

Seismicity in North-East Italy monitored by satellite techniques

Veneto and North East Italy are seismically active: the areas of Montello Alpi (provinces of Belluno-Treviso), the Schio Vicenza line and of Monte Baldo (Verona) are directly affected by the ongoing collision between the Adria microplate and the stable European foreland in the Southern Eastern Alps. According to the historic seismic catalogues, an earthquake of Magnitude 6.6 took place in the area of Asolo in 1695, of $M=6.3$ in the Belluno area in 1873 and of $M=6.49$ in the Verona Area in 1117. Considering the damage produced by the 1976 Friuli earthquake ($M=6.5$) and the more recent but smaller events in Emilia ($M=6.1$), and the fact that typical recurrence times for earthquakes of $M=6$ or larger are of several centuries, it is clear that every effort has to be made to improve our knowledge of the physical indicators of ongoing seismicity, with the intent to mitigate the hazard related to such events. The recent events in Emilia call for a particular attention of the scientific community, particularly in the North East, on the use of the most advanced technologies for a better understanding of a phenomenology with strong scientific and social/economic impact.

We know the potentially seismic areas, and we need to monitor them. Space techniques are candidates to this task from several viewpoints: GNSS (i.e. GPS, GLONASS and Galileo navigation Systems) signals provide measurements of temporal changes of coordinates of receiving stations with millimetric precision and time resolution of the order of seconds, in near real time. InSAR techniques (Cosmo Skymed, Radarsat, EnviSat..) have the capability to measure deformations occurring between two passes over the seismic areas (typically days or weeks), with comparable accuracy with GNSS. Changes in the concentration of free electrons in the ionosphere over the seismic area are also believed to be connected to seismic events. Such changes in electron content can be measured locally by specifically equipped satellites, or by measuring the change with frequency of the time of flight of signals received on the Earth from radio sources (typically GNSS satellites, but in principle any celestial radio source such quasars, pulsars .. outside the ionosphere).

The University of Padova has a long term experience and international reputation in the development of space technologies for the exploration of the Solar System, including the Earth.

The North East of Italy is covered by a few stations of the seismometric network managed by the Civil Protection, the Istituto Nazionale di Oceanografia e Geofisica Sperimentale (INOGS) and the Istituto Nazionale di Geofisica e Vulcanologia. There is a dense network of permanent GNSS stations, with data analyzed at the University of Padova on a regular basis. There is a growing research in the field of InSAR data processing and ionospheric monitoring, thanks to international collaborations.

The principal lines of research are 1) measurement by satellite techniques (GNSS, SAR) of deformation of an elastic/viscoelastic seismogenic crust subject to a horizontal (tectonic) and vertical (lithostatic) stress, and 2) relation to seismicity of changes of the density of electrons in the ionosphere, by means of sensors on dedicated satellites, or by measuring the differential delay of radio signals at different frequencies.

Over the three years period the PhD candidate is expected:

- to be able to map in detail the deformation in the entire North East (Friuli VG, Veneto, Trentino AA, Tirol/Carinthia in Austria and Slovenia) by GNSS techniques, by capitalizing on previous experience and data we have matured over the years. Deformation by InSAR will be investigated acquiring data, particularly from the Italian Cosmo SkyMed of the Italian Space Agency ASI.

- to demonstrate that the deformation process is active and defined in detail as precisely as possible, and that it is related to the background seismicity measured by the seismometric network, and the Database of Individual Seismogenic Sources of INGV.
- to generate high resolution (spatially and temporally) maps of the ionosphere above the study area, and correlate it with the seismic activity. This can be accomplished effectively through a web page.