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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Active Faults sources of the Morelia-Acambay Fault System, Mexico based on Paleoseismology and the estimation of magnitude M_w from fault dimensions" *by* Avith Mendoza-Ponce et al.

M. Meghraoui (Referee)

m.meghraoui@unistra.fr

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Comment on manuscript nhess-2018-63 titled "Active Faults sources of the Morelia-Acambay Fault System, Mexico based on Paleoseismology and the estimation of magnitude Mw from fault dimensions" submitted by Mendoza-Ponce et al.

The manuscript (ms) presents the fractal characteristic of active faults in the Morelia-Acambay Graben, their seismic parameters (length, width, slip, paleoseismic history) and fractal dimension and behavior. The issue is emphasized using a rich database

with numerous previously published neotectonic works. The statistical analysis is quite interesting in assigning a maximum magnitude and "area of influence" (earthquake damage area?) for the seismic hazard assessment. The article is however not well written and suffers of several weaknesses that make the presented work difficult to understand. I recommend a very major revision.

Here are some recommended general and specific changes that may improve the presentation of the manuscript:

General remarks ïĆğ The main topic of the ms is on the fractal fault distribution and its related seismic activity but this is not clear neither from the title, nor for the abstract and text. This article needs to be restructured in order to clearly put forward the fractal analysis, the authors do not present new fault data and hence, the presented neotectonic and seismotectonic characteristics cannot be considered as the main topic of this article. ïĆğ The authors mention the existence of 316 fault segments in text and about 22 fault characteristics (in Table 1) of the Morelia Acambay Graben. However, they do not explain how they did select these 22 items among the 316 faults, and which fault segments where used for the fractal analysis. The 316 fault segments deserve to be shown as a supplemental material. ïĆğ The seismicity and neotectonic database and related catalogs need to be clearly presented in the form of tables with appropriate legends showing the origin of data. A table of paleoseismic, historical and instrumental earthquakes is needed in this manuscript, at least for earthquakes with Mw $\geq$ 5.4 (according to their concluding remarks). Table 1 needs a to include the minimum and maximum, observed and estimated coseismic slip/event for the known faults. Table 1 needs a serious legend. ïĆğ An interesting issue is the difference between the fracture density and fracture concentration. This section of the manuscript needs to be developed in order to show the meaning of this difference, explain well the correlation between box dimensions and the effects of the size of fracture concentration. The calculation of the Hurst Exponent H and related strong persistent process, Devil staircase and box dimension should be explained more extensively. These aspects that

are fundamental in this manuscript should appear in a separated Methodological section. ïĆğ The uncertainties of seismic and neotectonic data are totally neglected in this manuscript.

Specific remarks Title: It has to be reconsidered because as presented, it shows that active faults and paleoseismic analysis are the main topic of the manuscript. I think that the fractal analysis from existing fault data should be clearly announced in this title.

Abstract: The authors use different magnitude scales (Ms, Mb, Mw). If a seismicity catalogue with homogenized magnitudes exists for Mexico, then the authors should use Mw only in this section. The main addressed topic (fractal analysis) that is left in the last 4 or 5 lines of the abstract should be put forward.

The Introduction section is not well written, and although it includes several paragraphs as seismotectonic settings, it does not explain the geodynamic context with clear stress and strain distribution. For instance, Figures 1 A and B that are redundant they show only the topography and bathymetry. Figure 1C is supposed to show the seismotectonic setting but it looks only like a geographic indication of the Morelia-Acambay Graben. The introduction needs to be better organized to explain the context and main issue, the used general methodology (fractal analysis) and its application elsewhere in comparable seismotectonic domains, previous works emphasizing the main results and finally the main steps adopted in this ms.

(Neotectonic and seismotectonic settings?) Since the Morelia-Acambay Graben has a rich database, a specific section in neotectonics and seismotectonics would therefore be needed after the introduction. In this case, the authors should organize their text and avoid a mix of data. This section needs to present: 1) the seismicity (historical and instrumental) with emphasis on major events and their characteristics, 2) the geodetic results (GPS, conventional), focal mechanism solutions and fault kinematics for the stress and strain distribution, and 3) the paleoseismic data and results including the estimated slip rates with the corresponding time window and related uncertainties. This

section has not to be long but it has to focus on major results showing the related references and how completed is the database (reference to tables in supplementary material is recommendable).

Line 20 – 21: Please note that historical earthquakes needs to indicated with their intensities (or inferred magnitudes), their severity (number of victims whenever possible). Line 22: ".. set of earthquakes . . ." of what magnitudes? Line 26_27: These lines are concluding remarks and should be moved at the end of ms.

