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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Introduction

The Corinth Rift in Greece (Fig.1) lays between the collision of the Anatolian and the African Plates, with subduction of the latter in the Hellenic Arc.

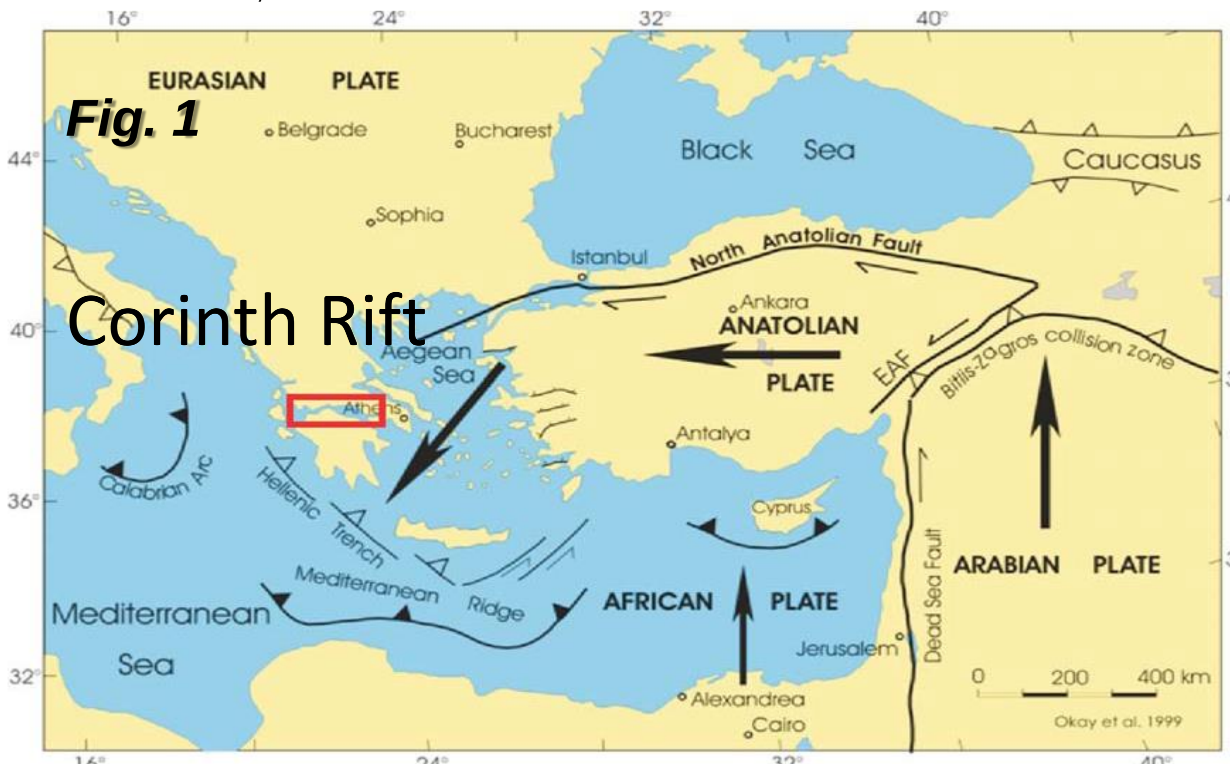


Fig1. With red rectangle the Corinth Rift is shown.

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 with cumulated offset ~3 km and a series of tilted blocks along the south coast. 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) (Fig2).

