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Basal crevasses in Larsen C Ice Shelf

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Within the Larsen C ice shelf large scale surface features perpendicular to the ice shelf flow direction with a width of several hundred meters can be detected on remote sensing data. During a field campaign in the 2009/2010 austral summer we gathered 50 MHz ground penetrating radar data as well as differential GPS on profiles across several of these features in the southern part of Larsen C located downstream of Joerg Peninsula. The basal reflector clearly revealed that the elongated features are the surface expression of large basal crevasses, extending upwards from the base of the ice shelf and penetrating more than halfway through the ice column. Analysis of Landsat optical imagery showed that these crevasses and similar ones in different locations on Larsen C are generated within the ice shelf tens of kilometers away from the grounding line. GPS measurements of the trough depth of the surface expressions suggest that they are not in hydrostatic equilibrium, which might be caused either by stress bridging or accumulation of marine ice within the crevasse. Other types of crevasses are generated at the grounding line. They show a shorter, more consistent repeat cycle and less penetration height.
We compare the measured basal crevasses to predictions from a fracture model driven by stress fields from an ice flow model calibrated using field and remotely-sensed data and demonstrate that linear elastic fracture mechanics modelling leads to realistic estimations of basal crevasse height.
If we extrapolate our findings to similar features on the ice shelf and consider the abundance of these, we come to the conclusion that basal crevasses are likely to modify the exchange of mass and energy deep within the shelf in a significant way and could play a fundamental role in ice shelf stability by altering its mechanical properties.