Line 40: Instead of cortical, the term "crustal" is ususally used in active tectonics. Line 46: "The kinematics of them . . ." change in Their kinematics . . . This sentence mentions details on the neotectonic episodes and a reference is needed here. Line 49: normal-right ? change in Oblique fault with right-lateral normal component. Line 53-54: You give Dmax to all faults except to the Pastores Fault, why? Line 55: The 8.2 km depth of the Maravatio earthquake needs uncertainties. The sentence should be rewritten "Subsequently, another earthquake in 1979 with a magnitude Mb = 5.3 and a depth of 8.2 km (Astiz-Delgado, 1980), caused major damage in Maravatío." Line 59: "is very probable that this sequence of earthquakes is related to the La Paloma fault of 13 km of length . . .". How did you infer this? If this is obtained from the two local stations then the "probable" should turn into "possible". Please explain. Line 59-60: ". . . active from the Holocene" does not mean much. I would suggest considered active because it affects Holocene deposits. Line 63: remove seismic risk and put seismic hazard instead. Lines 65 to 84: In all these paragraphs, slip rates need to be explained (from which field trenches and markers, e.g., lateral or vertical offset of streams, . . .) and measurements span which timeframe. Line 81: What is the mechanism of the dozen faults? Are they in table 1.

Line 90: Active faults are . . . Lin 92: ". . . speeds of approximately . . ." ; fault speed is not used in active tectonics. Slip rate is more appropriate. Please apply correction throughout the text. Line 94 : . . . or capable of generating coseismic rupture length . . . How about coseismic displacement (slip)?

Line 91: The title is inappropriate in this ms. You are only extracting the data from previous works and not mapping and describing the faults of the Morelia-Acambay Graben.

Figure 2 is a bad quality map. Unless a clear srtm background topography can be shown, it should be removed, leaving only the seismicity and tectonic data in the map. The dates and magnitudes of focal mechanisms need to indicated in the map and in a table with their characteristics (in the supplemental material).

Line 100: CeMIEGeo - Project 17 needs a reference. Line 102: Unless you indicate criteria for selection, the characteristics of the 316 fault segments need to be shown at least in the supplemental material.

Lines 105 and 106: Fault length, Fault scarp height (?). Line 111: Distance between a locality and fault zone.

Lines 115 to 120: The use of the empirical equations (Wells and Coppersmith, 1994; Anderson et al. 1996; and Wesnousky, 2008) is a solution for the Mw determination. However, there is also another method using simply the seismic moment Mo = μSU (as defined by Aki (1967). In this case, you will better estimate your moment magnitude (Mw from Hanks and Kanamori, 1979) taking into account the uncertainties of fault parameters (length, width and average slip U). Estimation of Mw magnitudes as shown in Figures 3 a and b needs a reevaluation. Including the uncertainties of fault parameters is critical in the fractal analysis.

Line 126: The reference of Hurst (1951) for the Hurst component for the roughness measurement is needed here.

The section 2.4 on the fractal analysis is devoted almost entirely to the methodological aspect; please indicate it accordingly as for instance “Method of faulting study using fractal analysis”. The manuscript is mainly based on this methodology section and it should be presented before the database (seismotectonic) section.

Line 149: In equation (??), please complete.

Line 162: . . . as fault planes . . . Also remove speeds, and replace by slip rate. Line 164-165: “. . . earthquakes of magnitude Mw $\geq$ 5.2 or related to rupture lengths greater than or equal to 3 km.” Why Mw $\geq$ 5.2 and why lengths $\geq$ 3 km? How about hidden faults below Holocene deposits? As indicated by Langridge et al., (2013) and Sunye-Puchol et al., (2015) some faults can be hidden by young sedimentary deposits. In this case the fault lengths may increase. This issue needs to be discussed.

Line 174-175: Recurrence interval of which earthquake magnitudes? Line 177-178: The described seismicity, frequency and related b-value which is also a fractal distribution needs to be called earlier along with the fractal analysis in this manuscript. As this work is based on the Magana-Garcia Master thesis, that is not published and difficult to access as a reference, it should be presented with some details in introduction and seismotectonic section (or even in the supplemental material).

Line 180: Why this Table 1 is called only in section 3. This reference to the database should be called earlier !!! Line 184: Please give a reference to the Environmental Seismic Intensity scale (ESI 07) Line 185: What are class B events? Line 189: Hurst (1951) does not exist on the list of references. Line 191-192: The reference to the Hurst Exponent H and strong persistent process for the slip-rate distribution, along explanations on the Devil staircase should be explained in the methodology section. Line 192-193: “. . .cycles or periods with different seismic activity . . .”, you mean variable seismic cycles ? Line 195: Explanations on the Devil’s staircase and related (very bad) figure 4 need a serious revision! Line 200: This has to be included in the Methodology section. Line 205: How do you determine the stability of faults? Line 207: The reference of Soria-Caballero et al., is missing eve if it is in preparation (please provide the manuscript). Line 221: What us the mathematical behaviour? You mean the mathematical or statistical expression of faulting behaviour?

Mustapha Meghraoui IPG Strasbourg, France

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2018-63/nhess-2018-63-RC2-supplement.pdf

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