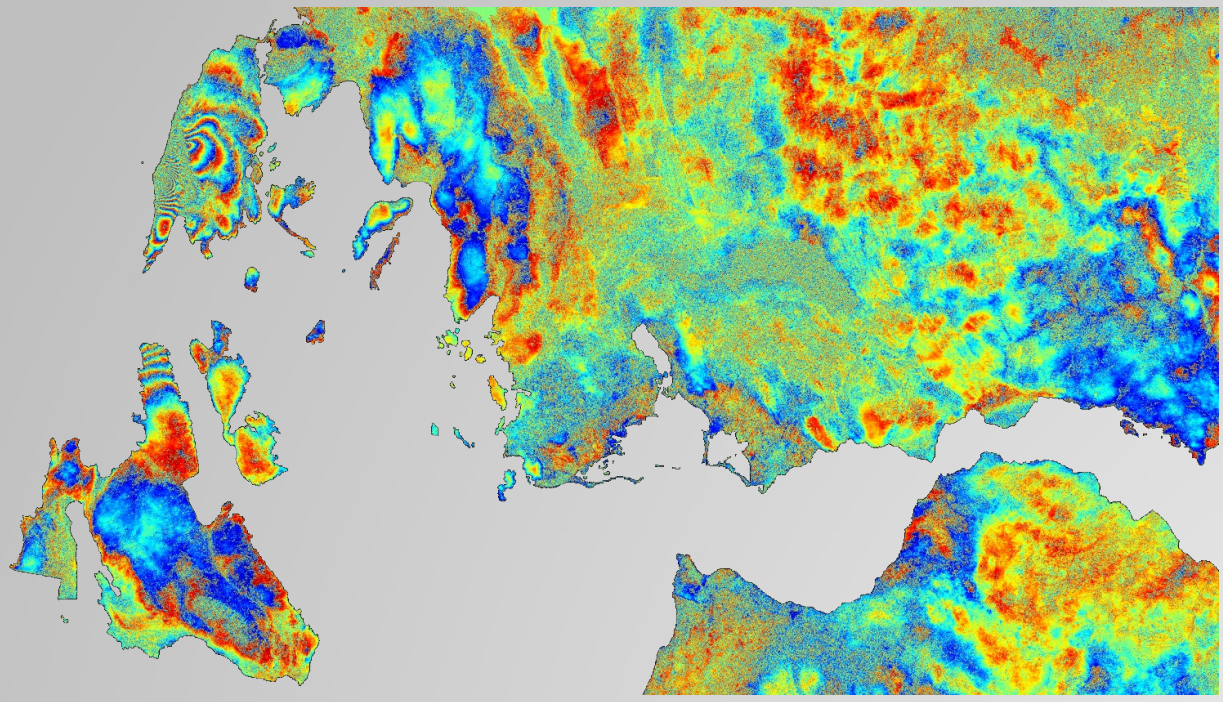
CRL - GEP meeting

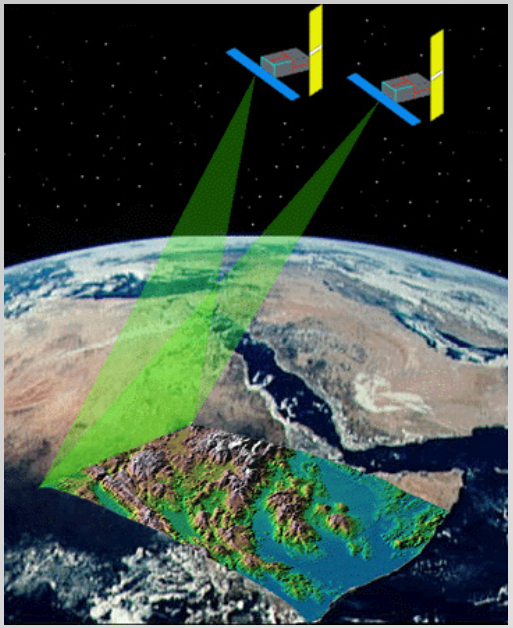
Corinth Rift Laboratory (CRL)
Imaging and monitoring the ground deformation exploiting space geodesy



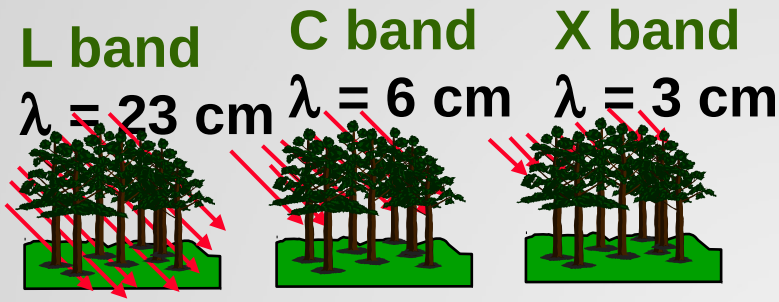
Panagiotis Elias - Pierre Briole (PI of CRL-GEP Pilot Project)
& CRL team

Space missions with InSAR capability

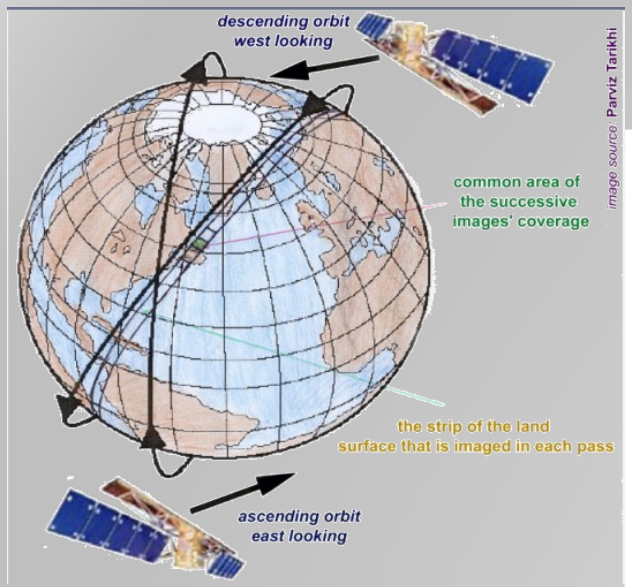
- **ERS 1** 1992-2000 – band C
- **ERS 2** 1995-2001 – band C
- **ENVISAT** 2002-? – band C
- **RADARSAT 1** 1995-? – band C
- **RADARSAT 2** 2007-?– band C
- **ALOS** 2006-? – band L
- **ALOS-2** 2014-? – band L
- **TERRASAR X** 2007-? – band X
- **COSMO** 2007-? – band X
- **SENTINEL 1** (GMES, 2011) – band C

