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A late glacial record of ice-sheet dynamics and melt supply recovered in the sediments of IODP Expedition 347 in the Baltic Sea

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Modern observations of increased surface ablation, meltwater routing to the bed, and increases in glacial speeds point to feedbacks between ice-sheet dynamics, melt supply, and subglacial discharge. Paleorecords have the potential to explore the decadal to centennial variability of these systems, but until recently such records were short and discontinuous in ice-proximal settings and underutilized for this specific purpose. The Integrated Ocean Drilling Program Expedition 347 in the Baltic Sea recovered annually laminated sediments that document the dynamics of the Scandinavian Ice Sheet. Hydraulic piston cores recovered from Sites M0060, M0063, M0064, and M0065 allow us to reconstruct a nearly complete record of ca. 6000 years in ice retreat history at annual to decadal resolution between ca. 17 and 11ka. The late glacial successions of these four IODP drillsites comprise of a till or proglacial fluvioglacial sediment overlain by variable thicknesses of well-laminated deglacial successions within several high-recovery holes. As the Scandinavian Ice Sheet retreated from the western Baltic Sea, and to the North, the ice-sheet's grounding line migrated across the four sites and deposited overlapping sections of high-resolution ice-proximal to ice-distal successions. Laser particle size results from Sites M0060 and M0063, and inspection of line-scan images, show shifts in sedimentary facies and lithologies that were not recognized during initial visual core description. For example, at Site M0060 in the Kattegat, ice-rafting fluxes in silty clays decrease upward and are negligible in the overlying varved succession. These characteristics are interpreted as ice retreat within a calving bay environment from ca. 17ka onward, followed by distal glacial marine deposition from sediment plumes governed by meltwater discharge. Moreover, at Site M0063 in the Baltic Sea, laser particle size distributions record an abrupt shift from interlaminated clayey silt to laminated clay within deglacial Baltic Ice Lake strata (ca. 13-11ka), marking a shift from rhythmic hyperpycnites to distal varves. The excellent recovery of both proximal and distal rhythmites at multiple drillsites provides a unique opportunity to study feedbacks between Scandinavian Ice Sheet dynamics and its hydrological system on decadal to millennial timescales.