

Answer to Referees

We thank all the reviewers for their comments. They have been taken into account in the revised version of the manuscript, with some betterment on figures too. Hereinafter the detailed answers to the points they raised, posted in the discussion forum.

#1

This paper describes the seismicity of the instrumental era in the area of Lodi (Italy). The authors have collected all available data to perform source location of local earthquakes. The topic of the paper is interesting, thus it is worth to be considered for publication in Solid Earth, but only after some revision. I do not find any serious problems in the manuscript with regards to methods, figures, results, interpretation and conclusion. The main problem is that the paper is unnecessary long. In my opinion at least 30% of the text should be erased because not important for the comprehension of the paper. Too many details, descriptions of unimportant matters and comments make some parts of the manuscript more like a technical report than a scientific paper. I suggest the authors to make a strong revision of the text with the aim of reducing considerably the length.

Thanks to R#1 for the positive comments.

We reduced the length of the paper by deleting from the main text the description of data providers and past initiatives of earthquake catalogues in Italy, as suggested by R#3 too; these details, that we believe are however useful for who wants to perform similar revision works on instrumental seismicity, are now handled in a separate Appendix.

We did also some other minor changes tracked in the text, to simplify some verbose sentences. Short additional comments have been added too, as required by R#3. We acknowledge however that without removing at least some figures (and related description), we cannot reach the target of 30% text reduction required. We therefore ask R#1 to more clearly indicate which parts he/she believes are not important for the analysis here presented, and the Editor to indicate us the page/figure/table limits we have to satisfy.

#2

The topic of the paper is certainly interesting for the scientific community. In particular and beyond the 'local' interest about the seismotectonics of the investigated area, the major outcomes of the paper will raise awareness to end-users of seismological data. In some sections the text seems slightly verbose, but I guess it is a matter of writing style and/or of scientific background of the potential reader. I 'pencilled' minor corrections on the attached file.

Thanks to R#2 for the positive comments.

According to R#1 and R#3, we reduced the length of the paper by deleting from the main text the description of data providers and past initiatives of earthquake catalogues in Italy; these

details, that we believe are however useful for who wants to perform similar revision works on instrumental seismicity, are now handled in a separate Appendix. We did also some other minor changes tracked in the text, to simplify some verbose sentences.

We accepted all the corrections, except the use of mm/a instead of mm/yr, tracked now in yellow in the revised manuscript. We kindly ask the Editorial office to give us the final answer on the journal standard on it.

#3

In this paper, the authors provide new information about the seismicity in the area of Lodi (Po Plain, Italy), considering recorded historical seismicity and the difficulties due to instrumental differences with the most recent times and instrumentations. The results will add new information about source locations in the area, which can be helpful for the seismic hazard assessment for the Po Plain.

The text is probably too long, particularly when describing the data providers. I suggest adding some statistical graphs (if possible) and to make clearer the differences between old and new locations.

Specific comments:

Line 63: why have you chosen 3 Km as the maximum ID distance from the reservoir (and 15 km for the ED)? Any reason in particular?

Probably it is not clear enough to me, but are the events between 0-10 Km in Figure 5 now deeper due to the new locations (in Figure 8)? It could be helpful to have the previous locations and the new ones in the same figure (maybe just black and red dots), or side by side, to make it clearer.

It can be interesting to have histograms comparing the RMS, SEH (or ERH) and SEZ (or ERZ) before and after the relocations. This could help even further in understanding the differences given by the relocations.

Can the cluster of events, SE of Figure 8-profile B, be related to the active fault (thrust) slightly north of the cluster? Are there any events (among them) suitable enough to obtain focal mechanisms?

Minor comments: Figure 1: What are the short and thin grey lines in the figure? Seismic profiles? Figure 3: the yellow arrow is not visible enough. I suggest changing the colour (red?).

Figure 4 is not cited in the text.

Thanks to R#3 for the useful comments.

We reduced the length of the paper by deleting from the main text the description of data providers and past initiatives of earthquake catalogues in Italy; these details, that we believe are however useful for who wants to perform similar revision works on instrumental seismicity, are now handled in a separate Appendix. We did also some other minor changes tracked in the text, to simplify some verbose sentences.

Concerning the comparison between old and new locations, unfortunately we cannot represent it in terms of statistical graphs, or maps, as 1) the majority of initial earthquake locations derive from catalogues that do not list their errors in location (this is the case of CSI catalogue by INGV for example, and the early ISC Bulletins), and 2) hypocentral solutions may have different standards in location procedures and error definition (this is the case, for example of the datasets of UNIGE that changed algorithms in time), thus the representation of errors can be misleading. Note that for these reasons, the error bars/different symbols used in Figs 8-9 are not applied in Fig. 5, as mentioned at lines 250-251 of the first manuscript; a statistical comparison pre-post is therefore impossible. Conversely, the representation of standard errors of the relocated dataset, with the known limits on standard errors of Hypo71, it is now provided in a new figure, that we suggest to handle separately, in Appendix 2.

About the differences in location, and especially the generalized increase in depth, this is strongly influenced by the velocity model adopted, as Table 2 shows in a very simplified way by the “mean depth”. The representation of the shift on a map or a section is not trivial, as the “connections” between pre-post locations of events make the image extremely blurred, and as previously said, no errors can be accounted for in the starting dataset. In addition, some events moved out of the represented frame, and are therefore no more visible in the plots. For answering to the R#3 request, we computed the distances of pre-post location, and plotted in histograms too, briefly commented in Appendix 2 as well. We hope it fit the R#3 request.

About the other more specific comments:

- 1) there is no particular reason for the 3/15 km distance, except that these values have been taken as reference by the Italian guidelines for gas storages;
- 2) the cluster SE in Fig. 8, corresponding to the distance at km 100-110 in section BB' can be related to the buried thrust mapped slightly north of the cluster. Consider that the section is taken approximately along the fault strike, and therefore it is not representative of possible geometries at depth. Consider also that the set of events is not complete (cut by geographical selection, as it is at the very corner of the target area studied) and it represents small magnitude earthquakes (max magnitude ~3), for which no focal mechanism is provided by standard investigation. We invite the reviewer to contact us if he/she is interested in deepening the investigation in this area, with an ad-hoc reprocessing of existing data.
- 3) The thin grey lines in Fig. 1 are seismic lines, now added in the figure caption.
- 4) Fig. 3 modified, and Fig. 4 is now cited in the text.

Some other minor changes have been done in the figures.