Spatiotemporal structure of changes in carbon dioxide and oxygen fluxes through the surface of Arctic seas in changing climate

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The balance of CO_2 and O_2 in the Arctic seas is maintained by a complex of interplaying processes. Rapidly evolving changes in the balance of these gases can lead to deterioration of marine ecosystems, their irreversible modification or collapse. Numerous studies have shown that the Arctic seas (AS) provide a sink of CO_2 that amounts from 25% to 50% of its anthropogenic emissions into the global atmosphere (Totterdell, 2013; Borges et al., 2006; Sabine et al., 2004). Thus, the AS substantially contribute to mitigation of greenhouse effect. The role of AS can change in the future if water temperature continues to increase along with sea ice retreat. This will result in changing the intensity of gas exchange between the atmosphere and sea. Many studies have discussed possible impacts of alternate changes in CO_2 fluxes, driven by global climate evolution in XXI century, on regional ecosystems. Shift in carbon balance due to global warming may lead to AS acidification, which in turn can cause negative implications for marine biota.

The question over how the ongoing climate change in XXI century will affect gas fluxes in the polar regions, and what are the accompanying uncertainties, is essential. The primary goal in the gas exchange analysis is connected with clearer understanding of flux-related physical processes in the atmosphere and the ocean. Here the analysis of "atmosphere-ocean" gas exchange over the Arctic seas using gas exchange model (Bortkovsky, 2006) driven by CMIP5 and MGO pan-Arctic RCM climate change simulations is conducted (Shkolnik and Efimov, 2013). The gas exchange model model accounts for gas transfer by bubbles under strong wind conditions by including source (sink) members in the gas exchange equations. Provided that global (regional) climate models generate an input for the model, it can calculate intensity of CO_2 and O_2 fluxes.

Here the spatiotemporal patterns of CO_2 and O_2 fluxes through the surface of the Barents, Kara, Laptev and East-Siberian seas are analysed. Each of the seas is characterized by specific features: shelf structure, currents, salinity, depth, amount of fresh water input from rivers. The study aims at analysis of changes in CO_2 and O_2 fluxes over AS under projected evolution of global and regional climate system.

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