Geophysical Research Abstracts
Vol. 21, EGU2019-16734, 2019
EGU General Assembly 2019
© Author(s) 2019. CC Attribution 4.0 license.

The Role of Ocean Eddies in the Southern Ocean Response to Observed Greenhouse Gas Forcing and the Southern Annular Mode

Simge Irem Bilgen and Benjamin Kirtman

Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, United States
(sbilgen@rsmas.miami.edu)

Here, a fully coupled model run at multiple resolutions from coarse to eddy resolving, driven by observed atmospheric and fixed CO_2 concentration is used to investigate the role of ocean eddies in modulating the Southern Ocean response to greenhouse gas forcing. The purpose of this study is to examine how resolved ocean eddies impact the simulation of large-scale climate variability of the Southern Ocean, use local feedback mechanism to investigate the discrepancies between the atmospheric and ocean models and to isolate how Southern Ocean regional climate changes and affects global climate by which changing ocean dynamics impacts polar climate. The high-resolution versions of the model show an increase in eddy kinetic energy after applying climate change scenario correspondingly effect fluctuations in the dominant mode of Southern Hemisphere atmospheric variability, the Southern Annular Mode (SAM). At all resolutions the model captures the temperature response to the greenhouse gas forcing is characterized by enhanced warming north of 45[U+F0B0]S. However, in the coarse-resolution implementation of the model the response to sea surface temperature is inconsistent with the eddy resolving model especially for the south of the Antarctic Circumpolar Current. This response is showing that eddies do play an important role especially for the southern flank of ACC where Antarctic sea-ice is intimately coupled to the atmosphere-ocean processes over the Southern Ocean. Also, the Antarctic sea-ice fraction for coarse resolution model is larger than eddy resolving simulations, which mostly accounts for the significantly larger sea-ice loss, and leads greater surface temperature increase for the LR version. Our results provide a useful insight into the contributions of GHG forcing and the seasonal SAM to the historical SO SST trends and help identify a combination of model characteristics that favors simulating a 1941–2014 SO cooling by eddy resolving model similar to the observed SST trend but the magnitude of this cooling is quite different in the atmosphere and ocean models for the same period.