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The 21st century changes in the Arctic sea ice cover as a function of its present state : what can we learn from CMIP5 models ?

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Projections of Arctic sea ice changes for the mid- and late 21st century conducted with 16 CMIP5 atmosphere-ocean general circulation models under four representative concentration pathways (RCPs) are analyzed. We find a large inter-model spread in the modeled winter and summer sea ice losses (e.g., a range of 5 million km2 for the decrease in September sea ice extent with RCP4.5 between 1979-2010 and 2080-2100). Several factors can explain this scatter. Here, we focus on some simple mechanisms and try to understand the main links between the present (1979-2010) mean state of the Arctic sea ice cover as simulated by these models and the projected changes in 2030-2050 and 2080-2100. For instance, the sea ice thickness changes during both wintertime and summertime are found to be particularly sensitive to the present state of the late summer sea ice thickness and extent; in turn, the changes in late summer sea ice extent are well correlated with the area of the Arctic basin covered by thin (< 0.5 m) ice over the recent summers. These relationships indicate that models with a more expansive and thicker current sea ice cover tend to thin ice faster, while at the same time, models with a larger proportion of thin ice within the sea ice pack for present-day conditions tend to simulate stronger reductions in ice extent. Based on such relationships, we make some recommendations with the objective of developing a mechanistically motivated metric for reducing uncertainties in projections of Arctic sea ice changes.