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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.

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Overview of manuscript:

Mendoza-Ponce and co-authors present a work, where they aim to evaluate the characteristics of the seismic sources in the Morelia-Acambay fault system in Mexico by using a quantitative approach. Their approach considers the spatial properties and distribution of the active faults and slip-rate estimations of earlier studies. They analyse a data set of 316 faults, which is partly mapped by the authors and partly compiled from

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Discussion paper

earlier studies. The analysis involves fault lengths, distances between faults and their slip-rates. They calculate maximum earthquake magnitudes based on fault lengths. The statistical method Mendoza-Ponce et al. are using allows to distinguish random from non-random systems and to identify the persistence of a trend within a time series; here slip-rates (Hurst Exponent). According to their analysis, Mondoza-Ponce et al., conclude that 1) the entire faults system is active, 2) expected maximum earthquake magnitude for the study area is Mw 7.0 and 3) the studied faults are tending to growth. Consequently, they suggest that their findings contribute to define the seismic risk of the Morelia-Acambay Faults system and improve the vulnerability efforts in Mexico.

Remarks

This study offers a compilation (GIS database) for active faults with paleoseismic studies in the Morelia-Acambay Faults system Such data are useful in seismic hazard evaluation and therefore might be of interest to the readers of NHESS. On the other hand, the manuscript needs significant improvements on the presentation and structure of the work; more information methodology, the approach and the significance of the results. The text is very fluent and easy to read, however the manuscript is difficult to follow if a reader is unfamiliar to the study area and the applied methods. It provides a comprehensive summary for the seismotectonic setting of the area. However the figures lack significantly of useful information that are necessary to comprehend the study area. Many cities, locations, fault names mentioned in the text are not available in maps and figures, making it difficult for the reader to orient him/herself spatially. Although the authors provide some theoretical information on the statistical calculations the connection and relation to the seismic hazard evaluation is poorly given, the geological significance for each input and output are not provided and discussed in the manuscript sufficiently. The aim of the study is confusing because throughout the text authors describe several different purposes:

1-prepare an intrinsic definition for active faults (abstract) 2-estimation of possible maximum earthquake magnitudes (abstract) 3-understand the seismic activity from

Patzcuaro to Acambay sector (introduction) 4-define the intracontinental structures that are susceptible to generate moderate and strong seismic events (line 85)

Aside the quantitative results, the study addresses only the first two purposes clearly. Maximum earthquake magnitudes are calculated via fault length measurements and a comprehensive definition is given for active faults. Based on the Hurst Exponent it is concluded that the fault system is active, however the possibility of an inactive fault system is not discussed within the manuscript. The maximum magnitude proposed for the region is Mw 7.0 and is calculated using three different magnitude-scaling relationships. The authors illustrate (Fig 3) that these relationships give different magnitude estimations for the same fault section but do not discuss how they interpret this difference. No reasoning is provided why authors prefer to take into account the Wesnousky (2008) relationship. The analysis assumes that each fault section has the potential to rupture the entire crust individually; (at all scales like 3-5 km). Why is 3 km the minimum preferred fault length that is included into the dataset? Can these faults also create surface ruptures? Furthermore, this analysis needs to consider the spatial distribution and interaction of the faults. An earthquake may rupture several adjacent fault segments; which would necessarily imply a larger earthquake magnitude. Authors need to consider multi-segment ruptures according to fault segmentation patterns and spatial distribution of the faults. Therefore, I consider that the estimation of maximum magnitude needs a revision. Since fault length is a critical parameter in their analysis the mapping procedure should be clearly explained. The authors apply most likely remote-sensing techniques but the mapping approach and the "type and quality" of base-maps is poorly given ("imagery" + 15x15 m DEM). The "morphological" criteria used to classify the faults as "active" should be given definitely. A complex definition for active faults is provided in the manuscript: "an active fault, is defined here as a plane that ground-rupturing with speeds of approximately 0.001 mm/year, with seismic activity associated, at least, in the last 10,000 years and is oriented in favour of the current stress field. The active fault planes must be related to earthquakes of magnitude Mw $\geq$ 5.4 or capable of generating rupture lengths greater than or equal to 3 km." Authors need to show that all 316 faults fulfil that definition (for example, have all faults a minimum of 0.001 mm/yr slip-rate? Which studies provide this information? What type of information provides the CeMIEGeo database on faults?). The seismicity of the study area is concentrated to the eastern part (Figure 2). Leaving many earthquakes in the West with no earthquakes at all. How are faults satisfying the Mw $\geq$ 5.4 criteria? The entire dataset should be available for download so the results can be reproduced and tested. The text provides a theoretical but limited description of the Hurst Exponent analysis. The method tests the tendency of a time-series (here the various slip-rates given in Table 1). However, the slip-rates are controlled by the spatial distribution of the stress field and therefore have a local significance. The authors need to explain why this approach based on time-series is applicable on a dataset that has a spatial significance. In addition, more information is necessary on how slip-rates have been exactly used in the calculations. Uncertainties and error ranges are not discussed in the manuscript. What are the error ranges for the fault length and slip-rates? How do they affect the results? This questions should be addressed within the text. Similarly, the fractal analysis lacks of adequate information on the geological significance of the analysis. What is the meaning of a staircase like pattern from a tectonic/geologic perspective? In line 198 the author states the high value of the fractal dimension "may indicate the possibility" for generation of a major earthquake on the faults of the MAFS; which is a highly ambiguous result. More information is needed on how the method is applied. Which dataset is exactly used? What are the 2D boundaries of the study?

