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Sea ice thickness in the Weddell Sea, inferred from upward looking sonar measurements

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Sea ice has been routinely monitored by satellites since 1979. However, thickness measurements of sea ice are still very sparse, especially in the Southern Hemisphere. Satellite altimetry still provides relatively uncertain estimates of ice thickness. Today, the only tool for monitoring sea ice thickness over long time periods with highest accuracy (5-10 cm) are moored upward looking sonars (ULS). The instruments measure the subsurface portion (draft) of the ice, which can be converted into total ice thickness.
We present a data set of ULS time series from 13 positions in the Atlantic sector of the Southern Ocean (Weddell Sea), which were made in different years between 1990 and 2010. Monthly mean sea ice draft shows high interannual variability and can reach more than 3 m in the dynamic coastal regions of the eastern and western Weddell Sea. The thinnest ice is found away from the coast in the eastern Weddell Sea and rarely exceeds 1 m in the monthly mean. In single years the ULS data allow for a clear discrimination between thermodynamic ice growth and dynamic ice growth due to rafting and ridging of the floes. We demonstrate that the thermodynamic ice thickness can reach its theoretical maximum value of 1 m in the central Weddell basin. Despite significant gaps, the presented data set provides an important validation tool for satellite algorithms and sea ice models.