Northastern Mediterranean time series study: Seasonal and interannual variations in nutrients and chlorophyll-a

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Abstract- A time series sampling program in connection with the Project entitled as "Atmosphere-ocean-land interactions in the coastal system of the Cilician Basin: Resources, transport, ecological cycles and long-term changes" supported by the Turkish Scientific and Technical Research Council has been initiated by the Institute of Marine Sciences/Middle East Technical University (IMS/METU) in April 1997. Sampling is conducted mainly on a weekly basis at two permanent stations (Shallow Station 1: 34°16'E, 36°33'50''N, 20m; Deep Station 2: 34°22'E, 36°30'N, 120m) across the Turkish continental shelf in the Northeastern Mediterranean Sea. Basic oceanographic parameters, such as temperature, salinity, density, nutrients (PO_4-P, NO_3+NO_2-N, Si) and chlorophyll-a were monitored. Five years of observations at this site, offer a unique opportunity to investigate the seasonal and interannual variability of mixing, nutritional status and primary standing stocks in the Northeastern Mediterranean

Keywords- Nutrients, chlorophyll-a, time series, NE Mediterranean

Introduction

The Mediterranean basin is divided into two major sub-basins by the shallow sill of the Strait of Sicily. The eastern basin can also be partitioned into two major regions, the western Ionian Basin and the eastern Levantine basin. Our study is concentrated in the northern Levantine basin (Cilician Basin) that is one of the well known region of low productivity over the world due to limited nutrient supply to its surface waters both from its lower layers and from external sources (the Atlantic inflow, riverine discharges and atmospheric input) [Yılmaz and Tuğrul, 1998; Herut et al., 1999; Krom et al., 1999].

Materials and Methods

Data were collected during the number of cruises (1997-2002) in the Northeastern Mediterranean. Water samples for chemical measurements were collected with 5L Niskin bottles on a Rosette attached to the Sea-Bird CTD probe down to 0, 15 m in the shallow station and 0, 25, 50, 75 and 100 m in the deep station, respectively (Fig 1). Chl samples, homogenized and extracted into 90% acetone solution, were measured by the standard fluorometric method, using a Hitachi F-3000 Model fluorometer and a commercially available chl standard (Sigma) [Holm-Hansen and Riemann, 1978]. Seawater samples for NO_3+NO_2 and

PO_4 were put into 50 mL HDPE bottles and kept frozen until analysis by a Technicon Model multi-channel auto analyser using the methods of Grasshoff et al., (1983).

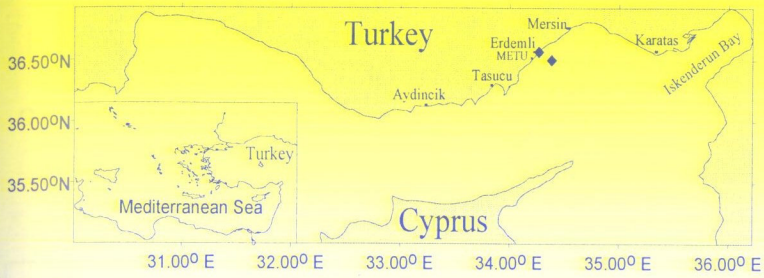

Fig 1. Map of the northeastern Mediterranean sea and the location of the two sampling area.

Results and Discussion

Basin-wide long term studies conducted between 1997 and 2002 have shown that the critical role of convective mixing and advection of deep water in winter on the spatial and seasonal variations of the nutrients in the upper layer of NE Mediterranean. Though the seasonal variability was more significant at the deep station, blooming periods coincided generally with March-April (as spring bloom) and with October-November (as autumn bloom) for both stations. One month shifts for the pre- and post-bloom periods were common. Maximum chlorophyll-a concentration reached up to 0.9 μgL^{-1} at the upper surface layer (for the top 25m) for the deep station (Figs. 2 and 3) and up to 1.5 μgL^{-1} (very rarely up to 2 μgL^{-1}) for shallow station. In general, average chlorophyll-a concentration was determined as 0.5 μgL^{-1} for bloom periods and <0.2 μgL^{-1} for non-bloom periods. No seasonal trend was observed for relatively deep layers (e.g. 50-100m), where the deep chlorophyll-a maxima (up to 0.5-1 μgL^{-1}) was observed at around 50 m and the concentration decreased to 0.2-0.3 μgL^{-1} below 75m (Fig.3). As was clearly observed in Fig. 4, a well defined deep chlorophyll maximum (DCM) is a prominent feature of the Mediterranean Sea during a large part of the year [Yılmaz and Ediger, 1996, Ediger et al., 1999].

