Geophysical Research Abstracts
Vol. 21, EGU2019-9755, 2019
EGU General Assembly 2019

Northern hemisphere atmospheric response to Arctic summer sea ice loss in the CNRM-CM6 climate model : mechanisms and impacts

Svenya Chripko, Rym Msadek, Emilia Sanchez-Gomez, and Laurent Terray
CERFACS/CECI, UMR 5318, Toulouse, France (chripko@cerfacs.fr)

Arctic sea ice extent has declined by more than 10 % per decade during summer since the late 1970s. Climate projections indicate a high probability of having ice-free summers by the middle to end of the century due to increasing greenhouse gas concentrations (Stroeve et al. 2012). Further, climate model studies have shown that the decrease in Arctic sea ice cover can affect weather and climate not only locally but also over remote regions through changes in the mid-latitude atmospheric circulation. However, the mechanisms beneath this teleconnection are not completely understood. In this study, we investigate the atmospheric response throughout the Northern hemisphere to an idealized and rapid Arctic summer sea ice loss, using coupled ocean-atmosphere experiments realized with the CNRM-CM6 high-top model recently developed for CMIP6. A 40-member ensemble is generated by reducing the albedo of sea ice to the ocean value. Each member is run for 24 months, producing two consecutive summers with complete Arctic sea ice loss after initialization in winter. The response of surface air temperature, precipitation and net surface energy budget over the Arctic Ocean is maximum in the autumn following the summer sea ice loss. The temperature response is characterized by a classical Arctic amplification over the Arctic Ocean in each season and by a weak but significant cooling over central Asia. We decompose this response into a thermodynamical contribution due to sea ice forcing and a dynamical component due to natural climate variability. We show that the weak magnitude of the temperature response over land can be partly explained by opposite anomalies in the thermodynamical and dynamical components. We find that the rapid and strong summer sea ice loss in CNRM-CM6 yields weak changes in the zonal-mean westerly flow in mid-latitudes after the first summer. However, the response becomes more intense after the second summer of sea ice loss, with a clear narrowing of the jet stream the following autumn along with a strengthening of the polar vortex. Changes in vertical and meridional propagation of the planetary waves from the troposphere to the stratosphere allow to partly explain the dynamical mechanisms beyond this response. Finally, we show that the results are overall not sensitive to an increased horizontal resolution in the atmosphere.