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Decay Phase Thermodynamics of Ice Ridges in the Arctic Ocean

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Four ice ridges (R1, R2, R3, and R4) were studied during the spring of 2015 in the Arctic Ocean. During the Norwegian Young Sea Ice expedition (N-ICE2015) from January 11 to June 23, the R/V Lance was moored at four different ice floes (Floe 1, Floe 2, Floe 3, and Floe 4) and drifted along with them. Ice ridge studies were performed on Floe 3 (R1, R2) and Floe 4 (R3, R4). From May 21 to June 23, all ice ridges were drilled several times for structural measurements and cored for physical property measurements. In addition, ridges R1 and R4 were instrumented with Oceanetic thermistor buoys, model 908-20 (OTB 908-20), which remotely logged the vertical temperature profile through the sail and keel of the ridges from April 29 to June 28. After combining these datasets, we obtained thermodynamic properties and evaluated heat budgets of the ridge keels in R1 and R4. Ridge R1 was measured during the transition from the main phase to the decay phase, and ridge R4 was measured during the decay phase. In R1, a 3-4 W/m^2 upwards vertical conductive heat flux through the keel was calculated, which caused cooling of the keel and the growth of new ice (i.e., 0.5 m over 22 days from May 5 to May 27, as observed by temperature readings). The total amount of heat extracted from the keel was spent on cooling the keel and growing new ice in fractions of 0.4 and 0.6, respectively. In R4, a downwards vertical conductive heat flux (up to 2 W/m^2) transported energy into the keel through the top surface of the keel, while the bottom of the keel melted (i.e., 1.6 m over 12 days from June 12 to June 24) due to the oceanic heat flux.