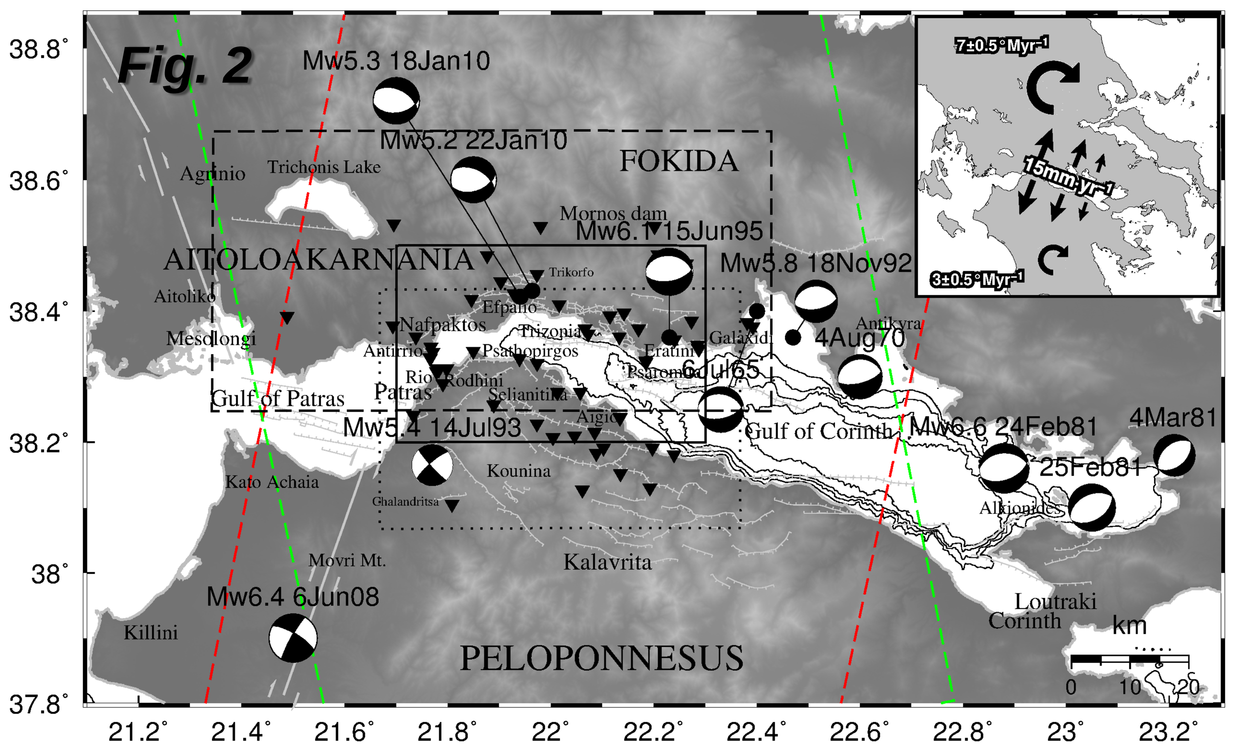


Fig2. Major earthquakes in the last ~50 years in and around the Corinth rift. Red and green dashed lines show the swaths of the ASAR/ENVISAT ascending track 415 and descending track 279, respectively used in the study . Reversed black triangles show the locations of the GNSS sites used in the study. The solid and the dotted box delimit the north and the south 'view', respectively.

Previous geodetic studies conducted, which were based on GPS observations, revealed North – South extension rates across the gulf of up to about 1.5 cm/yr during the last 20 years.

The Corinth Rift Laboratory (CRL) **(http://crlab.eu)** is based on the joint efforts of various European institutions to study fault mechanics and related hazards. 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).

Deformation rate map of the Corinth Rift Laboratory

70 ASAR/ENVISAT acquisitions between 2002-2010 used to produce 700 interferograms with Doris software from two LOS (Fig.2) and produced 8 layers of multitemporal interferometry (PSI/SBAS) deformation rates using StaMPS software. Then we used 73 GNSS horizontal deformation rates to eliminate tiltings, set the reference and extract vertical and east-west (Fig.3) deformation rates.

