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A means-corrected estimate for the Arctic sea-ice volume in 1990–2019

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Decadal changes in sea-ice thickness are one of the most visible signs of climate variability and change. To gain a comprehensive understanding of mechanisms involved, long time series, preferably with good uncertainty estimates, are needed. Importantly, the development of accurate predictions of sea ice in the Arctic requires good observational products. To assist this, a new sea-ice thickness product by ESA Climate Change Initiative (CCI) is compared to a set of five ocean reanalysis (ECCO-V4r4, GLORYS12V1, ORAS5 and PIOMAS).

The CCI product is based on two satellite altimetry missions, CryoSat-2 and ENVISAT, which are combined to the longest continuous satellite altimetry time series of Arctic-wide sea-ice thickness, 2002–2017. The CCI product performs well in the validation of the reanalyses: overall root-mean-square difference (RMSD) between monthly sea-ice thickness from CCI and the reanalyses ranges from 0.4–1.2 m. The differences are a sum of reanalysis biases, such as incorrect physics or forcing, as well as uncertainties in satellite altimetry, such as the snow climatology used in the thickness retrieval.

The CCI and reanalysis basin-scale sea-ice volumes have a good match in terms of year-to-year variability and long-term trends but rather different monthly mean climatologies. These findings provide a rationale to construct a multi-decadal sea-ice volume time series for the Arctic Ocean and its sub-basins from 1990–2019 by adjusting the ocean reanalyses ensemble toward CCI observations. Such a time series, including its uncertainty estimate, provides new insights to the evolution of the Arctic sea-ice volume during the past 30 years.