SAR multi-temporal interferometry for precise ground deformation mapping of the Corinth rift, Greece. Deriving parameters of Rio-Patra oblique slow slipping fault

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The Corinth Rift (Greece) is one of the narrowest and fastest extending continental regions worldwide, and has one of the highest seismicity rates in the Euro-Mediterranean region. At its western termination, several active faults are located beneath the city of Patras and the surrounding area, a region of major socio-economic importance for Greece.

The Corinth Rift (Greece) is one of the narrowest and fastest extending continental regions worldwide. It is bounded on both sides by active normal faults, on- and off-shore (Moretti et al., 2003; Palyvos et al., 2007) with cumulated offset ~3 km and a series of tilted blocks along the south coast (Doutsos and Poulimenos, 1992; Koukouvelas et al., 1999). It has one of the highest seismicity rates in the Euro-Mediterranean region with, on average, one Mw > 6 earthquake per decade. Recent large earthquakes include Alkyonides 1981 (M = 6.7), Galaxidi 1992 (Mw = 5.8), Aigion 1995 (Mw = 6.1) and Movri 2008 (Mw = 6.4). This last event is located outside of the rift, but is connected to it and is crucial for deciphering the deformation processes at the western termination of the rift and its junction with the Gulf of Patras, where, several active faults are located beneath the city of Patras and the surrounding area, a region of major socio-economic importance for Greece. Previous geodetic studies conducted, which were based on GPS observations observations, revealed North – South extension rates across the gulf of up to about 1.5 cm/yr [Clarke et al., 1997; Briole et al., 2000; Avallone et al., 2004] during the last 20 years.

The Corinth Rift Laboratory (CRL) institution (http://crlab.eu) is based on the joint efforts of various European institutions to study fault mechanics and related hazards in the study area. It is included in Geohazards Natural Laboratories of the GEO Supersites and will be one of the Near Fault Observatories (NFO) of European Plate Observing System (EPOS).

Displacement rates for the period 2002-2010 obtained from ascending and descending ASAR/ENVISAT multi-temporal interferometry are combined with Global Positioning System measurements from permanent and campaign stations to produce a map of vertical and east-west ground velocities. More specifically initial datasets derived from Persistent Scatterers and Small baselines Subsets techniques. These datasets has been doubled by performing a second running with different initial parameters. Combination of ascending and descending tracks has been used to calculate the east-west and vertical deformation components rates. The wealth of information provided by the availability of eight measurements per original pixel and the combination of several original pixels, allows tracking efficiently the unwrapping errors. Finally improved vertical and east-west velocities were calculated by using an averaging filter and a cutoff threshold based on r.m.s. scattering.

In the city of Patras and through the gulf of Patras, the northern continuation of the 2008 Movri earthquake fault (Serpetsid;aki et al., 2014) is connected to the oblique transform zone of Rio. The Rio-Patras fault is off-shore, in front of downtown Patras and penetrates inland between Patras and Rio. Then it rotates progressively and connects with the Psathopyrgos normal fault at the entrance to the Corinth rift. To model the GPS and InSAR velocities, we assume a fault system locked in part of the crust and slowly slipping elsewhere. The deformation shape of the Rio-Patras fault indicates a shallow locking depth and suggests slow slipping below that depth. The large gradient of strike-slip velocities between the south and the north coast at both ends of the Rio-Antirio bridge support a model of deformation accumulation in a very narrow locked layer in the crust, with the rest being unlocked, and therefore not associated with strong seismicity (at least in the last decades until present).

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