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Exploiting along-track GOCE gravity gradients for the modeling of subduction plates

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The study of subduction zones, i.e. regions where one tectonic plate moves under another and sinks into the mantle, is a fundamental topic in many Earth related sciences. For example it is required in tectonophysics to model Earthquakes, it is useful in petrology and it is a basic information to study the Earth crust by means of gravity observations.
In the present work the possibility of characterizing subduction zones by exploiting GOCE along-track gravity gradients is investigated. Basically the proposed solution consists of the following steps. First of all the gravitational effect of the subduction plate is isolated. Afterwards, a geometrical model of the plate, characterized by a set of unknown parameters (e.g. coordinates of the barycenter, size, dipping and strike angles), is defined and its gravitational effect is computed by means of point masses. Finally the unknown parameters are estimated by fitting the residual GOCE signal with the model gravitational effect by means of a simulated annealing procedure.
The whole procedure has been firstly applied on a closed-loop experiment to assess the performance of the inversion algorithm and then it has been applied to real data to study the Tonga subduction. The closed-loop simulation confirmed the efficiency of the proposed approach in estimating the subducting plate parameters even in presence of noise. As for the Tonga subduction, the estimated model seems to confirm the geometry already proposed in literature.