THE IMPACT OF DIFFERENT APPROACHES IN ESTIMATING HORIZONTAL GEO-CHEMICAL FLUXES: AN EXAMPLE STUDY OF A NORTH ADRIATIC TRANSECT

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Abstract

During the Adria02 cruise (September-October 2002), physical and bio-geo-chemical data were acquired along the Senigallia-Süsak Island line, where 7 ADCP and 3 current-meters were deployed. Through numerical model simulations higher resolution water current data are also available. Estimates were obtained of transported material fluxes entering and leaving the Northern Adriatic Sea using different methods, thus contrasting calculations made with geostrophic assumptions, hydrodynamic model simulations, and direct current measurements.

Keywords: horizontal fluxes, North Adriatic Sea.

Since the Nilo River damming at Assuan in 1970, the North Adriatic Sea receives the highest river runoff of the Mediterranean Sea, most of it coming from the Po River (Fig. 1). The shallowness of this sub-basin (average depth less than 35 m) makes its physical and ecological environment highly sensible to variations in river runoff and atmospheric conditions. River runoff affects the circulation through buoyancy input, which is one of the major driving forces of the Western Adriatic Coastal Current (WAC or WACC), and impacts the ecosystem by introducing large amounts of organic matter, nutrient salts and sediments. Some studies have attempted to quantify the exchange rates of water and transported materials between the northernmost part of the Adriatic Sea and the remainder of the basin. The first study (1) used chemical data, measured roughly biweekly in the north Adriatic at one station located in the western area and one station located in the eastern area, combining them with a water exchange rate of 10^5 m^3 s^{-1} derived by previous geostrophic calculations. A second study (2), conducted in the same area (roughly indicated by the dotted line in Fig. 1) but with different methodologies (more stations but only 4 samplings during 1995/96, with direct current measurements), quantified the outflow fluxes in summer 1995 and winter 1995/96 (only the summer values are reported in Tab. 1 as this period is more closely related to our study period). The average nutrient flux estimate for summer 2001 reported in Tab. 1 is derived by monthly estimates made in a third work (3). Physical and chemical data were collected along the Senigallia-Süsak Island transect (southeastward of the two previous studies); geostrophic velocities were computed and combined with measured nutrient salts data to obtain fluxes.

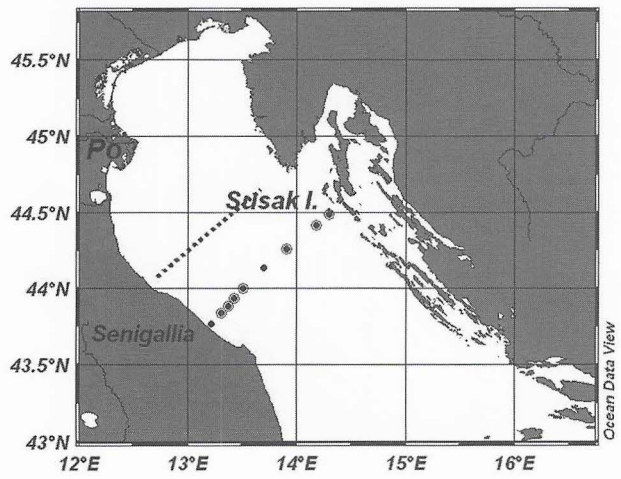

Fig. 1. North Adriatic Sea map with area of previous flux estimations (dotted line) and positions of ADCP (circled dots) and current-meter moorings (dots) along the Senigallia- Süsak Island transect.

Table 1. Flux estimates according to previous authors (2. reported DIN instead of NO_3+NO_2) and the present work.

	Degobbis Gilmartin yearly	Gacic et al. Summer 1995	Paschini et al. Summer 2001	Geostr. 28 Sep 02	Model 28 Sep 02	ADCP 28 Sep 02
Net flux						
TSM (g s^{-1})				35562	111487	313215
PO_4 (mol s^{-1})	3.90		0.82	1.13	1.70	8.63
$Si(OH)_4$ (mol s^{-1})	135.08		32.02	59.11	291.67	786.96
NO_3+NO_2(mol s^{-1})	74.52		17.02	57.56	114.41	215.77
SEward flux						
TSM (g s^{-1})		19543		151337	250243	393057
PO_4 (mol s^{-1})	6.18	0.82	2.67	4.88	9.73	14.51
$Si(OH)_4$ (mol s^{-1})	321.85	30.67	86.03	357.30	672.39	1037.58
NO_3+NO_2(mol s^{-1})	127.79	19.16	38.97	167.16	330.54	380.97

From 19 September to 8 October 2002 the international cruise Adria02 was carried out in the Adriatic Sea onboard the R/V Alliance. The simultaneous availability along the Senigallia transect of high resolution CTD casts, bio-geo-chemical sampling stations, hydrodynamic model simulations, ship-tethered ADCP surveys, and 7 bottom mounted ADCP plus 3 traditional moored current-meters at 2 sites, made possible the computation of fluxes across the transect using different methods. On 28 September all the data sets had an optimal coverage along the transect, so computations were made at this specific date; geostrophic velocities, daily averaged current data and model velocities were combined with bio-geo-chemical parameters to obtain fluxes (Tab. 1).

Fluxes based on geostrophic velocities are in good agreement with previous published fluxes, while fluxes computed using direct measurements and model velocities are in some cases several times larger. For these computations, the area northeastward of Süsak was excluded; this fact can significantly affect the net fluxes, while it can be considered negligible for the southeastward fluxes.

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