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Supercooled Southern Ocean Waters

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In cold polar waters, temperatures sometimes drop below the freezing point, a process referred to as supercooling. However, observational challenges in polar regions limit our understanding of the spatial and temporal extent of this phenomenon. We here provide observational evidence that supercooled waters are much more widespread in the seasonally ice-covered Southern Ocean than previously reported. In 5.8% of all analyzed hydrographic profiles south of 55° S, we find temperatures below the surface freezing point ('potential' supercooling), and half of these have temperatures below the local freezing point ('in-situ' supercooling). Their occurrence doubles when neglecting measurement uncertainties. We attribute deep coastal-ocean supercooling to melting of Antarctic ice shelves, and surface-induced supercooling in the seasonal sea-ice region to winter-time sea-ice formation. The latter supercooling type can extend down to the permanent pycnocline due to convective sinking plumes—an important mechanism for vertical tracer transport and water-mass structure in the polar ocean.