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Arctic sea ice variability in IPCC climate of the 20th century experiments in comparison to ocean-sea ice hindcasts

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Climate scenarios predict a more or less pronounced thinning and retreat of the Arctic sea ice cover.The models with the strongest trends even produce an ice free summer situation within the next 100 years. The resulting change in the Arctic fresh water balance is thought to have a strong impact on climate.

Due to the adverse weather conditions in the Arctic Ocean, data availabilty is still problematic: satelite data of ice extent exist from the end-70s, ice thickness data are mostly still point measurements- sparse in space and time.

Therefore we use the results of a coupled sea ice-ocean model as a comparison data set. The model has been run in hindcast mode forced with NCEP/NCAR reanalysis data and has been validated against the available sea ice data.

All IPCC models used for scenario runs have been started with a climate of the 20th century experiment. The 20C3M experiment design includes historical solar irradiation, sulfate aerosol concentration, volcanic aerosol optical depth, greenhouse gas concentrations, and ozone concentration according to the observed development. Thus, part of the variability generated in the models is externally forced. Many of these parameters show a clear trend for the last decades, so at least the trend should be visible in the results and thus allow a comparison of the last 50 years to the hindcast model.

We have included all IPCC models with available 20C3M ice thickness data. The results are quite diverse, some deficiencies clearly visible, some easily explainable. The final amount of sea ice as of year 2000 differs considerably among the models, in thickness as well as in the overall spatial pattern.

All IPCC model results considered show a negative trend in sea ice volume for the period 1950-2000. This is in contrast to the hindcast suggesting that either some important external forcing is missing in the IPCC experiments or that the internal multi-decadal variability of the real climate system is underestimated in IPCC models.