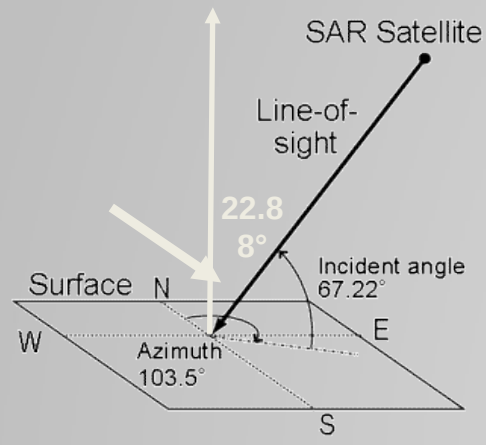


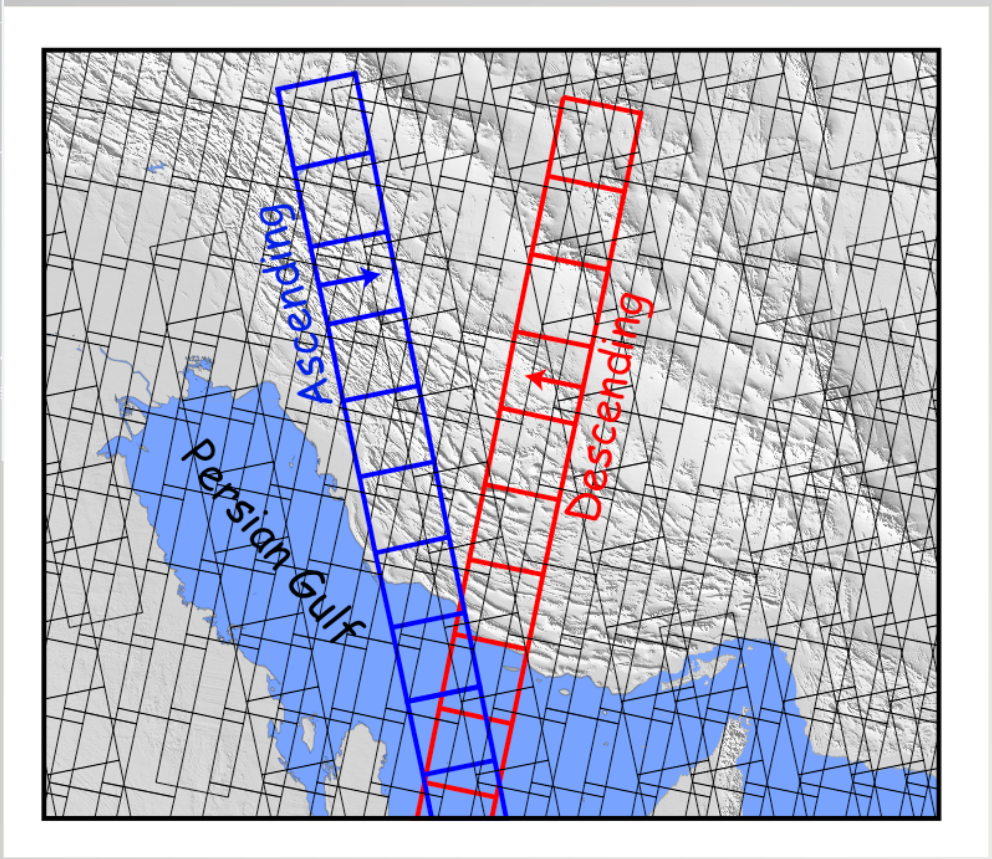
Revisit time: 4 to 35 days



Acquisition Geometry

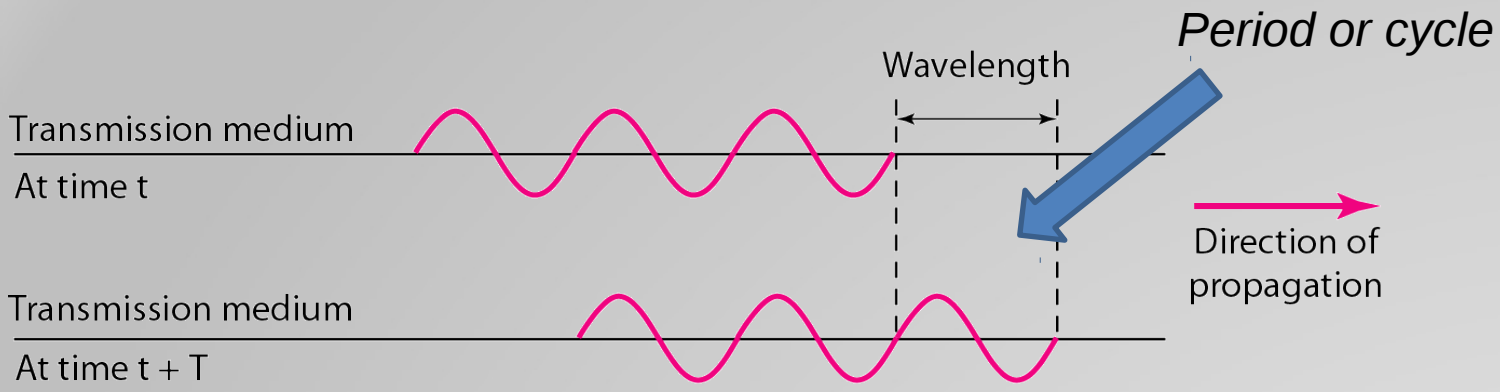


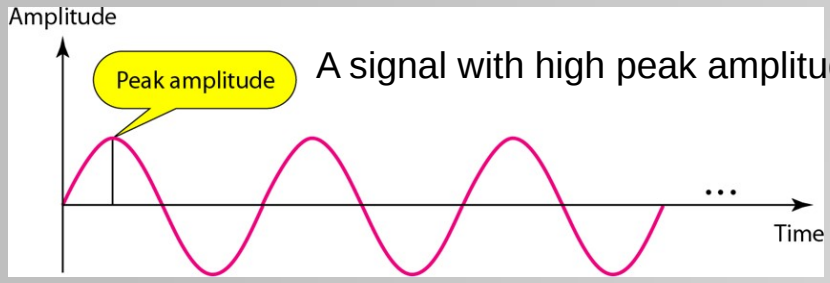


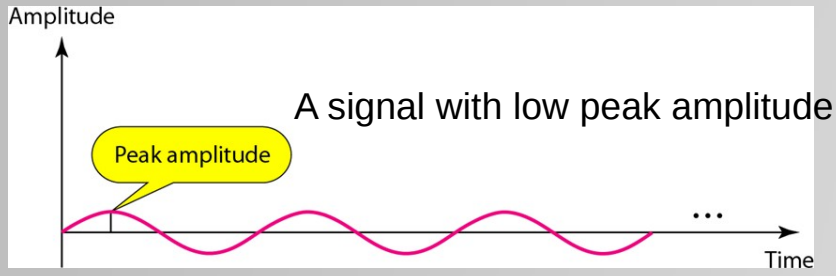


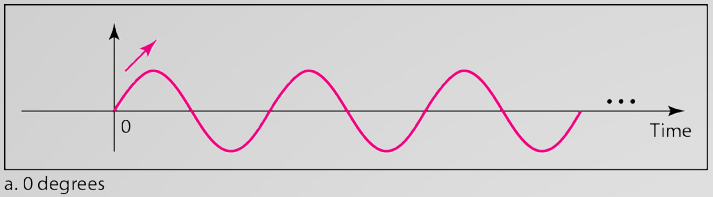
Modified from Rowena Lohman

Signal Properties

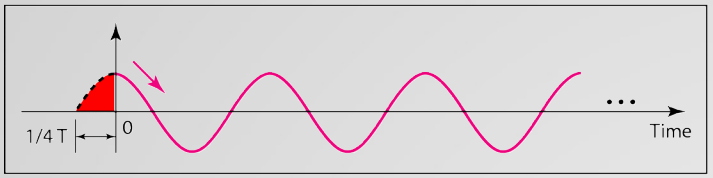




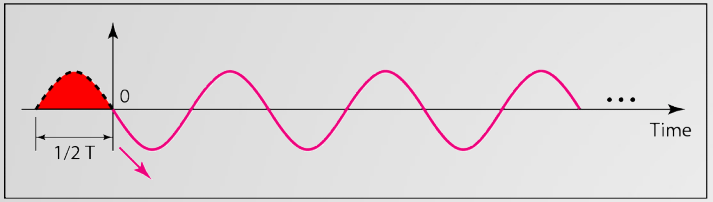




a. 0 degrees



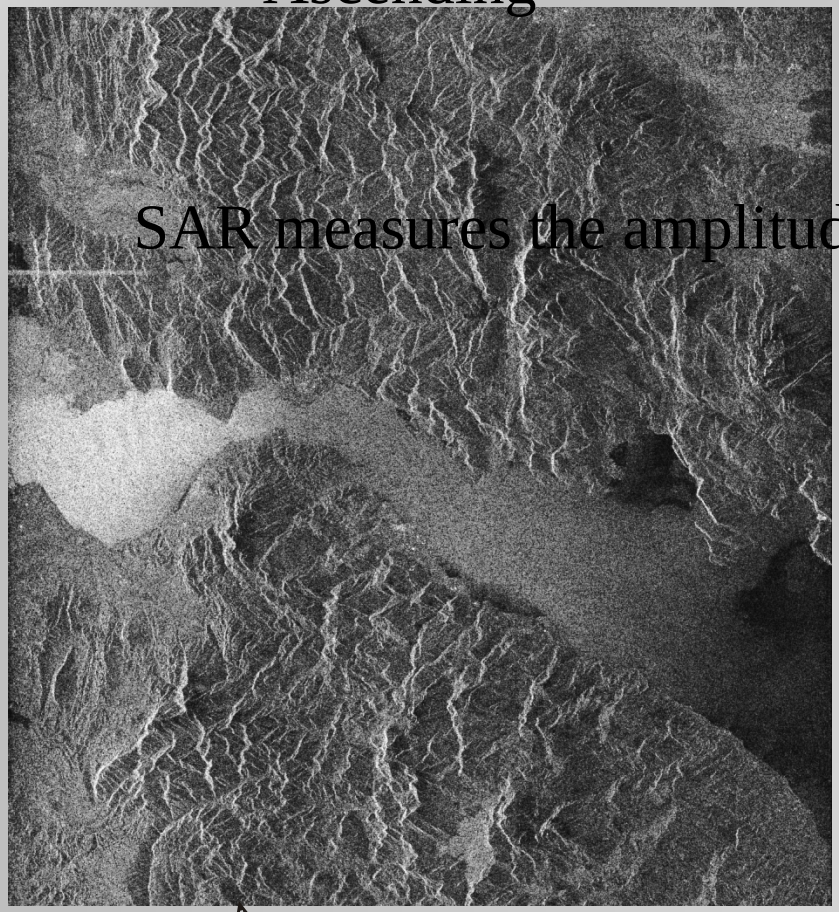
b. 90 degrees



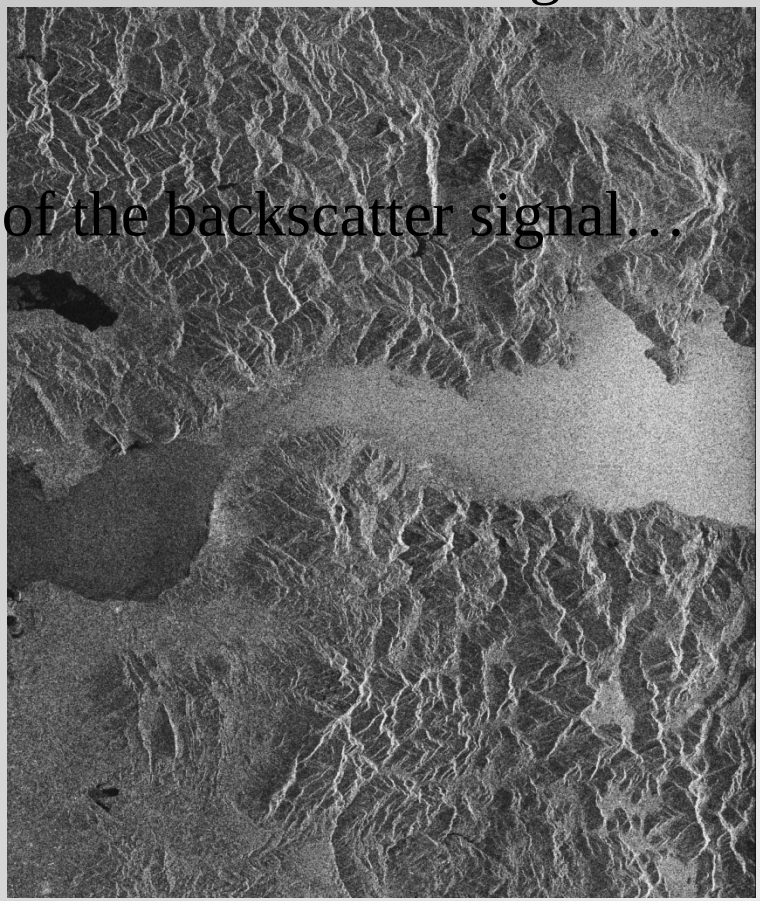
c. 180 degrees

Synthetic image of the amplitude of microwave backscattering

Ascending



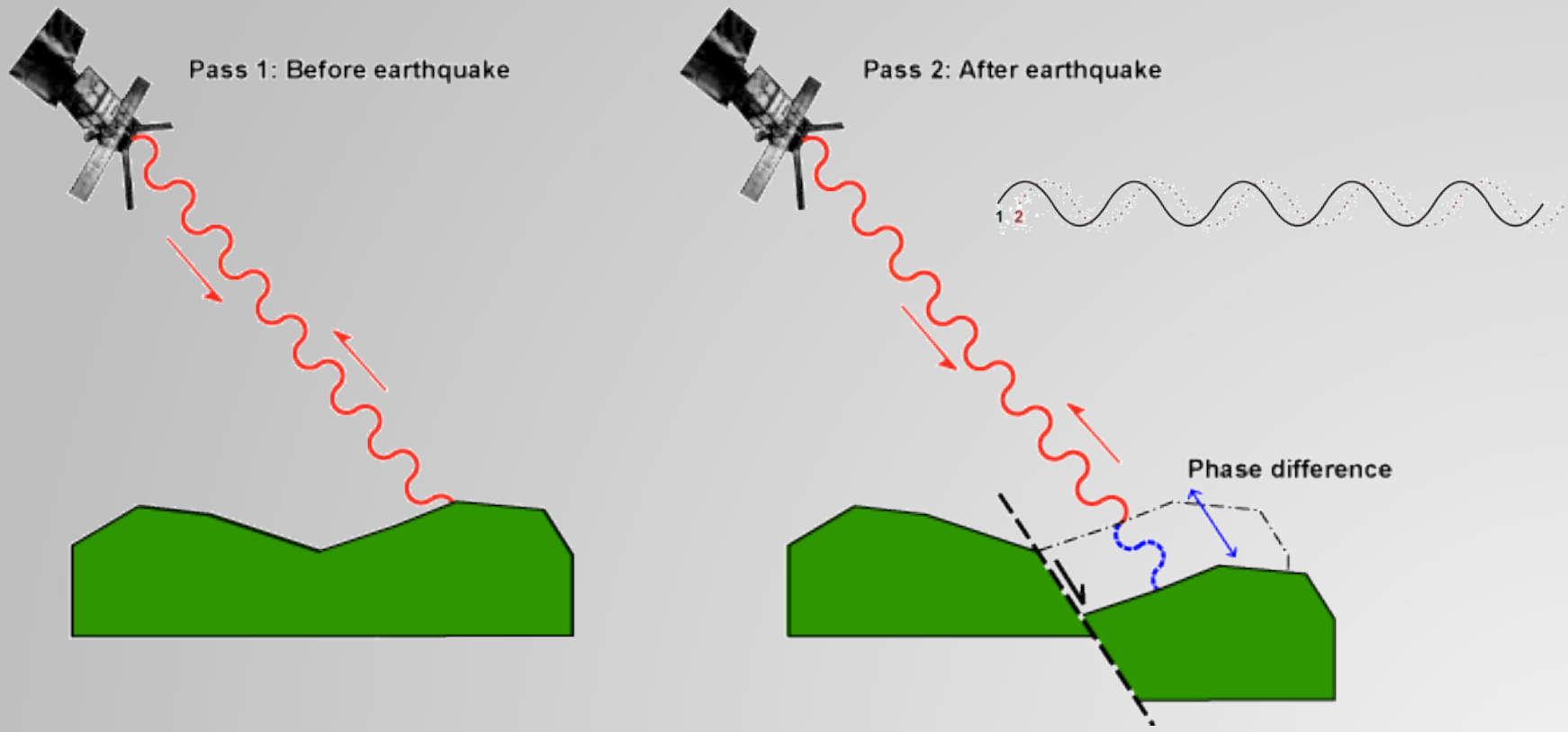
Descending



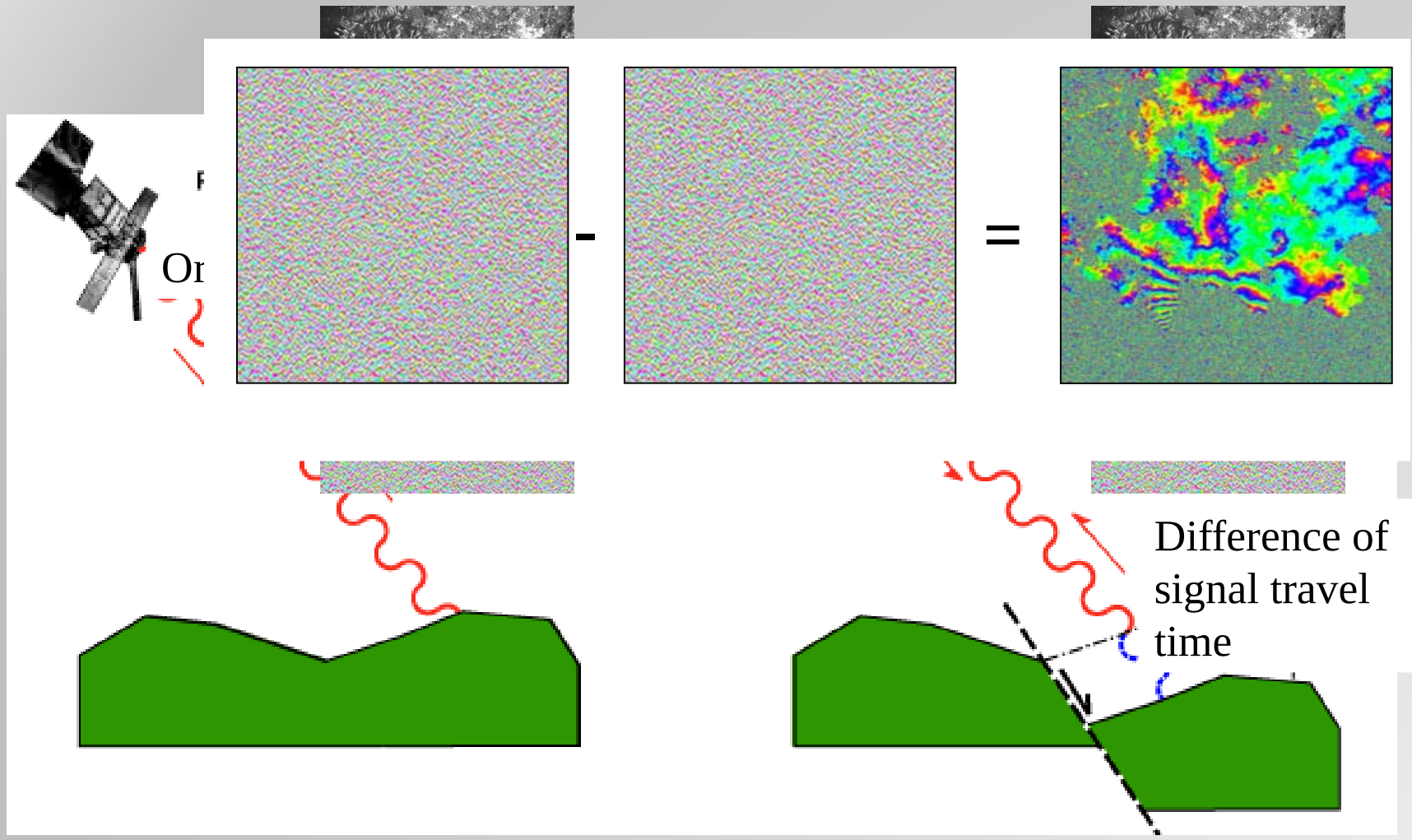
SAR measures the amplitude of the backscatter signal…

Phase difference of microwave backscattering

…and also the difference of phase between the transmitted
and backscatter signal in the LOS between to different time slots

