

Answers to reviewer #1:

*We thank E. Brockmann for the careful and detailed comparison he did between our solution, the swisstopo solution and others solutions.*

R#1: Page 1, 11 “Environmental noise is no network-wide bias. Please specify more clearly, what you mean.”

*A: we have replace “environmental” by “unmodeled large scale processes”*

R#1: Page 1, 18 “Correlation of velocity with elevation might be visible – but can you follow from this that post glacier rebound is the (only) reason and explanation of your finding. The conclusion must be reconsidered! See also comments later in this table.”

*A: See answers below.*

R#1: Page 3,10 “Why 10 degree elevation – this is a quite old standard. Today, GNSS data are analyzed with 3 of 5 degrees cut-off. Please specify the reason and please mention that that is not current standard.”

*A: This is true when the GNSS sites are sitting on a flat land, but most of the processed sites have a mask due to surrounding topography, so in order to maintain a more homogenous satellite constellation in our processing we use a 10 degrees cutoff elevation.*

R#1: Page 3, 15 “Choice of troposphere model: please specify what you mean (only apriori Model, which models)? Next sentence only addresses the Mapping Function, only.”

*A: As written in the sentence: “A priori troposphere parameters are derived from the European Centre for Medium-Range Weather Forecasts (<http://www.ecmwf.int/>).”*

R#1: Page 4, 26 “The filter -> 3 parameters per day? time correlation? please specify more clearly”

*A: we have added “...for each component ...” to make it clearer.*

R#1: Page 5, 9 “0.1 and 0.2 -> 0.1 and 0.3 (is probably closer to the numbers you show in table 2) better than -> in the order of about”

*A: Change has been made.*

R#1: Page 6, 10 ff “Did you considered the transformation of the velocities to ETRF2000(R08) instead of using 61 sites and define a sum=0 condition? Please formulate more precise, what you mean with “minimize 61 velocities”. Would nice to explain, why ETRF2000 is not used (e.g. ETRF2000 frame mainly is used at mapping agencies but for this scientific work we only analyze differential velocities in the Western Alps).”

*A: Minimizing the velocities is a classical approach used to define a reference frame for tectonic studies (e.g. Reilinger et al., 2006; Vernant et al., 2004; Payne et al., 2012 ...). To make it*

*clearer we have added: "... through the estimation of an Euler vector, ...". About ETRF2000, for tectonic studies the reference is either ITRF or a local reference frame as explained above. Since we are writing a scientific paper in a scientific review we do not think that any explanation to ETRF2000 and mapping agency is needed.*

R#1: Page 6, 13 "Figure 6 – error ellipses? How computed, from coordinate repeatability (and subtraction of the model)? Formal error? Multiplied by an empirical factor?"

A: *See "3.1 Time series model", the computation of the uncertainties is explained with references included such as Williams et al. (2003).*

R#1: Page 7, 17 "Station elevation are a good proxy of the mean elevation of the surrounding area – this is very rough and probably not true – station are partly too low (easy accessible, bad signal collection) or up in the mountains (bad access but good data). Please re-formulate."

A: *Similar to reviewer #3 comment (see answer to R#3). Fact is, that it is very close from being true.*

R#1: Fig 10 "Also correlation with elevation – probably too easy – is probably a function of location (not elevation only) – also in the Western Alps there is a different uplift (higher in North than is South) – would not be visible in you f(elevation) graph. Might be a profile plot N-S (e.g. function of latitude) for the vertical velocities is better suited than a function of elevation plot for the Alps and an W-E profile (function of longitude) for the Pyrenees."

