

Interactive comment on “Present-day geodynamics of the Western Alps: new insights from earthquake mechanisms” by Marguerite Mathey et al.

Anonymous Referee #1

Received and published: 29 December 2020

Dear editor, I have read the paper Present-day geodynamics of the Western Alps: new insights from earthquake mechanisms by Marguerite Mathey et al. and I am now ready to share my suggestions. You can pass this comments to the authors. The paper is based on a large dataset of focal mechanisms in the Western Alps that are used for the computation of seismic stress and strain, later apparently interpreted in a geodynamic perspective. Despite the number of data used, I have several concerns on the quality of the dataset and, as a consequence, on the reliability of the obtained results. Moreover, I don't see any geodynamic interpretation, but a seismotectonic one. I also believe that the references are not up to date and not adequately taken into account in the discussion. Therefore, in my opinion, the paper is not ready for

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publication in the present form and needs major revision. I am available for a second round of review. Coming to detail, the authors use 2215 focal mechanisms that, in my opinion, are selected with not enough restrictive criteria. In particular, the maximum allowed azimuthal gap of 90° between polarities and the maximum azimuthal gap of 60° for incidence angles is not sufficient to constrain the quality of a focal mechanism. With such a threshold the dataset is, according to the description reported by the authors, made of only 0.7% of data with quality A; 2.3% have a quality B, 3.2% have a quality C while the majority of focal mechanisms (93.8%) have a quality D. These latter events have an uncertainty on the strike of 45° to 55° , which is a lot given that this uncertainty also likely affects the other focal parameters. However, it looks like all data are treated as equal quality in the computations. In my opinion, the authors should improve the quality of the dataset or discharge the lower quality events. One more issue is that, according to what the authors state, they make an arbitrary choice of focal solution (“A preferred focal mechanism was computed for each of the 2,215 events meeting these criteria”). It is necessary to describe on which criteria the selection is made. A constrained focal solution does not require choices. I have also issues about how the authors could recognize clear polarities on waveforms for events with magnitude lower than 1.0 (in my experience, it is even hard to do it on 2.0 and above magnitude events). Anyone dealing with seismogram phase pickings know that the S/N ratio of most seismic stations does not allow to push down to smaller magnitudes. However, some examples, added to the supplementary material, could help the reader evaluate the quality of the polarity readings and thus of the focal solutions.

Minor issues Line 90 “by six local or national networks operated from 1989 to 2014” Only five are listed

Line 105 “Arrival time uncertainties were harmonized.” How ? “Potential picking errors were identified and cleared out.” How ?

Line 110 “The complete set of earthquakes includes blasts, quarrying or mining events.” I do not see the significance of plotting non-natural seismicity. Please discharge these

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events from the dataset

Line 120 "Thanks to the high density of stations provided by the combination of six networks, we were able to apply strict computation criteria. The maximum allowed azimuthal gap between polarities was set to 90° and the maximum azimuthal gap of incidence angles to 60°." As already discussed, these criteria are not strict at all.

Line 175 "Strain rates are computed by averaging moment tensors (i.e., symmetrical 9 components 2nd order tensor, plus seismic moment amplitude), for which the 9 components directly depend on strike, dip and rake parameters of the focal mechanisms." That means that the quality of focal mechanisms is fundamental.

Line 315 "we investigated the distribution of stress orientations using focal mechanism inversions. All inverted earthquakes are equally weighted, regardless of their magnitude" If all focal mechanisms are equally weighted their quality is not considered

Line 375 "The angle between the direction of extension and the strike of the belt is of the order of 30° to 40°." I disagree, northern of GP is almost perpendicular.

Line 380 "All the western periphery of the belt (corresponding to the zones VSN, DPH, NMT,VAR Figure 5) show strike-slip stress fields, with a rotating state of stress compatible with dextral motions along longitudinal directions (typically along longitudinal faults such as the Belledonne fault, Thouvenot et al., 2003). " Ok for VSN and DPH why for the other sectors?

Fig. 9 Named cross-section in the text as in the figure 9

Line 535 "The seismic events seem grouped in several clusters along these two transverse profiles" Where are seismic events in figure 10a? Do you mean the focal mechanisms? The focal mechanisms cannot have clusters, it depends on which earthquakes you choose to compute focal mechanisms.

Line 540 "While the depth distribution of the seismic events follow the structure of the European crust (Figure 10b)," Where are seismic events in figure 10b?

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Line 585 "former stress inversions in the Alps have established a first order contrasted stress field. It is characterized by roughly orogen-perpendicular extension all along the backbone of the arc, surrounded by a transcurrent stress state at the periphery of the orogeny, locally modulated by a reverse component." Which authors?

Line 600 "Thirdly, the direction of the principal stress axes in the internal zones (namely 600 the extensional σ_3 axes) is systematically deflected of 30° to 40° clockwise from the radial extension pointed out up to now." I disagree.

Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2020-196>, 2020.

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