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Fold interaction and linkage in 3D numerical models of multilayer detachment folding

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We have investigated the evolution, lateral propagation, interaction and linkage of folds that develop from random noise in several 3D high-resolution forward simulations of a multilayer detachment setup. Numerical simulations were performed using the parallel finite element code LaMEM (Lithosphere and Mantle Evolution Model) and are aimed at studying how folds grow and interact between each other within a model domain where statistically meaningful number of folds develop from random noise.

The non-dimensional parameters defined by Grasseman and Schmalholz (2012) together with curvature analysis were used to characterize the 3D folds and track their evolution. Importance of the initial rheological parameters on both wavelength (that can be predicted using computationally costless analytical solutions), and aspect ratio of the developed folds was investigated, as well as lateral propagation velocity of fold segments and linkage modes.

All linkage types defined by Bretis et al. (2011) based on geomorphological studies in the Zagros Mountains could be observed in simulations with different rheological parameters. The different ways in which the laterally propagating folds interact with each other further influence the wide variety of final fold geometries. On the one hand, dome-like structures result from folds that grow isolated by being prevented from linking with other contiguous folds. On the other hand, long folds result either from the linkage of several linearly contiguous structures (resulting in long and straight hinge line folds with several culminations and saddles), from the oblique linking of individual folds (forming long but deflected hinge line folds) or from a combination of both. Examples of all can be observed in the 3D numerical simulations. However, the final pattern of 3D fold interactions is initially controlled by the location of the initial random noise.

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