



Declining arctic ice thickness from 26 years of US Navy submarine cruises

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A large data set on arctic sea ice thickness, derived from 120,000 km of submarine cruise tracks between 1975 and 2000, records the variations of ice thickness at various times of the year over the central half of the Arctic Ocean. These data are publicly archived at the National Snow and Ice Data Center. Multiple regression has been used to separate the variations in thickness with year, with season, and with region. We find the linear downward trend in ice thickness during these 26 years to be 7 cm yr^{-1} , a total of 1.7 m. This loss is 45% of the mean thickness of 3.8 m over the area for the period. The annual cycle over the sampled area has a peak-to-peak amplitude of 1.0 m. The data corroborate previous results. However, this data set is far more extensive and better documented than any submarine surveys of the arctic previously analyzed. The accuracy of submarine data relative to each other is 22 cm [Rothrock and Wensnahan, 2007]; the derivation of this error estimate will be reviewed. The spatial field, one of the products of the analysis, will be presented; it can be used by ice modelers for model testing or intercomparison. The data set is so strong that higher order (up to 4th order) estimates of the temporal and spatial variation are found to be statistically significant. Through the year 2000, there is no sign of recovery in thickness following the period of strong cyclonic circulation (high North Atlantic Oscillation and Arctic Oscillation indices and strong Icelandic low) between 1989 and 1994 that caused a large export of older, thicker ice from the Arctic Ocean.