Geophysical Research Abstracts
Vol. 19, EGU2017-18855-2, 2017
EGU General Assembly 2017

Arctic Ocean Pathways in the 21st century

Yevgeny Aksenov (1), Simon J. van Gennip (1), Stephen J. Kelly (2), Ekaterina E. Popova (1), and Andrew Yool (1)

(1) National Oceanography Centre, Marine Systems Modelling, Southampton, United Kingdom (yka@noc.ac.uk), (2) University of Southampton, Graduate School of the National Oceanography Centre, Southampton, United Kingdom

In the last three decades, changes in the Arctic environment have been occurring at an increasing rate. The opening up of large areas of previously sea ice-covered ocean affects the marine environment with potential impacts on Arctic ecosystems, including through changes in Arctic access, industries and societies. Changes to sea ice and surface winds result in large-scale shifts in ocean circulation and oceanic pathways. This study presents a high-resolution analysis of the projected ocean circulation and pathways of the Arctic water masses across the 21st century. The analysis is based on an eddy-permitting high-resolution global simulation of the ocean general circulation model NEMO (Nucleus for European Modelling of the Ocean) at the 1/4-degree horizontal resolution. The atmospheric forcing is from HadGEM2-ES model output from IPCC Assessment Report 5 (AR5) simulations performed for Coupled Model Intercomparison Project 5 (CMIP5), and follow the Representative Concentration Pathway 8.5 (RCP8.5) scenario. During the 21st century the AO experiences a significant warming, with sea surface temperature increased by in excess of 4 deg. C. Annual mean Arctic sea ice thickness drops to less than 0.5m, and the Arctic Ocean is ice-free in summer from the mid-century. We use an off-line tracer technique to investigate Arctic pathways of the Atlantic and Pacific waters (AW and PW respectively) under this future climate. The AW tracers have been released in the eastern Fram Strait and in the western Barents Sea, whereas the PW tracer has been seeded in the Bering Strait. In the second half of the century the upper 1000 m ocean circulation shows a reduction in the eastward AW flow along the continental slopes towards the Makarov and Canada basins and a deviation of the PW flow away from the Beaufort Sea towards the Siberian coast. Strengthening of Arctic boundary current and intensification of the cyclonic gyre in the Nansen basin of the Arctic Ocean is accompanied by weakening of the current and an anti-cyclonic gyre spin-up in the Makarov Basin. This presents a shift of the Arctic circulation “dipole” and of the Transpolar Drift, with the consequence that the PW flow towards Fram Strait is significantly reduced by the end of the century, weakening the Pacific-Atlantic connection via the Arctic Ocean, and reducing the Arctic freshwater outflow into the North Atlantic. Examination of the simulations suggests that these circulation changes are primarily due to the shift in the wind.