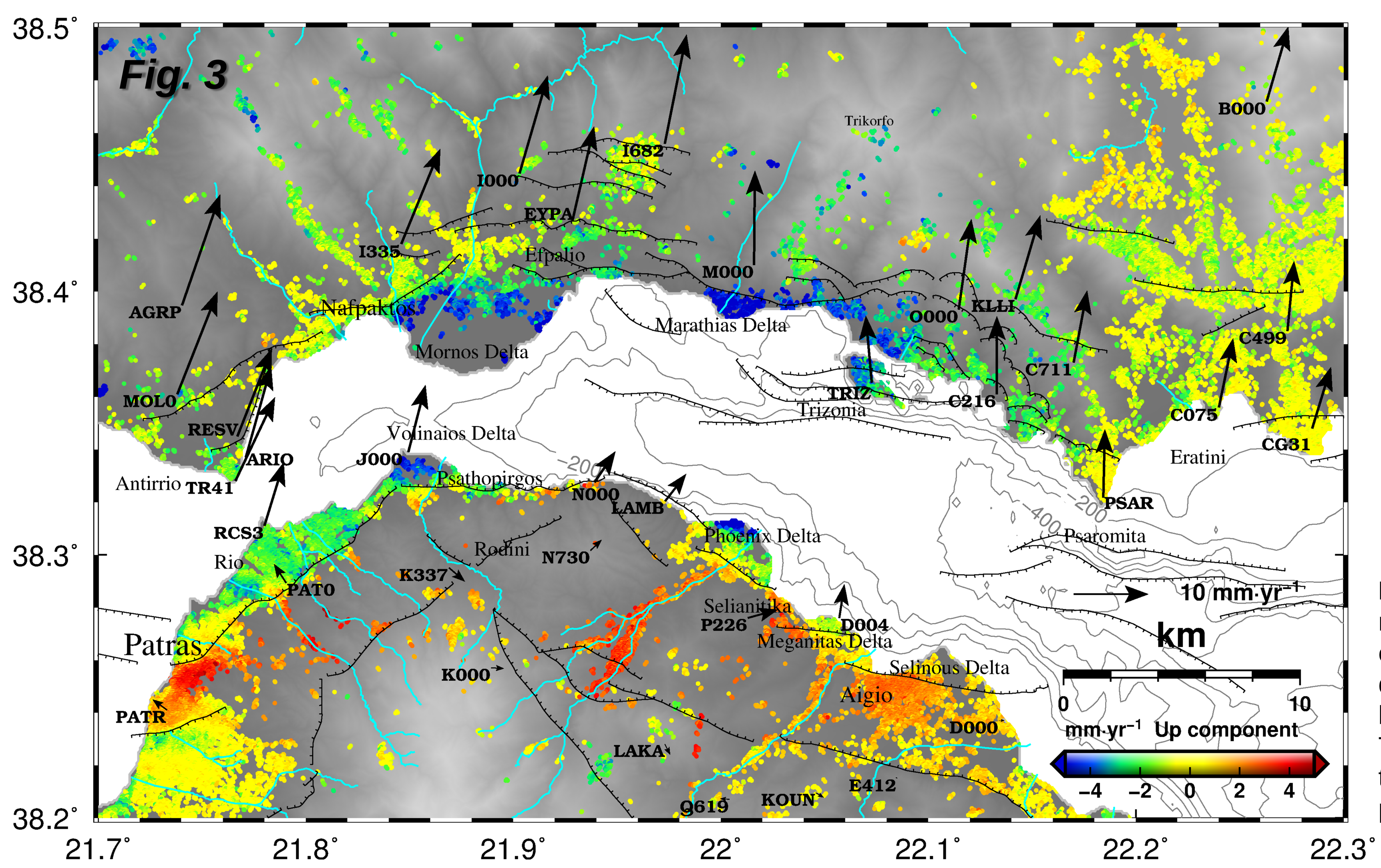


Fig3. Vertical velocities map from the combination of ascending and descending views. Black lines indicate the faults. The velocity vectors and the names of the GNSS points are shown

Applying a special postfilter on 8 multipass/multiprocessed layers of deformation rates including spatial averaging and r.m.s. cutoff criterion we produced a more precise deformation rate map. (Fig.4).

