

Variability in winter surface chlorophyll distributions, Saronikos gulf.

by

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Abstract

Within such an oligotrophic sea as the Aegean, chlorophyll values over $1/4 \text{ mg/m}^3$ can be taken as evidence of enrichment. The eutrophic field generated by the Athens outfall extends over a large portion of the Saronikos Gulf. Fluctuations in illumination and the type of circulation seem to cause uneven distribution in the surface chlorophyll values found, which are discussed in the context of several sets of winter observations.

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Surface chlorophyll distributions generally provide a helpful index to the photosynthetic activity in the underlying water. In cases where the coverage must be synoptic or the means are limited, the simplicity and speed of chlorophyll measurement make it a feasible alternative to other more cumbersome methods of estimating photosynthesis. For these reasons chlorophyll was measured as a part of an observational program (Saronikos Systems Project) to define the effect of the Athens sewage outfall on the Saronikos Gulf.

The observations that follow were taken during the 1973 and 1974 winter seasons within the Saronikos Gulf environ. The surface water samples were glass fiber filtered, their pigments extracted with acetone, and their chlorophyll *a* content determined with a calibrated fluorometer (SSP *Data Report 8* or WOLFF v. GUDENBERG, 1972).

In January 1973 the chlorophyll displayed a broad tongue-like distribution extending to the south (Fig. 1); although the area inside the 0.25 mg/m^3 contour is large, the maximum of 0.64 mg/m^3 is fairly low and well away from the outfall. Reference to Table 1 shows a low variable radiation but strong steady winds during the period. A circulation that moves surface water south from the outfall and to the north-west along the Attikis peninsula, as suggested by COACHMAN *et al.* [1973], is also indicated here.

During November 1973, samples were taken of surface water pumped continuously while traversing the outfall area (Fig. 2). The sample spacing is close enough to resolve the typical patchiness. The immediate outfall area shows low values and slight gradients. The patch of lowest values to the south is probably source oligotrophic water advected or upwelled into the region. The higher values due west of the outfall indicate the beginning of a phytoplankton plume. This distribution could result from a large proportion of source oligotrophic water available off Piraeus and a slow circulation moving it north for mixture with the sewage effluent and then west and south-west along Salamis island.

The December case provides an interesting comparison to that of January 1973; the radiation was also low but even, and the circulation also strong but unsteady. The resulting chlorophylls have quite a different distribution (Fig. 3), although in the Inner Gulf of the mean and standard deviation correspond nicely, especially when the slightly increased radiation of December is considered. In the Outer Gulf

the low chlorophyll water intrudes on the western side leaving a region of relatively high values to the east, demonstrating, if nothing else, the increased range of the eutrophication.

The relatively calm conditions during the February 1974 sampling period produced a distribution with most of the chlorophyll confined to the northern half of the inner Gulf (Fig. 4). Particularly noticeable are the low values on the eastern half of the Outer Gulf, indicating oligotrophic source water entering from the south-east and eutrophic water exiting south along the eastern shore of Aegina, in agreement with the situation of January 1973 but in contrast to that of December 1973.

Table 1 also includes chlorophyll values for the Elefsis Bay and Psitalia Area separately. Both of these regions are sufficiently separate not to be compared with the Inner Gulf, and thus would bias a data summary if included. The Psitalia area is sometimes similar (SSP2) and sometimes dissimilar (SSP9) to the Inner Gulf, dependent on how actively it is flushed. Elefsis Bay is uncoupled to the extent that its chemistry and biology always deviate from the Saronikos proper. Planktonic production of chlorophyll is not restricted by nutrient deprivation in the Bay where nutrients accumulate to high values. Allowing for differences in plankton population, the Elefsis chlorophyll values indicate a maximum eutrophic response for the area in general.

Table 1.

Cruise	Sample Period ¹	Radiation ²	WIND ³		Chlorophyll ⁴					
			Speed	Direction	Inner Gulf	Psitalia Area	Elefsis Bay			
SSP2	22-26 Jan 73	131 ± 66 %	5.0	W	0.41 ± 43 %	0.60 ± 11 %	1.61 ± 24 %			
			6.0	NE						
			9.0	NE						
			11.0	NE						
			5.0	NE						
SSP7A	13-14 Nov 73	212 ± 35 %	4.2	S	0.60 ± 42 %					
			3.0	WNW						
SSP8	16-19 Dec 73	172 ± 31 %	12.5	NNW	0.59 ± 47 %	0.39 ± 31 %	1.26 ± 59 %			
			5.8	WNW						
			3.0	NW						
			2.3	NW						
SSP9	16-18 Feb 74	247 ± 46 %	4.6	SE	1.14 ± 67 %	1.99 ± 26 %	3.72 ± 42 %			
			2.2	WNW				(.60 ± 41 %) ⁵	(.82 ± 12 %)	(.64 ± 17 %)
			3.5	WNW						

Notes :

¹Includes the day before sampling began.

²g cal/cm²/day ± standard deviation in %

³Prevailing winds during each day of the period

⁴mg chl/m³ ± standard deviation in %

⁵gmC/m²/day ± standard deviation in %

References

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