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Refinement methods of Arctic sea-ice initialization for improving the decadal prediction skill in the Arctic

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Reduction of the regional sea ice cover during early winter in the Arctic can cause substantial near-surface warming locally during winter, and thus may affect the mid-latitude climate. In this study the decadal prediction skills are investigated using the climate model EC-Earth initialized with anomaly initialization (AI) for the ocean and sea ice components with a 5-category sea ice module. Initialization of the sea ice loss with AI technique is not straightforward as it could result in unphysical, negative values of the sea ice concentration and thickness. We introduce three methods to split the sea ice from observation into the different sea ice categories with (1) a fixed ratio of 20% among the 5 categories, (2) a weighting function or (3) a likelihood function, based on the knowledge from multi-centennial preindustrial control simulations with EC-Earth3 for CMIP6. We perform a set of decadal prediction experiments initialized from November 2007, after the Arctic ice extent just experienced an unprecedented minimum. In the case there is a positive bias in the sea ice initial state, the prediction of annual maximal ice volume will drift away from observations after the first 3-year simulations. Here we investigate how to refine sea ice volume in order to minimize regional errors in the initial state to research the abnormally low sea ice condition of autumn 2017. We aim at address how a better initialization of Arctic sea ice can be translated into near surface temperature skill in decadal predictions with a focus on linking the Arctic sea ice loss and the mid-latitude winters.