INSIGHTS INTO THE SEISMIC POTENTIAL OF THE VENETIAN SOUTHERN ALPS (ITALY) FROM THE INTEGRATION OF GPS AND INSAR VELOCITIES

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The Venetian sector of the Eastern Southern Alps (ESA) is part of the convergence margin between the Adriatic and the Eurasian plates, where most of the strong instrumental and historical earthquakes in Northern Italy have been recorded. However most of the seismogenic sources associated with these large earthquakes are still debated (DISS working group). In this work we integrate InSAR and GPS velocities across the Montello and Bassano-Valdobbiadene thrust system, with the goal of determining a new spatially dense 3D interseismic velocity field. The integrated geodetic velocity field has been used in order to characterize faults that are accumulating elastic strain.

We use two InSAR velocity fields obtained from ENVISAT satellite acquisitions along both ascending and descending orbits in the 2004-2010 time-span and elaborated using the SBAS multitemporal InSAR technique (Berardino *et al*., 2002). We use a GPS velocity field obtained

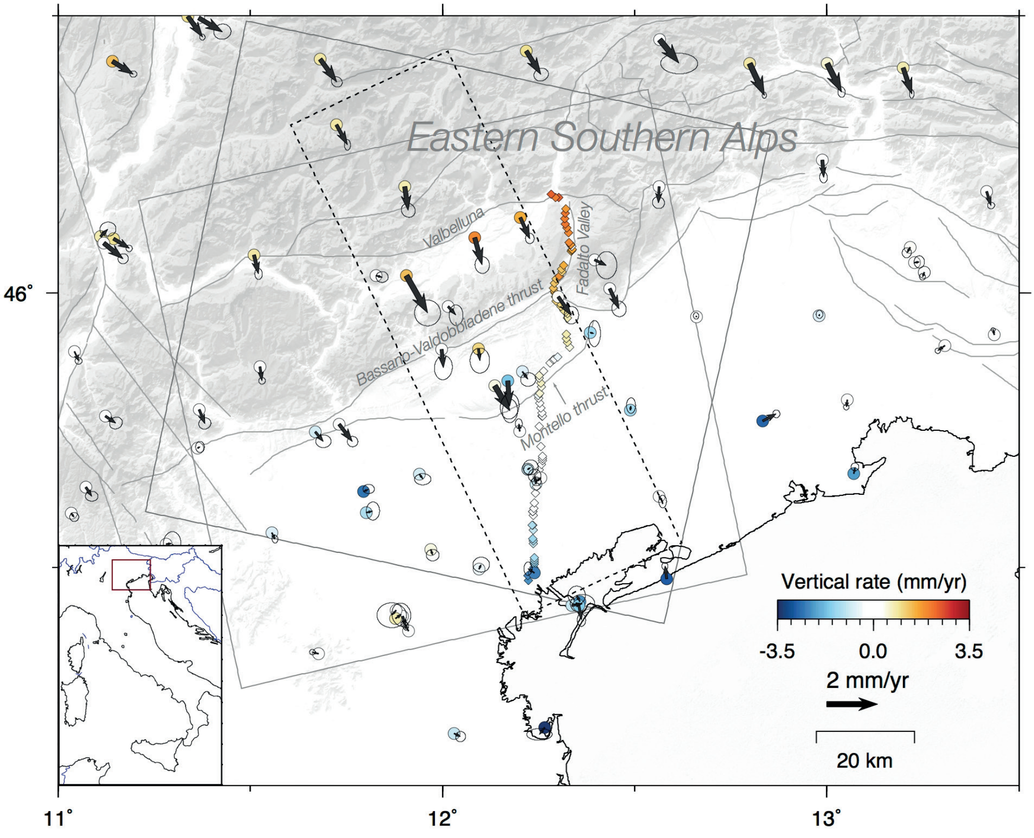

Fig. 1 - Geodetic velocity dataset: the black arrows show the horizontal GPS velocities (with 95% error ellipses) in a fixed-Adria reference frame, whereas the colored circles show the vertical GPS velocities. The colored diamonds show the vertical ground motion rates estimated from the IGMI leveling data and the two squares indicate the ascending and descending ENVISAT frames.