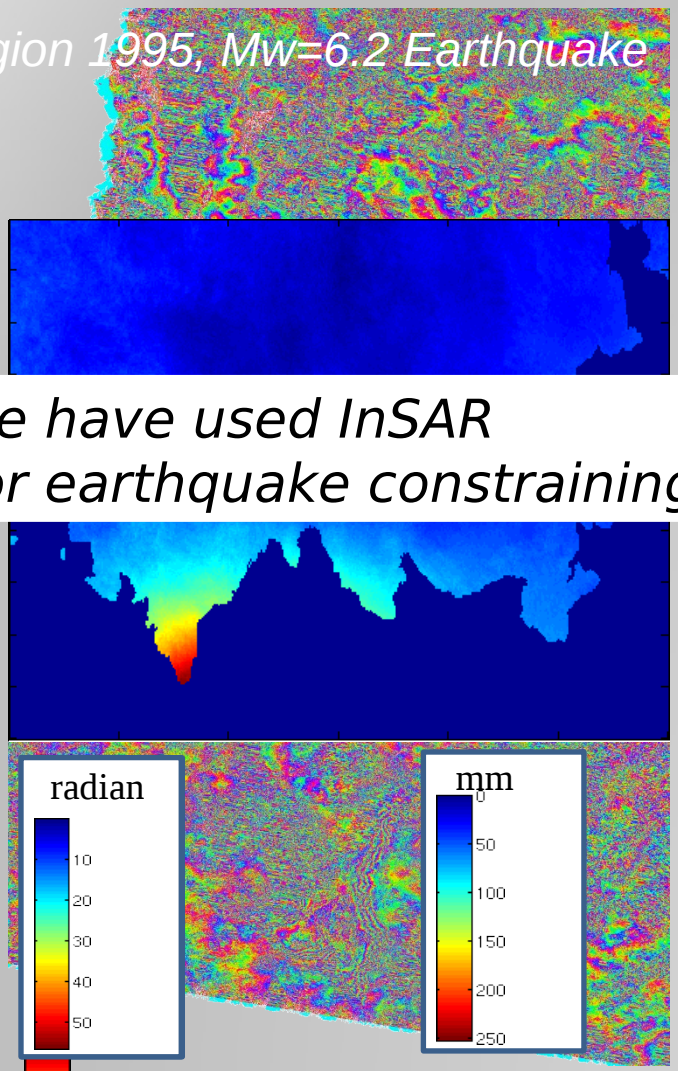


Correlation of SAR images



Differential and multitemporal Interferometry

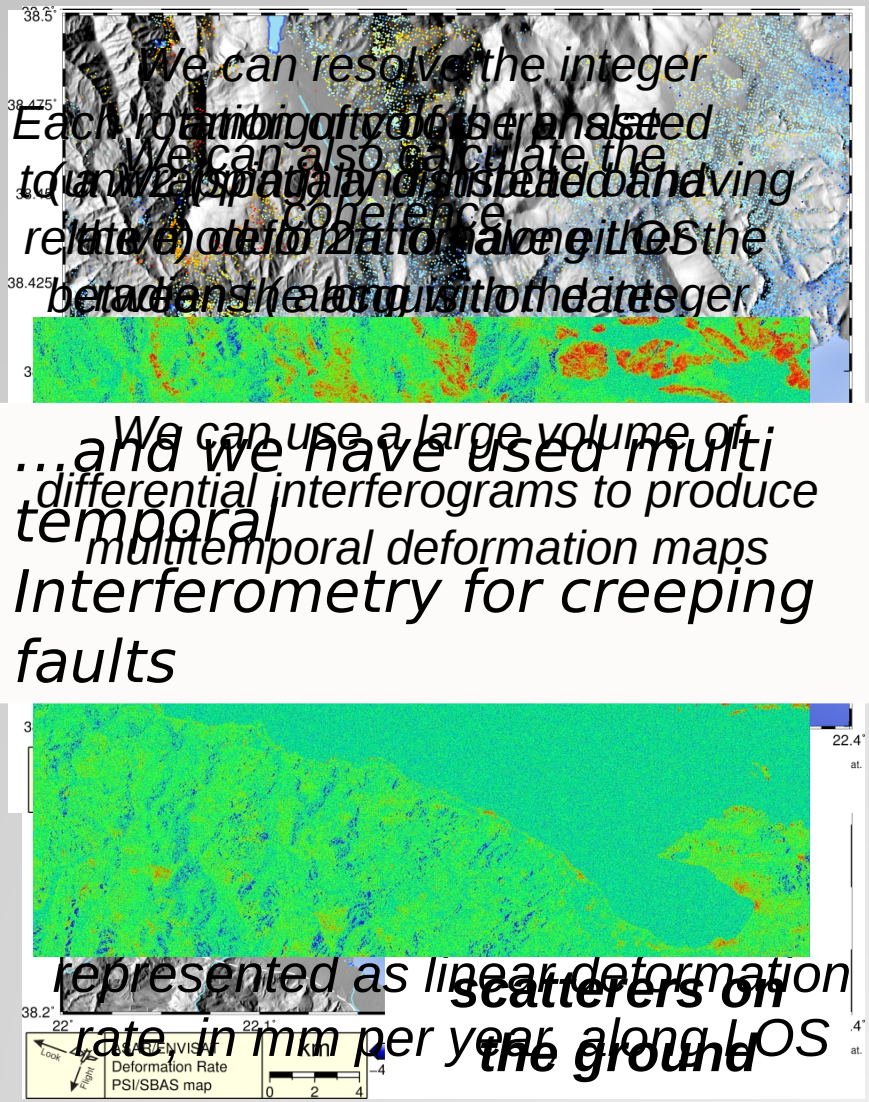
Aigion 1995, Mw=6.2 Earthquake



We have used InSAR
For earthquake constraining

OR

...and we have used multi temporal
Interferometry for creeping faults



We can resolve the integer ambiguity of the unwrapped interferograms

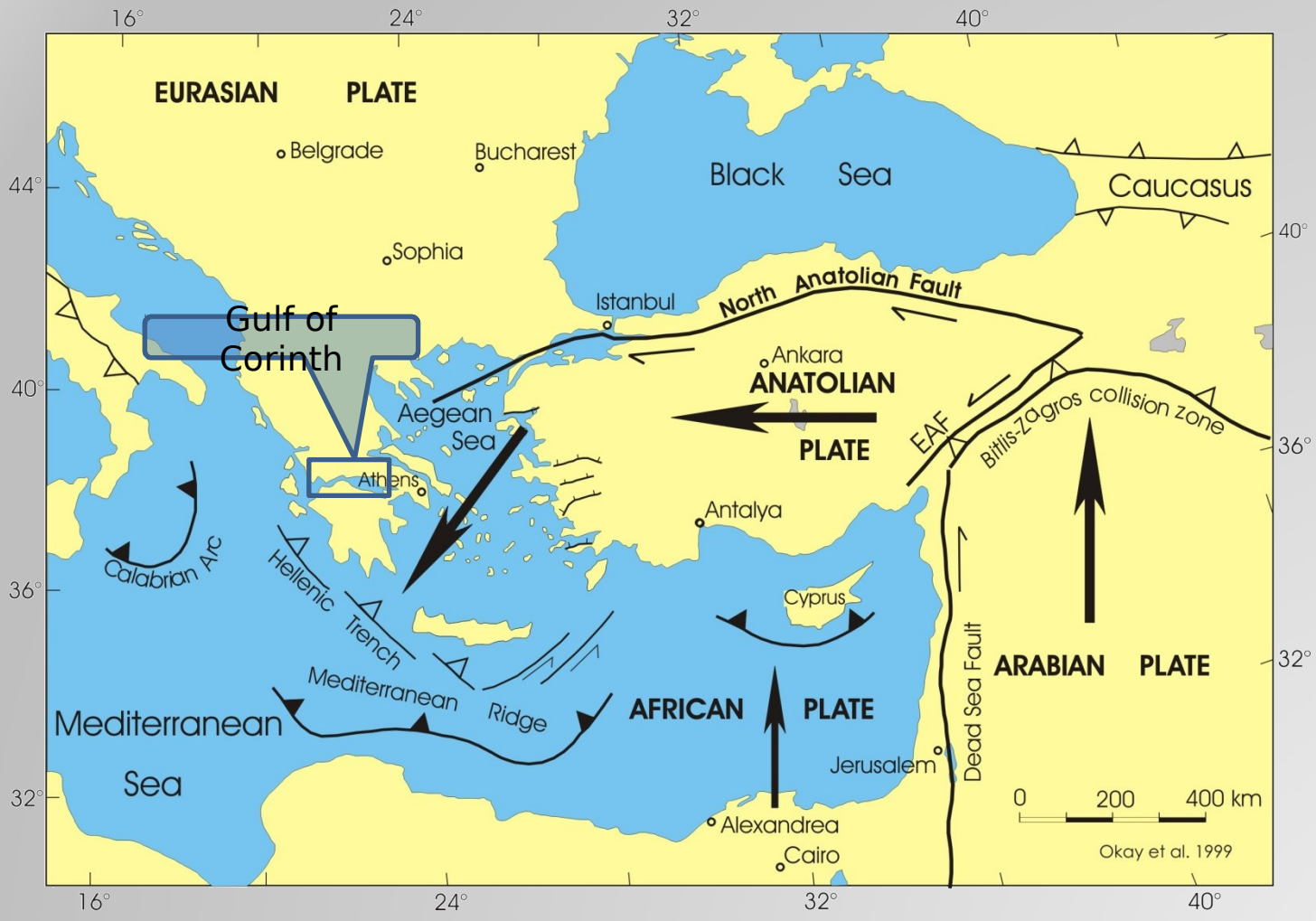
We can also calculate the coherence

We can use a large volume of differential interferograms to produce multitemporal deformation maps

represented as linear deformation rate, in mm per year, along LOS

scatterers on the ground

Gulf of Corinth Area



Corinth Rift Laboratory

The **Corinth Rift Laboratory** (CRL) project is based on the joint efforts of various European institutions to study fault mechanics and related hazards in the study area.

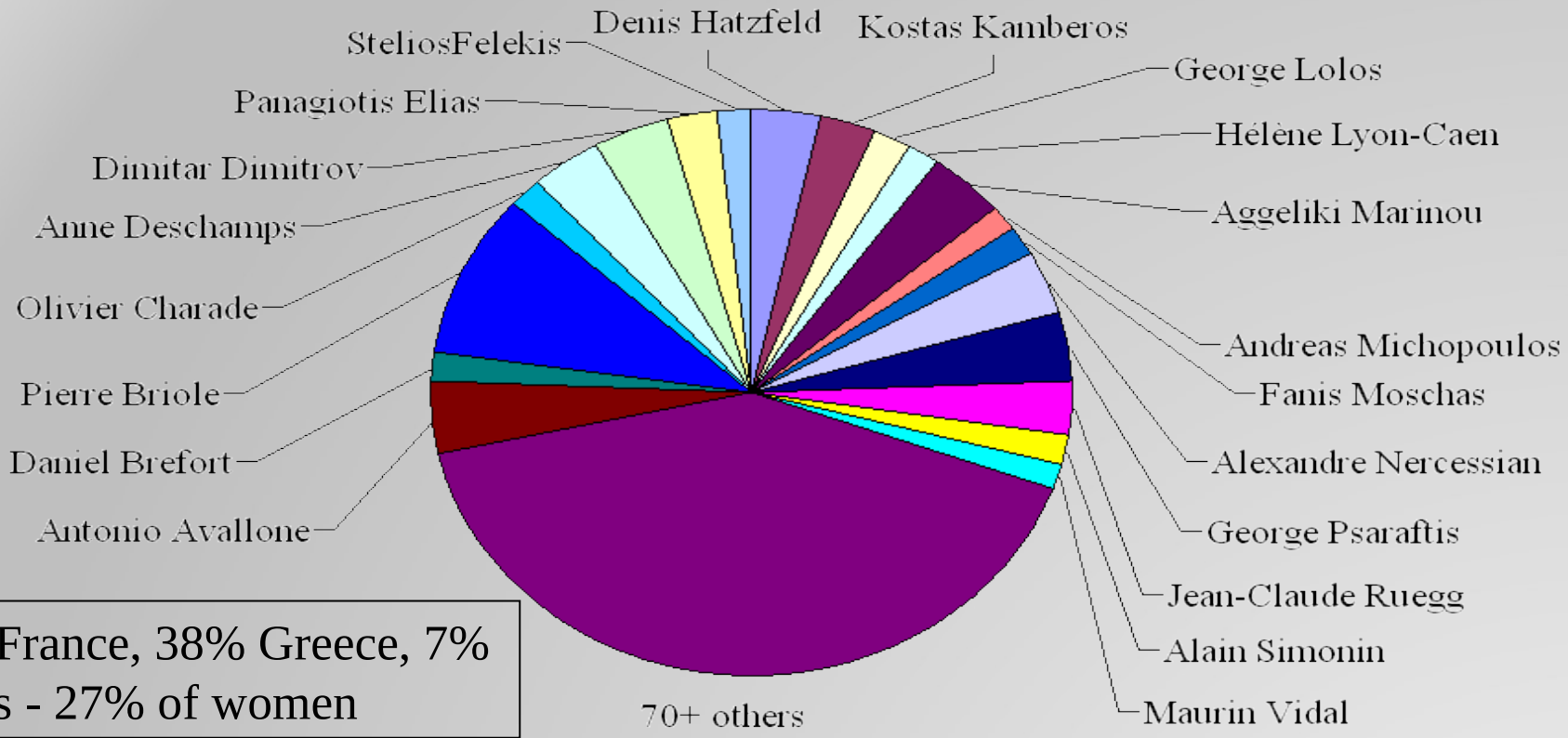
Corinth **R**ift **L**aboratory

is included in Geohazards Natural Laboratories of the **GEO Supersites**

is one of the Near Fault Observatories of **European Plate Observing System** (WP9 of EPOS)

A large number of surface networks are operating **seismological, strong motion,** permanent and repeated **GPS, strain**, **tilt and tide gage** networks for almost more than a decade.

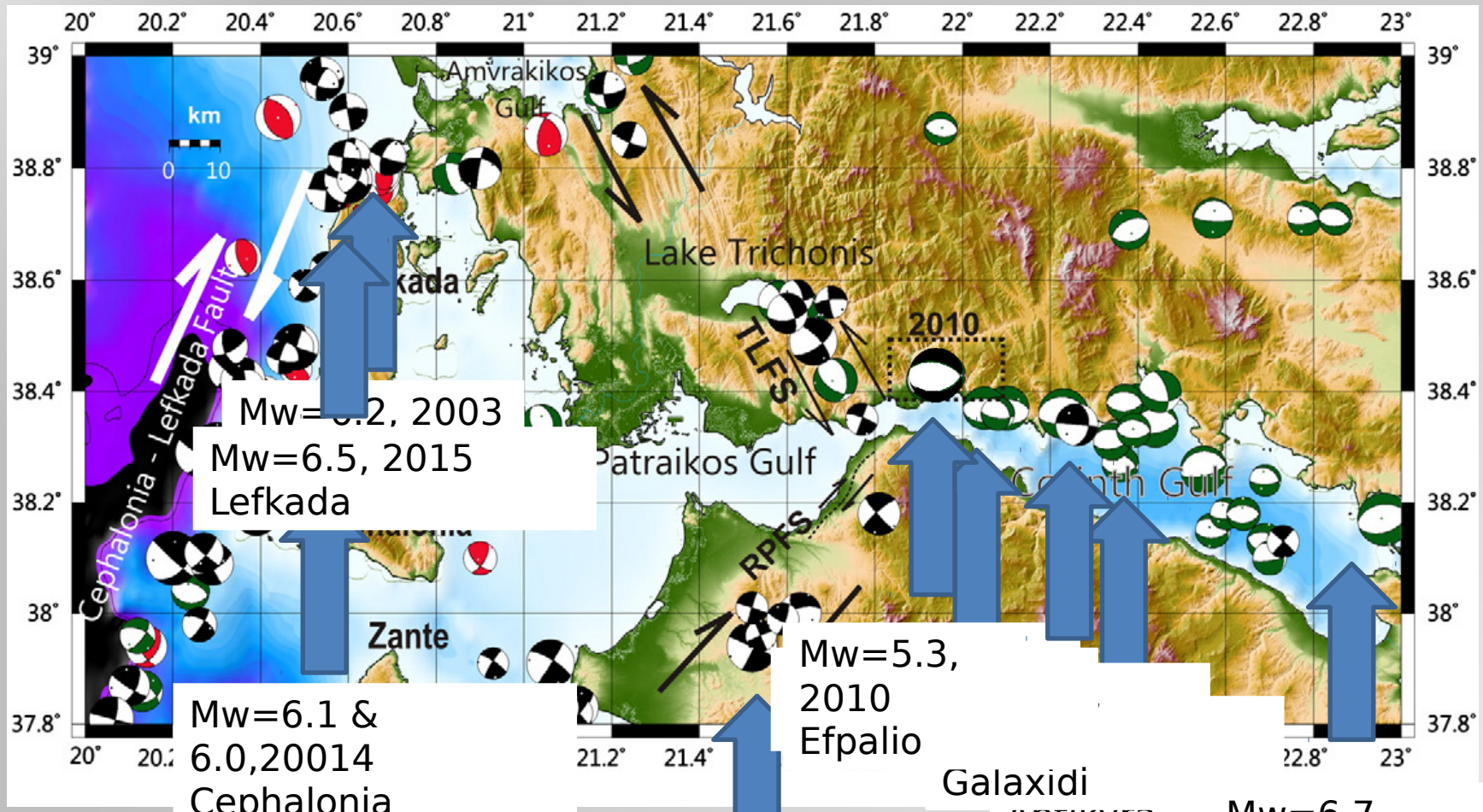
CRL Participants



55% France, 38% Greece, 7% others - 27% of women

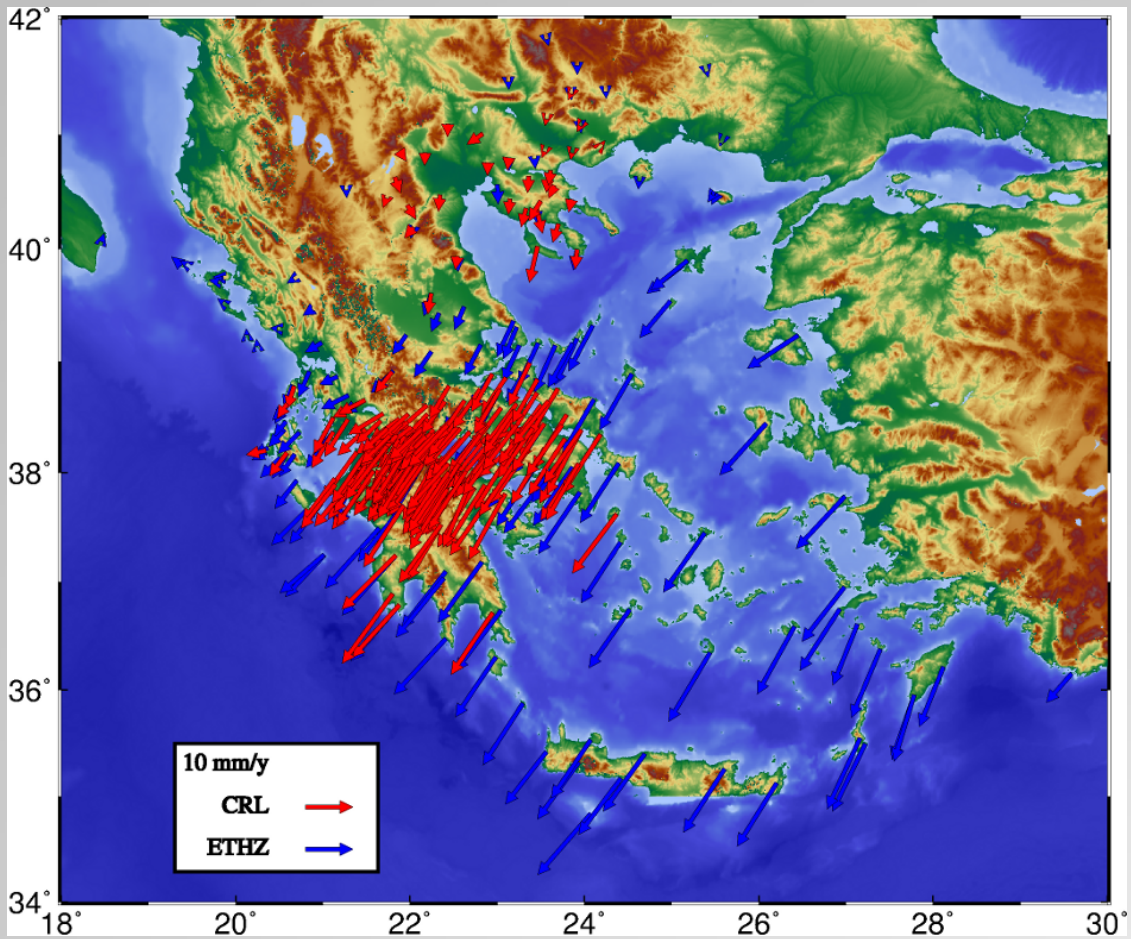
Luigi Abruzzese, Stamatis Adonakos, Jérôme Ammann, Rolando Armijo, Pascale Bascou, Pascal Bernard, Georges Buffet, Michel Capderou, Yann Capdeville, Rodolphe Cattin, Ferdaous Chaabane, Rana Charara, Jean Chéry, Haroula Chrisofilaki, Marielle Collombet, Jean-Bernard de Chabalier, Marianna Drakontaidi, Thierry Duquesnoy, Grégory Durand, Véronique Farra, Nathaniel Findling, Jean-François Gamond, Emmanuel Gaucher, Roland Gaulon, Omiros Giannakis, Nicolas Houlié, Alexia Karamanou, Kostas Katsambalos, Anastasia Kiratzi, Yann Krien, Kamel Lammali, Cécile Lasserre, Penelope Lopez-Quiroz, Roland Machenbaum, Raul Madariaga, Isabelle Manighetti, Iannis Maris, Joseph Martinod, Antonino Memmolo, Bertrand Meyer, Sylvain Morvan, Antonios Mouratidis, Akis Panagis, George Papaioannou, Demitris Papanastasiou, Epy Papazissi, Frédéric Pesqueira, Patrick Pinettes, George Priovolos, Alexis Rigo, Cyrille Rioux, Frédérique Rolandone, Vassilis Sakkas, Vasso Saltogianni, Paris Savaidis, Dorothée Streiff, Olga Sykioti, Mathieu Sylvander, Christel Tibéri, George Veis, Christophe Vigny, Vangelis Zacharis, …

