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Spatial and temporal variability in summer snow pack in Dronning Maud Land, Antarctica

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To quantify the spatial and temporal variability in the snow pack, snow temperature, density, and layering were measured in four summers in the Dronning Maud Land, Antarctica. Data from a 310-km-long transect showed that horizontal gradients in snow density, temperature, and hardness were largest in the escarpment region, and the most homogeneous snow pack was found on the Riiser-Larsen Ice Shelf. On the local scale, day-to-day temporal variability dominated the standard deviation of snow temperature, while the diurnal cycle was next important, and horizontal variability on the scale of 0.4 to 10 m was the smallest component. The day-to-day and total small-scale variability decreased exponentially with depth with an e-folding depth at 0.25 to 0.30 m. In the uppermost 0.2 m, the snow temperature correlated with the air temperature history over the last 6-12 h, whereas at the depth of 0.3 to 0.5 m, the most important time scale was 3 days. Snow temperature depended on the cloud cover in the uppermost 0.30 m and snow density in the uppermost 0.10 m. Both on the intra-pit and transect scales, the ratio of horizontal to temporal variability increased with depth. On the intra-pit scale the temporal variability in snow density exceeded the horizontal variability throughout the uppermost 0.50 m layer, but on the 100-km scale only in the uppermost centimetres. The horizontal standard deviation of snow density increased rapidly between the scales of 0.4 and 2 m, and much more gradually from 10 to 100 m.