Geophysical Research Abstracts
Vol. 20, EGU2018-17844-2, 2018
EGU General Assembly 2018

Anthropogenic carbon in the Arctic Ocean

Jens Terhaar (1), James Orr (1), and Laurent Bopp (2)

(1) Laboratoire des Sciences du Climat et de l'Environnement, LSCE/IPSL, CEA-CNRS-UVSQ, Université Paris-Saclay, 91191 Gif-sur-Yvette, France, (2) Laboratoire de Météorologie Dynamique (LMD), IPSL, CNRS/Ecole Normale Supérieure/Ecole Polytechnique/UPMC, 24 rue Lhomond, 75231 Paris Cedex 05, France

The Arctic Ocean is projected to experience not only amplified climate change but also amplified ocean acidification. Modeling future acidification depends on our ability to simulate baseline conditions and changes over the industrial era. Such centennial-scale changes necessitate a global model to account for exchange between the Arctic and surrounding regions. Yet the coarse resolution of typical global models may poorly resolve that exchange as well as critical features of Arctic Ocean circulation. Here we assess how simulations of Arctic Ocean storage of anthropogenic carbon, the main driver of ocean acidification, differ when moving from coarse to eddy admitting resolution in a global ocean circulation-biogeochemistry model . The coarse-resolution model configuration (2°) stores 1.6 Pg C between 1860 and 2005, while an eddy admitting version (1/4°) stores 2.2 Pg C. Data-based estimates of anthropogenic carbon storage in the Arctic Ocean are higher (2.5 to 3.3 Pg C). All models underestimate Arctic Cant storage because their intermediate waters are poorly ventilated based on model-data CFC-12 evaluation. But that intermediate-water deficit lessens with increasing model resolution. The increase in Cant storage with resolution also implies greater acidification, e.g., an increase in the shoaling of the aragonite saturation horizon between 1958 and 2012 from 40 m in the coarse-resolution model to 170 m in the eddy-admitting model. Acidification of the Arctic Ocean is also influenced by river input. About 10% of the global river discharge flows into the Arctic Ocean, which represents only 4% of the global ocean surface area. Arctic rivers mainly drain Siberian permafrost regions, whose future degradation may greatly enhance carbon delivery. To quantify how this enhancement may affect Arctic Ocean biogeochemistry, we made sensitivity tests increasing atmospheric carbon, riverine carbon, and riverine nutrients, each by 1% per year but sequentially. About 50% of the additional riverine carbon stays in the Arctic Ocean, while 30% is lost laterally to the Atlantic and Pacific Oceans and 20% is lost to the atmosphere.