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The Transient and Equilibrium Response of the AMOC to Arctic sea decline in a coupled model.

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Since the mid-20th century, the Arctic has experienced two major impacts of climate change: a warming at a faster rate than the global mean surface temperature and a reduction of both winter and summer sea ice cover. However, the impact of the Arctic sea ice loss on global climate remains under debate, in particular the impact on the Atlantic meridional overturning circulation (AMOC). Specifically, some studies find that in response to Arctic sea ice decline, the AMOC weakens on multi-decadal timescales, reaching a new equilibrium state with a significantly reduced AMOC, while others studies see a weak AMOC reduction followed by a partial or full recovery. To further investigate the impact of sea ice loss on the climate, ensemble simulations are performed with the coupled atmosphere-ocean general circulation model CM5A2 from the Insitut Pierre Simon Laplace (IPSL-CM5A2). To induce the change in sea ice, the Arctic sea ice albedo is reduced by about 23%, previously shown to be consistent with the sea ice changes expected to occur by approximately the year 2040. The experimental design compares the response to sea ice loss starting from AMOC minimum and neutral phases, respectively. The objective of our experiment is to further investigate the AMOC-sea ice relationship in the transient and equilibrium responses to decreased sea ice and the robustness within a coupled model. The initial 30-year response results in similar spatial patterns in sea ice volume and 500mb potential height responses (inducing a negative NAO-like pattern) for both types of initial conditions. In both cases, the AMOC reduces by 0.5 to 1.5Sv Sv (about 15% of the model mean AMOC) during the first ~100 years of the experiment. Yet, there are differences in the response depending on the AMOC initial state, for example, in the magnitude and timing of the AMOC reduction. The AMOC eventually recover towards years 151-200. Our results give insight into the importance of decadal variability for anticipating the response of the next decades to climate change, as well as improves the understanding of the long-term transient and equilibrium responses between AMOC and Arctic sea ice.