I consider the manuscript brings together an important amount of information concerning the paleoseismic results of the study area. A significant number of faults where mapped/digitzed within this study, which have a value in the seismic hazard assessment of the region. However, a distinction should be made among faults mapped within this work and obtained from other sources so readers can better evaluate the contribution of this work. In addition, the mapping approach should be defined precisely in order to evaluate the reliability of the fault map. The main results of this work are based on a statistical analysis of the fault map and paleoseismic findings. However the results are poorly discussed and their significance in terms of active tectonics is not well addressed. I think, the applied fractal analysis is not a novel approach for evaluating the seismic hazard of a region. Authors need to improve extensively how this analysis contributes to the seismic hazard assessment. Structurally, the manuscript lacks of a proper organization. Overall, results of the work do not address sufficiently the purposes given in the text. Therefore, I consider the manuscript requires a major revision.

Further remarks on the manuscript.

1-Title: The title calls for a manuscript that actually deals with significant amount of paleoseismic field work that permit to determine new seismic sources and their characteristics. However, the work is based on mathematical approaches on previous works. I suggest to revise the title that is more compatible with the used methodology. 2-Abstract: 2/3 of the abstract is dedicated to the seismotectonics of the study area. Most of this general information is neither connected to the applied methods nor the results of this work. The abstract may get more informative if more detail is provided on the approach and methodology. Also, the significance of the results is not sufficiently and clearly expressed. 3-Figure 1 and 2 require additional information on location names, major faults systems and information on concerning the seismic activity. 4-Acambay earthquake location and related surface rupture should be given in figure 2 5-Figures 2 , add Focal Mechanisms need information for earthquake magnitude and time. 6-Slip-rates should be placed on the fault map (Figure 2) 7-Line 162: The active faults in Figure 2, do not full-fill the definition given in line 162-165. The corresponding seismic activity is not available, slip-rate estimations are missing, paleoseismic studies are missing. Therefore more information is needed on how faults are selected. 8-Figure 3 : It is unclear what it represents. Is it based on fault central points from A to B? Requires a detailed figure caption. 9-The results and discussion section contains theoretical information on the used methods, which should be placed to appropriate section. 10-Figure 4 requires more explanation. Requires labelling and a detailed figure caption.

11-In Table 1: The 2 mm/yr slip-rate for the Vento de Bravo fault could not be found in the related citation (Suter et al., 1995). 12-Table 1 Add error ranges for slip-rates, fault length and scarps. 13-Line 173-179 and 184-188: The purpose of these texts within the context of maximum magnitude is not clear.

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