a decrease of blooming intensity in the period considered, suggesting a more stable stratification and a reduced nutrient input by vertical mixing in the basin, in line with its reported warming trend. Larger and larger anomalies appear in hot spots along the Catalan and the Egyptian-Israeli-Lebanese coast, possibly owing to local factors such increased runoff.
*Keywords : Remote Sensing, Ocean Colours, Pigments, Phytoplankton, Blooms.*

Systematic ocean colour observations allow the monitoring of algal blooming at basin scales and over seasonal to multi-annual periods. Assessments of SeaWiFS-derived (1998-2003) chlorophyll-like pigment concentration (Chl) were used to survey phytoplankton growth patterns in the Mediterranean Sea. The image data were processed to correct for atmospheric contamination and to compute Chl values. After re-mapping to a common geographical grid, Chl yearly and monthly means (as well as climatological means) were derived by averaging individual images for the 6 years. Chl anomalies were obtained subtracting from each yearly/monthly mean image the corresponding climatological image.

The Chl climatological yearly mean is shown in Fig. 1. The Chl average basin value (Chl/abv), derived from the 6 yearly means composing this picture (Fig.2a), shows a decreasing trend over the period of SeaWiFS coverage, on the order of 20% of the climatological value (0.2 mg/m3). The Chl/abv, derived from the sequence of 72 monthly means (Fig. 2c), shows a bimodal seasonal pattern, with maxima from late winter to early spring, followed by minima from late summer to early fall. A liner fit to this curve displays a decreasing trend similar to that of the yearly case. The climatological seasonal pattern, obtained computing the sequence of 12 Chl/abv derived from the climatological monthly means (Fig. 2c), suggests that the Mediterranean Sea has a behavior similar to that of a sub-tropical basin - where the light level is never a limiting factor (so that its decrease in winter does not inhibit algal growth), but the nutrient level always is (so that vertical mixing, regulated by stratification of the water column, becomes the bloom trigger). Some regions have a different seasonality, due to particular boundary conditions (namely the north-western sub-basin, due to the deep convection driven by extreme wind forcing), which affects basin statistics, when the integrated Chl/abv values are used to describe the behavior of the basin as a whole.

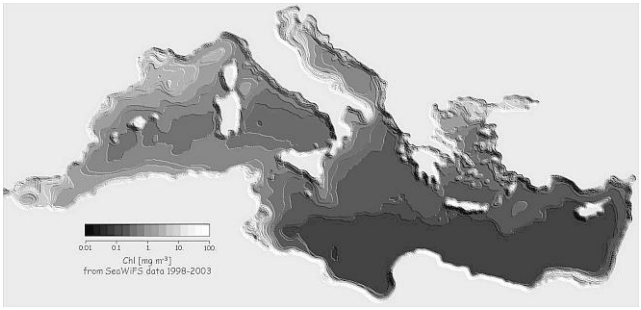


Fig. 1. Climatological yearly mean of the SeaWiFS-derived (1998-2003) chlorophyll-like pigment concentration (Chl) in the Mediterranean Sea.

The Chl anomalies trend was analyzed by means of a pixel-by-pixel linear fit to the (monthly) images. Negative slopes, with positive intercepts, prevail almost everywhere, suggesting that, between 1998 and 2003, anomalies have been getting smaller and smaller over most of the basin interior. This implies a general decrease of the blooming intensity, in good agreement with the decreasing trend of Chl/abv seen in the yearly and monthly means. Both these elements point to a more stable stratification of the basin and a reduced nutrient input by vertical mixing, in line with the general warming trend of the Mediterranean Sea, appearing in the sea surface temperature record of the last three decades [1]. The residual positive slopes, with negative intercepts, suggest that anomalies have been getting larger and larger in selected hot spots, such as open water gyres and, mostly, recurring coastal plumes.

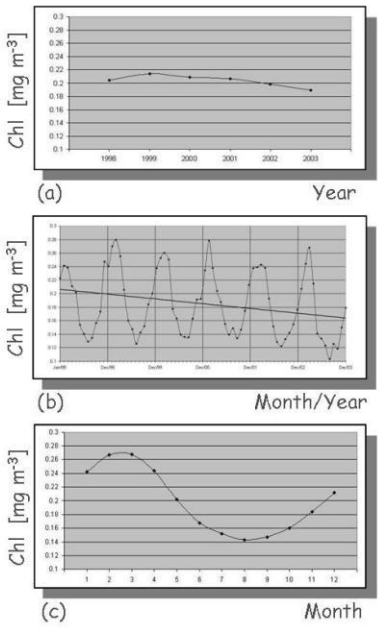


Fig. 2. Inter-annual (a), seasonal (b) and climatological (c) trend of the SeaWiFS-derived (1998-2003) chlorophyll-like pigment concentration (Chl), average basin value, in the Mediterranean Sea.

The major hot spots occur along the Catalan coast and the Egyptian-Israeli-Lebanese coast, and present a number of similarities: patterns of high Chl, rooted at particular coastal sites; likely large nutrient sources of continental origin; strong current systems, inducing the offshore spreading of plumes. The positive trend of Chl anomalies, appearing in both these areas between 1998 and 2003, tallies with a growing biological dynamism at these sites, i.e. with the intensification of harmful algal blooms, in the north-west, and the increase of coastal fisheries, in the south-east, recently reported in the literature [2,3].

## References

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