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Finite Element Simulation of Crack Propagation in the Wilkins Ice Shelf

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Processes leading to break-up events in ice shelves have been the subject of extensive study during the last years. However there are still huge gaps in the understanding of the various break up mechanism. Previous studies on vertical as well as horizontal cracks in ice showed a strong dependence of crack criticality and crack growth direction on the applied boundary conditions. Former simulations of Pine Island cracks yielded a method to transform velocity fields from measurements or ice dynamical simulations into in-plane forces for a fracture mechanical analysis of cracks. This method is now applied to a more complex situation at the Wilkins Ice Shelf. Unlike the relatively free floating Pine Island Glacier tongue, the Wilkins Ice Shelf lies between several islands, has three calving fronts and is pinned by a number of ice rises. Additionally, the simulation has to include a system of horizontal cracks propagating in different directions. The two-dimensional finite element simulation of the ice shelf therefore studies the dependence on different boundary influences from external boundaries as well as ice rises. As remote sensing often covers only parts of the ice shelf, the applicability to incompletely covered ice shelves and the resulting adaptation of the boundary conditions at the end of the covered area is tested. We present the simulation of crack merging and calving of ice shelf parts. For the fracture mechanical analysis an linear elastic material law is used. Configurational forces at the crack tip are evaluated to compute the crack criticality and crack growth direction.