EGU21-9848, updated on 27 Jul 2021
https://doi.org/10.5194/egusphere-egu21-9848
EGU General Assembly 2021

The tilt and strainmeter network of NE Italy: multi-decadal observations of crustal deformation as ground truth for DinSAR.

Carla Braitenberg, Alberto Pastorutti, Barbara Grillo, and Marco Bartola
University of Trieste, Department of Mathematics and Geosciences, Trieste, Italy (berg@units.it)

Decade-long series of tilt- and strain-meter observations in NE Italy allow monitoring the crustal deformation from short transient to long-term phenomena. These recordings, some of them started in 1960, are generated by sources spanning a wide spectrum of spatial scales, such as sudden underground flooding due to extreme rainfall [1, 2], years-long fluid diffusion transients due to fault behavior [3], the free oscillation arising from megathrust earthquakes (e.g. Chile 1960, Sumatra 2004, Tohoku 2011).
The instrumental sites lie on karst formations, in an area of continental collision and active seismicity, the northeastern portion of the Adria microplate, where the south-directed thrusts of the Alpine system merge with the NW-SE transpressive regime of the External Dinarides. Measurements include the ongoing interseismic strain accumulation processes, including the peculiar observation of episodic disturbances and southward tilting in the three years preceding the 1976 Mw6.4 Friuli earthquake [4].

The channel systems of Karst hydrology, which undergo complete flooding and overpressure buildup in extremely short time spans (e.g. near-simultaneous flooding over a distance of 30 km) result in observable surface deformation and a change in the gravity field. Tilt time series allow to extract and model this type of hydrology-forced uplift and associated deformation [2,5].

Tilt- and strain-meters allow for accuracy and precision in measuring crustal deformation, to a level which space-borne geodesy cannot provide. The main drawback, however, is that only point measurements are provided, in locations where stations could be set up.
On the other hand, the thousands of points on the surface that DInSAR can provide are affected by coarser accuracy and influenced by atmospheric effects - resulting in LoS displacements uncorrelated to the actual surface deformations. We aim at enabling the transfer of knowledge from tilt- and strain-meters observations to DInSAR-derived data, thus allowing a first assessment of ground-truth constrained displacement models.

[1] Braitenberg C. (2018). The deforming and rotating Earth - A review of the 18th International Symposium on Geodynamics and Earth Tide, Trieste 2016 , Geodesy and Geodynamics, 187-196, doi::10.1016/j.geog.2018.03.003

[2] Braitenberg C., Pivetta T., Barbolla D. F., Gabrovsek F., Devoti R., Nagy I. (2019). Terrain uplift

due to natural hydrologic overpressure in karstic conduits. Scientific Reports, 9:3934, 1-10, doi.:10.1038/s41598-019-38814-1

[3] Rossi, G., Fabris, P. & Zuliani, D. Overpressure and Fluid Diffusion Causing Non-hydrological Transient GNSS Displacements. Pure Appl. Geophys. 175, 1869–1888 (2018). https://doi.org/10.1007/s00024-017-1712-x

[4] Dragoni M., Bonafede M., and Boschi E. (1985). On the interpretation of slow ground deformation precursory to the 1976 Friuli earthquake. Pure and Applied Geophysics 122, 781–792. doi:10.1007/978-3-0348-6245-5_3

[5] Grillo B., Braitenberg C., Nagy I., Devoti R., Zuliani D., Fabris P. (2018). Cansiglio Karst-Plateau: 10 years of geodetic-hydrological observations in seismically active northeast Italy. Pure and Applied Geophysics, 175, 5, 1765-1781, doi:10.1007/s00024-018-1860-7.