Recent Seismicity



CRL campaigns and continuous GPS

The network (218 points)



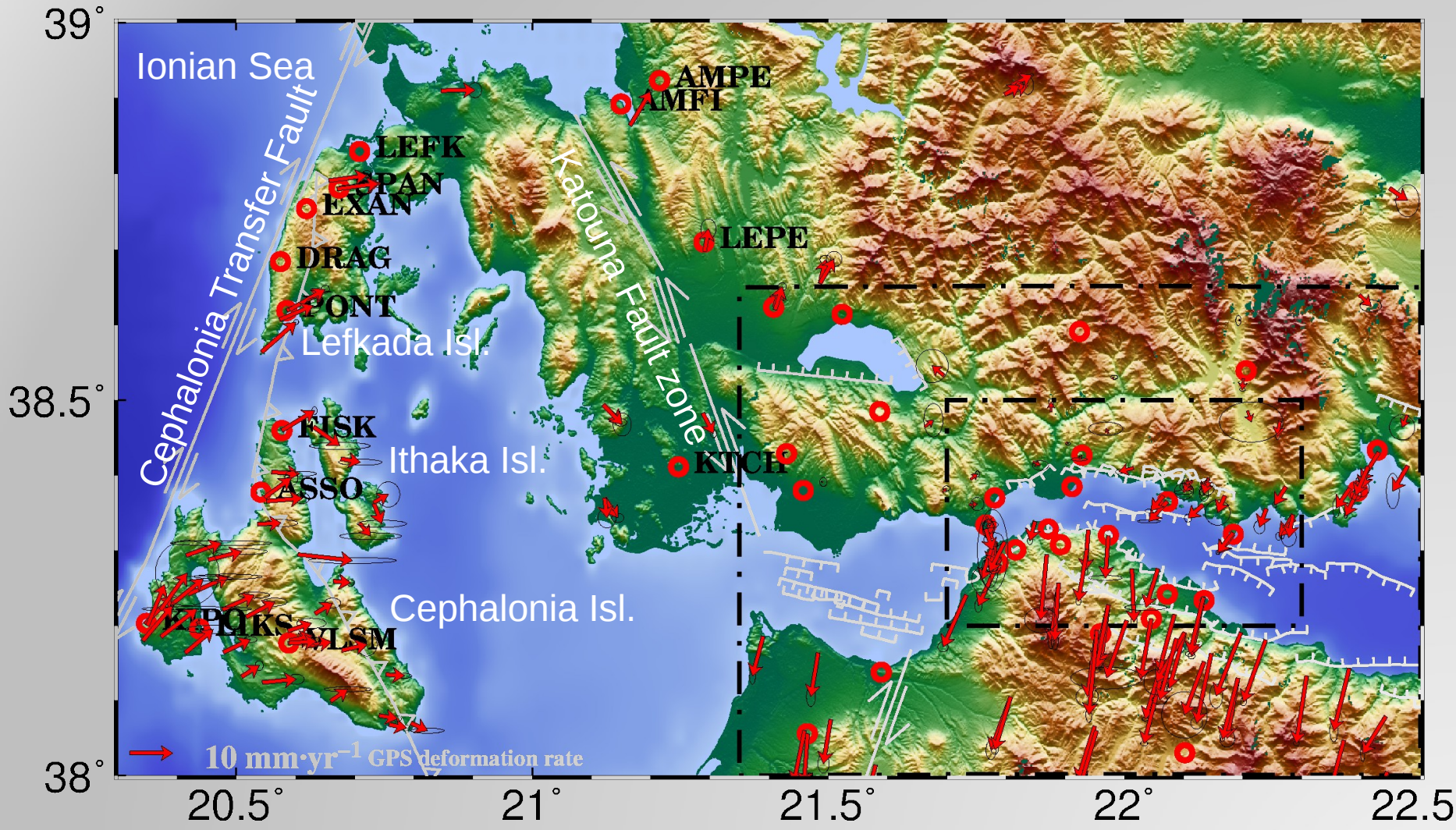
40 permanent stations

2688 campaign files (duration 2 to 24h)

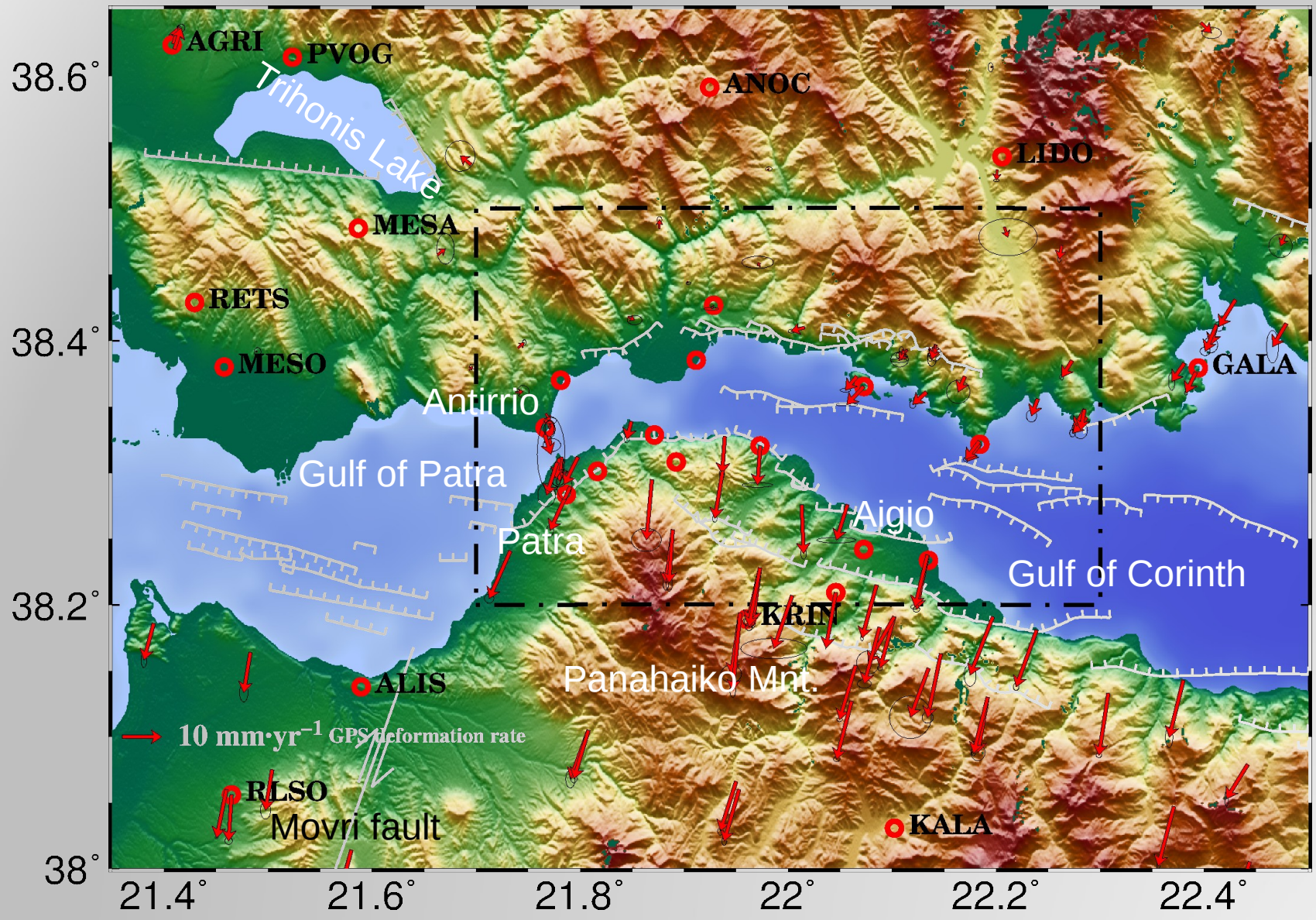
Data processed with Gipy-Oasis v 6.1.2

+123 velocities from the ETHZ network (M.D.M. Müller, 2011, Analysis of long-term GPS observations in Greece (1993–2009) and geodynamic implications for the Eastern Mediterranean, Doctorate of Sciences, Diss. ETH No. 19796)

