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Numerical two-wedge model applied to the Alpine orogeny

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Two prominent phases of deformation characterize the structure and current geometry of the western-central Alps: 1) nappe emplacement and stacking associated with single-vergent, NW-directed thrusting, and 2) backfolding associated with doubly-vergent, SE-directed movement. For the Monte Rosa region, early subduction and delamination of crustal units has been proposed to explain the nappe stack sequences that emplace ophiolite units onto continental crustal units, associated with areas of high-pressure metamorphism. However, the reasons for switching to late-stage backfolding associated with major uplift at lower grade metamorphic conditions is still ambiguous. This change in deformation style of the Alpine orogeny could potentially be explained by the relative weakening of the orogenic, wedge-shaped, lid with respect to the lower wedge in which nappe stacking took place.
We present simple two-dimensional numerical simulations of two-wedge corner flow, which aim to understand the mechanisms that control the large-scale geometries of the Alpine orogeny. The model consists of a lower wedge situated above the subducting European plate and an upper wedge, which represents the orogenic lid. The model is based on incompressible power-law viscous flow. We aim to quantify: 1) the differences between numerical solutions and analytical solutions valid for simple geometries and linear viscous flow, 2) the impact of variable viscosity contrasts between the two wedges, 3) the impact of an evolving deformable interface between the two wedges, and 4) the impact of linear and power-law viscous flow on the results. Moreover, we compare our model results with the current geometry and tectono-metamorphic history of the Monte Rosa region in the Western Alps.