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Marine Biogeochemistry Under The Influence of Fish And Fisheries: An Ecosystem Modeling Study

Deniz Disa (1,2), Ekin Akoglu (1), and Baris Salihoglu (1)

(1) Middle East Technical University, Institute of Marine Science, Turkey (dnzdisa@gmail.com), (2) ETH Zurich, Department of Environmental System Sciences, Switzerland

The ocean and the marine ecosystems are important controllers of the global carbon cycle. They play a pivotal role in capturing atmospheric carbon into the ocean body, transforming it into organic carbon through photosynthesis and transporting it to the depths of the ocean. Fish, which has a significant role in the marine food webs, is thought to have a considerable impact on carbon export. More specifically, fish has a control on plankton dynamics as a predator, it provides nutrient to the ecosystem by its metabolic activities and it has the ability of moving actively and transporting materials. Fishing is also expected to impact carbon cycle because it directly changes the fish biomasses. However, how fish impacts the biogeochemistry of marine ecosystems is not studied extensively.
The aim of this study is to analyze the impact of fish and fisheries on marine biogeochemical processes by setting up an end-to-end model, which simulates lower and higher tropic levels of marine ecosystems simultaneously. For this purpose, a one dimensional biogeochemical model simulating lower tropic level dynamics (e.g. carbon export, nutrient cycles) and an food web model simulating fisheries exploitation and higher tropic level dynamics were online and two-way coupled. Representing the marine ecosystem from one end to the other, the coupled model served as a tool for the analysis of fishing impacts on marine biogeochemical dynamics.
Results obtained after incorporation of higher trophic level model changed the plankton compositions and enhanced detritus pools and increased carbon export. Additionally, our model showed that active movement of fish contributed to transport of carbon from surface to the deeper parts of the ocean.
Moreover, results after applying different fishing intensities indicated that changes in fisheries exploitation levels directly influence the marine nutrient cycles and hence, the carbon export. Depending on the target and the intensity of fisheries, considerable changes in the biogeochemical responses observed.
In conclusion, unlike the models that do not represent the fish explicitly, we demonstrate how marine biogeochemical processes are impacted by the activity of fish assemblages and fisheries exploitation.