

# ***Interactive comment on “Using spatial Markovian chain for the statistical analysis of seismic occurrences in the Azores Region” by M. C. M. Rodrigues and C. S. Oliveira***

**Anonymous Referee #1**

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Nat. Hazards Earth Syst. Sci. Discuss., doi:10.5194/nhess-2016-113, 2016 Using spatial Markovian chain for the statistical analysis of seismic occurrences in the Azores Region Maria Cecília M. Rodrigues Carlos S. Oliveira

This is an interesting paper, providing a simple statistical tool and analysis of seismicity and seismic zones. It has important and practical implications to seismic hazard estimation, and therefore beyond the academic point of view, I find it a valuable contribution. However, there are several issues that should be improved, in order to make this paper better and of more value for research and for society: 1. Generally, more emphasize should be given in the introduction on the significance and implications of this work. 2. I find the statistical relation between the zones of background seismic-

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ity and the zones of high seismic rates, poor, with no dependency; the only reason that the probability of the next event in Zone 5 is high for these background zones, is because Zone 5 is the most active in any case. This is different from the conclusion and discussion of the authors. As I see it, the tool is good, but its analysis should be improved. 3. The tool does not take into account magnitudes! It seems that it works well without including it, but I reckon that by adding magnitude you could get better understanding of the seismic zones. Authors should either add the magnitude to their analysis, or consider the magnitudes in their discussion: What do they expect? How would the addition of magnitudes affect their results?

These are the main issues that I would like the authors to refer to and improve in their revised manuscript.

There are also smaller issues that I referred to during the reading, and are listed here chronologically:   • Lines 46-47: Not clear: "N-step transitions are also analyzed, and Markovian chains are applied for this purpose". Please clarify and expand!   • Lines 48-50: Estimation of the sequence of the seismic zones. Do You mean: how seismicity moves from zone to zone?   • Line 51: "Traditionally, seismic phenomena have been described using Poisson models". To the best of my knowledge, there are many ways of analyzing the seismic phenomena, by either statistical or physical manner. Poisson models are one of many descriptions. Please, either rephrase or add supporting literature.   • Lines 63-67: A detailed map is missing. Figure 1 doesn't show the Geography well enough.   • Lines 68-74: Are too scattered, and should be more focused explaining what kind of modeling is discussed here.   • "Memory": appearing in many places: Please define the term: "Memory", what exactly do you mean by that. This is essential for what comes after.   • Lines 97-100, end of Introduction: How comes you did not refer to the magnitude frequency dependency. This seems to be essential here as a baseline for analyzing the statistical nature of each of the zones, so that we will know what is the completeness of the data.   • Lines 127-128: Please clarify, what do you mean that data are not constrained to completeness. . . or to filtration. . . ?   • Fig-

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ure 3: "Density": is not defined: not in the text and not in the figure caption.    Lines 224-230: This part should appear before, at the Methodology section; it would make everything more clear.    Lines 286-288: Not just a "different zone": What I see is that in the more active seismic zone, there is the highest probability that an event would trigger the next event within the zone, and in the other zones of background seismicity, there is no real relation between the event and the following event, and Zone 5 "wins" only because in any case it has the highest seismic rate. . . Up to now these conclusions seem reasonable.    Lines 289-290: I would argue on that! Your results prove in my eyes, that the background seismicity is practically detached from the more active zones: 2,4 and 5. What is more interesting in my eyes is that the more active zone: 2,4 and 5, at least statistically, do not trigger each other: meaning that 5 triggers 5, 4 triggers 4 and 2 triggers 2!    Line 325-326: This doesn't sound right. Please, correct your English.    Figure 6: Also here. You have to define what is: "Density"?    Line 339-341: Please extend and add a short explanation of the Chi-square test.    Line 434: Again, here, as mentioned before: not just a different zone, but specifically Zone 5, naturally since Zone 5 is the most active zone.

Please refer also to the annotated PDF, in which some grammatical corrections have been also added.

Please also note the supplement to this comment:

<http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2016-113/nhess-2016-113-RC1-supplement.pdf>

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