Understanding the Black Sea ecosystem functioning during the eutrophication phase using mathematical modelling.

Grégoire M., Barth A., Borges A.V., Beckers, JM., Capet A., Joassin P., Naithani, J., Soetaert K., Vandenbulcke L.

A coupled physical-biogeochemical model has been developed to simulate the ecosystem of the Black Sea at the end of the 80's when eutrophication and invasion by gelatinous organisms seriously affected the stability and dynamics of the system. The biogeochemical model describes the foodweb from bacteria to gelatinous carnivores and explicitly represents processes in the anoxic layer down to the bottom. Additionally, in order to estimate carbon sequestration, the model includes an explicit representation of the DIC and alkalinity dynamics.

For calibration and analyses purposes, the coupled model has first been run in 1D in several places in the Black Sea. The biogeochemical model involves some hundred parameters which are first calibrated by hand using published values. Then, an identifiability analysis has been performed in order to determine a subset of identifiable parameters (~15). An automatic calibration subroutine has been used to fine tune these parameters. In 1D, the model solution exhibits a complex dynamics with several years of transient adjustment. This complexity is imparted by the explicit modelling of top predators. The model has been calibrated and validated using a large set of data available in the Black Sea TU Ocean Base.

The calibrated biogeochemical model is implemented in a 3D hydrodynamical model of the Black Sea. Appropriate nesting techniques are developed in order to couple at the shelf break the high resolution shelf model (~1-2 km) and the basin scale coarse model (5km). First results will be presented.