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Gridded Arctic sea ice concentration reconstruction for the first half of the 20th century based on different proxy data

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Global warming in the recent decades has been accompanied by a rapid decline of the Arctic sea ice area most pronounced in summer (10% per decade). To understand the relative contribution of external forcing and natural variability to the modern and future sea ice area changes, it is necessary to evaluate a range of long-term variations of the Arctic sea ice area in the period before a significant increase in anthropogenic emissions of greenhouse gases into the atmosphere. Available observational data on the spatiotemporal dynamics of Arctic sea ice until 1950s are characterized by significant gaps and uncertainties. In the recent years, there have appeared several reconstructions of the early 20th century Arctic sea ice area that filled the gaps by analogue methods or utilized combined empirical data and climate model's output. All of them resulted in a stronger than earlier believed negative sea ice area anomaly in the 1940s concurrent with the early 20th century warming (ETCW) peak. In this study, we reconstruct the monthly average gridded sea ice concentration (SIC) in the first half of the 20th century using the relationship between the spatiotemporal features of SIC variability, surface air temperature over the Northern Hemisphere extratropical continents, sea surface temperature in the North Atlantic and North Pacific, and sea level pressure. In agreement with a few previous results, our reconstructed data also show a significant negative anomaly of the Arctic sea ice area in the middle of the 20th century, however with some 15% to 30% stronger amplitude, about 1.5 million km² in September and 0.7 million km² in March. The reconstruction demonstrates a good agreement with regional Arctic sea ice area data when available and suggests that ETWC in the Arctic has been accompanied by a concurrent sea ice area decline of a magnitude that have been exceeded only in the beginning of the 21st century.