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Transformation of creep stresses in ice shelves for fracture mechanical analyses

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Recent disintegrations of ice shelves and calving at ice fronts require a better understanding of fracture mechanical processes involved in these events. Previous studies on cracks in ice shelves with different stress states, density profiles and material parameters highlighted the dependence of the crack criticality on the choice of boundary conditions and the applied material law. To this end, we present different approaches how to transfer the flow induced viscous stresses into the fracture mechanical analysis for the study of vertical and horizontal crack scenarios. The numerical simulations are performed using Finite Elements and the concept of configurational forces for the evaluation of stress intensity factors. This approach is rather flexible and can account for inhomogeneous material properties, volume forces and crack face loadings, e.g. due to additional water pressure. The methods are applied to 2-dimensional geometries under various loading conditions and material parameters. The methods are validated using data from the literature and the results are compared to fracture events that have been documented using remote sensing data analysis.