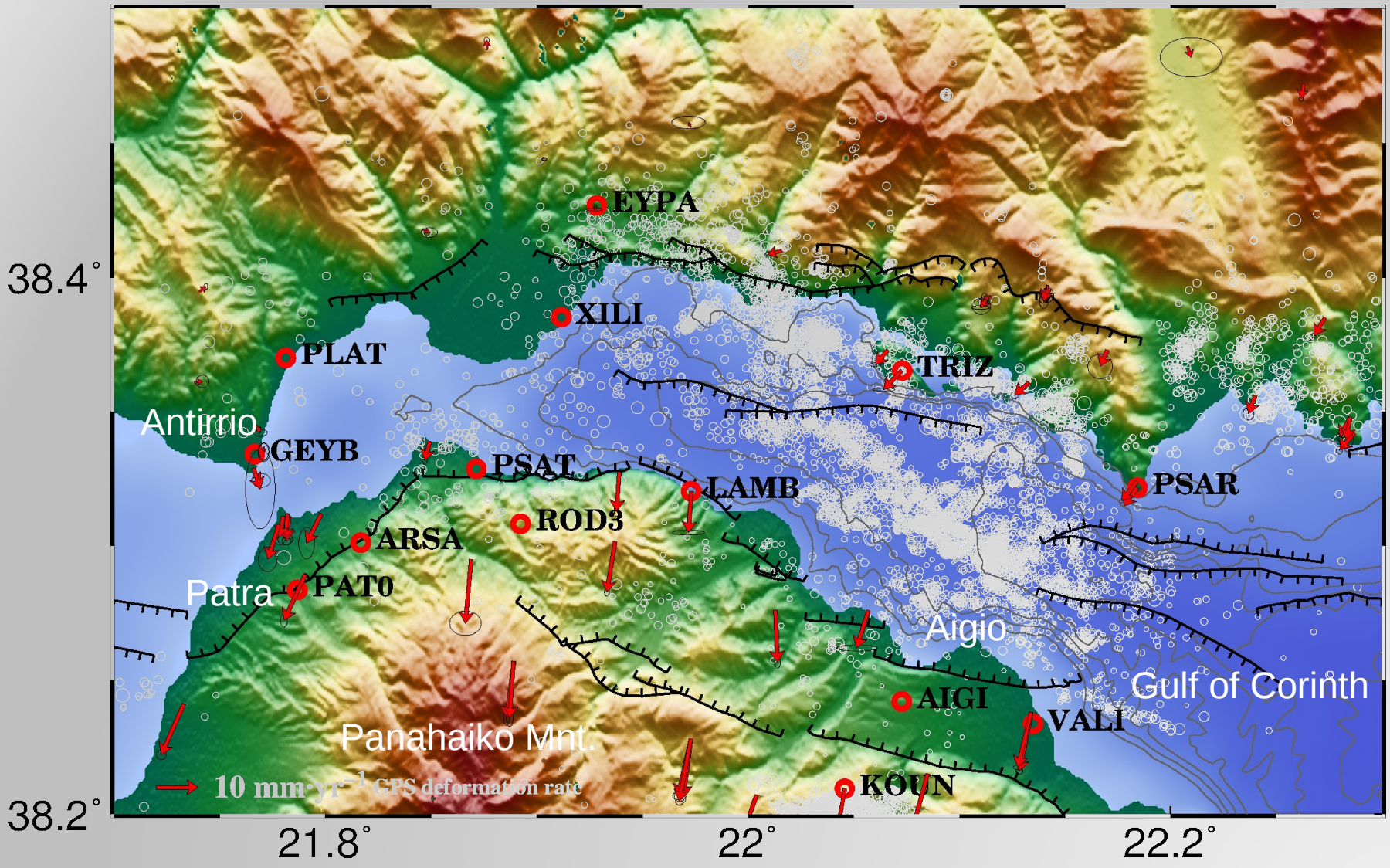
CRL wide 40 cGPS



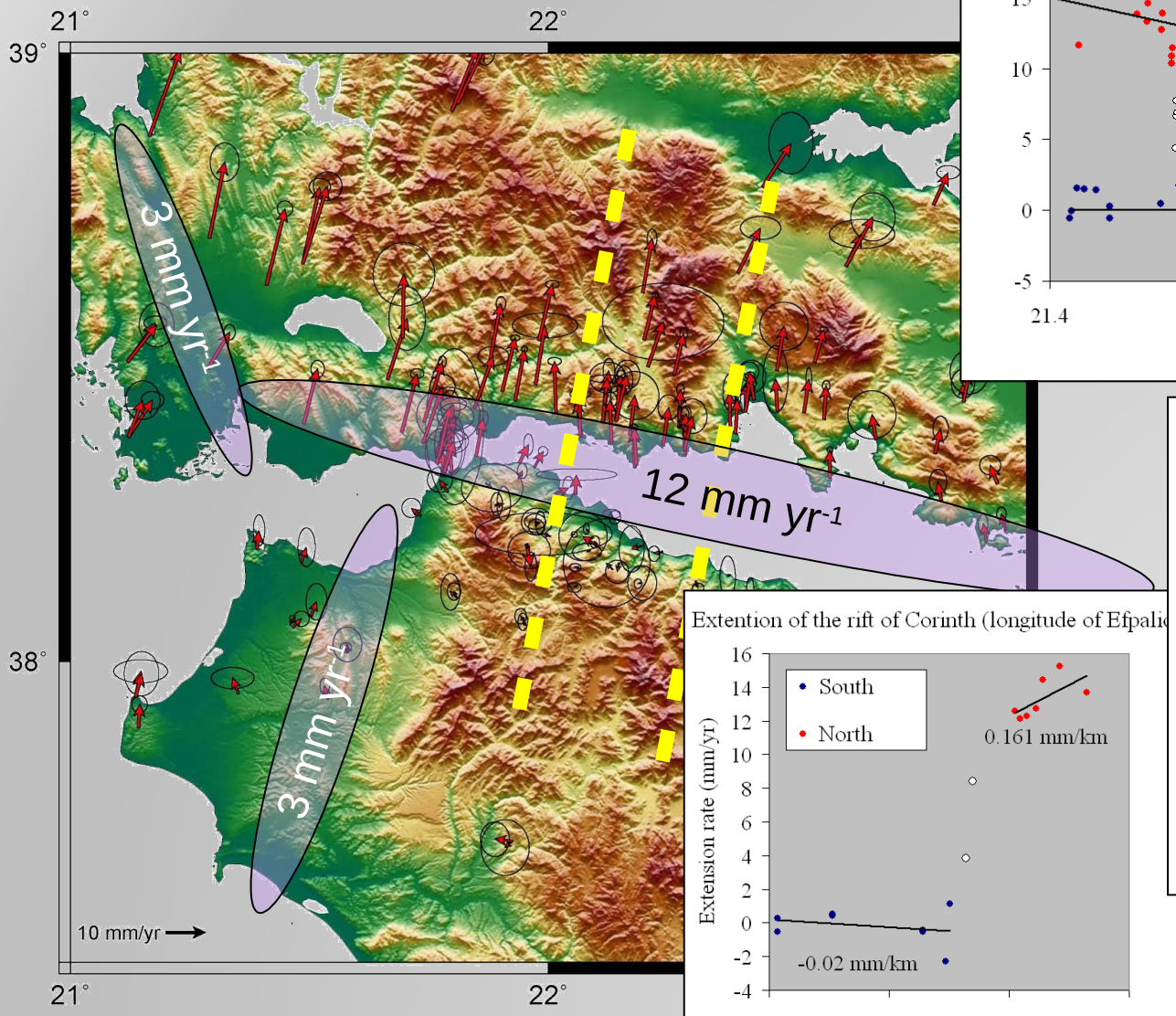
CRL extended 26 cGPS

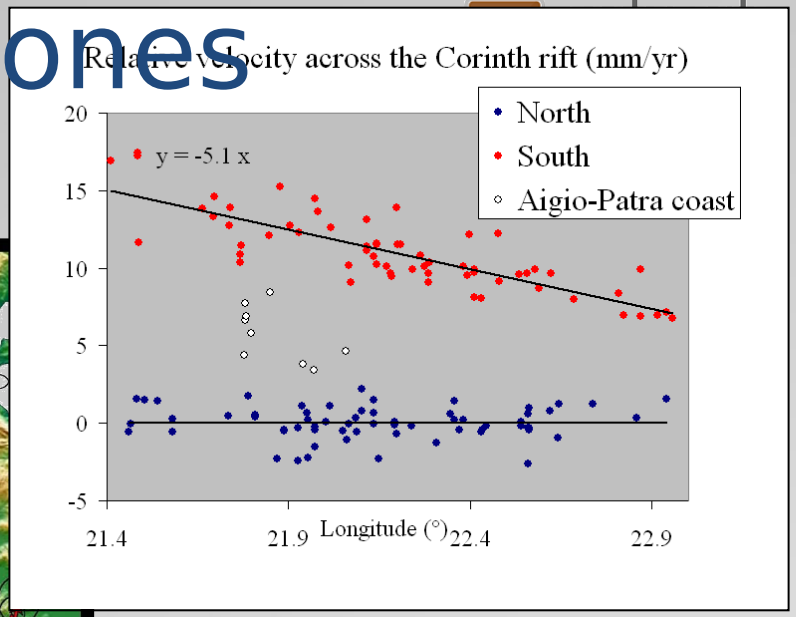


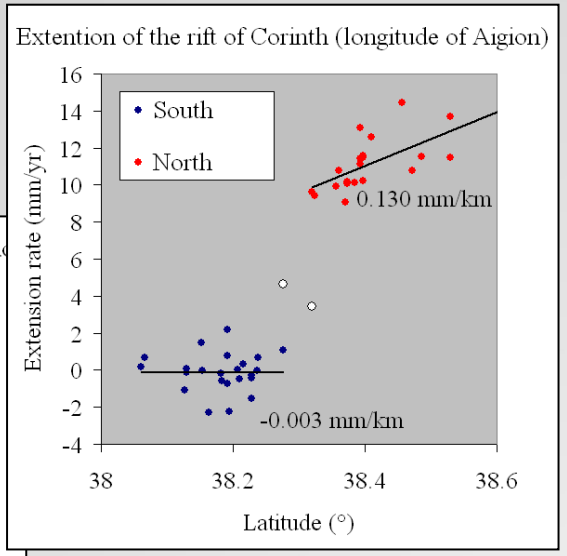
CRL core 14 cGPS



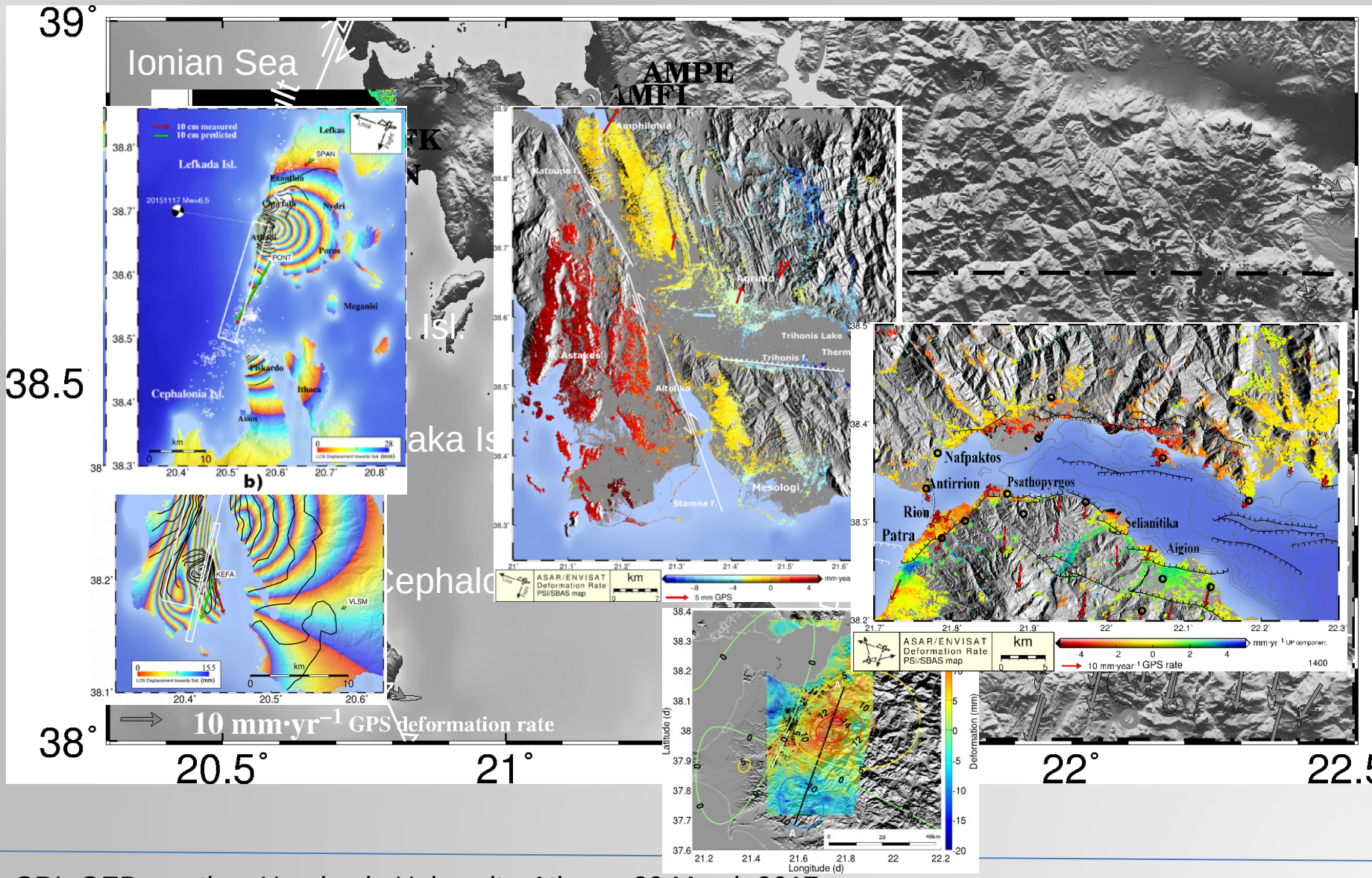
Deforming zones



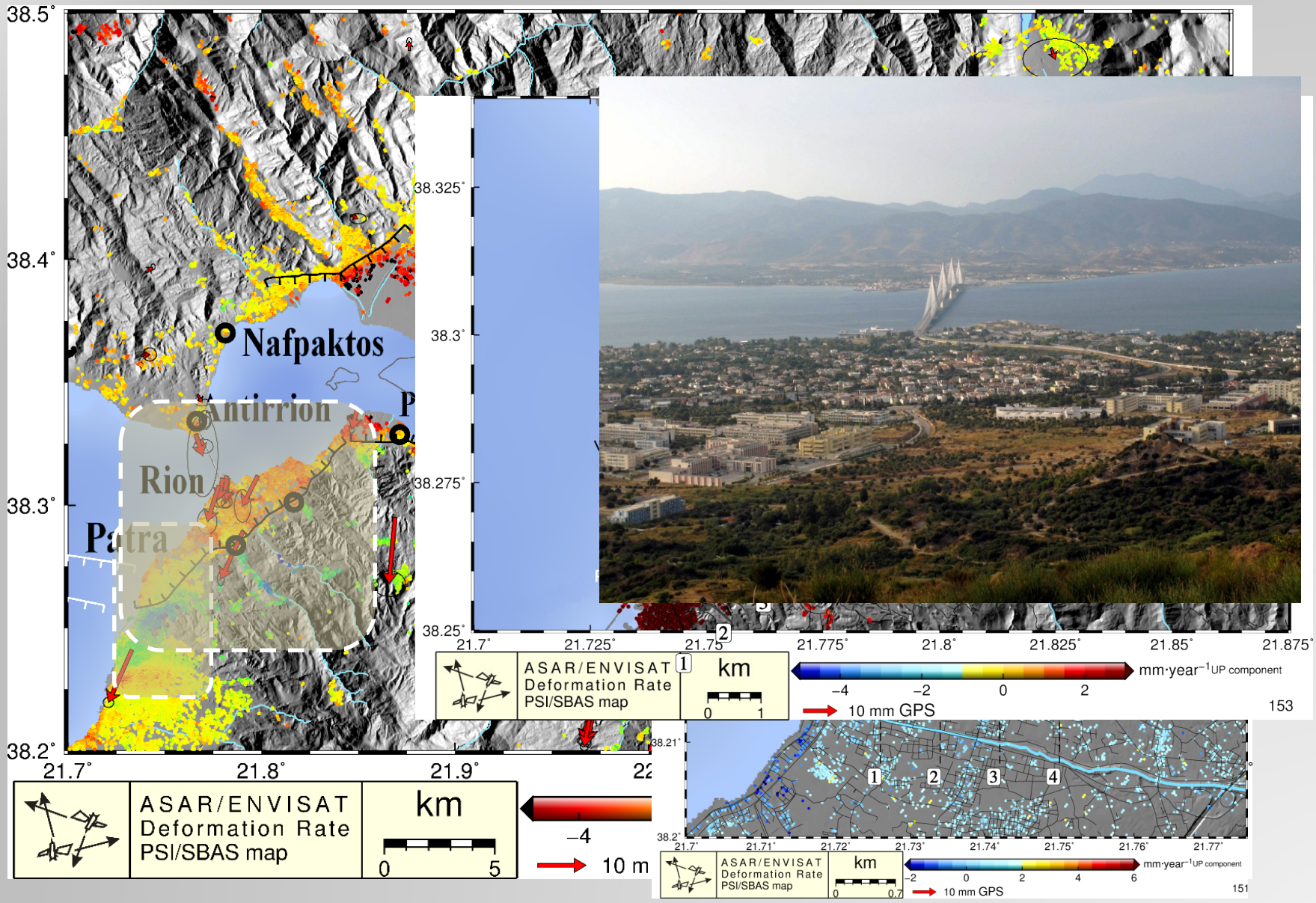




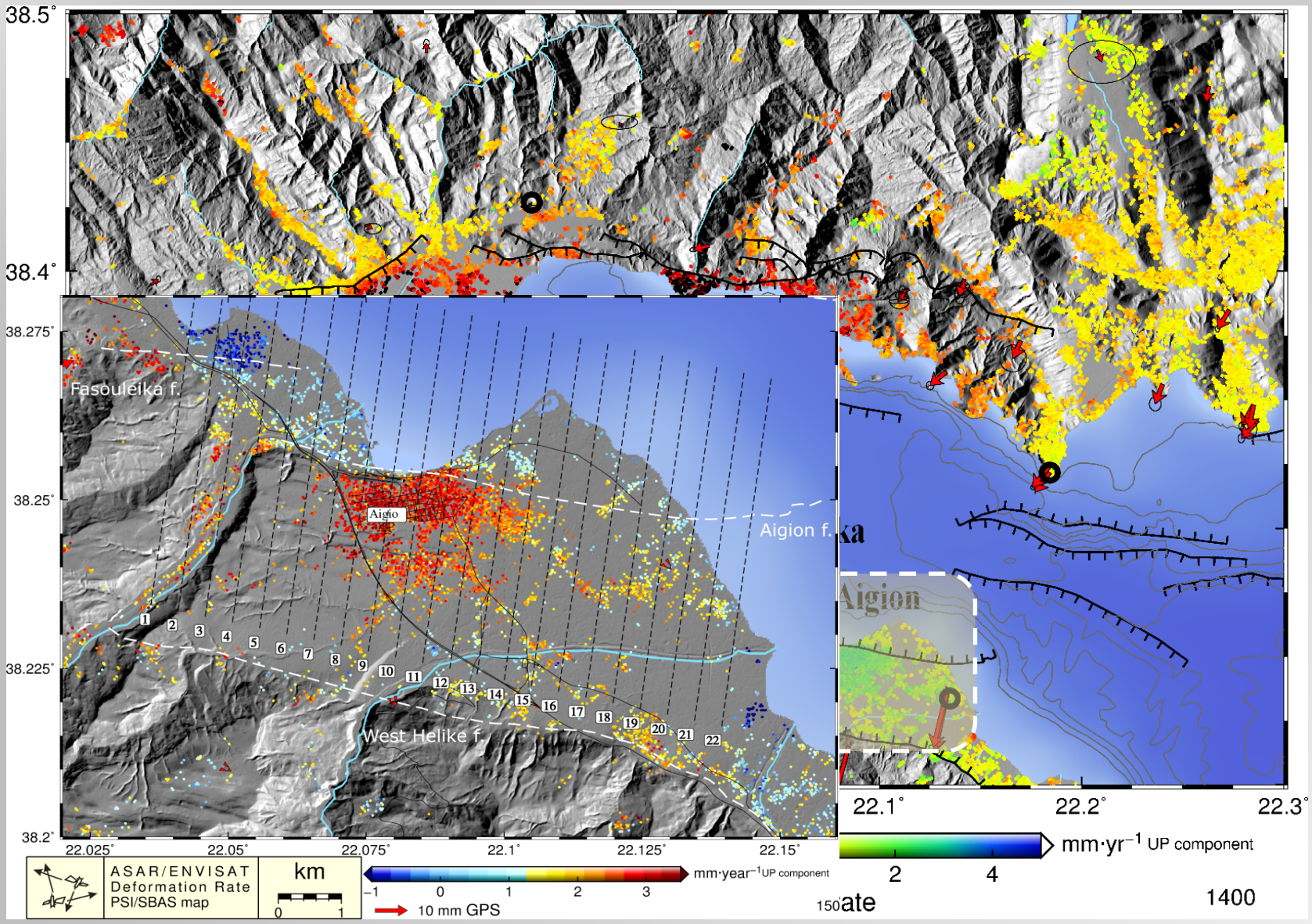
Corinth Rift Laboratory and INSAR



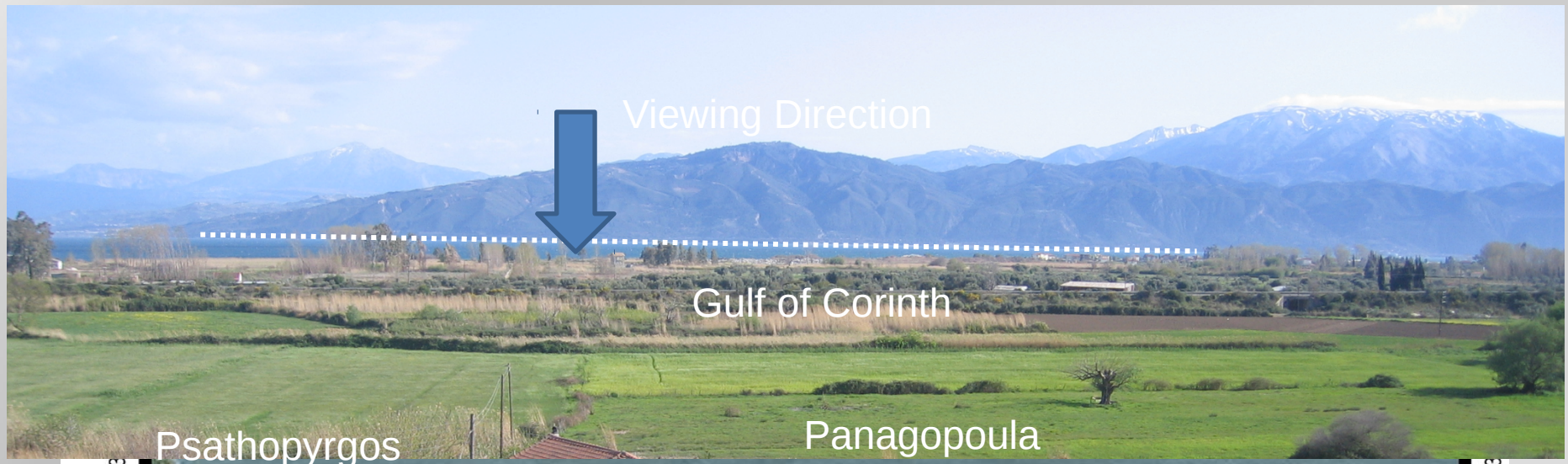
Final Deformation map on the Vertical deformation

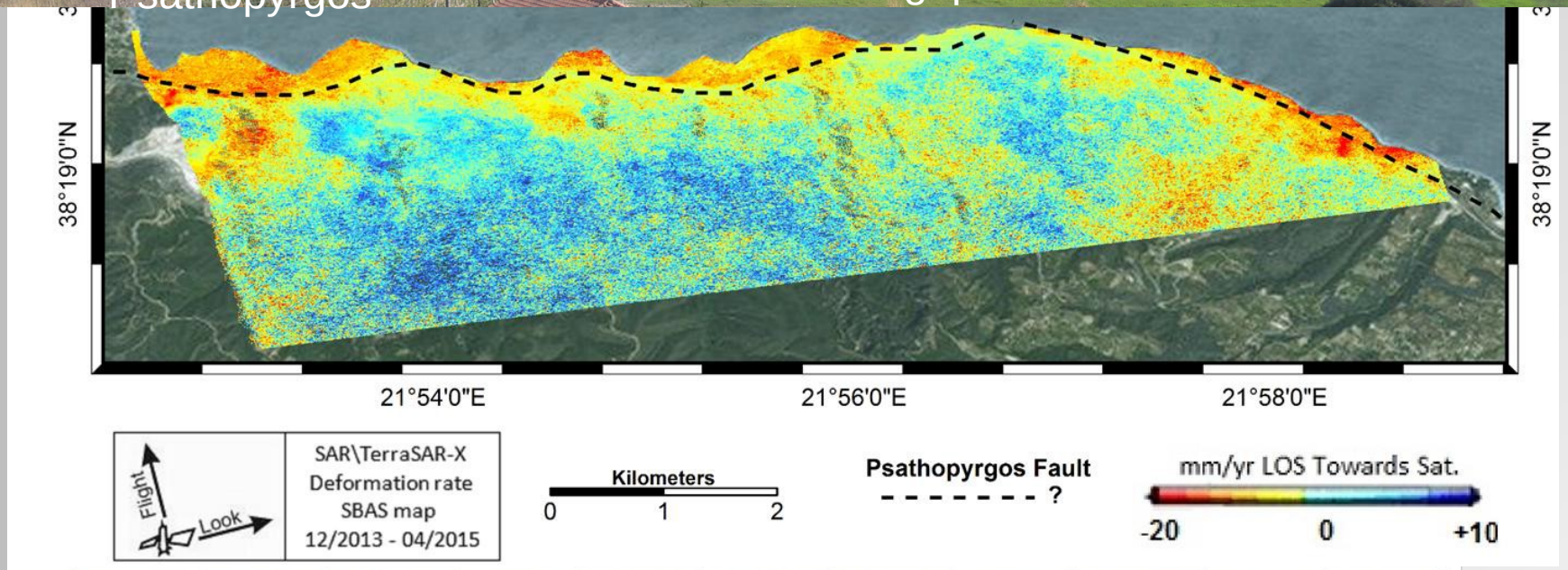


InSAR Vertical Deformations



InSAR very high resolution def. rate





