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Horizontal and Vertical CGPS Velocity Fields and the Active Deformation of the European Alps

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Velocities from 110 Continuous Global Positioning System (CGPS) stations are used to study the on-going deformation of the European Alps and surroundings.

The horizontal velocity field reveals that extension dominates the current tectonics of the Western Alps and Rhine graben while compression dominates the current tectonics of the Central and Eastern Alps. Transcurrent tectonics is reported all over the Alps. We compute a kinematic model of the active deformation as well as strain and rotation rates. Major blocks are defined and average translation velocities are constrained. Where data are well distributed the velocity field can be explained well by block motion and localized slip across block boundaries. The reported large ratio of geodetic over seismic strains in the Western Alps is confirmed and is smaller within the Eastern Alps.

The vertical velocity field shows larger values over the high elevation parts of the Alps. The Western Alps are likely undergoing larger upward movements when compared to the Central and Eastern Alps. On the average, the Alps are accommodating more vertical movement than horizontal ones. What dynamics drive this vertical movement? Although several geodynamic processes have been proposed to answer the precedent question, we focus on the modeling of the Post Glacial Rebound (PGR) using a realistic ice-model for Quaternary ice age, accounting for both glaciation and deglaciation phases. We compute, at high resolution, both the present-day uplift rate and the static gravity anomaly due to PGR. This latter will be compared with GOCE data over the alpine region. We also use the model of Little Ice Age, and present-day deglaciation on the Alps, to calculate the most recent contribution to the present-day uplift rate and to the gravity anomaly. Our computations are done at high resolution in correspondence with the GPS sites so to allow comparison with the continuous geodetic time series.

We discuss and interpret our results in light of other independent data sets and recent literature.