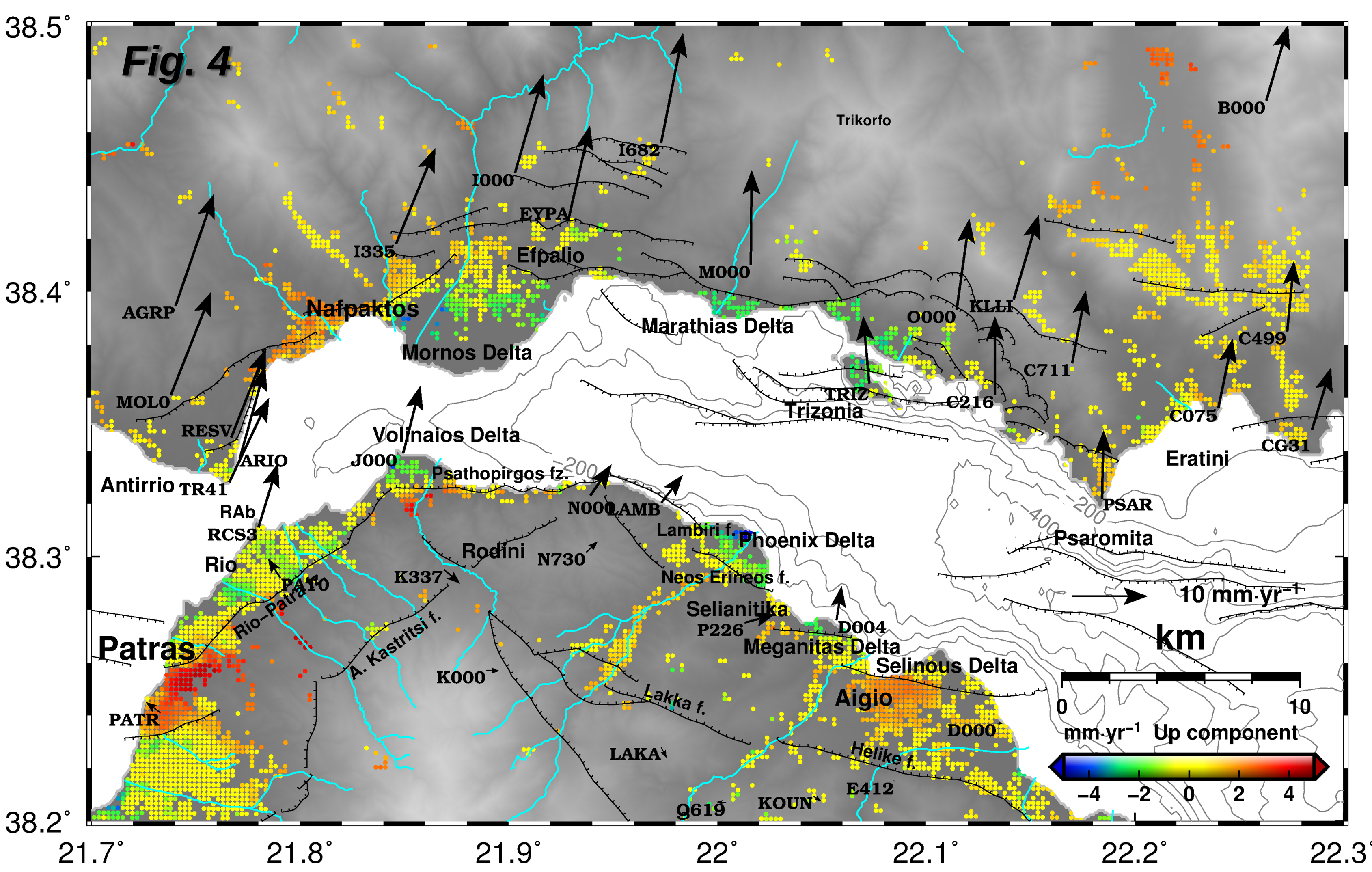
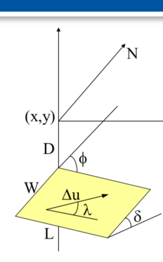


Fig4. Best constrained 4391 vertical PS/SBAS velocities for pixels of 200m. This is the best results when using pixels of 200m x 200m (doi:10.5281/zenodo.1205496)

The velocities are available at http://nfo.crlab.eu/insar-velocities

Rio-Patra fault Zone

Exploiting 8 continuous GNSS horizontal rates and assuming that a fault system is locked in part of the crust and slowly slipping elsewhere, we modelled the Rio-Patras fault system using the nine parameters of the Okada formalism (right). We modelled two main segments (Fig.5 right) : F1 oblique right-lateral, its top buried at 0.6 km, dipping NNW with an angle of 45° and a slip rate of 9 mm/year, width 2km and F2 vertical, its top buried at a depth of 2 km, width of 15km and a slip rate of 5 mm/year