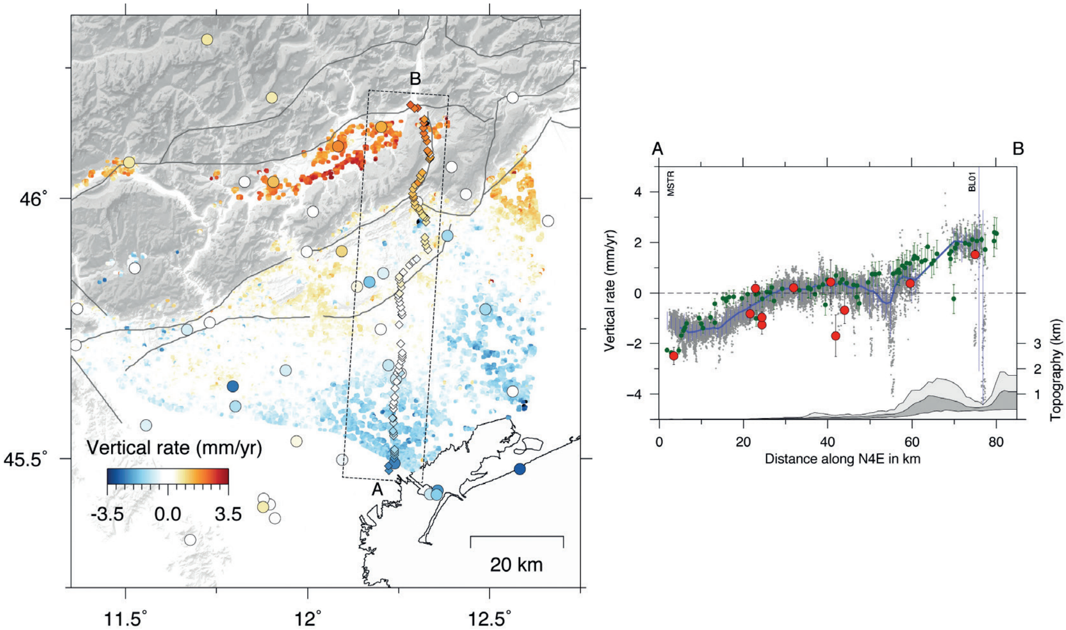

Fig. 2 - Left: Vertical velocity field from InSAR data decomposition (dots), from GPS measurements (circles) and from the IGMI leveling data (diamonds). Right: cross section of vertical velocities along the A-B profile.

from the analysis of data from continuous and semi-continuous stations, using the GAMIT/GLOBK software (Herring *et al*., 2015) and following the three-step procedure described in Serpelloni *et al*. (2013).

As shown in Fig. 1, across this sector of the ESA, GPS measurements show ~1 mm/yr of SE-NW shortening accommodated in ~40 km and a regional uplift of ~1 mm/yr in the Alps with maximum values close to 2 mm/yr in Valbelluna. We compare our results with the vertical rates from precise leveling measurements performed by the Istituto Geografico Militare (IGM; IGM-RG, 1978), over a distance of ~200 km, from the Venetian plain to the Southern Alps mountain belt, along the Fadalto Valley.

The InSAR velocities have been tied to the GPS velocity field, rotated in a Adria-fixed reference frame (Serpelloni *et al*., 2016), correcting for long-wavelength residual orbital errors (Zebker *et al*.,1994), estimating a planar ramp and an offset between the two velocity datasets. This adjustment provides an improved agreement between InSAR and GPS velocities, projected along theLOS. The corrected ascending and descending LOS velocities have been combined in order to derive the vertical InSAR velocity component. This result has been compared with the vertical GPS and leveling rates, showing a notable agreement, as illustrated in Fig. 2. The integrated geodetic vertical velocity field allows to identify a velocity gradient of ~1.5 mm/yr occurring in less than 20 km of distance in correspondence of the Bassano-Valdobbiadene thrust (BT). In order to provide insights into the origin of the geodetic uplift, we developed a simple 2D dislocation model, jointly inverting GPS and InSAR velocities along a NNW-SSE oriented profile, crossing the Montello and Bassano-Valdobbiadene faults. Most of the fault geometry parameters are constrained by local instrumental seismicity, focal mechanisms (Danesi *et al*., 2015) and the interpretation of the TRANSALP (Castellarin *et al*., 2006) and geological profiles (Galadini *et al*., 2005).