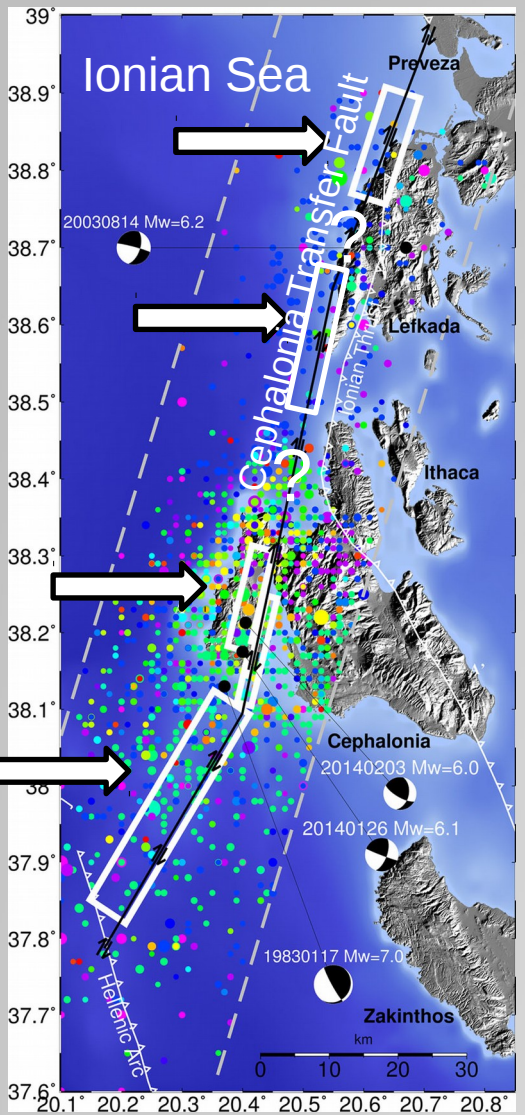
Hellenic Arc subduction zone, CTF

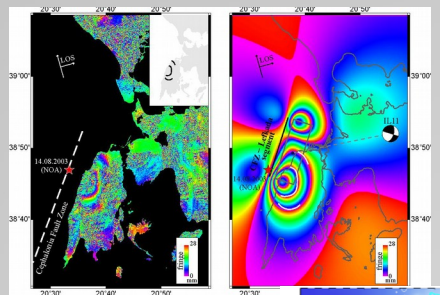
2003 Mw=6.2

2015 Mw=6.5

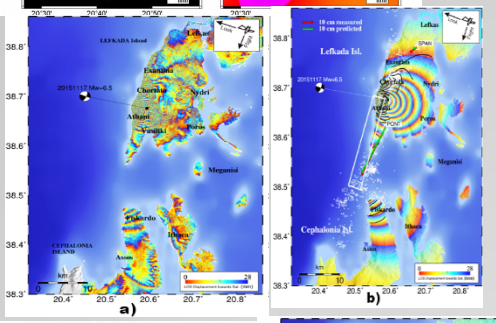
2014 Mw=6.1, 6.0

1983 Mw=7.0

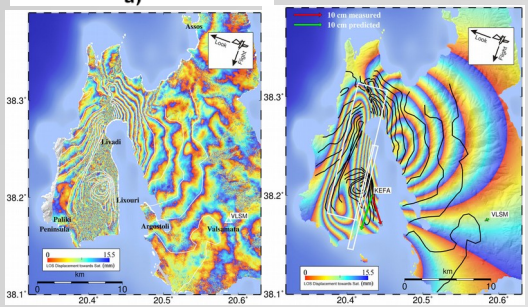




Ilieva et al., 2016

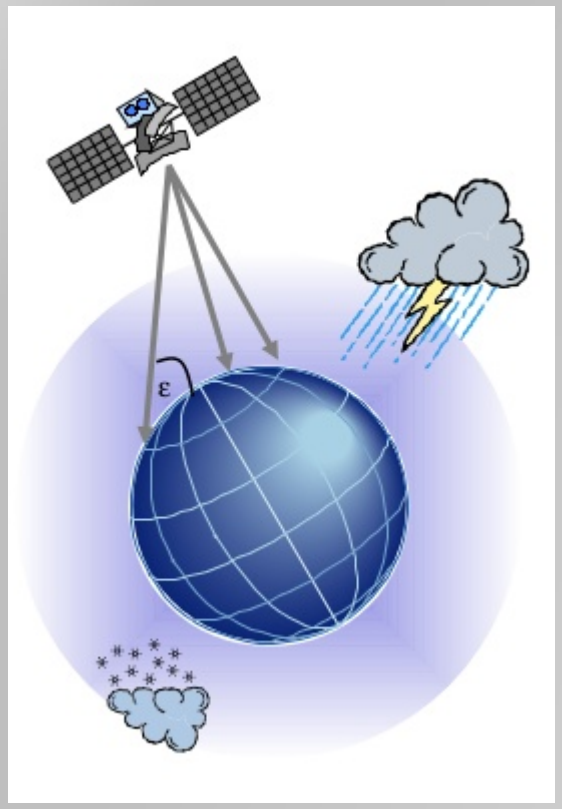


Ganas et al., 2016

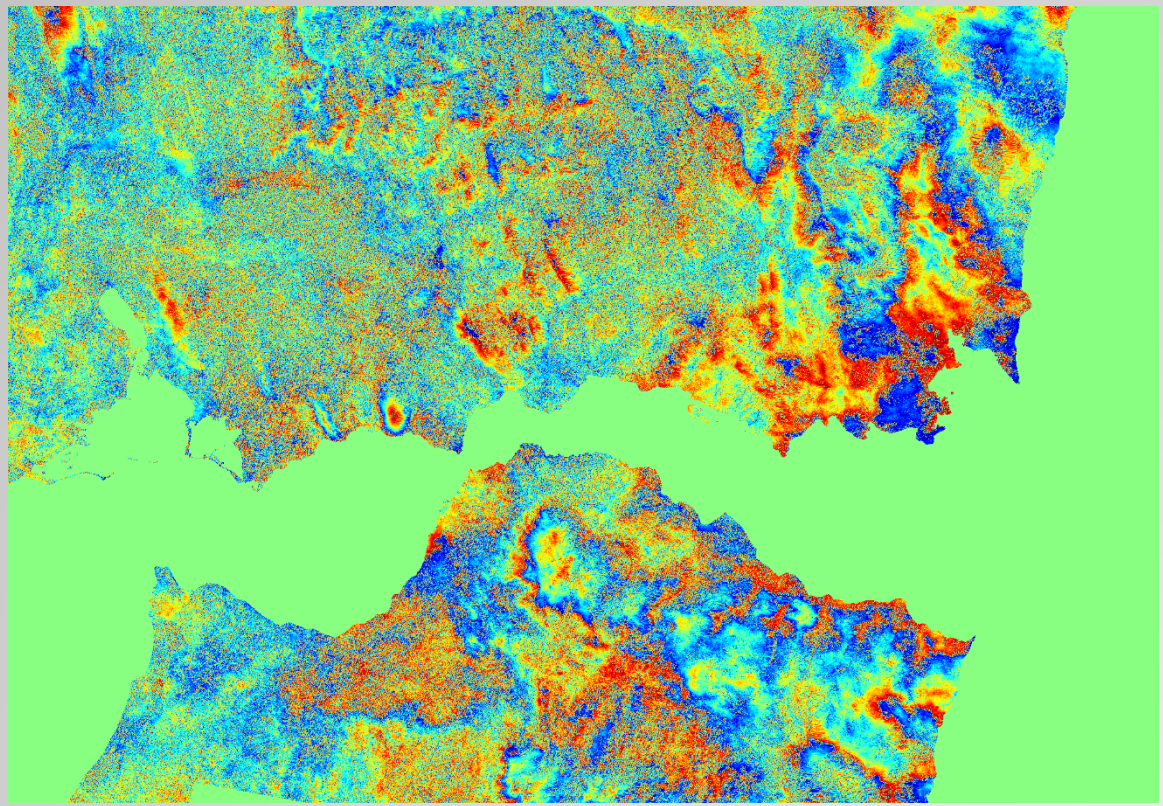


Briole et al., 2015

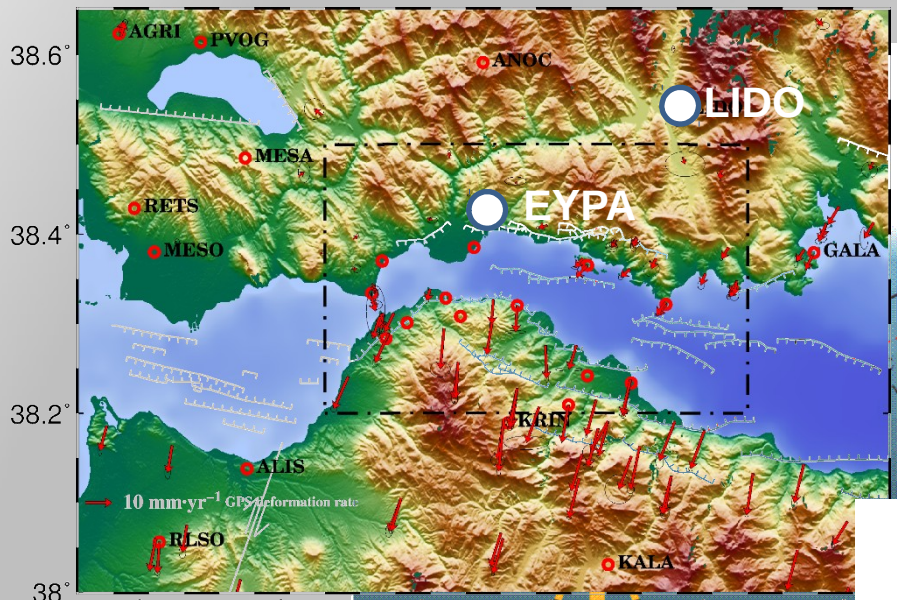
Tropospheric noise

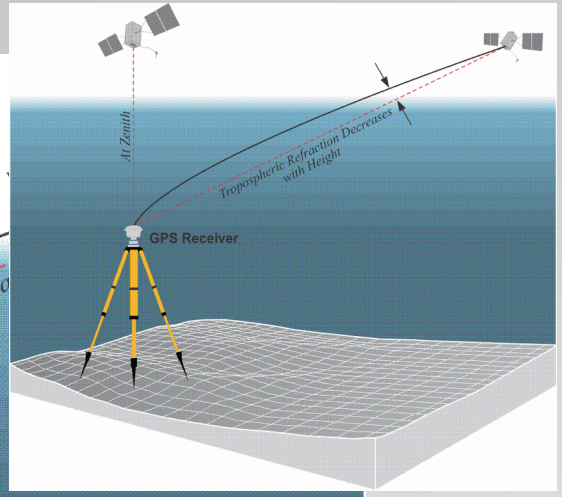


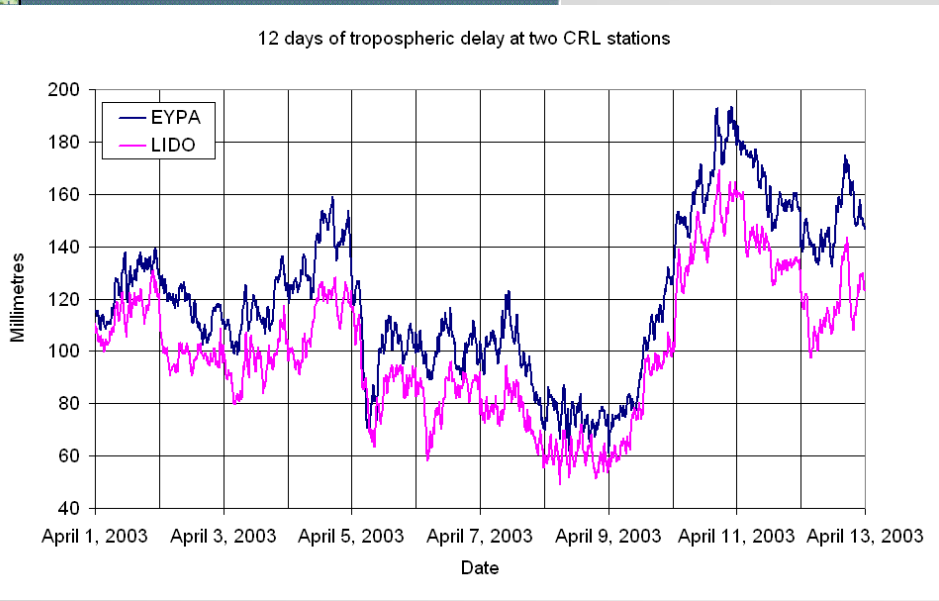
Tropospheric fringes correlated with the topography in the core area of the CRL-NFO



