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Manual point-measurements of sea ice mass balance during the MOSAiC Expedition

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Sea ice plays a critical role in the Arctic climate system, regulating much of the energy transfer between the ocean and the atmosphere. Repeat measurements of ice mass balance at discrete points allow us to determine the direct response of sea ice mass to environmental conditions. We installed a network of mass balance measurement sites across the MOSAiC Central Observatories, distributed over a diverse range of ice types and features. The sites were composed of gridded arrays of 9-17 hotwire thickness gauges, each paired with a surface ablation stake. Seven sites were installed on first year ice, and seven on second or multi year ice, with a total of 120+ individual measurement stations. The sites were operational over different periods throughout the year; several were destroyed or became inaccessible during ridging events. Initial ice thicknesses ranged from 0.13-3.50 m. We made measurements of ice and snow interfaces and thicknesses with 1 cm precision at each station, at intervals of 2-3 weeks during the growth season and as few as 1-2 days during the melt season. From these measurements, we infer ice growth, ice bottom melt, ice surface melt, snow deposition, snow erosion, and snow melt. The time series spans October 2019–September 2020, with a five-week measurement gap beginning mid-May 2020. We present an overview of the measurements and preliminary analysis, partitioning results by ice type and comparing mass balance to concurrent atmosphere and ocean measurements. We identify trends in the seasonal evolution of different ice types, and give particular attention to notable events in the time series. As true point-measurements, the data are especially relevant in improving one-dimensional thermodynamic sea ice models. The results also provide validation for satellite and electromagnetic induction ice-thickness measurements made during MOSAiC, which

offer higher areal coverage but lower measurement- and spatial-precision.