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Using the level set method in slab detachment modeling

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Slab detachment plays an important role in the dynamics of several regions in the world such as the Mediterranean-Carpathian region and the Anatolia-Aegean Region. It is therefore important to gain better insights in the various aspects of this process by further modeling of this phenomenon. In this study we model slab detachment using a visco-plastic composite rheology consisting of diffusion, dislocation and Peierls creep. In order to gain more control over this visco-plastic composite rheology, as well as some deterministic advantages, the models presented in this study make use of the level set method (Osher and Sethian J. Comp. Phys., 1988). The level set method is a computational method to track interfaces. It works by creating a signed distance function which is zero at the interface of interest which is then advected by the flow field. This does not only allow one to track the interface but also to determine on which side of the interface a certain point is located since the level set function is determined in the entire domain and not just on the interface. The level set method is used in a wide variety of scientific fields including geophysics. In this study we use the level set method to keep track of the interface between the slab and the mantle. This allows us to determine more precisely the moment and depth of slab detachment. It also allows us to clearly distinguish the mantle from the slab and have therefore more control over their different rheologies. We focus on the role of Peierls creep in the slab detachment process and on the use of the level set method in modeling this process.