Geophysical Research Abstracts
Vol. 19, EGU2017-12231, 2017
EGU General Assembly 2017

Importance of Ocean Processes and Feedbacks with Sea Ice in Arctic Amplification

Wieslaw Maslowski (1), Dominic DiMaggio (1), Younjoo Lee (1), Robert Osinski (2), and Andrew Roberts (1)

(1) Naval Postgraduate School, Oceanography, Monterey, United States (maslowsk@nps.edu), (2) Institute of Oceanology, Polish Academy of Sciences, Sopot, Poland

The Arctic is undergoing some of the most coordinated and rapid climatic changes currently occurring anywhere on Earth. While historical reconstructions from Earth System Models (ESMs) are in broad agreement with these changes, the rate of change in ESMs remains outpaced by observations. This is due to a combination of coarse resolution, inadequate parameterizations, under-represented processes and a limited knowledge of physical interactions. We hypothesize that these limitations are in part the result of an inadequate representation of critical high-latitude processes controlling the accumulation and distribution of sub-surface oceanic heat content and its interaction with the sea ice cover, especially in the western Arctic.

Several CMIP5 models are evaluated using a skill metric that combines both variance and correlation between modeled and observed quantities. Models inadequately represent the upper ocean hydrology in the central Canada Basin, and the potentially important heat sources of the near-surface temperature maximum and Pacific Summer Water are missing. This is evidenced by the fact that the CMIP5 multi-model mean exhibits a cold temperature bias near the surface and a warm bias at intermediate depths. To identify the sensitivity of upper Arctic Ocean hydrography to physical processes and model configurations, a series of experiments are performed using the Regional Arctic System Model (RASM), a high-resolution, fully-coupled regional climate model. Analysis of RASM output suggests that surface momentum coupling (air-ice, ice-ocean, and air-ocean), brine-rejection parameterization, and model resolution, both horizontal and vertical, influence thermohaline structure down to 700 m. We argue that such improvements are needed in future CMIP-type models to advance their simulation and prediction of Arctic climate change.