CARBON BUDGET AND BACTERIA GROWTH EFFICIENCY IN THE ADRIATIC SEA: A THEORETICAL MODELLING STUDY

L. Polimene [1] *, E. Fiori [1], M. Zavatarelli [1], A. Pugnetti [2], N. Pinardi [1]

[1] Università di Bologna Centro Interdipartimentale per la Ricerca sulle Scienze Ambientali Via S. Alberto 16348100 Ravenna Italy. - l.polimene@sincem.unibo.it

[2] C.N.R Istituto di Scienze Marine, Castello 1364,I-30122 Venezia Italy

Abstract

On the basis of numerical simulations carried out with a three dimensional ecosystem model, a carbon budget for the Adriatic Sea was estimated and a theoretical scenarios of carbon exchanges between four Adriatic sub-basins is offered. Bacteria Growth Efficiency (BGE) was also estimated in six different stations sub-sampled from model domain in order to highlight the trophic variability of the basin.

Keywords : Adriatic Sea, Models, Carbon.

A three dimensional biogeochemical-hydrodynamic coupled ecosystem model was used to study the carbon fluxes and the Bacterial Growth Efficiency (BGE) variability in the Adriatic Sea.

The model domain encompasses the whole Adriatic basin and extends south of the Otranto channel into the northern Ionian Sea, where the only open boundary is located.

The model has been validated in a previous work for the major biogeochemical bulk properties [1]. Here we further validate simulations against observed primary production profiles.

The ratio between gross primary production and community respiration (GPP/R) and the sedimentation fluxes were estimated for the whole Adriatic Sea and in different Adriatic sub-basins. The BGE was estimated in 6stations sub-sampled from the model domain. The subdivision in sub-basin was made following [2] who divided the Adriatic in 4 main sub basin: the shallow North, the deep North, the central and southern basin; shallow and deep north were separated on the basis of the 40-m isobath The stations were chosen in order to follow the chlorophyll gradient on the basis of the SeaWiFS chl-images.

The Adriatic simulated yearly GPP/Rvalue is less than 1 implying that the Adriatic could be considered as a source of $CO_2$for the atmosphere. On the other hand the GPP/R value presents an high variability when calculated in the different sub-basins. Only the shallower northern basin has a GPP/R>1 while deep north basin is at equilibrium and the central and the southern ones present an excess of respiration. Starting from the mass conservation, considering a southward net transport and the sedimentation fluxes in each sub-basin, we found that the surplus of carbon produced in the shallow north would be theoretically sufficient to explain the GPP/R value in the central basin and to match all the sedimentation fluxes but is not sufficient to explain a GPP/R value less than 1 in the southern basin. This implies that allochthonous organic carbon is respired in this sub-basin. We supposed that the ingression of Dissolved Organic Carbon (DOC), mainly associated to the Levantine Waters ingression trough the Otranto Strait, increasing the bacterial respiration, could be responsible of the GPP/R value in the southern sub-basin. This Idea is supported by the fact that the simulated value of the bacterial respiration to community respiration ratio increases from the north to the south where reaches the value of 0.75 mining that bacteria are the principal contributor to the community respiration in that zone.

The model consider the open boundary as a DOC input/output on the basis of the value of the velocity normal to open boundary prescribed from the hydrodynamic model. When this velocity is >0then a fixed DOC concentration (dependent on the depth) is transported in side the model domain; when the velocity on the boundary is <0 the DOC amount simulated on the boundary is transported outside the model domain. On the basis of model simulation the yearly DOC flux at the open boundary is positive implying that the Otranto strait is a source of DOC for the Adriatic Sea.

Sensitivity experiment carried out by taking off the ingression of DOC at the open boundary showed a value of GPP/R equal to 1 for the south basin while left unaltered the GPP/R in the others sub-basins.

The simulated values of BGE range from 0.4 to 0.05 that are value characteristic of eutrophic and oligotrophic environment respectively. High BGE values are simulated in the stations located in the northern area were in high GPP/R value and high sedimentation fluxes were also simulated.

The high variability of GPP/R value and BGE implies the presence of different trophic regimes from the herbivorous chain, in the coastal northern zone, to the so called "microbial loop", in the central and southern basin.

References

1 - Polimene L., Pinardi N., Zavatarelli M., and Colella S., 2006. The Adriatic Sea Ecosystem Seasonal Cycle: validation of a three dimensional ecosystem model , *J. Geophys.Res. (In Press)*

2 - Zavatarelli M., Raicich F., Artegiani A., Bregant D., and Russo A., 1998 Climatological biogeochemical characteristics of the Adriatic Sea *J. Mar. Syst. 18,* 227-263.