Inverse and forward multiscale numerical modeling of the Alpine orogeny (IFMMALPO)

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The Alps is a part of the Alpide mountain belt which formed as a result of the collision of the African (Adriatic) and Eurasian plates during the Cenozoic Era. Numerical modeling of the collision process leading to the Alps formation might be a key to our understanding of tectonic processes accompanying the Alpine orogeny. Nevertheless, only few 2D numerical models for this region are known to date. These models consider deformation processes in the lithosphere, neglecting the influence of the mantle flow and 3D far-field stress originated from the large scale plate motion. To better understand how the mantle flow affects the lithospheric and crustal deformation during Alps formation since Early Cenozoic, a model of the relative plate's motion in a larger scale in 3D is required. However, it is not obvious how the heterogeneity of density and viscosity in the mantle can be related to plate motion and deformations in the lithosphere. The initiation of a forwards-in-time modelling of the plate motion in a past based on present-day knowledge of the mantle structure is also an issue because of several reasons such as an irreversible thermal diffusion and incomplete geophysical data for the Alps. To overcome these problems, we are going to use the latest methods and data provided by cooperation within the SPP 4D-MB project that will give us a possibility to create an inverse-in-time large-scale model of the whole-mantle convection during Cenozoic with a focus on the collision of the African and Eurasian plates and for the first time simulate in 3D+time the Alpine orogeny, using the results of the global mantle convection model as an initial an temporary varying boundary conditions. The IFMMALPO project will use the data from the seismic networks (AF-A,B,C,D), geological studies (AF-E) and contribute to the current and next stages of the SPP 4D-MB providing data on the structure, tectonic evolution (RT1, RT3), and the stress state of the lithosphere and mantle in the Alpine region (RT2, RT4).