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Future Arctic sea ice extent: less in summer but more in winter

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Arctic sea ice property distributions and their variability are of great interest to various groups. For example the Barents and Kara Sea and the area off the western coast of Greenland are deemed to be especially important for oil and gas extraction over the next few decades. We analyse the development of arctic sea ice with the focus on these regions within the ACCESS (Arctic Climate Change, Economics and Society) project. They are mostly covered by relatively thin single-year ice in winter and few or none ice in summer due to melting and sea ice transport. The change of these properties under the influence of increasing green house gases until 2040 is part of our analysis. Within the Coupled Model Intercomparison Project phase 5 (CMIP5) more than 30 global climate GCMs (general circulation models) provide sea ice parameters for historical simulations and possible future warming scenarios. A comparison of the historical simulations with satellite-derived sea ice fields is used to identify the range of GCM sea ice distribution and variability. The winter sea ice edge was situated in the southern Barents Sea during 1979-2005. For this time period, several CMIP5 models overestimate the ice coverage in the Barents Sea and thus overestimate the seasonal variability. We use a cost function approach to filter out the six best-performing GCMs in terms of sea ice concentration in the selected regions.
The variability between the so filtered GCMs is still large: (i) The model variability is shown by the fact that all six models agree on decreasing mean sea ice thickness until 2040. However, they do not agree on the strength of the decrease. (ii) The strength of the natural variability varies with the models. (iii) There is no clear distinction between the two future scenarios RCP 4.5 and RCP 8.5, which differ in the amount of green house gas emissions. The mean sea ice thickness seems to develop independently of this strength in the scenarios.
However strong the differences between the models are, they all agree on a change in the seasonal cycle in terms of an earlier melting and a later freeze up of the sea ice. The change of the seasonal cycle results in the reduction of the sea ice extent during summer. In contrast, the sea ice extent expands in winter.
To further develop an understanding for the reasons behind the expansion, further sea ice related parameters such as sea ice velocity, mean sea level pressure and near surface air temperature are analysed.