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Ridge-formation simulations in three dimensions using discrete element methods

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Sea-ice ridges form as a part of sea-ice deformation, while the ice is moved by winds and ocean currents. While ridging is a localized process, it is assumed to limit the compressive strength of sea ice in large scale. However, formulations of large-scale ice strength, as used in Earth System Models, do not consider individual ridge formation processes in detail. Thus, it is necessary to understand the energy spend in ridge formation and various processes related to generating ice rubble and redistributing it. To investigate ridge formation in detail, we use the Aalto University in-house discrete-element-method (DEM) model. This three-dimensional DEM model features deformable, multi-fracturing, ice floes, which can fail and form ridges when coming into contact, while recording the ridging forces. With this, we discuss why three-dimensional simulations are important to investigate ridge formation process.