MONITORING AND MODELING EFFORTS FOR NUTRIENT CYCLING AND FLUSHING DETERMINATION IN A COASTAL LAGOON

P.K. Leontarakis [1] *, D.A. Markou [2], N. Kamidis [2], G.K. Sylaios [2], V.A. Tsihrintzis [3], D. Koutsoubas [1]

[1] Department of Marine Science, Faculty of Environment, University of the Aegean, University Hill, 811 00 Mytilene, Lesvos, Greece - pleon75@altecnet.gr

[2] National Agricultural Research Foundation, Fisheries Research Institute, 64007 Nea Peramos, Kavala, Greece

[3] Laboratory of Ecological Engineering and Technology, Department of Environmental Engineering, School of Engineering, Democritus University of Thrace, 67100 Xanthi, Greece

Abstract

Physicochemical parameters and nutrient concentrations were measured during 13 monthly samplings in the water and 4 seasonal samplings in the sediment at Eratino Lagoon, northern Greece. Salinity data were utilized for freshwater content and discharge determination. Lagoon-open sea interactions were assessed through direct monitoring and budget calculations. An integrated lagoon biogeochemical model was developed to describe nutrient cycling and transformation.

Keywords : Lagoons, Sediments, Phosphorus.

Introduction

Eratino is a shallow (mean depth: 0.5 m) coastal lagoon located in northern Greece with a surface area of about 3.5 km^2. It is part of a coastal lagoon system, with a total area of 1,700 ha, located at the western part of Nestos River Delta. The lagoon is supplied with freshwater by a small stream (2 km long), draining agricultural land, and communicates with the nearby Kavala Gulf by a tidal channel. Tidal elevation at the lagoon's mouth ranges between 0.14 and 0.39 m [1, 2]. The present study provides a preliminary approach aiming towards the estimation of nutrients influx, the determination of flushing and exchange with the adjacent sea, and the understanding of nutrients cycling inside the lagoon.

Materials and methods

Overall 13 sampling cruises were conducted between August 2005 and August 2006. Water temperature, salinity, pH and dissolved oxygen content were measured in situ at 10 stations inside the lagoon, using portable instrumentation. Nutrients (N-NO_2, N-NO_3, N-NH_4, P-PO_4, Si-SiO_2), chlorophyll-a and total suspended solids were determined at each site [3, 4]. Sediment samples were collected seasonally using a box-corer sampler at 5 stations, to determine nitrates, total Kjeldahl nitrogen (TKN) and total phosphorus content (TP) [3]. Salinity data were used for the freshwater content and discharge estimation [5], while flushing and exchange dynamics were considered from previous monitoring efforts [1]. A lagoon biogeochemical box model was developed [6], and the present dataset were imported for preliminary runs. The model simulates the temporal variability of nutrients (nitrates, ammonium, phosphates, silicates), phytoplankton, zooplankton, detritus (nitrogen, phosphorus and silica), dissolved oxygen and benthic nutrients (nitrogen, phosphorus and silica).

Tab. 1. Mean values of water and sediment quality parameters with temporal standard deviation in parentheses.

	Parameters	Station group		
		tidal	lagoon	fresh
Water column	T (°C)	18.2 (8.2)	18.6 (8.6)	19.3 (8.0)
	S	22.5 (6.7)	18.3 (5.6)	15.5 (6.9)
	DO	7.7 (1.4)	8.6 (2.4)	8.9 (2.0)
	pH	8.38 (0.25)	8.41 (0.23)	8.19 (0.23)
	NO2 (μg-at l^{-1})	0.43 (0.49)	0.61 (0.78)	1.43 (1.28)
	NO3 (μg-at l^{-1})	5.9 (10.1)	7.0 (9.3)	23.6 (25.6)
	NH4 (μg-at l^{-1})	4.2 (2.8)	3.6 (2.9)	10.5 (11.4)
	PO4 (μg-at l^{-1})	4.7 (2.3)	5.3 (2.6)	8.4 (3.0)
	Si-SiO2 (μg-at l^{-1})	62.9 (25.2)	84.0 (35.9)	112.8 (30.4)
	Chl-a (μg l^{-1})	15.7 (14.3)	20.8 (16.0)	43.3 (57.5)
	TSS (mg l^{-1})	24.9 (16.1)	24.6 (18.1)	21.5 (14.0)
Sediment	NO3 (μg g^{-1} d.w.)	14.8 (1.9)	16.0 (2.9)	15.6 (1.5)
	TKN (mg g^{-1} d.w.)	0.64 (0.15)	1.07 (0.33)	1.23 (0.70)
	TP (μg g^{-1} d.w.)	91.8 (52.3)	39.9 (10.1)	73.6 (11.6)

Results and discussion

Sampling sites were classified in three groups (tidal, lagoon, freshwater) according to the factors driving their water quality. The temporal variability of the in situ measurements in the water column, as well as the results from the chemical analyses of the water and sediment samples is presented in Table 1. Salinity depicts inversely proportional relations with nutrient concentrations along the main lagoon axis, although the spatial and temporal variability of sediment nutrient concentrations do not follow a similar pattern. Preliminary model runs evaluate the rates of phytoplankton grazing and mortality, heterotrophs excretion, detritus mineralization and nutrients uptake, along with benthic mineralization, absorption and denitrification.

References

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