The Geophysical Model Generator: A tool to unify and interpret geophysical datasets

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Geophysical datasets and their interpretations form the basis of geodynamic simulations of the Earth's mantle and lithosphere. Yet, going from data to models is often non-trivial, particularly in complex regions such as the Alps. This is because creating consistent three-dimensional models from these datasets is often challenging due to technical discrepancies such as different data set formats, different spatial resolutions or discrepancies between different data sets. At the same time, the different datasets obtained through initiatives such as AlpArray contain a wealth of data that can help to constrain subsurface models to an unprecedented extent. Yet interpreting these different data still involves subjective steps and ideally different datasets are combined in the process.

To facilitate the joint interpretation of these datasets and the generation of geodynamic model setups, we therefore developed an open-source package - the Geophysical Model Generator (GMG) - to assist with unifying these datasets in a common data format that can then be further used to visualize, compare and interpret data. Within this package, we provide a set of routines to import different datasets, convert them to a common data format and to process them further (e.g., to create vote maps from different tomographies). These unified datasets can then be exported as vtk-files for further 3D visualization (e.g., Paraview). Moreover, with the Geophysical Model Generator it is also possible to create model setups for numerical models (such as the 3D geodynamic code LaMEM). This package thus covers the entire workflow from data import to numerical model generation. Key features of the Geophysical Model Generator include 1) the creation of 3D volumes from seismic tomography models, 2) the import of 2D data (e.g., surface or Moho topography or screenshots from published papers) and 3) the incorporation of point data such as earthquake locations or GPS measurements. Both scalar and vector data can be handled. With these tools, one can then create a consistent overview of the entire data available for a given region.

The package is written in Julia and hosted as a public open-source repository on GitHub (https://github.com/JuliaGeodynamics/GeophysicalModelGenerator.jl). To assist the joint interpretation of different geophysical datasets, we furthermore provide a graphical user interface that allows to view and compare them (https://github.com/JuliaGeodynamics/DataPicker). The GUI works provides an interactive webpage, allows loading different datasets and facilitates the manual interpretation of different structures (such as subducting slabs) along profiles and visualize them in 3D while taking different data into account. An example of the current version is given in Figure 1.

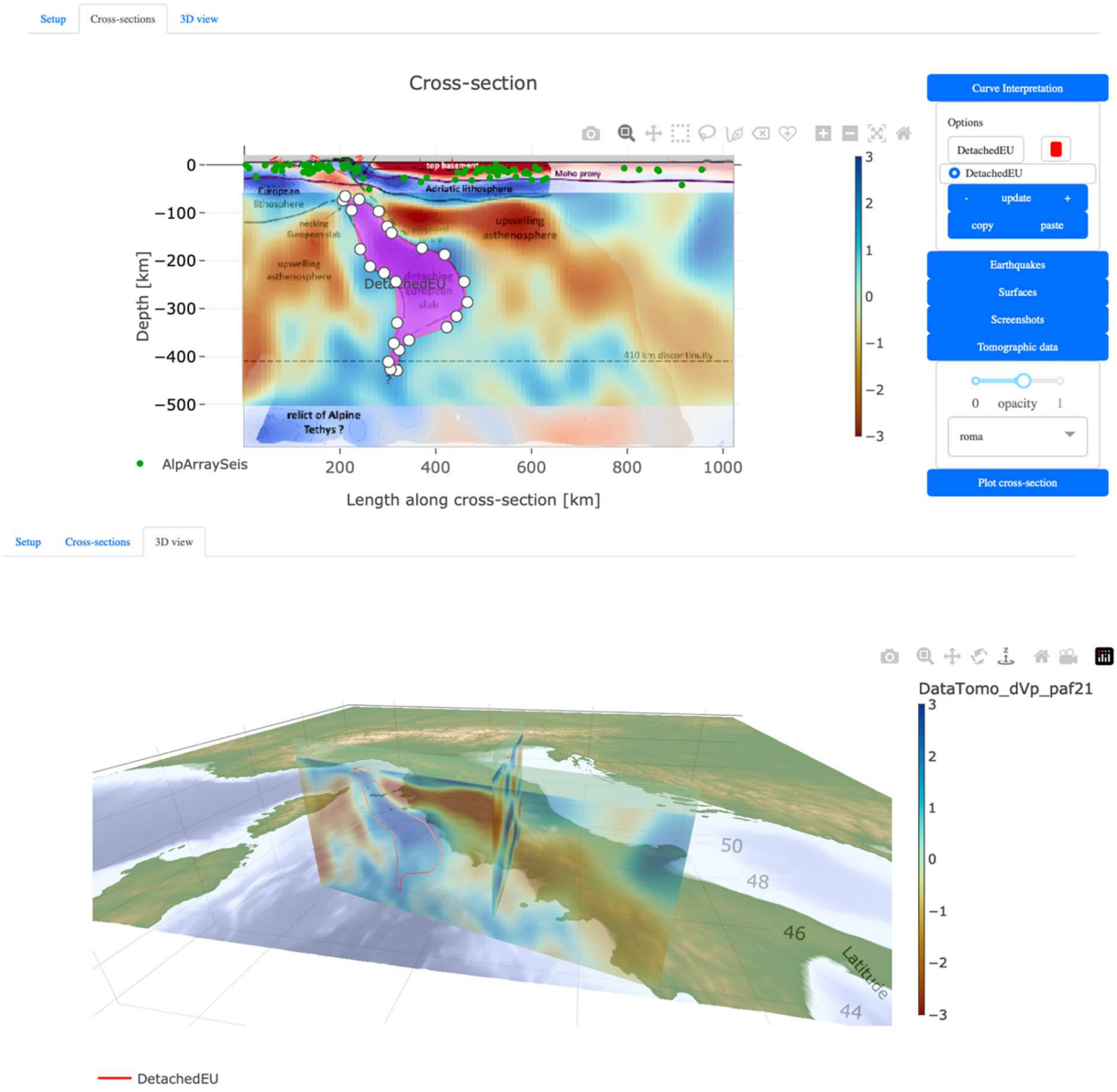

Figure 1: Snapshots of the GMG GUI with which Data processed with the Geophysical Model Generator can be analyzed and interpreted (provided in the GMG DataPicker package).