Internship available – Master 1 or 2 (Lyon & Paris) *Published on Septembre 2021*

Bayesian estimates of coseismic strain : application to the Petrinja earthquake (Mw 6.4, Croatia, 2020)

Estimation probabiliste des déformations cosismiques : cas du séisme de Petrinja (Mw 6.4, Croatie, 2020)

Context :

During major earthquakes, the lithosphere surface is deformed due to the sudden release of seismic energy and associated damage in the surrounding of the active fault hosting the earthquake. Mapping the coseismic deformation give information on the earthquake itself, the active fault geometry but also on the rheology of the of the medium surrounding the fault.

On the one hand, in the last years, ground displacement measurements conducted around major continental and well recorded earthquakes (i.e. 2019 Mw 6.4 Ridgecrest sequence) showed that a significant part of the deformation can be distributed in the volume surrounding the active fault and not only accommodated by static slip on the fault plane itself. The ratio between the volumetric vs localized deformation could be an indirect proxy for the fault maturity, and may help to better understand the fault's seismic history.

On the other hand, the surface deformation associated with major earthquakes is captured by a set of geodetic tools that are now commonly used (GNSS, InSAR, optical correlation). However, these techniques give estimates of surface displacement or velocities that are associated with non-negligible errors and that can not fully describe the strain field if used alone. GNSS measurements are often sparse in epicentral zones, while InSAR data provide dense, middle and far-field measurements in the line of sight of the satellite, that can be complemented by 2D or 3D measurements from high resolution, near-field optical image correlation data. To progress in the understanding of the coseismic modes of deformation around faults, there is an important need for properly combine these data sets and derive continuous coseismic displacement fields, associated with consistent errors. In the last years, we developed at LGLTPE a software that invert the strain rate tensor (so far only from discrete GNSS velocity field) using the Bayesian transdimensionnal framework (Pagani et al. 2021).

Aims :

During this internship, the intern will apply the Bayesian transdimensionnal inversion method developed at LGL-TPE to the coseismic displacement fields associated with the Petrinja Mw 6.4 strike-slip earthquake that stroke Croatia in decembre 2020. He/She will adapt the current code to the discrete displacement field obtained in very near field from GNSS campaign measurement (Kodic et al. 2021) and to continuous maps of the coseismic displacement coming from optical correlation techniques. This work will give insights on the amount of volumetric deformation associated with this major earthquake.

Tools :

The intern will use the fortran code developed by C.Pagani and T.Bodin. He/She will use a python based tool to visualize the results and produce understandable maps of the deformation. The inversion will be run on LGL-TPE clusters, that are operated via command lines (Unix system).

Scientific team :

The intern will be supervised by Thomas Bodin, Cécile Lasserre and Marianne Métois at LGLTPE. He/She will benefit from a large consortium of french and european researchers working on the Petrinja earthquake in the frame of several CNES funded projects. In particular, the intern will interact closely with Maxime Henriquet, a postdoctoral student working between LGLTPE and CEREGE laboratory.

Pay: for M2 intern 554€/month (CNES TOSCA funding)