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New algorithm to eliminate sources till a prescribed depth, or how one can cut a field in slices

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A new algorithm has been derived to eliminate the sources from the Earth's surface till a prescribed depth h. The algorithm allows to separate the effects of subsurface and deeper objects and to extract the gravity signal of sources located in horizontal layer between given depths. The algorithm along with our programs for 3D gravity data inversion is applied to find a 3D relief of the Moho boundary for the Hellenic subduction zone.

The algorithm is based on upward and downward continuation and includes two steps. Firstly, we continue the data upward to the height z=h to diminish the influence of the sources in the subsurface layer. This operation causes the main errors in the vicinity of the boundary of the area. To reduce them we subtract previously from the given field the values of a function, which we treat as a regional field. Secondly, we continue the obtained function downward to the depth z=h, i.e. to the distance 2h in downward direction. It should be emphasized, that the problem of downward continuation is a linear ill-posed inverse problem, therefore we must use some regularization. Since the integral operator is self-adjoint and positive, we apply the Lavrent'ev's approach. The obtained field has no singularities till the depth h, so we could treat it as an effect of the deeper sources.

The same approach is applied for the spherical geometry. In this case we use not a solution of the Dirichlet problem for a half-space, but the Poisson kernel; we don't need to subtract preliminaty some function. For a global gravity field, generated by means of harmonic coefficients, derived from satellite data, our algorithm provides an opportunity to evaluate the field of the sources till a prescribed radius or to extract the signal of sources located in a given spherical layer.