Does calving matter?
Evidence for significant submarine melt

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During the summer in the northeast Pacific Ocean, the Alaska Coastal Current sweeps water with temperatures in excess of 12 °C past the mouths of glacierized fjords and bays. The extent to which these warm waters affect the mass balance of Alaskan tidewater glaciers is unknown. Here we report hydrographic measurements made within Icy Bay, Alaska, as well as associated submarine melt rates. We find strong stratification consistent with estuarine circulation and evidence that warm Gulf of Alaska water reaches the head of 40 km-long Icy Bay, largely unaltered. A 10 - 20 m layer of cold, fresh water overlies warm, saline water. The saline water layer is observed to reach up to 10.4 °C within 1.5 km of the tidewater terminus of Yahtse Glacier. By quantifying the heat deficit within the cold surface layer, we place bounds on the rate of submarine melt. The submarine melt rate is estimated at > 9 m d^{-1}, at least half the rate at which ice flows into the terminus region, and can plausibly account for all of the submarine terminus mass loss, 17 m d^{-1}. Our measurements suggest that summer and fall subaerial calving is a direct response to thermal undercutting of the terminus, demonstrating the critical role of the ocean in modulating tidewater glacier dynamics.