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Swiss Alps 3D: building a large-scale 3D underground model of the Central European Alps

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The Swiss Geological Survey (SGS) is the competence centre for the investigation of the subsurface and georesources of the Swiss Confederation. It provides up-to-date, high-quality spatial reference data for the entire country in the form of nationwide geological 2D datasets and 3D geological models. Between 2024 and 2030, the SGS is funding the Swiss Alps 3D (SA3D) project, which consists of eight research projects involving multiple universities and aims to develop a consistent large-scale underground 3D geological model of the main contacts and structures of the Central Alps.

In this presentation we show the workflow that will be used to build the SA3D model and the project plan until 2030. The main challenge for 3D modelling in Alpine regions is the lack of subsurface data (seismic data, borehole data, etc.). However, the high relief, the sparse vegetation and the large number of scientific studies make these regions an excellent site for advanced surface-based 3D geological modelling. In addition, researchers from several universities in Switzerland and Europe, as well as the SGS, have a wide range of expertise in regional geology and 3D geological modelling. SA3D aims to bring all this know-how together in teams of people with diverse expertise. The result will be a large-scale 3D geological model validated by scientific arguments.

Based on the new Tectonic Map of Switzerland 1:500'000 (swisstopo, 2024), the target area is divided into eight 3D modelling projects according to their paleogeographic origin and structural evolution. The resulting models will be then compiled into a single large-scale 3D model. Within each project, the target structural and lithostratigraphic contacts are modelled at the equivalent scale of 1:25'000. A network of regularly spaced (1000 m) geological cross sections and scientific concepts, discussed and reviewed by the different modelling teams, are then developed to strengthen the modelling interpolation. The workflow developed for the SA3D project offers the chance to gain validation approaches for domains only weakly constrained by/ or with no subsurface data available, by generating a 3D model that integrates multiscale geological data unified by a common dataset provided by the Tectonic Map.

SA3D will generate key knowledge by establishing an experienced modelling community and 3D visualization of the main geological structures and lithostratigraphic boundaries of the Central European Alps. The development of such a project will provide a framework model of the area as a basis for higher resolution 3D geological models to be used for infrastructure planning, groundwater studies, natural hazard assessment, education and research purposes. In addition, the models will facilitate access to strategic subsurface knowledge, which is essential for the management and exploration of geo-resources and geo-energy.