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A New Semi-Continuous GPS Network and Temporary Seismic Experiment Across the Montello-Conegliano Fault System (NE-Italy)

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Motivation

The Montello–Conegliano Thrust (Fig. 1) is the most remarkable active tectonic structure of the Southern Alpine fault belt in the Veneto-Friuli plain, as a result of the conspicuous morphological evidence of the Montello anticline, which is associated to uplifted and deformed river terraces and diversion of the course of the Piave River. However, in spite of the spectacular geomorphic and geologic evidence of activity of the Montello-Conegliano Thrust, there is only little evidence on how much contractional strain is released through earthquakes and how much goes aseismic. The Italian seismic catalogues have very poor-quality and incomplete data for the events associated with the Montello thrust, leaving room for different interpretations, as for example the possibility that these earthquakes were generated by nearby structures. In this latter case, the whole Montello–Conegliano Thrust would represent a major "silent" structure, with a "recurrence interval" longer than 700 years, because none of the historical earthquakes reported in the Italian Catalogues of seismicity for the past seven centuries can be convincingly referred to the Montello Source, or, alternatively, a fully aseismic fault.

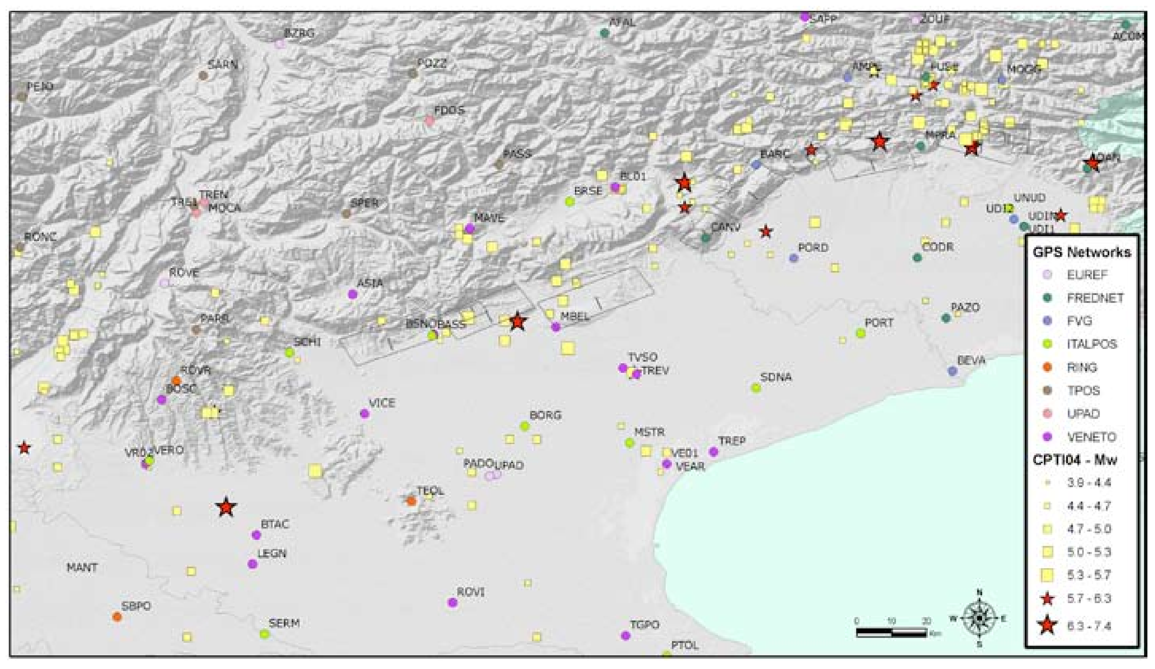
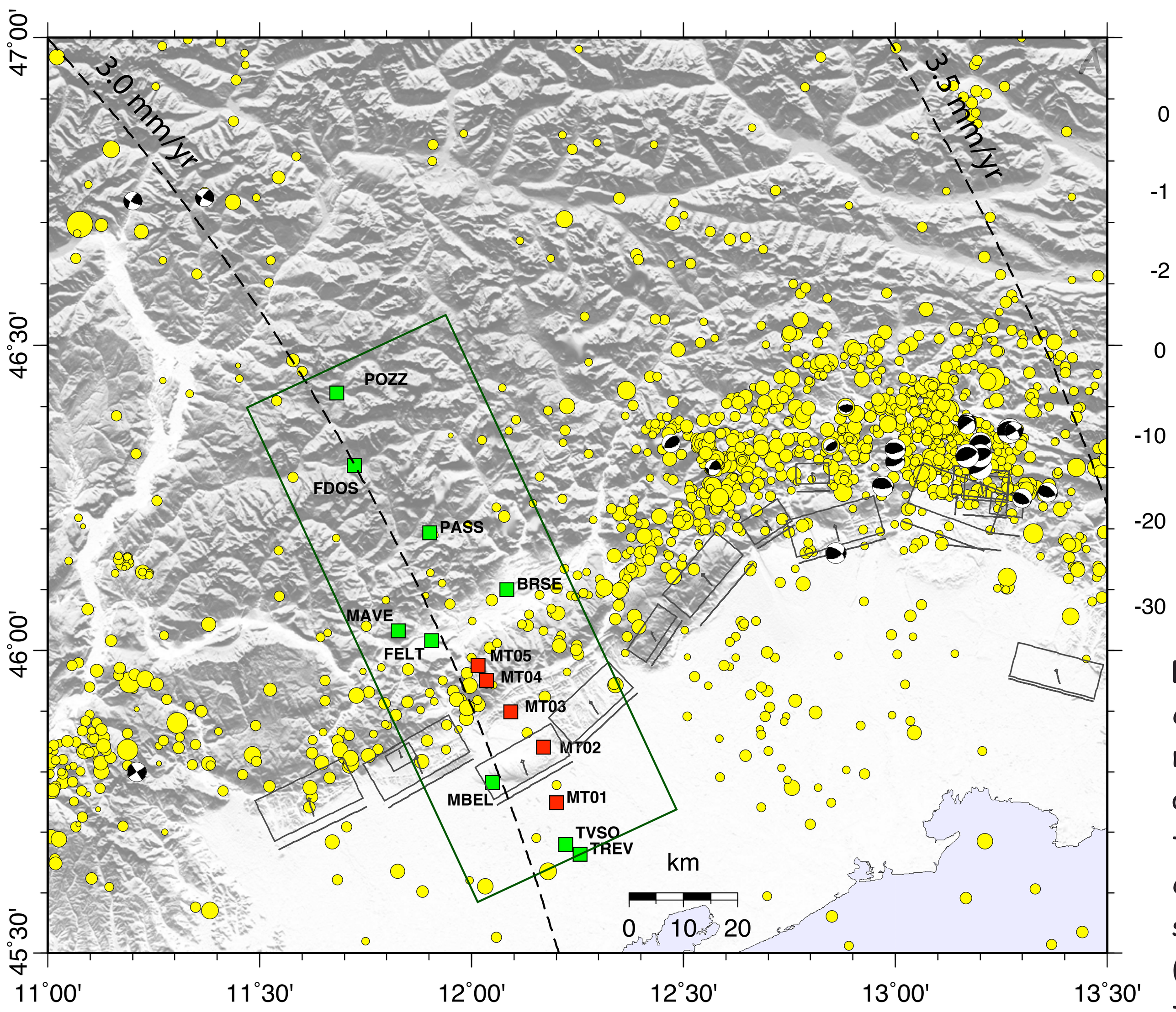


Fig. 1 - Map of the Southern Alpine region showing active faults from DISS3.0 and historical seismicity, together with existing CGPS networks.

