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# IGMAS+ – a tool for interdisciplinary 3D potential field modelling of complex geological structures.

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We introduce a new approach for 3D joint inversion of potential fields and its derivatives under the condition of constraining data and information. The interactive 3D gravity and magnetic application IGMAS (Interactive Gravity and Magnetic Application System) has been around for more than 30 years, initially developed on a mainframe and then transferred to the first DOS PCs, before it was adapted to Linux in the ’90s and finally implemented as a cross-platform Java application with GUI called IGMAS+. The software has proven to be very fast, accurate and easy to use once a model has been established. Since 2019 IGMAS+ has been maintained and developed in the Helmholtz Centre Potsdam – GFZ German Research Centre by the staff of Section 4.5 – Basin Modelling and ID2 – eScience Centre.

The analytical solution of the volume integral for the gravity and magnetic effect of a homogeneous body is based on the reduction of the three-folded integral to an integral over the bounding polyhedrons (in IGMAS polyhedrons are built by triangles). Later the algorithm has been extended to cover all elements of the gravity tensor as well. Optimized storage enables very fast inversion of densities and changes to the model geometry and this flexibility makes geometry

changes easy. The geometry is updated and the gravity is recalculated immediately after each change. Because of the triangular model structure, IGMAS can handle complex structures (multi Z surfaces) like the overhangs of salt domes very well. Geophysical investigations may cover huge areas of several thousand square kilometers but also models of Applied Geophysics at a meter scale. Due to the curvature of the Earth, the use of spherical geometries and calculations is necessary.

The model technique is user-friendly because it is highly interactive, operates ideally in real-time whilst conserving topology and can be used for both flat (regional) and spherical models (global) in 3D. Modeling is constrained by seismic and structural input from independent data sources and is essential toward true integration of 3D thermal modeling or even Full Waveform Inversion. We are close to the demand for treating all geophysical methods in a single model of the subsurface and aim of fulfilling most of the constraints: measurements and geological plausibility.

We demonstrate the flexibility of the software by modeling: (1) the southern segment of the Central Andes which is designed to assess the relationship between the characteristics of the overriding plate and the deformation and dynamics of the subduction system; (2) the South Caribbean margin which defines the two flat-slab subductions of the Nazca Plate and the Caribbean Plate, with variable mantle density distribution implemented by voxels; (3) the North Patagonian Massif Plateau in Argentina which provides insight into the main height differences between the plateau and the surroundings; and (4) an Alpine model which interrogates the strength of the lithosphere at different locations through the Alps and their forelands.