Active faults in Lebanon : kinematics and interseismic behavior measured from radar interferometry (InSAR)

C. Lasserre[1], B. Pinel-Puysségur[2], M. Vergnolle[3], Y. Klinger[4], E. Pathier[1]

(1) ISTerre, Grenoble, France
(2) LDG, CEA, Bruyeres le Chatel, France
(3) GeoAzur, Sophia Antipolis, Nice

The Levant fault system, more than 1000 km-long, marks the limit between the Arabian and Sinaï tectonic plates, extending from the Aqaba gulf in the Red Sea to Turkey. Mostly left-lateral, it forms a transpression zone in Lebanon, associating strike-slip faults such as the Yammouneh fault and thrust faults such as the Mount Lebanon thrust. This fault system in Lebanon is at the origin of large historical earthquakes during the past two thousand years (551 AD on the thrust offshore and 1837 along the Roum fault inland, 1759 along the Rashaia and Sergaya faults). We aim at characterizing the present-day behavior of active faults in Lebanon, in particular the Yammouneh fault which did not break since 1202, to contribute to a better assessment of the seismic hazard in this region.
Space geodesy techniques (GPS, InSAR) allow to quantify the present-day displacements across faults (a few mm/yr during the interseismic period), and to model stress loading and relaxation processes during the seismic cycle, at the fault scale and at the regional scale. GPS campaign measurements have been made along profiles perpendicular to the Yammouneh fault. In addition, an important archive of radar images covering Lebanon (acquired by the ERS and Envisat satellites, along descending and ascending orbits) is also available.
We process ERS and Envisat radar data to obtain the average interseismic velocity field across faults over the past 15-20 years. Techniques of interferograms networks processing (MuLSAR), atmospheric phase delays correction from global atmospherical models, DEM correction and time series inversion (NSBAS) are used to overcome the main remaining limitations in the measurements accuracy (low coherence, strong atmospheric delays, long wavelength deformation signal). The final goal is to propose a modelling of the surface displacement field to quantify the present-day kinematics of active fauts in Lebanon, taking into account GPS data as well as tectonic and paleoseismological studies.