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Drifting Snow around Icebergs: Understanding the Role of Iceberg Size and Shape Through Modeling and Observational Data

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The state of research on snow mass balance over sea ice has advanced in recent years, with significant progress in understanding the complex snow-ice interactions. However, challenges remain in accurately assessing the snow depth variability over sea ice in both space and time, particularly when considering the effect of snow transport by wind. In Antarctica, the calving of ice shelves generates icebergs that get trapped in landfast sea ice and act as obstacles to drifting snow. By accumulating snow around them, icebergs may influence the dynamics of land-fast ice in coastal areas but their precise impact on the mass balance and spatial distribution of snow remains uncertain. Drifting snow models are valuable for isolating the geometric properties of obstacles and independently examining their impact on snowdrifts. In our study, we investigate the effect of iceberg geometry on snowdrift quantities by combining aerial laser scanner observations and numerical Euler-Lagrange simulations. Properties such as iceberg size, roundness and elongation were evaluated and the model outcome was compared to the observations. Results show that the size of icebergs governs the snowdrift quantities, while other shape characteristics mostly affect the snow distribution across the iceberg sides. A new scaling law has been discovered, revealing a clear power-law relationship between the size of snowdrifts and icebergs. Our work improves the understanding of drifting snow processes over Antarctic land-fast ice, particularly the impact of large-scale features on the snow distribution. It can offer deeper insights into the comparison of regions with small and large icebergs, along with their associated land-fast ice characteristics and help to quantitatively predict sea ice dynamics.