We subsampled InSAR points in order to reduce the computational costs of the data inversion, and we apply a relative weight between GPS and InSAR datasets in order to calibrate the relative importance of the two different velocity fields. We jointly invert GPS and InSAR velocities along a SE-NW oriented profile from the venetian plain to the Dolomites in order

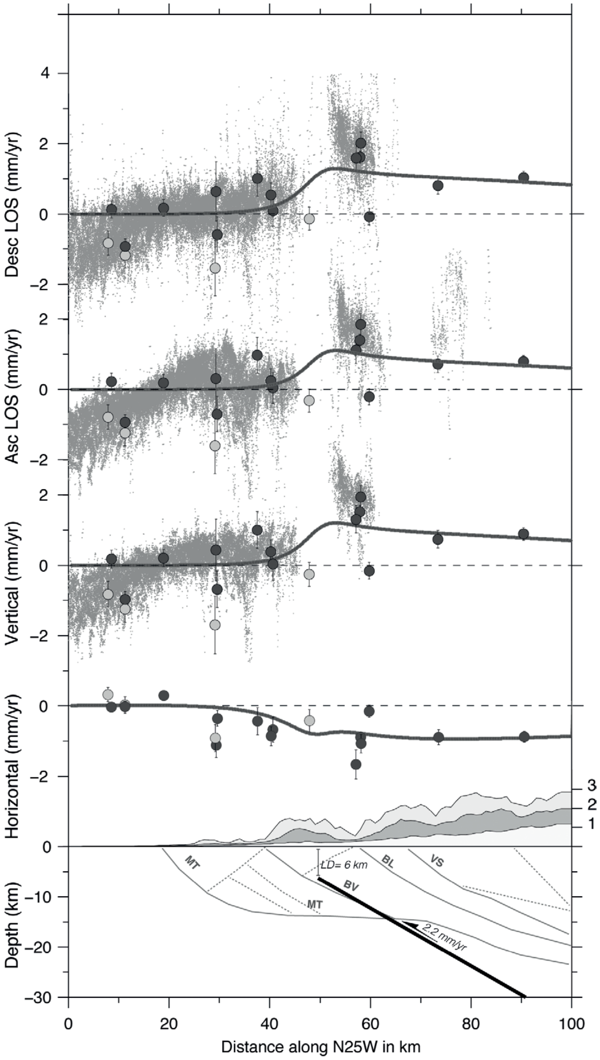

Fig. 3 - Cross sections across the Montello and Bassano-Valdobbiadene thrust faults showing the results obtained using a 2D dislocation model for the Bassano thrust (Model 1)

to estimate the locking depth (LD) and dip-slip rate of the fault model. We test two scenarios: a first model with only the Bassano-Valdobbiadene thrust fault accumulating elastic strain (Model 1) and a second model with a 3-fault system, adding to the BT the ramp-décollement system pertaining to the Montello thrust (Model 2). Fig. 3 displays the inversion results with the Model 1, showing that the horizontal and vertical velocity gradients are decently reproduced with the simplest dislocation model. This result suggests that the BT may accommodate elastic seismic deformation with an estimated slip rate of ~2 mm/yr. The data inversion with Model 2 provide similar results to Model 1, except for a slight better fit of data located above the Montello hill. In the second model the LD of BT is ~8 km with same slip rate and the Montello thrust has a very shallow LD (~3 km) with a sub-mm slip rate (~0.5 mm/yr), in agreement with previous results showing a limited locking for the Montello thrust ramp (Serpelloni *et al.*, 2016)

All the results will be discussed in terms of seismic potential of the considered fault systems in comparison of the available geological and geomorphological information, and providing some explanations on systematic residuals we obtain in the datasets modeling.

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