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Sheath fold development around slip surfaces subject to general shear

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Sheath folds are cone-shaped structures, which typically develop in high-strain shear zones in a variety of geological settings. When observed in the cross-sections perpendicular to the shear direction, sheath folds display characteristic elliptical closed contours. The aspect ratio of the outermost closed contour is commonly used for the classification and quantitative analysis. Alsop and Holdsworth (2006) showed that the outermost aspect ratio observed in the natural sheath folds varies between 1 and 7.
Previous work on sheath folds development around slip surfaces focused on simple shear deformation (Reber et al., 2013). The aspect ratio developing under such conditions exhibits values larger than the ones observed in nature. Therefore, we investigate sheath fold development around slip surfaces under general shear conditions, in which a shortening component acts in the direction parallel to the shearing plane and perpendicular to the simple shear direction. In our models, the out-of-plane shortening is accommodated by 1) extension in the shear direction only or by 2) uniform extension perpendicular to the shortening direction (dilation). On one hand, the pure shear deformation leads to a decrease of the aspect ratio of the outermost closed contour of the developed sheath folds. On the other hand, it also modifies the slip surface size and orientation, which promotes development of sheath folds with larger aspect ratios. The numerical simulations show that the latter effect is minor and, for the two tested scenarios, we generate sheath folds with the aspect ratios of the outermost ellipse that favourably compare to the range observed in nature.