SEASONAL DYNAMICS OF PARTICULATE MATTER IN THE NE MEDITERRANEAN SEA: ANALYSIS OF A HISTORICAL (1991-2001) DATA SET OF LIGHT TRANSMISSION MEASUREMENTS

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Abstract

Light transmission measurements in the NE Mediterranean, during the period 1991-2001 are homogenized and interpreted. The period of high precipitation and river freshwater discharge (winter-spring) is characterized by high beam cp values in the Northern Aegean Sea and coastal areas of Greece at the surface (0-50 m) waters. The Rhodes cyclonic gyre is related to relatively higher beam cp due to an increase in productivity. Summer-autumn conditions exhibit more relaxed features and generally less turbid waters. Beam cp is markedly correlated with particulate matter concentration and particulate organic carbon, enabling the definition of empirical equations to be used in future projects, budget estimates and modeling.

Keywords : light transmission, particulate matter concentration, particulate organic carbon, NE Mediterranean Sea

Introduction

Light attenuation is an important parameter providing information on the quantity and dispersal patterns of particulate matter (PM) throughout the water column. PM dynamics studies have attracted the scientific community's interest in large multidisciplinary projects, i.e. the JGOFS North Atlantic Bloom Experiment [1, 2]. However, within the NE Mediterranean Sea, similar investigations have focused only in specific geographical regions, i.e. the NW Aegean Sea [3], and the NE Aegean Sea [4]. A major objective of the present communication is to study, for the first time, particulate matter dynamics over the entire NE Mediterranean Sea. For this purpose, the historical data set of light transmission measurements, obtained by the Hellenic Centre for Marine Research (HCMR) during 1991-2001, was analyzed and interpreted.

Methods

The initial data set comprised light transmission measurements conducted in parallel with routine CTD casts in 3136 stations (Fig. 1). Data have been obtained from 40 cruises of 14 research projects on board the *R/V Aegaeo*. Metadata, light transmission readings, and beam c_p (attenuation due to particles, m^{-1}) were stored in the 'Ocean Data View' format [5] for archiving and visualization.

Particulate matter concentration (PMC, 1689 samples) and particulate organic carbon (POC, 638 samples) data obtained over the period 1997-2001 were utilized to calibrate optical measurements against those parameters.

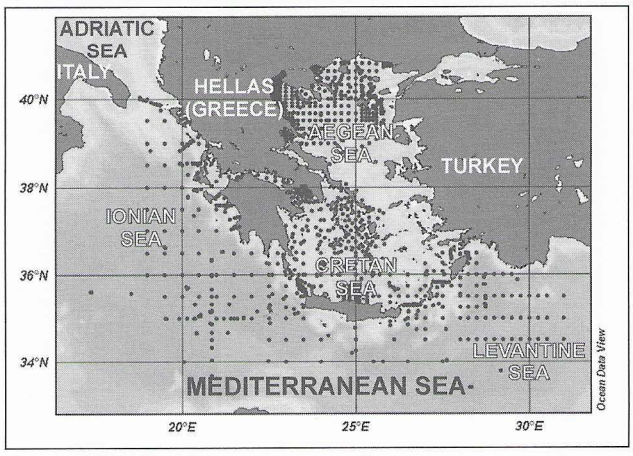

Fig. 1. Light transmission stations obtained during 1991-2001 by HCMR in the NE Mediterranean.

Results and discussion

Transmissometry

A preliminary assessment of beam c_p distribution in the NE Mediterranean Sea shows the following:

1. The surface nepheloid layer (at 5-m depth, SNL) exhibits the highest signal in c_p during the winter-spring (wet) period. The continental shelf of the Northern Aegean Sea appears to be the most turbid water area. This feature is attributed to the particulates introduced from a number of rivers (Axios, Aliakmon, Pineios, Strymon, Nestos, and Evros), which discharge into the area.

2. Relatively high c_p values appear in other coastal areas, such as the gulfs of Patras, Corinth, Kyparissiakos, and Saronikos.

3. Low c_p values generally characterize the deep sector of the N. Aegean Sea, the central Aegean Sea, the Cretan Sea and the Ionian Sea, indicating minimal terrigenous supply and oligotrophic conditions.

4. The Rhodes gyre (cyclone) is an area of elevated beam c_p signal, attributed to increased productivity due to the presence of nutrient-rich upwelling waters [6].

5. The aforementioned features can be observed at 20 m and 50 m depths. From 100 m depth up to 500 m depth beam c_p distribution is more homogeneous all over the NE Mediterranean Sea and reaches minimum values.

6. The dry period (summer-autumn) of low precipitation and low river discharge is characterized by more relaxed c_p signal. Relatively high beam c_p values appear only at the surface waters of the Northern Aegean Sea, whilst deeper waters maintain decreased c_p values.

Beam c_p vs. PMC and POC

Linear regression between c_p and PMC revealed a marked correlation (r=0.829, n=1689). Likewise, c_p was strongly correlated to POC (r=0.819, n=638). The overall positive and marked correlation of the aforementioned parameters may enable the definition of empirical functions relating optical measurements to PMC and POC. This could be useful for the estimate of PM and POC budgets and/or their use in models.

Conclusions

The analysis of historical light transmission measurements from the NE Mediterranean Sea was successful. Overall, we were able to differentiate distribution patterns between wet and dry seasons, in order to estimate the seasonal variability of PM in the NE Mediterranean. Elevated and/or relaxed features of beam c_p were identified and directly related to physical processes affecting PM distribution in the water column.

The correlation of optical measurements vs. PMC and POC is noticeable and may result to the definition of global (for the NE Mediterranean) equations, to be used in future research projects, estimations of budgets and in modeling exercises.

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