Long term observation of crustal deformation in NE-Italy

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The long term monitoring of crustal deformation in NE-Italy derives from tilt and strainmeter observations since 1960. The stations have been maintained by three generations of scientists starting with the geodesist Antonio Marussi, keeping the instrumentation active and up to date. The decade-long time series have given observations of rare events, as the free oscillations recorded by the largest earthquakes ever recorded (Chile 1960, Sumatra 2004, Tohoku 2011) and climatic extreme events leading to extremely intense rainfalls that generate underground flooding and surface deformation (Braitenberg et al., 2019; Braitenberg, 2018). The stations have the characteristic of being representative of geodetic monitoring in karst geologic formation, that they are placed in a seismically active area which has experienced a magnitude M 6.4 earthquake in the past (1976 Gemona), and that they are influenced by the ocean loading deformation of the Adriatic Sea. The seismic area implies that the strain accumulation is an ongoing process, presently activating the elastic energy of the next earthquake. We show some relevant observations, which could hardly have been caught without such a long time series. Between 1973 and 1976 the long base horizontal pendulums of the Grotta Gigante cave gave episodic disturbances, that seized 6 months after the Gemona main shock. The hydrology of the karst is made of an underground channel system that is completely flooded during extreme rainfall and is pressurized close to simultaneously over a distance of 30 km, leading to an observable uplift and deformation of the surface (Braitenberg et al., 2019). It has been possible to extract and model this type of deformation.

The tilt and strainmeters have high accuracies and precision in the detection of crustal deformation, with the drawback to be point measurements. InSAR acquisitions cover thousands of points on the surface, but with coarser accuracy. One major problem is in the correction of atmospheric effects in the InSAR signal, which produces apparent movement in the direction of Line of Sight, uncorrelated to the real soil movement. Our present research objective is the transfer of knowledge from the signals known in the tilt and strainmeter observations to the detection of these signals with InSAR.
