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Impact and response of a reduced Arctic sea-ice cover on ocean and atmospheric properties

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The sea-ice cover is declining over the last few decades and reached its minimum in 2007 recovering slightly thereafter. This study investigates the response and impacts of the atmospheric and oceanic properties on a one year period of low sea-ice area such as in summer 2007. Two ensembles of experiments, i.e., an equilibrium and a transient simulation, are produced with the Community Climate System Model. Then a sea-ice change is produced through an albedo change of one year to mimic the summer 2007 sea-ice conditions. The sea-ice area recovers in both ensembles after 3 years while the thickness takes 5 years. The sea-ice anomaly produces changes in ocean temperature and salinity to a depth of about 200 m in the Arctic basin. Further, the salinity and temperature changes in the surface layers trigger a 'Great Salinity Anomaly' which takes roughly 8 years to travel across the North Atlantic back to the Arctic Ocean. In the atmosphere the changes implied by the sea-ice anomaly do not last as long as in the ocean. The responses in the transient and equilibrium sets in fall and winter are different in nature. The surface warming over the Arctic basin propagates through the whole atmospheric column changing the geopotential height fields and thus the storm tracks. The location of Arctic surface warming vary in the two ensembles and thus the position of the geopotential height changes. While the equilibrium simulation shifts the storm tracks to the south in North America and Eurasia, the transient simulation shifts the storm tracks to the north. We conclude that the overall reduction in sea-ice cover is important for producing ocean anomalies, however, for atmospheric anomalies the regional distribution from the sea-ice anomalies is more important.