ÉCOLE DOCTORALE
SCIENCES DE LA TERRE ET DE L'ENVIRONNEMENT
ET PHYSIQUE DE L'UNIVERS, PARIS

Sujet proposé pour un début de contrat en octobre 2015

TITRE du SUJET : Modelling of the strike-slip earthquake mechanism with multiple friction laws

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The earthquake hazard assessment has been required for the safety of large facilities such as nuclear plant or urban development. One is, therefore, expected to develop a useful and reliable computational earthquake modeling tool that can combine detailed information from local geology, rock physics, hydrology and earthquake source physics for the quantitative earthquake hazard assessment. In this project, we focus on the strike-slip earthquake modeling to explore the fault behavior under the condition of the complex fault geometry and complex constitutive behavior of the rocks hosting them. Hence we aim to extend the existing fracture simulation algorithm, MUNROU, to account for (a) multiple friction laws consisting of the laboratory-derived laws: Rate and State friction, Flash heating and slip-weakening (b) Complex fault geometry (c) Anelastic constitutive behavior of the fractured medium surrounding the faults. This would the first attempt in earthquake source physics to combine the above three behaviors so that a realistic assessment of seismic hazard can de done.

This project will be done in the collaboration between *Dr. Esteban Rougier* (LANL) and *Drs. Harsha S. Bhat and Yann Klinger* (IPGP) to explore the earthquake rupture mechanism. Each advisor brings in a unique set of skills to the project. Dr Rougier is the developer of the FDEM code and has a lot of experience in modelling brittle failure. Dr. Bhat is a theoretical mechanician focusing on earthquake physics and rock physics. Dr. Klinger is a neotectonicist who will provide valuable insights on complex fault geometry and local geology.

We formulate a hypothesis that the accurate modelling of the earthquake rupture could be achieved by properly modelling the fault geometry, friction behaviour and inelastic nature of off-fault damage. *While some of the complexities have been explored separately, no study has tried to integrate all of them due to lack of appropriate tools.* The results would be benchmarked against the 1992 Landers Earthquake due to the high quality and variety of observational data available.

We propose to address the project by subdivided our tasks into the following three working packages.

WP #1: Extending the LANL code MUNROU to handle strike-slip earthquake ruptures
WP #2: Modelling the 1992 Landers earthquake rupture
WP #3: Hydro-Mechanical coupled analysis for the earthquake cycle