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Decadal and inter-decadal Arctic Climate Variability

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Understanding the Earth's climate system, particularly climate variability, presents one of the most difficult and urgent challenges in science. The strong decrease of Arctic sea-ice during the last few years is one of the indicators of rapid climate change. However, the system is complicated by the presence of several feedback mechanisms between sea ice, atmosphere, and ocean. Therefore, besides looking at the feedback mechanism within the coupled system, we looked at forced simulations with the stand-alone ocean sea-ice component.
The regionally high resolution Max-Planck Institute Ocean Model (MPIOM) was used with curvilinear coordinates. One grid pole located in Canada and the other in Russia resulted in a high resolution over the Arctic basin. The model has 40 vertical levels and the horizontal resolution over the Arctic region is about 10 km. A long-term simulation covering the period 1948-2007 was performed. Model results show the strongest decline of sea ice extent (September minimum) in the Laptev, East Siberian and Beaufort Seas during last years, which is in agreement with available satellite data.
The atmosphere affects the oceans and is in turn influenced by them. To understand the loss of sea ice area in the central Arctic due to the atmosphere variations on decadal time scale, a coupled simulation was performed. Ocean component is the MPIOM model (horizontal resolution is about 20 km) and the atmospheric component is the REgional MOdel (REMO). REMO model has 27 vertical levels between surface and 25 hPa, horizontal resolution is 1° x 1°. In order to estimate the ability of the model to reproduce current climate realistically, mean values for the main meteorological parameters were calculated and compared to observation and available re-analysis data. As for example mean sea level pressure, the model reproduces the monthly mean well with the differences from ECMWF analyses of less than 3 hPa. After model evaluation, the processes on the decadal and interannual time scale were studied.
Unfortunately, ERA40 does only cover the period 1958-2002. Thus the recent years with their large sea ice decrease are not included. Therefore, we will use NCEP-NCAR reanalysis in an upcoming simulation with higher spatial resolution.