Experiment Mode and Network Design

Kinematic models of the Adriaitc microplate predict that about 2÷3 mm/yr of plate convergence should be accommodated across this sector of the Southern Alps. Given the uncertainties regarding the seismic potential of the area we designed and realized a new kind of GPS experiment across the Montello region (Fig. 2), with the goal of measuring the rate and pattern of active shortening, and develop models of the inter-seismic deformation to (i.e., geometry, kinematics and coupling of the seismogenic fault/s). The goal of our network is to improve the sampling of the velocity gradient detectable across the Montello-Conegliano Thrust. During the 2010 a seismic network will be also installed in the region to allow the detection of local seismicity in the upper crust. For this project we use a new mode of GPS experiment, called semi-continuous, which allow to achieve the required accuracy with several advantages with respect to classic continuous GPS monitoring.



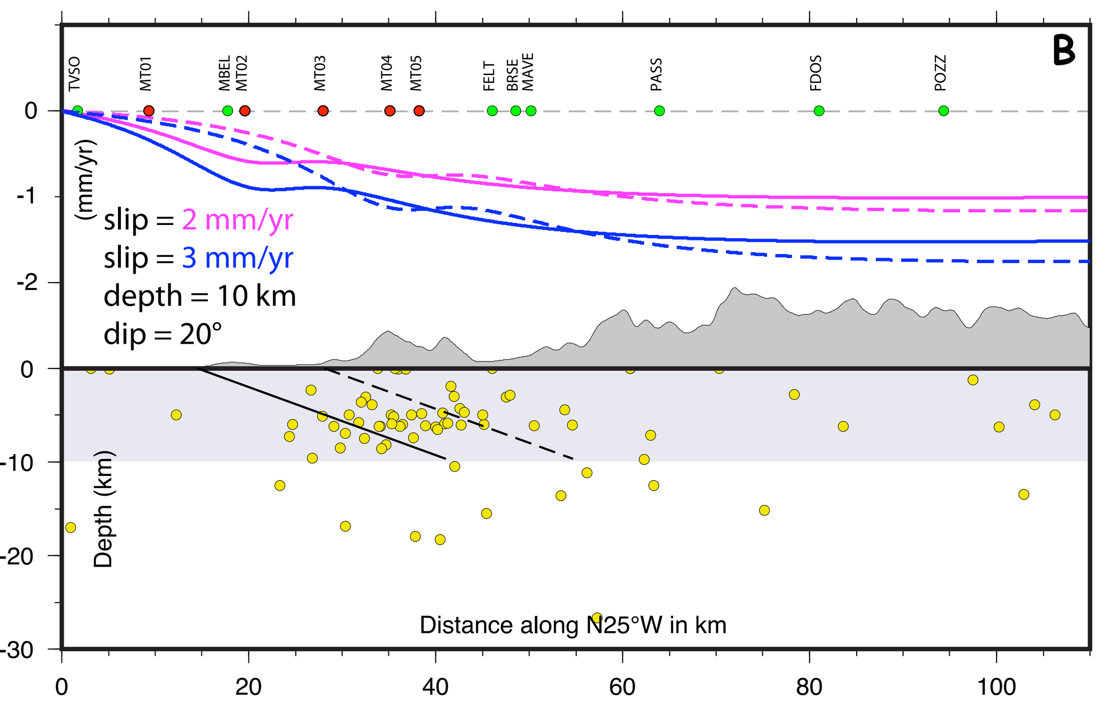
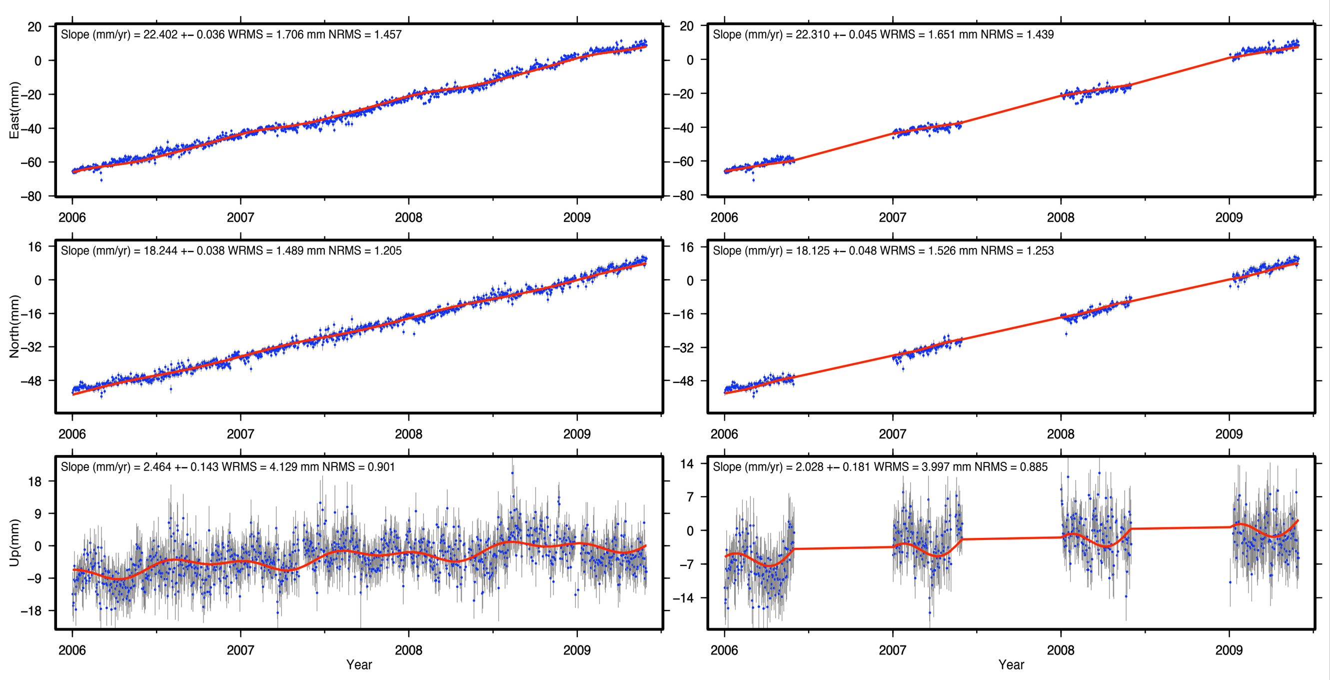


