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Multidecadal evolution of Black Sea hydrodynamics and biogeochemistry

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In the framework of the EU Southern European Seas: Assessing and Modelling Ecosystem changes (SESAME) integrated project, the long term functioning of the Black Sea hydrodynamics and biogeochemistry has been investigated using a 3D coupled hydrodynamical-biogeochemical model describing the food web from bacteria to gelatinous carnivores and explicitly representing processes in the anoxic layer down to the bottom. The hydrodynamical model is run during 40 years while the biogeochemical model is run during key time slices selected during the last 50 years (e.g. pristine, eutrophication, post-eutrophication, present).
The skills of the coupled model are deeply assessed using a hierarchy of techniques following the type and availability of observations (in situ and satellite). These techniques include the use of statistics dedicated to a point to point direct comparison, EOF decomposition and analysis of the spatio-temporal distribution of model errors.
A particular attention is given to the North-Western shelf and to the fate of the riverine material, for which we quantified sequestration and degradation on the shelf as well as the export in different form towards the deep sea. It has been found that the representation of benthic processes is very critical in order to get an acceptable distribution/budget of nutrients for the shelf and the deep sea over several years.
In a first step, a characteristic functioning of the shelf ecosystem is drawn from different climatological simulations corresponding to the selected time slices. Self-organizing maps are used to assess typical seasonal cycles and to define coherent regions of enhanced variability or stronger sensitivity in relation to water quality indicators.
Then, looking at an inter-annual evolution, several propositions are made to link observed changes of this characteristic functioning with variation in the hydrodynamics caused by atmospheric variations and/or modifications of the riverine materials linked to human activity.
In particular, the synergy between climatic oscillation and human induced pressure will be explored as it is believed that the drastic changes experienced by the Black Sea in the late eighties result from combined pressures of different types.