A: *To the first order and within the uncertainties, the only correlation with the latitude already appears in our graph since we have used different symbols to differentiate the sites in the southern part of the Western Alps (no significant uplift) from those in the northern part. Furthermore we don't see on Figure 9 any significant gradual change in the uplift rate from south to north in the Alps. For the Pyrenees, all the velocities are smaller than their uncertainties so we do not want to interpret results that are not significant.*

R#1: Page 8, 21 "Conclusion is not ok (so also comments above (p7, 17; Fig 10). Please re-formulate after further detailed studies

A: *So far given the uncertainties on our velocities the conclusions are safe and sound and do not need to be reformulated.*

R#1: Fig 3 "Partly still big differences. E.g. Difference forward – backward after 4-5 years in North is still 1 mm/yr. Seems big compared to the generally good agreements with a "zero-velocity field" and conclusion that 5 years are already acceptable."

A: *5 years are acceptable for a threshold of 0.5 mm/yr at a 66% confidence level, this is consistent with Figure 3. It is based on the statistical analysis of all the time series. We only show MTPL as an example in figure 3; this site is really good for the E and Up components but not so good for the N component.*

R#1: Fig 4 "Conclusion from these Whisker plots are not much discussed in the paper. Conclusions? Eventually skip?"

*A: We refer to this figure on page 5 and discuss it briefly since the figure is self-explanatory and we believe that a good figure is better than a long speech. We agree that it is not essential but believe that it could be of interest for some of the readers and we wish to keep it.*

R#1: Fig 5/ Fig 7 “Error ellipses? See comment above? Furthermore, normally not that extremely E- W shaped ellipses? Please comment on that. Fig 7: here, it seems other way round: uncertainty seems to be for quite some sites bigger in N-S. Please check carefully.”

*A: We answered to the first part of the comment above: see “3.1 Time series model.” Only the shorter time series are generally more E-W shaped. It illustrates the well-known fact that usually the northern component is better and quickly constrained than the eastern one.*

R#1: Fig 8 “Easier readable with country borders”

*A: Added.*

R#1: Fig 9 “Quite some stations in green as outliers to surrounding stations visible. E.g. in the northern western Alps where we see 2 mm/yr rise. It’s unrealistic that a station next to it moves downwards by -1 mm/yr (or is sledging, or time series still has un-modelled jumps. Please check station residuals more carefully and try to detect still problems (evt. remove stations not suited for velocity estimation).”

*A: The residuals have already been carefully checked, some of the sites are either poorly constrained due to short time series, or affected by local effects. These velocities are useless for tectonic studies but might be of interest to people who are looking at site effects, this is why we have chosen not to exclude them from the solution.*

R#1: Page 1, 11 “processing options -> processing parameters; troposphere delay -> troposphere modeling”

*A: Done.*

R#1: Page 3, 31 “Decomposed by -> modelled by (eventually)”

*A: Not the same meaning we keep “decomposed”*

R#1: Page 3, 32 “Skip: as well as visual inspection”

*A: You asked above for a careful check of the residuals, this where we say that we did a careful check of the time series, so we will keep it.*

R#1: Page 4, 1 “inverted -> adjusted; best-fit -> best-fitting”

*A: no need to change.*

R#1: Page 4, 4 “a function of the...positions -> depend on the position repeatability”

*A: Done.*

R#1: Page 4, 5 “presence of -> introduced”

A: *no need for change.*

R#1: Page 4, 23 “consists in removing -> removed”

A: *no need for change.*

R#1: Page 4, 24 “The residuals of the time series -> the coordinate time series residuals”

A: *no need for change.*

R#1: Page 4, 24 “Stacking the residuals ... might be you can mention: daily residuals”

A: *done.*

R#1: Page 4, 24 “(post ... cf. section 3.1) -> (once the original time series and once after modelling the time-series as explained in section 3.1)”

A: *no need for change.*

R#1: Page 5, 2 “on going -> going on”

A: *no, the exact term is “on going”.*

R#1: Page 10, 2 “Proceedings missing (saw by accident – no check of the other references)”

A: *Done.*

R#1: Fig 1 / Fig 7 / Fig 10 “Just a suggestion: normally green means “ok” and red “warning”. Might be you can turn the color code accordingly. Not essential.”

A: *We are not trying to define which site is “ok” and which is “not”, we are just color coding the sites depending on the length of the time series, so we will just leave it as it is.*

