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Characteristics of sea ice deformation in high-resolution viscous-plastic sea ice models

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Most climate models use a rheology of the viscous-plastic type to simulate sea ice dynamics. With this rheology, large scale velocity and thickness fields can be realistically simulated, but the representation of small scale deformation rates and Linear Kinematic Features (LKF) is thought to be inadequate. Here, the spatial grid spacing of a traditional VP sea ice model is gradually reduced to 1 km in order to investigate how LKFs emerge with increasing resolution and to explore spatial and temporal scaling laws for sea ice deformation.
Increasing the spatial resolution localizes the strain rates along the LKFs. At 1 km grid spacing, the distributions of strain rates have power-law tails that clearly deviate from the basin of attraction of Gaussian distributions and, in this sense, agree with satellite observations and results obtained with the elasto-brittle rheology. Increasing the resolution of the wind forcing leads to more small scale strain rate events in the ice and improves the agreement with observational spatial scaling laws.