Fig. 2 - [A] Map showing seismicity, focal mechanisms, active faults and convergence rates predicted by Adria-Eurasia geodetically derived kinematic models. Green squares show the position of operating CGPS stations across the Montello-Conegliano Thrust. Red squares show the position of the new semi-continuous GPS stations installed in the 2009. [B] N25°W cross section showing topography, crustal seismicity and position of GPS stations along the profile. Pink and blue lines shoh the velocity gradients (w.r.t. Treviso station) predicted by dislocation models of alternative thrust faults.



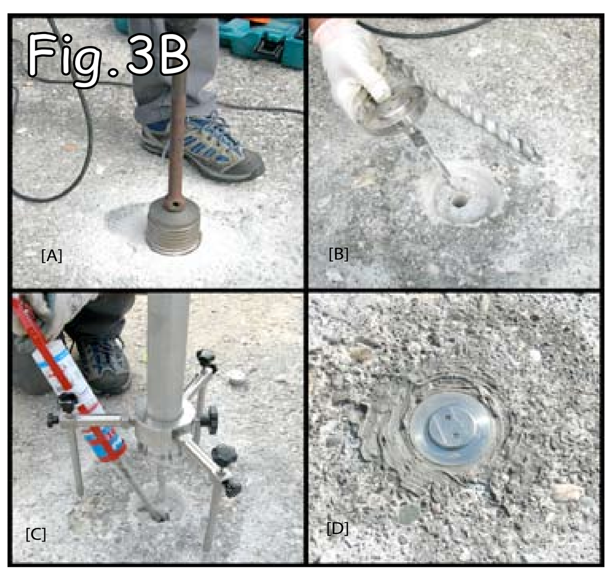
Why Semi-Continuous GPS?

