

## NERA PhD position

Effects of surface geology and geometry (e.g. sedimentary valleys, topography) significantly contribute to ground-motion amplification and variability, and should be accounted for in seismic hazard estimates. Their complexity, combined with the limitations of both geophysical investigation and numerical simulation techniques, made it impossible till now to include such effects in routine earthquake hazard assessment and risk mitigation policies: the vast majority of building codes does not include any provision for basin and surface topography effects. These effects are generally associated with a significant proportion of surface waves in the seismic wavefield, which may also generate large spatial variability over short distances, i.e., with large strains. The spatial decorrelation of ground motions and associated ground strains, which should also receive particular attention in the near-source area of extended faults, may affect significantly the behavior of large or long structures: reduction of the “translational” modes, emphasis on the torsional and rocking modes, and generation of large strains on lifeline facilities. Although recognized as an important component of the seismic wavefield in strong-motion seismology since the 1930s, it only received limited attention so far because of the generally poor spatial distribution of strong-motion stations.

The ultimate objectives of the PhD are twofold :

- to understand the key subsoil parameters that locally control the strain values and the spatial variability of ground motion,
- to develop and calibrate simple, engineering-oriented, correlations or models that could allow to incorporate basin and surface topography effects in seismic design (building codes, microzonation studies, ...).

Both will be achieved on the basis of numerical simulation results and basic physical insight, and tested on instrumental data and further results of 3D modeling, as briefly outlined below.

A series of recent advances in numerical simulations tools and computation facilities allow now 2D simulations of ground motion and strain over the whole frequency range of interest in earthquake engineering (beyond 10 Hz) and 3D simulations up to frequencies of obvious engineering usefulness (2-4 Hz). The first goal of the PhD will be to perform extensive, parametric numerical simulations on 2D and simple 3D basin models with varying mechanical (sediment-bedrock impedance contrast, sediment velocity and damping profile), geometrical characteristics, and incoming wavefields (point or extended sources with different distance and depth, plane waves with different azimuth and incidence angles). The PhD candidate will not have to develop a new simulation code, but to learn how to use already existing and properly checked numerical tools (spectral elements, finite difference). In a second step, the ground motion and strain synthetics will be analyzed in order to investigate the link between ground motion parameters, strains, seismic wavefield, source closeness and complexity and subsurface properties. Simple a priori models as well as more sophisticated correlation tools (neural networks, canonical correlation, ...) will both be considered in that aim. Then, these numerically derived estimates of ground motions and strains will be compared to actual specific measurements of spatial variability and strains that will be carried out during this PhD within the NERA / JRA1 and JRA3 research projects, and possibly with additional results of numerical simulation, in order to quantify the gain with respect to classical, 1D-type site amplification factors already accounted for in building codes

The PhD fellowship is granted by the NERA EU project (<http://www.nera-eu.org>). The PhD candidate will be included in the ISTERre "Risks" research team - where he/she could benefit from scientific exchanges with other scientists and projects -, and will actively collaborate with European partners of the NERA project. He/she could also participate in the planned field experiments. The candidate should have a good background in Earth Sciences, with an inclination for using numerical modelling and data processing tools, manipulating large data sets and using statistical tools.

PhD Period : 2011 - 2014. Starting : as early as possible, not later than October 2011.

Application : CV + motivation letter to the three scientists below.

Contacts :

Pierre-Yves Bard : [bard@obs.ujf-grenoble.fr](mailto:bard@obs.ujf-grenoble.fr) tel. +33 (0)4 76 63 51 72  
Cécile Cornou : [cornouc@obs.ujf-grenoble.fr](mailto:cornouc@obs.ujf-grenoble.fr) tel. +33 (0)4 76 63 51 52  
Emmanuel Chaljub : [echaljub@obs.ujf-grenoble.fr](mailto:echaljub@obs.ujf-grenoble.fr) tel. +33 (0)4 76 63 52 50