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Numerical modelling of strain localization by anisotropy evolution during 2D viscous simple shearing

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Strain localization and associated softening mechanisms in a deforming lithosphere are important for subduction initiation or the generation of tectonic nappes during orogeny. Many strain localization and softening mechanisms have been proposed as being important during the viscous, creeping, deformation of the lithosphere, such as thermal softening, grain size reduction, reaction-induced softening or anisotropy development. However, which localization mechanism is the controlling one and under which deformation conditions is still contentious. In this contribution, we focus on strain localization in viscous material due to the generation of anisotropy, for example due to the development of a foliation. We numerically model the generation and evolution of anisotropy during two-dimensional viscous simple shear in order to quantify the impact of anisotropy development on strain localization and on the effective softening. We calculate the finite strain ellipse during viscous deformation. The aspect ratio of the finite strain ellipse serves as proxy for the magnitude and evolution of anisotropy, which determines the ratio of normal to tangential viscosity. To track the orientation of the anisotropy during deformation we apply a director method. We benchmark our implementation of anisotropy by comparing results of two independently developed numerical algorithms based on the finite difference method: one algorithm employs a direct solver and the other a pseudo-transient iterative solver. We will present results of our numerical simulations and discuss their application to natural shear zones.