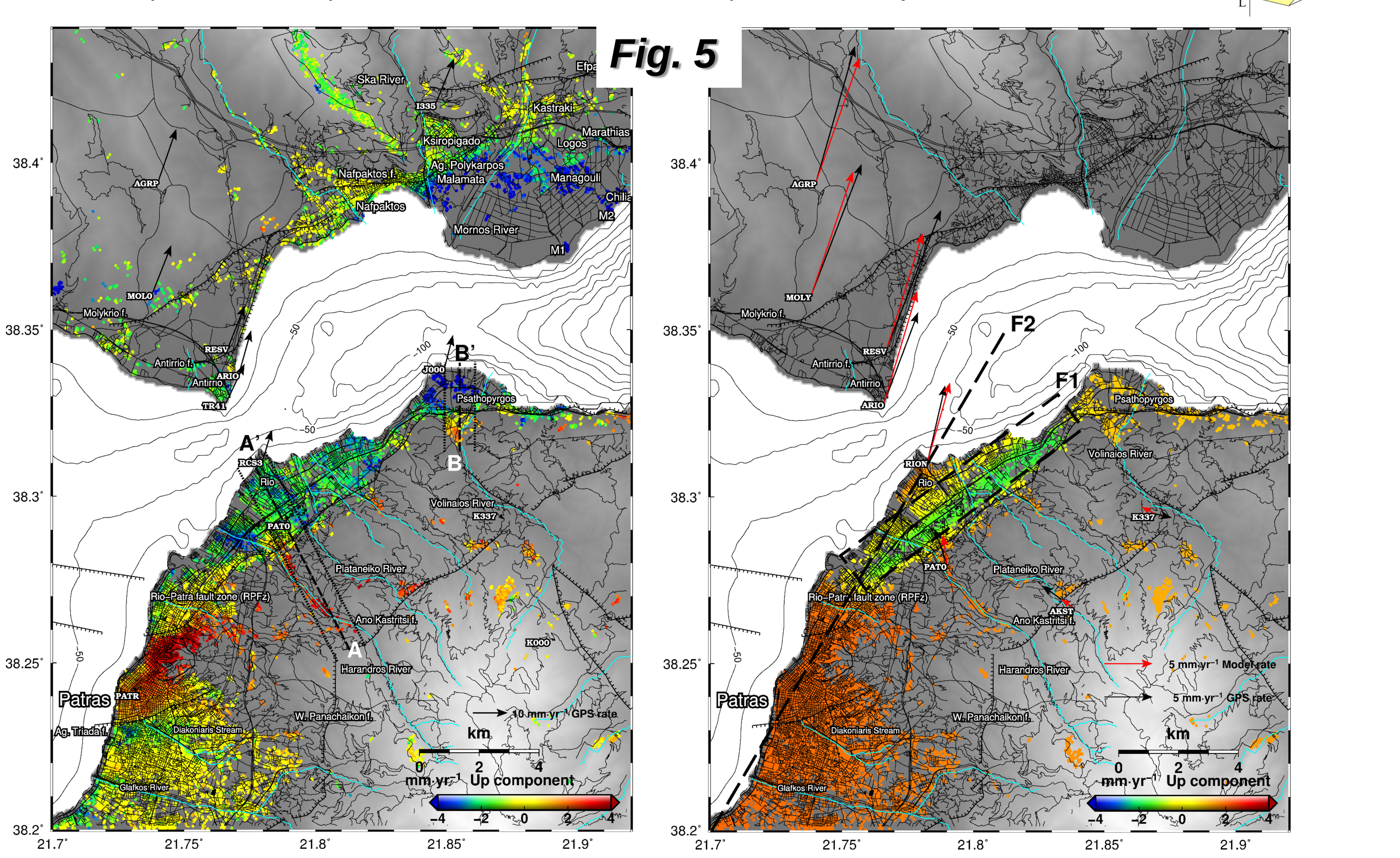


Fig5. Left: InSAR vertical velocities at the western termination of the Corinth rift, between Nafpaktos and Patras.. The dashed line A-A' corresponds to section across the Rio-Patras fault shown in Fig. 6. **Right:** Model of ground deformation induced by a hypothetical Rio-Patras fault marked by the dashed black rectangle F1 and line F2. Observed and modeled GNSS velocities are marked with black and red arrows

In Fig. 6 the full resolution and the best constrained vertical rates (for the cross section A-A' defined at Fig.5) are plotted. The discrepancy between the modeled and the observed rates could explained by the subsidence of the Rio area (due to sediment compaction or underground water drainage processes, parallel to the profile line) close to the coast (i.e. in the hanging wall of the fault between the shore and the fault line).

