Up to date geodetic velocity field of the Belledonne region (Western Alps, France)

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The Belledonne region, located on the western edge of the French Alps, behaves as a deformation transfer zone between the inner part of the western Alps, where geodesy and seismicity show extensional deformation, and its compressional surrounding basin (the Rhône Valley). Seismological and geodetic networks are less dense and younger in the Rhône Valley, which makes it more difficult to characterize its deformation. Nevertheless, these two regions have a moderate historical and instrumental seismicity. A large part of these earthquakes is concentrated on the Belledonne range and accommodated by the active NE-SW Belledonne fault, located at the western foot of this chain. The fault characteristics, such as its connection at depth with surrounding fault systems (e.g. Cléry fault), still need better constraints. The dense seismological network present in the Alpine region has made it possible to highlight its dextral strike-slip kinematics. To complete these observations, we present here an update of the geodetic velocity field around this fault from GNSS data recorded over the last two decades.

To do so, we first computed daily positions for a total of about 200 stations provided by different European networks (IGS, RENAG, RGP, GAIN, DGFI networks) over a period of 23 years (from 1997 to 2020), by using a double-difference processing with the GAMIT software (Herring et al. 2015). Then, we constrained a velocity field with the Kalman filter GLOBK with respect to the fixed European plate. We finally analyzed the residual motions in our area of interest with respect to stable Europe, as provided by our updated velocity field.

Across the Belledonne range, our results show a deformation pattern consistent with the dextral strike-slip mechanism observed by the current seismicity. Methodological studies concern the expected decrease of uncertainty on the velocity field thanks to the increase of recordings through time. These tests aim at quantifying the Belledonne fault present-day slip rate, including a well-constrained velocity uncertainty. We also exploit the new 3D velocity field to confirm and precise the local amplitude, in the Belledonne area, of the general uplift of the Alpine belt, as observed by previous geodetic studies.