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Results from a lab study of melting sea ice

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Sea-ice melting is a complex process which is not fully understood yet. In order to study sea-ice melt in detail we perform lab experiments in an approximately 2x0.7x1.2 m large tank in a cold room. We grow sea ice with different salinities at least 10 cm thick. Then we let the ice melt at different air temperatures and oceanic heat fluxes. During the melt period, we measure the evolution of ice thickness, internal temperature, salinity and surface temperature. We will present results from roughly five months of experiments. Topics will include the influence of bulk salinity on melt rates and the surface temperature. The effects of flushing on the salinity evolution and detailed thermal profiles will also be included.

To investigate these processes we focus on the energy budget and the salinity evolution. These topics are linked since the thermodynamic properties of sea ice (heat capacity, heat conductivity and latent heat of fusion) are very sensitive to salinity variations. For example the heat capacity of sea ice increases greatly as the temperature approaches the melting point. This increase results in non-linear temperature profiles and enhances heat conduction into the ice. The salinity evolution during the growth phase has been investigated and measured in multiple studies over the last decades. In contrast there are no detailed lab measurements of melting ice available to quantify the effects of flushing melt water and ponding. This is partially due to the fact that the heterogeneity of melting sea ice makes it much more difficult to measure representative values.