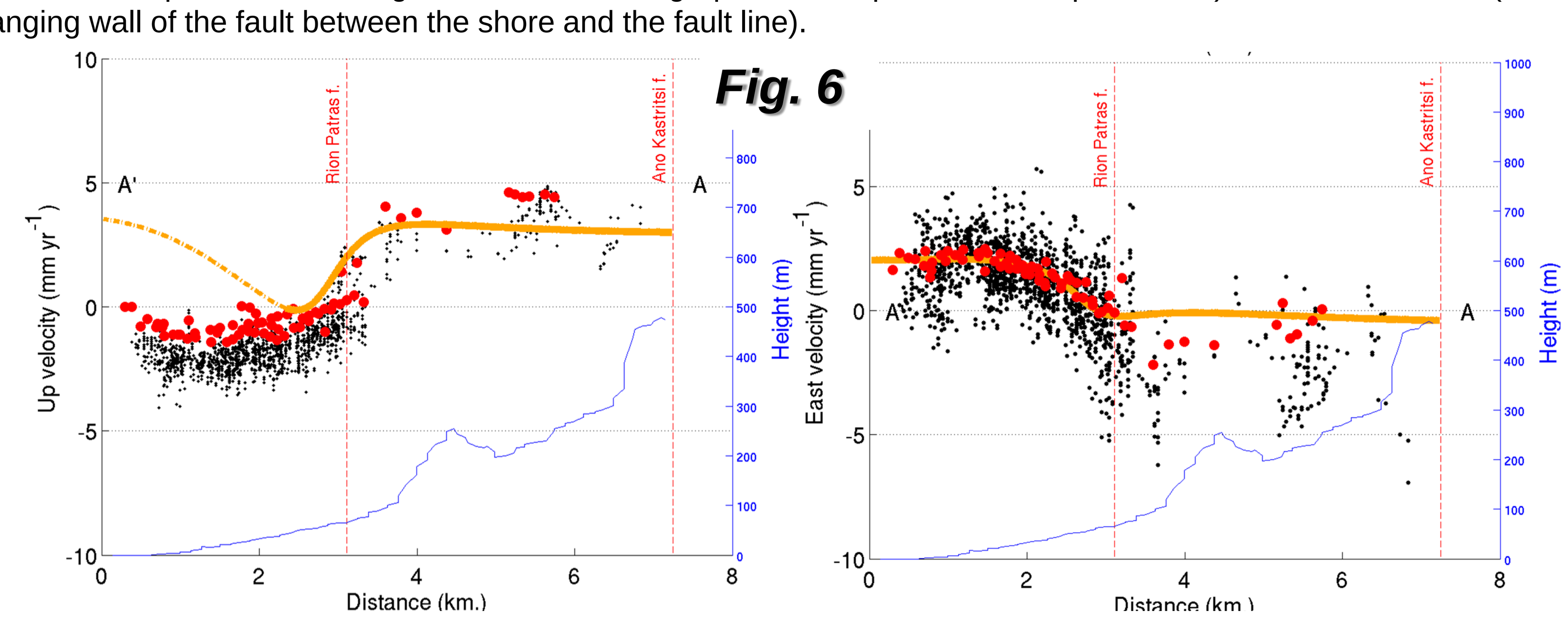


Fig6. Left: Vertical InSAR velocities across the Rio-Patras fault at the level of the section A-A' (see Fig. 5). The blue line is the elevation profile along the section. The selected pixels are those located between the two dotted lines visible on both sides of the section in Fig. 5. The red dots are the best constrained 4391 dataset, the black points are the original velocities using all selected pixels. The orange line is the prediction of the model. **Right :** Same as Fig. 11a but for the eastward velocities (with respect to Peloponnesus).

Reference - Acknowledgments

- Elias P. and Briole P., 2018. Ground deformations in the Corinth rift, Greece, investigated through the means of SAR multi-temporal interferometry. Geochemistry, Geophysics, Geosystems.

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