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3D imaging of the Corinth rift from a new passive seismic tomography and receiver function analysis

Maxime Godano (1,2), Alexandrine Gesret (1), Mark Noble (1), Hélène Lyon-Caen (2), Stéphanie Gautier (3), and Anne Deschamps (4)

(1) MINES ParisTech, PSL - Research University, Centre for geosciences and geoengineering, Fontainebleau, France, (2) Laboratoire de Géologie, Ecole Normale Supérieure, PSL - Research University, UMR8538 CNRS, Paris, France, (3) Géosciences Montpellier, Université de Montpellier, France, (4) Géoazur, Université de Nice Sophia-Antipolis – CNRS – IRD – OCA, Valbonne-Sophia Antipolis, France

The Corinth Rift is the most seismically active zone in Europe. The area is characterized by very localized NS extension at a rate of $\sim$ 1.5cm/year, the occurrence of frequent and intensive microseismic crises and occasional moderate to large earthquakes like in 1995 (Mw=6.1).
Since the year 2000, the Corinth Rift Laboratory (CRL, http://crlab.eu) consisting in a multidisciplinary natural observatory, aims at understanding the mechanics of faulting and earthquake nucleation in the Rift. Recent studies have improved our view about fault geometry and mechanics within CRL, but there is still a critical need for a better knowledge of the structure at depth both for the accuracy of earthquake locations and for mechanical interpretation of the seismicity.
In this project, we aim to analyze the complete seismological database (13 years of recordings) of CRL by using recently developed methodologies of structural imaging, in order to determine at the same time and with high resolution, the local 3D structure and the earthquake locations.
We perform an iterative joint determination of 3D velocity model and earthquake coordinates. In a first step, P and S velocity models are determined using first arrival time tomography method proposed by Taillandier et al. (2009). It consists in the minimization of the cost function between observed and theoretical arrival times which is achieved by the steepest descent method (e.g. Tarantola 1987). This latter requires computing the gradient of the cost function by using the adjoint state method (Chavent 1974). In a second step, earthquakes are located in the new velocity model with a non-linear inversion method based on a Bayesian formulation (Gesret et al. 2015). Step 1 and 2 are repeated until the cost function no longer decreases.
We present preliminary results consisting in: (1) the adjustement of a 1D velocity model that is used as initial model of the 3D tomography and (2) a first attempt of the joint determination of 3D velocity model and earthquake location.
In addition to the tomographic imaging, we perform a preliminary receiver function analysis of teleseismic data recorded by the broadband stations of the CRL network. The RF analysis should provide the interface depths beneath seismometers and increase the imaging resolution of the upper crustal structures provided by the 3D tomography. In this first attempt, we adjust the 1D velocity model that produces a synthetic RF as similar as possible to the observed RF for a subset of data. We compare the identified interfaces with structures imaged by the tomography.