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DIFFERENT MELTING CHARACTERISTICS OF ICE SHELVES, ICEBERGS, AND SEA ICE REVEALED BY SAR OBSERVATIONS AND MODELLING

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A thorough understanding of melting processes is required to model the decay of ice shelves and sea ice, and to make predictions for climate change scenarios. Observations of melt-onset dates and trends provide indications of different climate states. On the Larsen Ice Shelf, radar backscatter usually drops sharply at the onset of melt, because the snow becomes soaked with melt water. In contrast, backscatter of the neighbouring sea ice increases at the same time. During the international research cruise ISPOL of German RV Polarstern in December 2004 and January 2005, extensive measurements of snow properties were performed on the sea ice and two prominent icebergs adjacent to the northern Larsen C Ice Shelf. The temperature and liquid water content evolution of icebergs and snow on sea ice were simulated with a one-dimensional snow thermodynamics model. Radar backscatter of both icebergs behaved very different: while it decreased simultaneously on the southern iceberg and the adjacent ice shelf in mid-December, backscatter decreased on the northern iceberg only two weeks later in early January. At the same time, sea ice backscatter increased. Temperature measurements on January 2, 2005, revealed that the upper 1.0 m of the southern iceberg was at the melting point, while only the upper 0.8 m of the northern iceberg were 0°C warm. In contrast, only the upper 0.4 m of snow on sea ice were at the melting temperature. Results of the snow model show that the different initial temperatures of the icebergs, and the large heat capacity of the sea ice close to the melting temperature, and bottom cooling by the cold sea water are responsible for the observed different melting behaviour under equal atmospheric energy fluxes. The northern ice berg originated from the Filchner Ice Shelf, and was therefore much colder than the southern iceberg calved off the Larsen C Ice Shelf, thus delaying downward progress of the melting front. In contrast, snow melt on sea ice is even reduced, preventing it from rapid decay. Comparison with the radar data also shows that even 0.8 m of snow at the melting point can still backscatter significantly.