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A new procedure to built a model covariance matrix: first results

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In order to validate the results of geophysical models a common procedure is to compare model predictions with observations by means of statistical tests. A limit of this approach is the lack of a covariance matrix associated to model results, that may frustrate the achievement of a confident statistical significance of the results. Trying to overcome this limit, we have implemented a new procedure to build a model covariance matrix that could allow a more reliable statistical analysis.
This procedure has been developed in the frame of the thermo-mechanical model described in Splendore et al. (2010), that predicts the present-day crustal velocity field in the Tyrrhenian due to Africa-Eurasia convergence and to lateral rheological heterogeneities of the lithosphere. Modelled tectonic velocity field has been compared to the available surface velocity field based on GPS observation, determining the best fit model and the degree of fitting, through the use of a $\chi 2$ test.
Once we have identified the key models parameters and defined their appropriate ranges of variability, we have run 100 different models for 100 sets of randomly values of the parameters extracted within the corresponding interval, obtaining a stack of 100 velocity fields. Then, we calculated variance and empirical covariance for the stack of results, taking into account also cross-correlation, obtaining a positive defined, diagonal matrix that represents the covariance matrix of the model. This empirical approach allows us to define a more robust statistical analysis with respect the classic approach.

Reference

Splendore, Marotta, Barzaghi, Borghi and Cannizzaro, 2010. Block model versus thermomechanical model: new insights on the present-day regional deformation in the surroundings of the Calabrian Arc. In: Spalla, Marotta and Gosso (Eds) Advances in Interpretation of Geological Processes: Refinement of Multi scale Data and Integration in Numerical Modelling. Geological Society, London, Special publications, 332, 129-147. Doi: 10.1144/SP332.9 0305-8719/10.