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Study of the sea ice impact on primary production in the Barents and Kara Seas in past and future climates

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A regional coupled eco-hydrodynamic model of the Barents and Kara Seas based on the MITgcm has been developed. The biogeochemical module is based on a 7-component model of pelagic biogeochemistry including the ocean carbon cycle. This regional model allows revealing and explaining the main mechanisms of the interaction between marine dynamic and biogeochemical processes in the Barents and Kara Seas under a changing climate. We present the main results of simulations for the past (1975-2005) and future (2035-2065) climate.

A clear relationship between the marginal ice zone area and primary production has been obtained, proving the importance of this zone in the functioning of the marine ecosystem. The interannual variability of the integrated primary production and the total sea ice area demonstrates an antiphase behavior, which means that the reduced sea ice cover area in the previous winter is one of the main reasons for the increase in primary production in the current year.

The model simulations demonstrate that, of all the external factors, sea ice area plays a primary role in the formation of primary production: in the overwhelming majority of cases, the contribution of the ice area prevails, and the pattern "more ice - less primary production" and vice versa is fulfilled in the Barents and Kara Seas. The effect of a decrease of incoming short-wave radiation becomes significant only when a significant decrease of the ice area occurs.

Compared to the period 1975-2005, the simulated total primary production in the Barents and Kara Seas is much higher for the period 2035-2065, while the sea ice area significantly decreases.

A regression dependence has been obtained for the total annual primary production as a function of sea ice area and incoming short-wave radiation. Its validity is verified for both past (dependent) and future (independent) climatic periods. It justifies the use of such simple statistical model for quick estimates of the primary production in the Barents and Kara Seas.

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