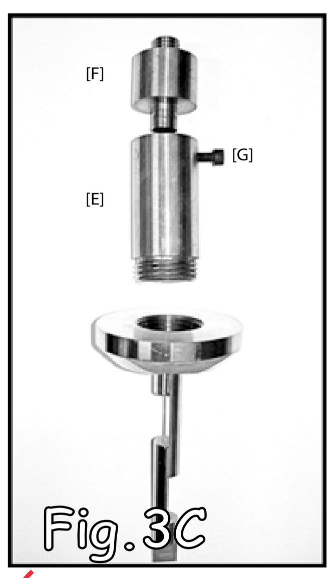
It sub-samples the continuous change of 3D positions, allowing to achive accuracies in the velocity estimates that are comparable to the continuous time-series. Other advantages are: 1) it is easy to install, 2) time-consuming permission requests are not needed, 3) it allows an optimal use of the GPS equipment, which can be used to other networks.

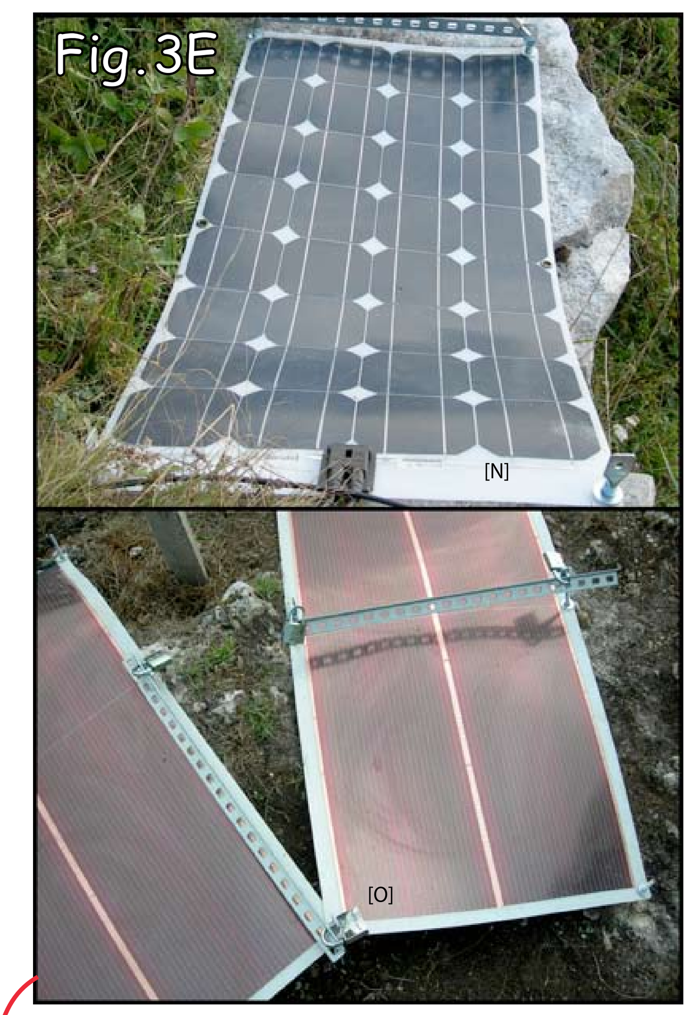
GPS Stations

In order to achive the maximum precisions and accuracies in the 3D velocity estimates, which are required to detect the relatively small velocity gradient expected across the study region, we need to put particular attention on the monument type, its realization and the level of repeatibility of position measurements during the different experiments. We use the "Max-Mount" type of monument (Fig. 3C), and a specifically designed leveling tool to realize the GPS markers (Fig. 3B). We use flexible solar-pannels (Fig. 3E) and GSM/GPRS modems (Fig. 3D) to allow for continuous data collection and operational cheking, respectively. Figure 3A shows a typical SGPS realization.

While SGPS stations represent an efficient and practical way to install dense networks across active faults, they represent sub-optimal realizations w.r.t. classic CGPS sites.







SGPS Stations Installed