Chlorophyll-a and nutrient concentrations were relatively high for 1997 and 1998 with respect to 1999, 2000 and 2001. Seasonal variability was not significant for all nutrients and the concentrations ranged between 0.02 and 0.3 (0.4) µM for PO_4-P, 0.02 and 2.26 (4.9) µM for NO_3+NO_2-N, 0.2 and 2.9 (4.37) µM for Si. The ranges are given for the deep station (Figs. 5 and 6) where the ones in parenthesis represent the maximum values measured at shallow station.

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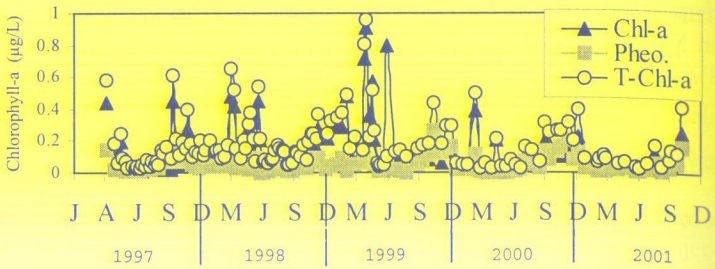

Fig 2. Distribution of chl-a at 2 m at deep station (St 2).

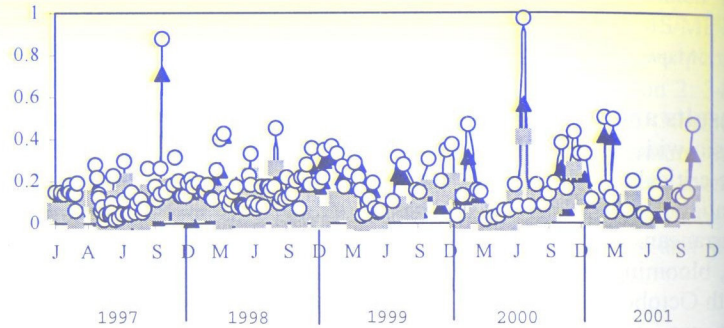

Fig 3. Distribution of chl-a at 50-100 m at deep station (St 2).

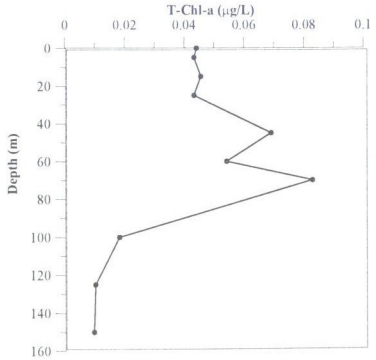

Fig 4. Recent T-Chl-a profile in agreement with deep chlorophyll maximum (St 2, July 2002, (Ediger E., *unpublished data*)).

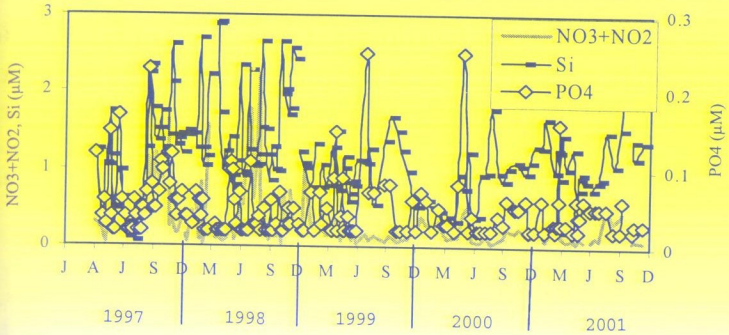

Fig 5. Distribution of nutrients at 2 m in St 2

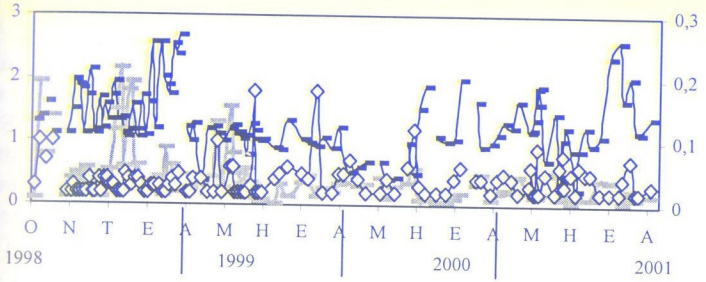

Fig 6. Distribution of nutrients at 100 m in St 2

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