Tropospheric delay from GPS





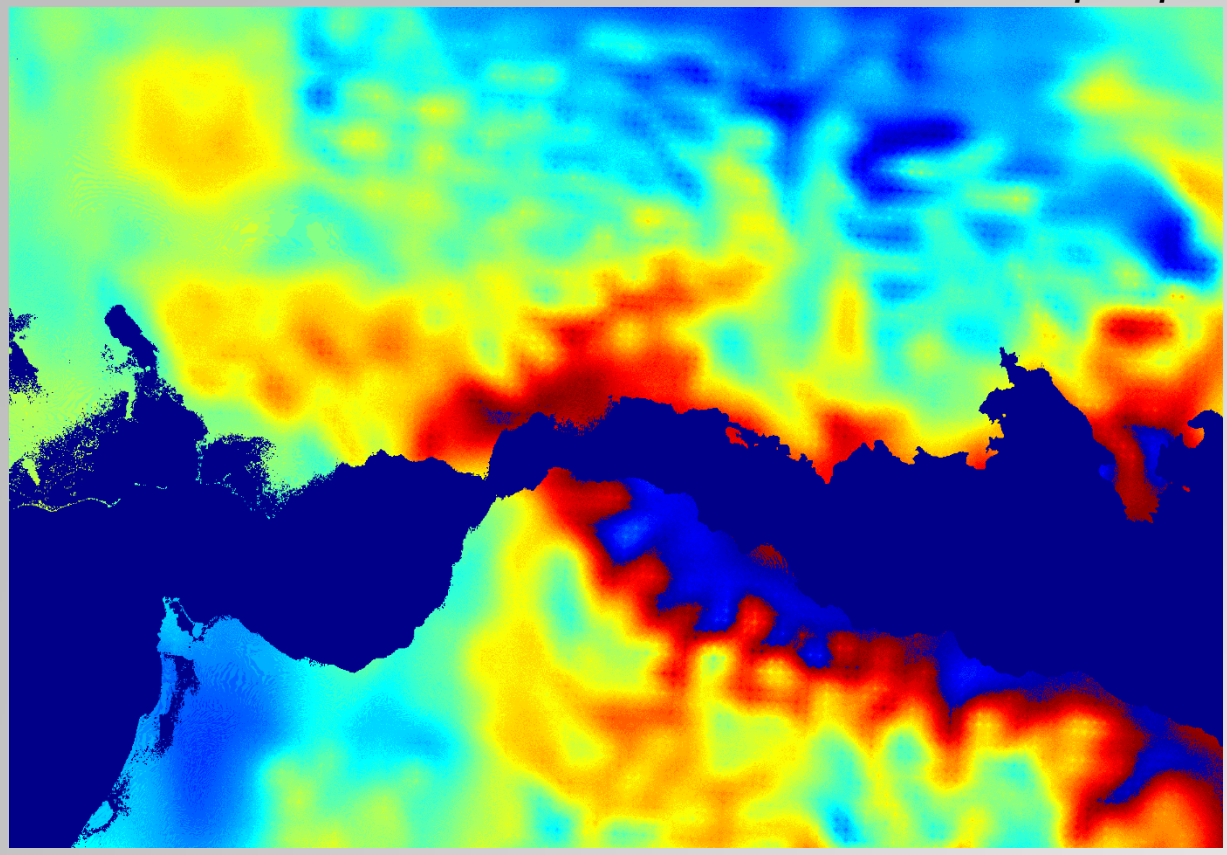


Tropospheric correction

Video outside

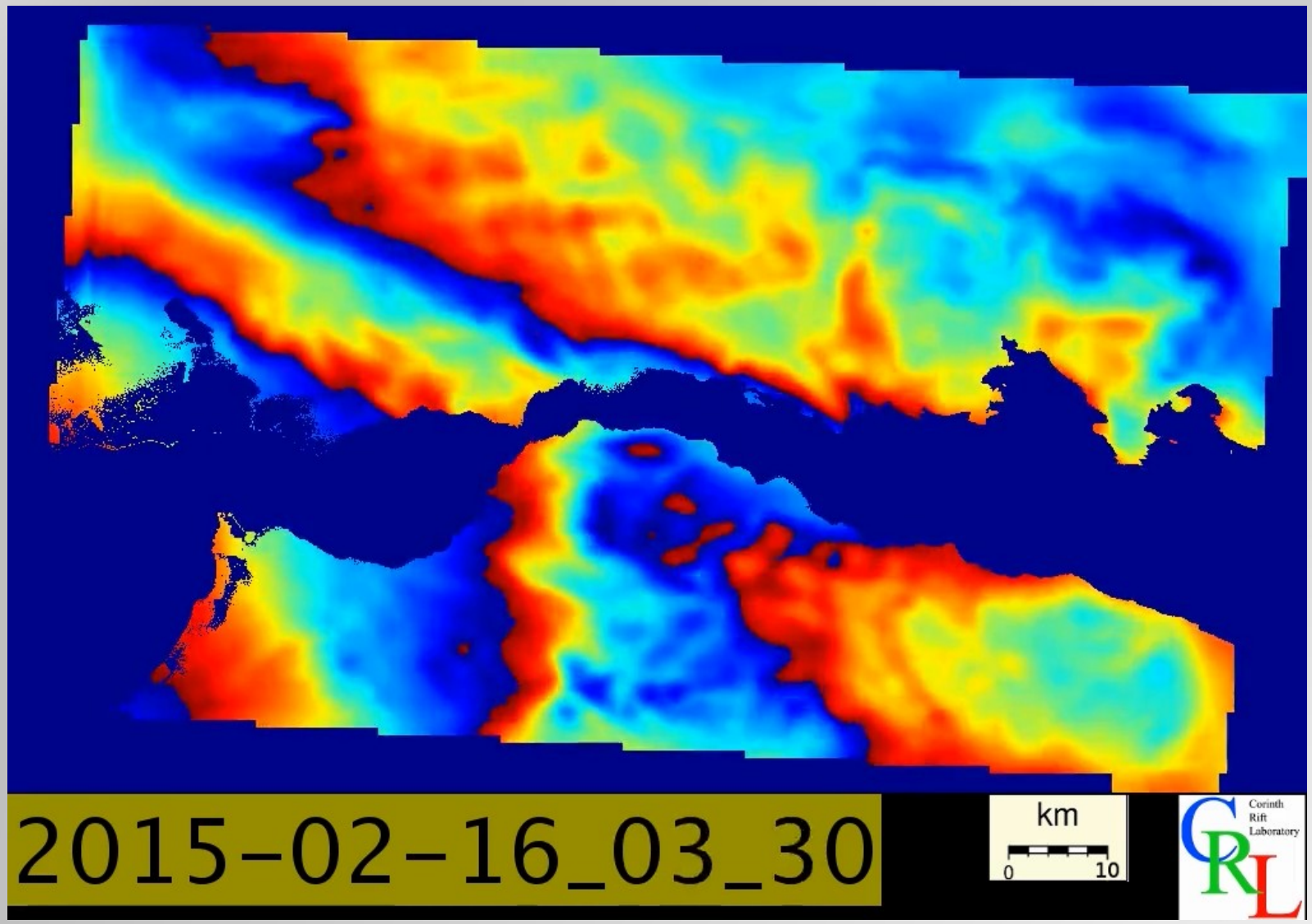
Tropospheric correction

Extraction of atmospheric conditions over the CRL area, for the time slots of SAR acquisitions, combining the available GPS and Meteo (WRF 1x1 km) observations for the correction of tropospheric INSAR noise

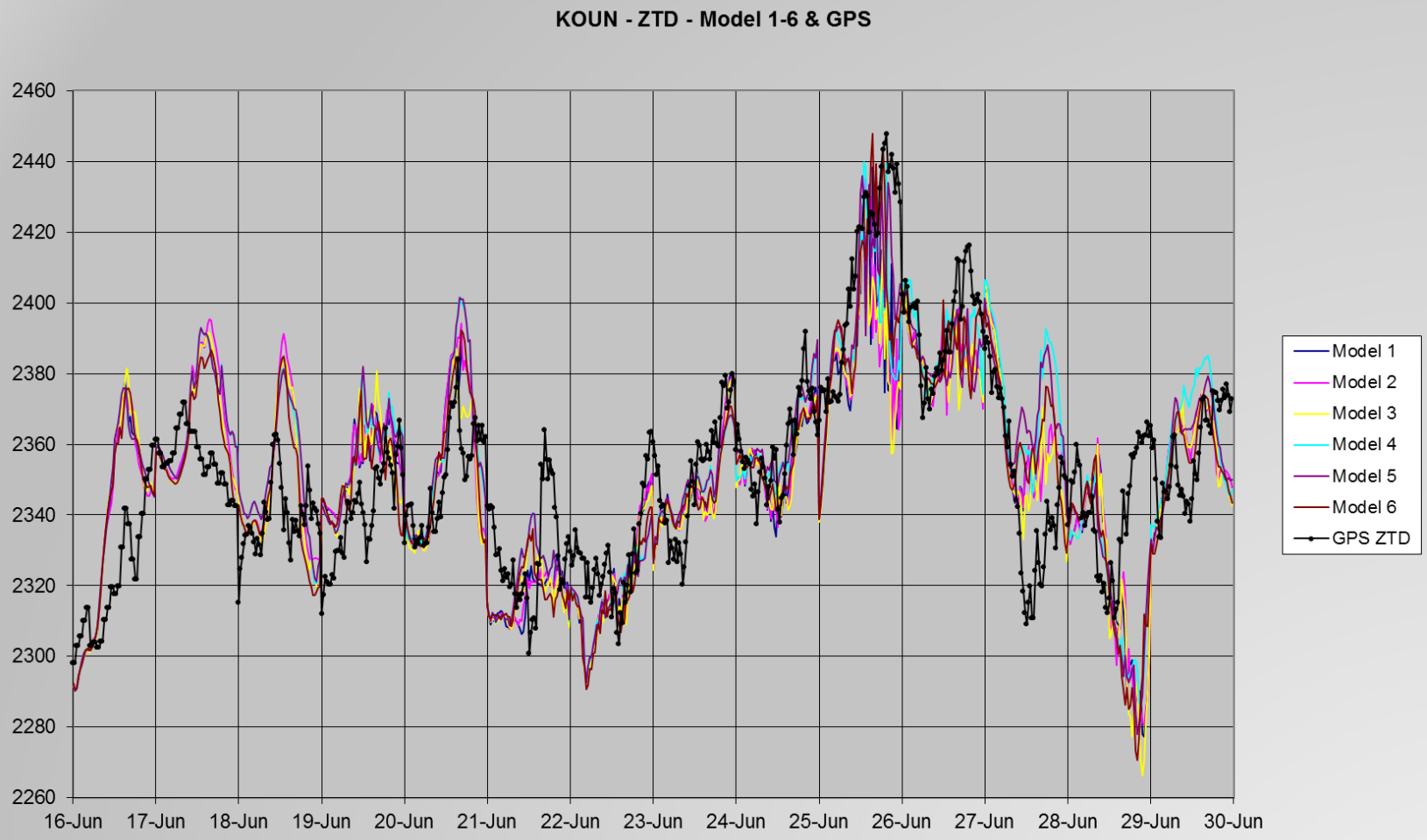


Meteogram (difference of phase delays) 2015-12-29 - 2016-01-22

Tropospheric correction



Tropospheric correction



CRL website

EPOS

Corinth Rift Laboratory

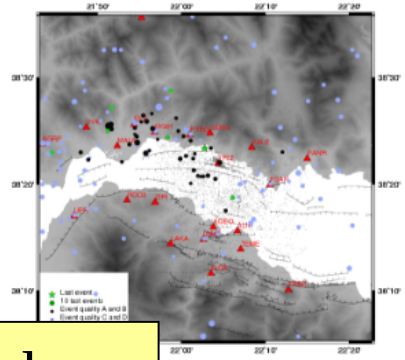
Partners Literature Projects Data-products Resources Education Links

The CRL Near Fault Observatory

The Corinth Rift Laboratory (CRL-NFO; 21.35°E-22.5°E; 38°N-38.65°N) is centered between the cities of Patras to the west and Aigion to the east. It is one of the most seismically active zones in Europe.

European scientists and engineers are joining their efforts to investigate fault mechanics, its relationship with earthquakes, fluid flow and the related hazards in the Corinth rift.

Seismicity of the last 15 days



ENTINEL interferogram (24 October 2016 – 5 November 2016)

Recherche...

