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Observational uncertainty of Arctic sea-ice concentration significantly affects seasonal climate forecasts

Felix Bunzel (1), Dirk Notz (1), Johanna Baehr (2), Wolfgang Müller (1), and Kristina Fröhlich (3)

(1) Max Planck Institute for Meteorology, Hamburg, Germany (felix.bunzel@mpimet.mpg.de), (2) University of Hamburg, Hamburg, Germany, (3) Deutscher Wetterdienst, Offenbach, Germany

We examine how the choice of a particular satellite-retrieved sea-ice concentration dataset used for initialising seasonal climate forecasts impacts the prediction skill of Arctic sea-ice area and Northern hemispheric 2-meter air temperatures.

To do so, we performed two assimilation runs with the Max Planck Institute Earth System Model (MPI-ESM) from 1979 to 2012, where atmospheric and oceanic parameters as well as sea-ice concentration were assimilated using Newtonian relaxation. The two assimilation runs differ only in the sea-ice concentration dataset used for assimilating sea ice. In the first run, we use sea-ice concentrations as derived by the NASA-Team algorithm, while in the second run we use sea-ice concentrations as derived from the Bootstrap algorithm. A major difference between these two sea-ice concentration data products involves the treatment of melt ponds. While for both products melt ponds appear as open water in the raw satellite data, the Bootstrap algorithm more strongly attempts to offset this systematic bias by synthetically increasing the retrieved ice concentration during summer months.

For each year of the two assimilation runs we performed a 10-member ensemble of hindcast experiments starting on 1 May and 1 November with a hindcast length of 6 months. For hindcasts started in November, initial differences in Arctic sea-ice area and surface temperature decrease rapidly throughout the freezing period. For hindcasts started in May, initial sea-ice area differences increase over time. By the end of the melting period, this causes significant differences in 2-meter air temperature of regionally more than 3°C. Hindcast skill for surface temperatures over Europe and North America is higher with Bootstrap initialization during summer and with NASA Team initialisation during winter. This implies that the choice of the sea-ice data product and, thus, the observational uncertainty also affects forecasts of teleconnections that depend on Northern hemispheric climate indices.