Long-term variations of the cGNSS data at the N-Adria plate edge and relation with deep fluid movements.

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Abstract

We analyze the GPS data from the cGNSS networks active at the northern tip of the Adria microplate, the low strain-rate region where the collision with Eurasia occurs. The 15 sites of the Friuli Regional Deformation Network (FReDNet) of OGS (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale), the 10 sites of the Marussi network of the Council of the Friuli-Venezia Giulia Region, and the EUREF station GSR1, in Slovenia, provides continuous observations since 2002. With time-series more than ten-year long, we can reliably evaluate not only the plate motion direction and velocity but also the possible plate acceleration, due to the superposition of other terms of the strain field time-space variations.

With this aim, we considered the longest time series available. We processed them using GAMIT/GLOBK, to generate daily estimates, correcting for satellite orbits, hourly tropospheric delays, atmospheric gradients. We transformed our daily free-network solutions onto ITRF2008 with a 6-parameter transformation (3 translations, 3 rotations) using the coordinates of 99 sites, and then we transformed the data in the Eurasia fixed reference frame. Then, we eliminated the outliers and filled the short gaps in the data through linear interpolation. A low-band pass filter allowed to obtain the time-series cleaned from the components with frequencies higher than 1.5 years. The resulting time-series of the two horizontal components show a dominant linear trend, as expected, whereas it is slight, or absent, in the case of the vertical component. Marked oscillations of some years of duration are superimposed on it for all the three components, with the same frequency content.

In particular, we focussed on an apparent transient signal of about 2-year period, apparently slowly propagating in a region about 150 km wide. The movement is initially upward, except one case, with a slight tilting parallel to the direction of the main tectonic structures with small time delays between the different sites. Later, the opposite behavior is observed. We analyze and corrected the data for the influence of surface and underground hydrological load effects at seasonal, annual, and multi-year scale. Having excluded these factors, we formulate the hypothesis of a porosity wave, originated by fluid mobilization due to tectonic processes in the region. We test such hypothesis, with an original tomographic approach. Therefore, we calculate the propagation velocity and the hydraulic diffusivity, obtaining values compatible with the lithotypes present in the area.

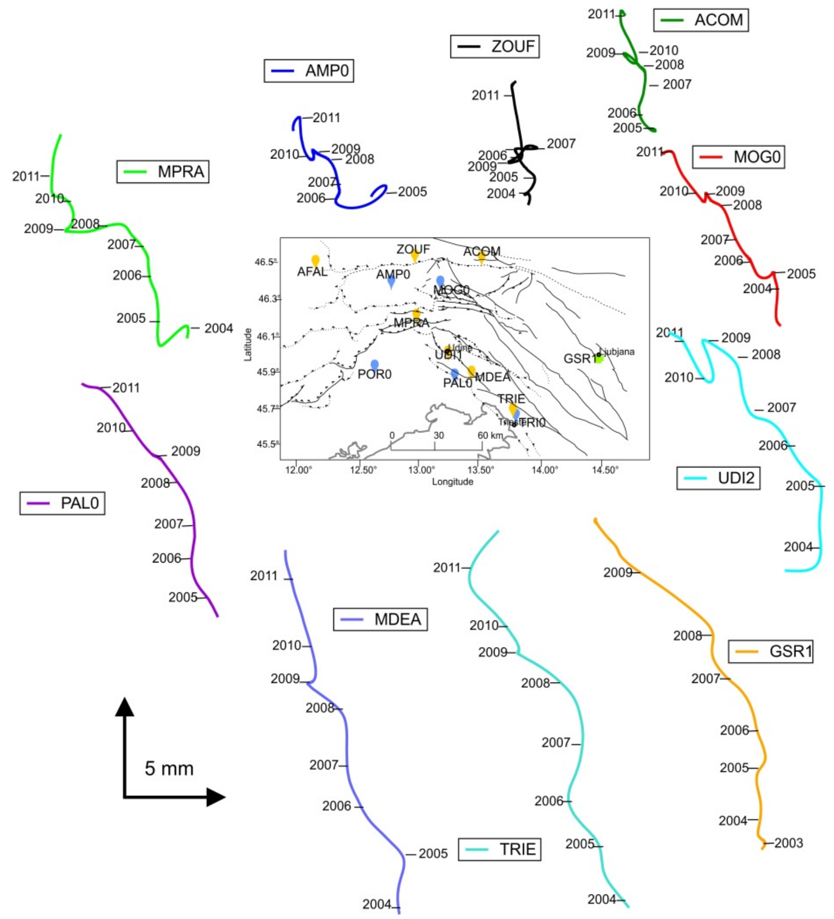

Figure 1. GPS hodograms in the horizontal plane of the data, after low-pass filtering T>1.5 yr: Each point corresponds to the daily amplitude of the EW displacement component versus the amplitude of the NS component. The labels mark the beginning of each year. A tectonic map of the region with the main lineaments is also shown. Yellow balloon: FReDNet GPS station (OGS); Blue balloon: Marussi GPS network station (Regional Council of the Autonomous Region Friuli Venezia Giulia); Green cross: GSR1 EUREF station (Ljubljana, Slovenia).