Assessing the seismic coupling of compressional faults of the Italian peninsula

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A comparison of the characteristic length of the earthquake record in Italy with the expected long-term slip rate for local faults suggests that the activity of two out of three sources of potentially damaging events may have gone undetected so far. This implies that not even one complete "seismic cycle" could be represented by the available earthquake sample. For this reason, over the past few years a growing number of seismicity and seismic hazard models have relied on information from geodesy and active faulting to obtain alternative estimates of the expected ground shaking, supplementing those derived from traditional extrapolation of the seismic catalog.
Each of these datasets, however, is affected by significant limitations that are quite hard to overcome: for instance, the tectonic motions documented by GNSS data are inevitably mixed with short-term tectonic transients and combined with signals due to different sources as, for example climatic and/or metereologic phenomena and anthropogenic activities.
The dataset on active compressive faults in Italy is affected by several major limitations: a) fault mapping remains incomplete and precise slip-rates are few. Mainly, very little is known about the seismic coupling of faults. Recently it has been shown that assuming that the long-term slip rates of faults in Italy is released seismically it may overestimate the seismic hazard for these fault zones. For these areas there is to report the difficult balance one has to strike between resorting to geodetic data and/or active faulting evidence to overcome possible – and in fact well-known – limitations of the earthquake record, and overemphasizing the role of geodesy and active faults. It follows that assessing the seismic coupling in all tectonic environments that contribute to a country's seismic hazard is a fundamental prerequisite for a correct use and integration of the active faulting In this context a more reliable estimation of the movements due to the regional tectonic processes and geological processes can help to improve the develop of seismic hazard model.
This PhD thesis should bring a significant and original contribution to our understanding of coupling mechanisms on the faults in Italy, and in particular in the Northern-Eastern sector of the peninsula. Moreover, it will permit methodological developments that should eventually allow a strategy avoiding an unwarranted use of any of these sources to assess the regional seismic hazard; an overestimation of the local earthquake potential could fatally harm the economy of portions of Italy. In this context, a different approach at the GNSS observation and in particular at the time series analysis of the position of the permanent and non continuous stations could provide important information on the space and time evolution of the coupling mechanisms on the faults. For this reason, during the PhD will could be also developed non conventional analysis methods of the GNSS position time series in order to try to understand the real contribution of the regional processes involved in the coupling mechanisms, respect to the contributions of the other phenomena.

Possible scientific collaborations:

INGV Sezione Sismologia e Tettonofisica, L'Aquila.
UCLA - Earth, Planetary, and Space Sciences (Prof. Peter Bird)
Institute of Hydrometeorology and Seismology of Montenegro.
Dipartimento di Fisica ed Astronomia dell'Università di Bologna.
Dipartimento di Ingegneria Civile, dei Materiali e dell'Ambiente dell'Università di Bologna