PAGES

- Borehole
- CRL School
- CRL-links
- Data-products
- Documents
- Earthquakes
- Education
- Geology
- GNSS
- Gravity
- HR imagery & DEM
- InSAR
- Intranet
- Literature
- Macroseismic
- Meteorology
- Networks
- Partners
- Projects
- Resources
- Seismology
- Selection_FB
- The CRL Near Fault Observatory
- Tide gauges

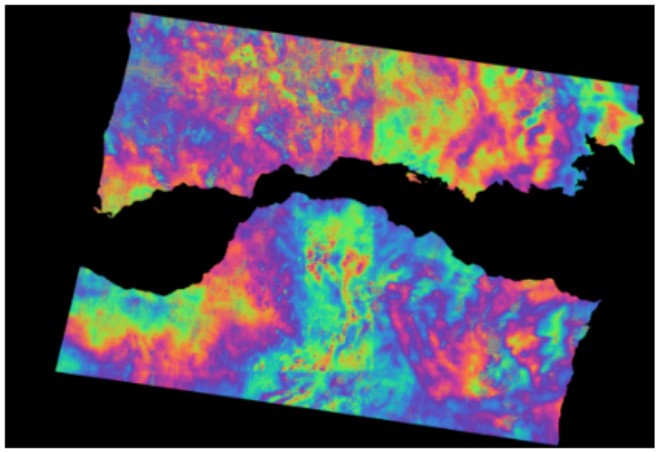
INTRANET

- Directory

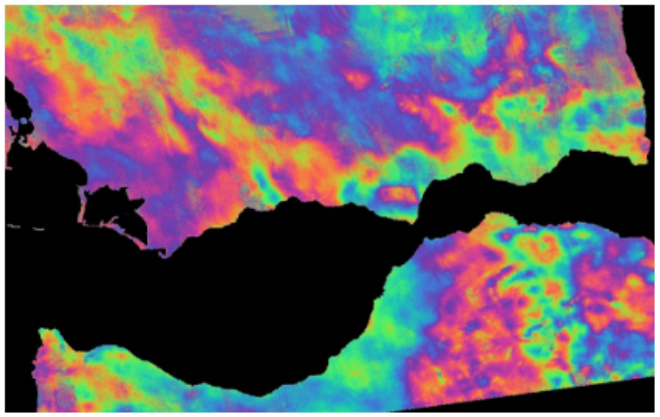
MÉTA

- Connexion
- Flux RSS des articles
- RSS des commentaires
- Site de WordPress-FR

crlab.eu

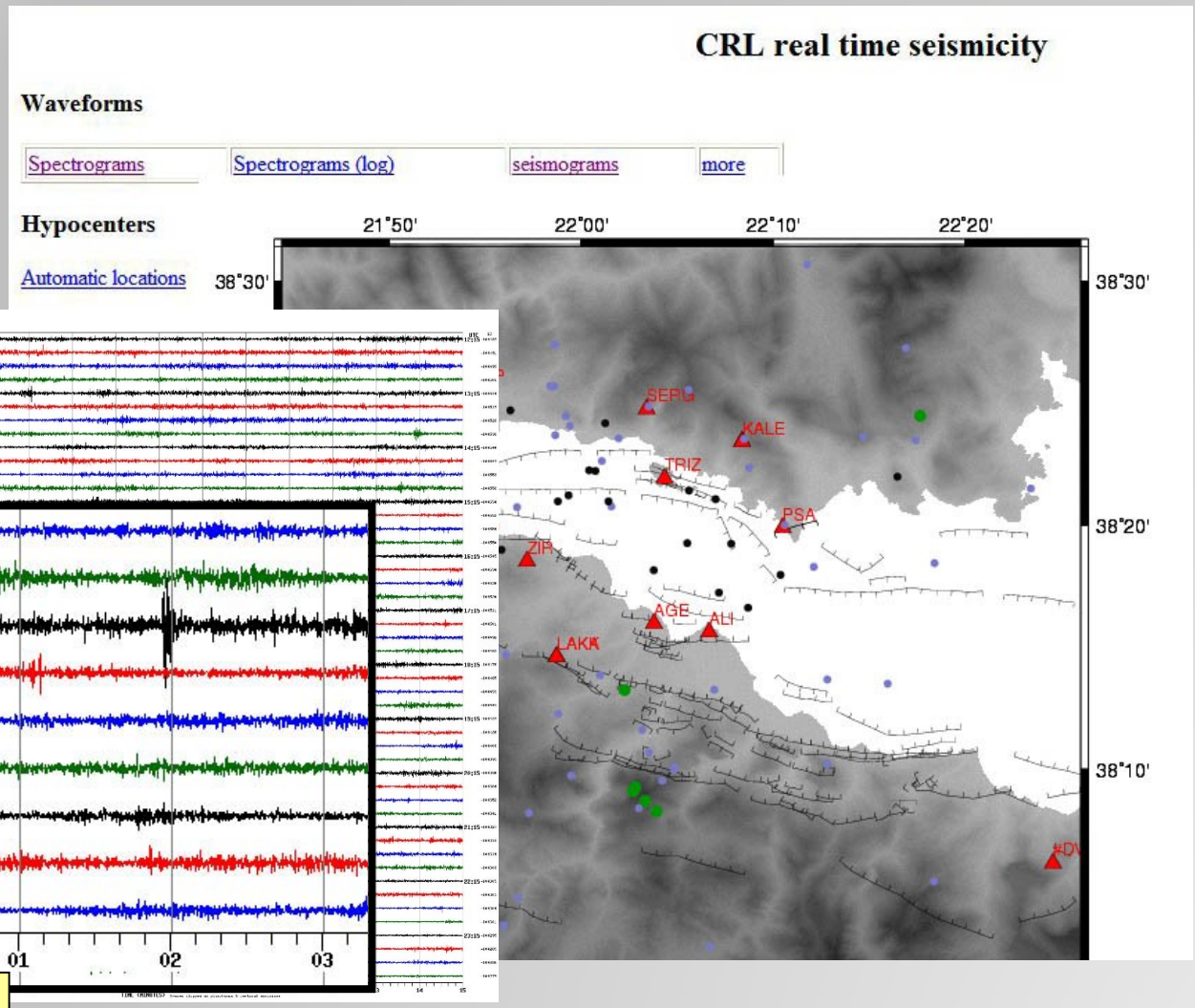


Last ascending SENTINEL interferogram (5 November 2016 – 11 November 2016)



Corinth Rift Laboratory / Fièrement propulsé par WordPress

CRL portal real-time seismicity



crlab.eu

European Plate Observing System

WP8: Siesmology

WP9: Near Fault Observatories

WG10: GNSS - Analytical and Experimental Laboratories;
WP11: Volcano Observatories
WP12: Earth Observation
WP13: Geomagnetism
WP14: Antropogenic Hazard
WP15: Geology
WP16: Multiscale Laboratories
Wp17: Geo-energy Test-beds

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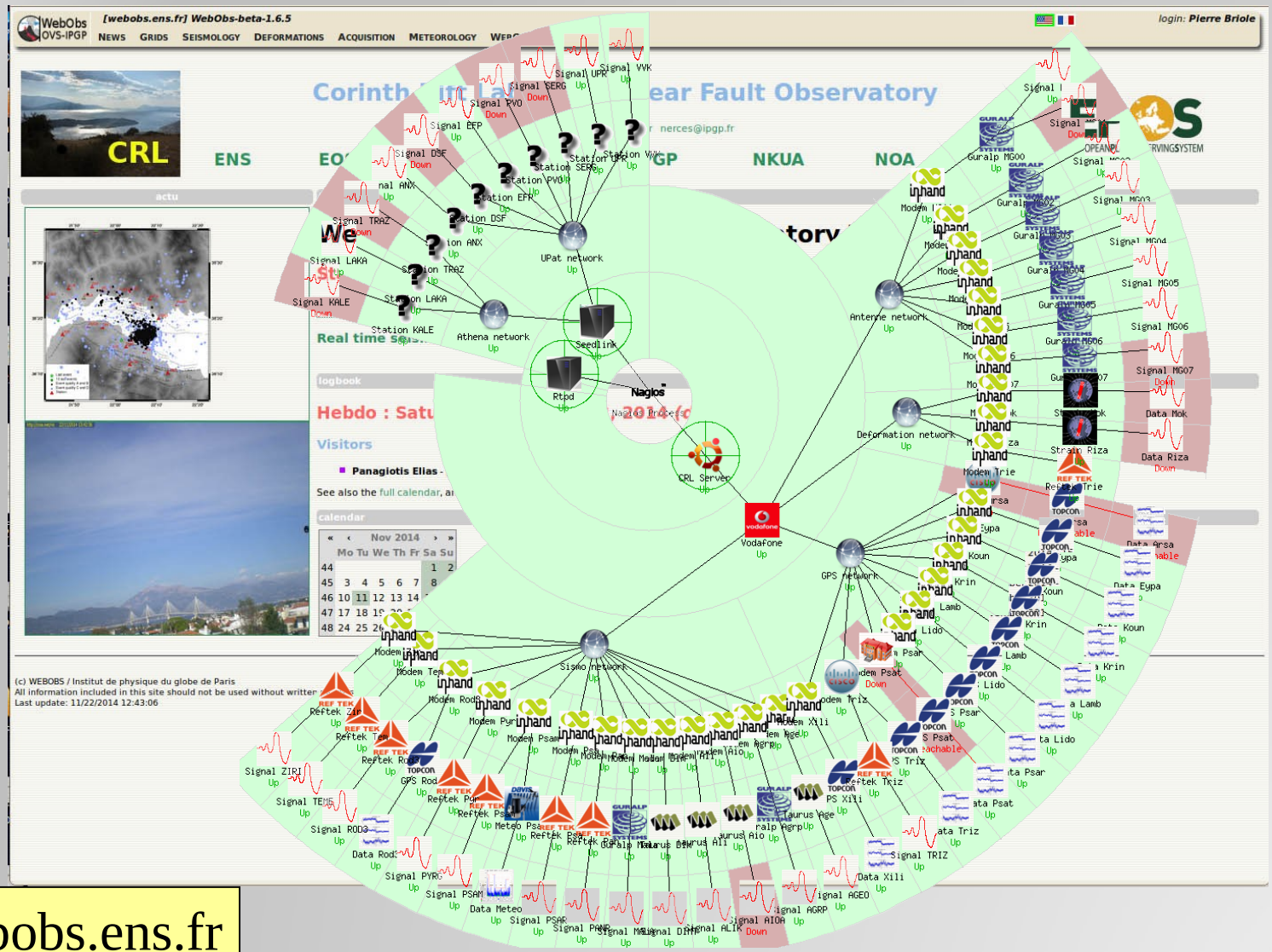
Corinth Rift Laboratory Networks



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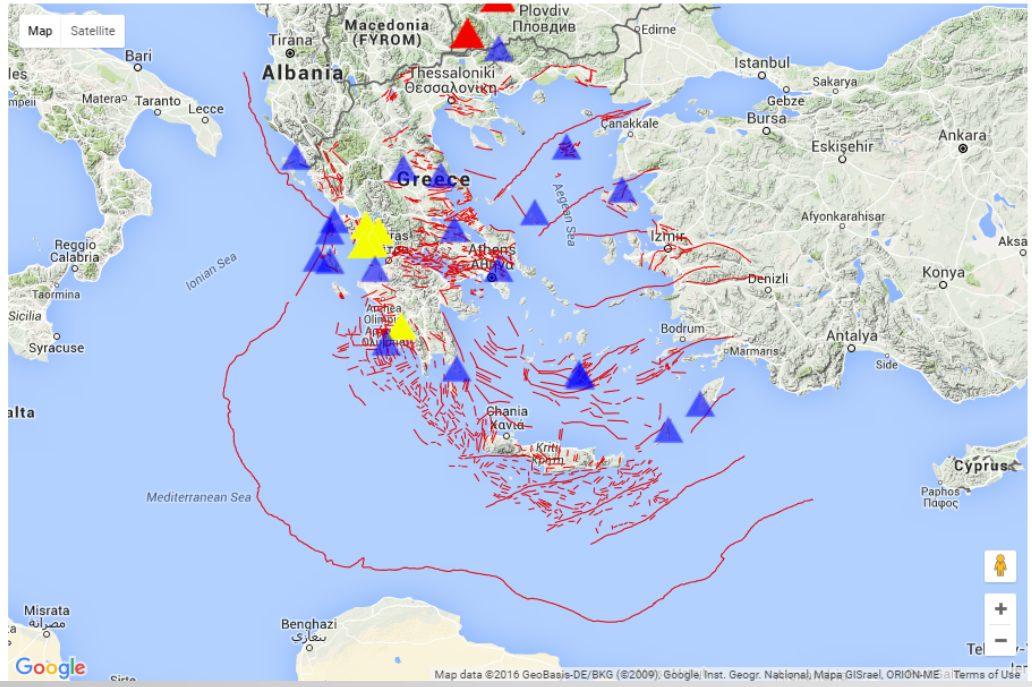

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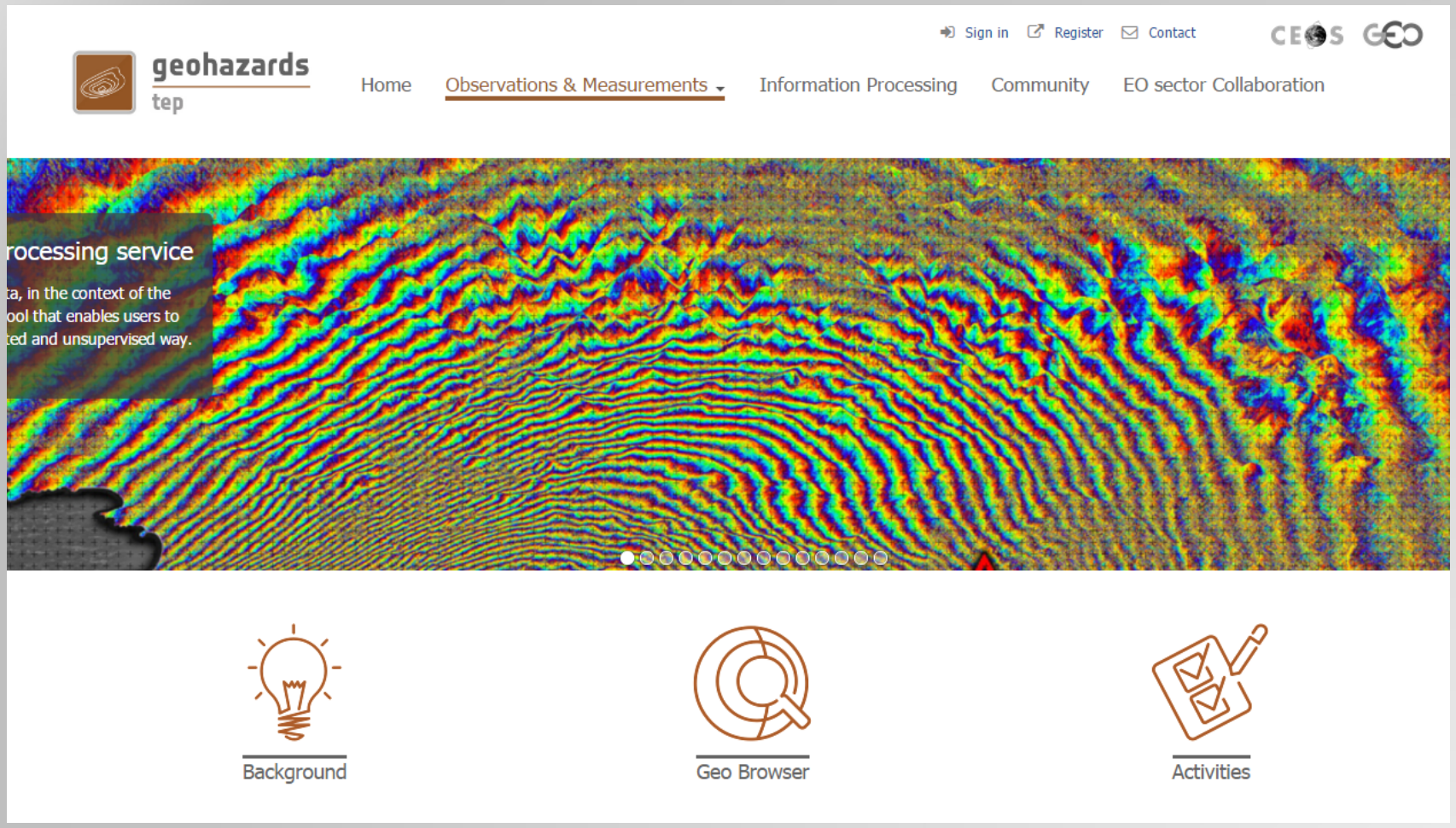
Terradue Geohazards TEP



CRL participates in the Terradue Geohazards *Thematic Exploitation Platform* Pilot Project

Conclusions

1. **The Gulf of Corinth is a unique place in Europe and in world in terms of the plurality and complexity of the geophysical phenomena gathered in a small area**

2. **Corinth Rift Laboratory is a mature natural laboratory for tectonic studies in terms of human networking and instrumentation**

3. **Earth Observation data supported by the in-situ instruments plays a crucial role for understanding the geophysical mechanisms underneath**

4. **The research community involved and the in-situ networks are steadily growing up**

Thank you very much for your attention!
Questions?