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Solid Earth
Discussions

Interactive comment on "Modeling active fault systems and seismic events by using a Fiber Bundle model. Example case: Northridge aftershock sequence" *by* Marisol Monterrubio-Velasco et al.

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Review of the manuscript se-2019-65ÂăÂăÂăÂăÂăSubmitted on 27 Mar 2019 Modeling active fault systems and seismic events by using a Fiber Bundle model. Example case: Northridge aftershock sequence Marisol Monterrubio-Velasco, Ramón Zúñiga, Carlos Carrasco-Jiménez, Víctor Márquez-Ramírez, and Josep de la Puente

General comments: The manuscript present a statistical modelling of earthquake occurrence of aftershocks using a fiber bundle model. An application is presented using

data from the Northridge aftershock sequence. The manuscript is well written, in good English. The logic is well explained, and equations are generally well described, the reference list is very good.

However, the general approach should be more explained in detail, in order to make the message more impactful, and there are improvements that could be made in order to make it clearer.

I have 4 main remarks: * if I understand well – this is only said in the last sentence of the conclusion – the study performed is based on analysis of epicentres. It means that the 3D structure of the fault is completely discarded. This should be mention right in the beginning pointing to the limitation of the study. By doing so, the message will be more powerful, as the scope is better defined. * From the results, it is not very clear in all figures that the parameter πfrac has strong influence on results. I was wondering whether it could be clearer to represent results as function of other parameters. * It seems results depends on the number of cells used. This is generally not good sign. You need to make clear why this is the case and give hints on the influence on the true behaviour. * Generally the figure captions are too short. You need to increase them to make the manuscript readable by readers and get the main message from the the figure caption also.

Details comments:

1. P1. Line 2. I would replace "difficult" by "challenging"

2. P1. Line 12 and 13. Give the definition of π and P also here. This will make the abstract clearer.

3. P2. Line 20. It would be nice to have a comment of the applicability of the method to other places, or specify if it is only applicable to Northridge.

4. P3. line 18. In equation (1), I did not find κ and σ explained...

5. P3. line 24. Please explain the notation U[0,1).

6. P4. Line 4. I am not sure the last sentence is useful here, as you mention equation 6, but t is not explained as yet.

7. P4. Line 18. Do you mean "...lost at each time step"?

8. P4. Line 23. it is the first time you talk about the area of computation. This sentence is very unclear, unless you explain the global procedure before. I initially though it was the fault plane. You should make it clear what is the area of computation. That it is the geographical area where you consider the epicentre of the earthquakes. You should make it clear to remind the reader what is the approach described in Correig et al. (1997) and others.

9. P4. Line 28. Could the method be used for mainshocks and foreshock? If yes it would be interesting to mention more clearly.

10. P5. Line 6. I understand the different cells may receive different weights. However, it is not clear how you define the weights. Please give more justifications how you proceed. Do their values have influence on the results?

11. P5. Line 7. Please indicate why not all cells that exhibit excessed load are authorized to fail. Again, what would be the effect of allowing them to fail as well?

12. P5. Line 9. Again not clear explanations on the choices of parameters values. How to you prescribe the Weibull index and the heterogeneity of the initial load.

13. P5. Line 24. It is a long time you have not describe π(x,y). Therefore, I suggest you write again their meaning as you did at line 8 recalling and P.

14. P5. Line 28. You are referring to figure 2, but no citation to figure 1 occurred as yet.

15. P5. Line 29-30. I would like to get more explanation to the values chosen for the parameters. It is not sufficient to refer to earlier paper. What would be the effect of choice or other parameters? Does this correspond to topography, to physical properties

you want to address, . . .?

16. P6. Line 1. Please indicate where we can find algorithm 1. May be indicate here that there are 3 algorithm in the methodology? Then is is easier to refer to them.

17. P6. Line 8. Please remove the initial in the reference.

18. P6. Line 10. It is not very clear what you do to filter our events. Give more explanation on why you need to do this.

19. P7. Line 8. I suggest to replace "afterwards" by "later" in this case.

20. P7. Line 25. In order to be able to have further explanation for the meaning of the capacity dimension, I would suggest you refer to the appendix A1.1.

21. P7. Line 26. You may recall in brackets what P is.

22. P8. Line 2. Is this the place to refer to figure 5?

22. P8. Line 11-12. Th sentence needs to be rephrased. As is, it is unclear!

23. P8. Line 15. I guess there is a typo. Fig. 6a instead?

24. P8. Line 18. How do you know the magnitude are overestimated? Could this be an effect that 3D effect are not modelled?

25. There is no reference to figure 8. Either remove or reference it.

26. P9. Line 8-9. I would put this sentence in the figure caption. It does not bring anything here. 27. P9. Lines 14-17. Unclear. This is too much information as once. Need to be more clear on what those figures mean and what do they bring to the demo. In additio0n, make reference to figure 9 clearer. Fig 9a or 9b?

28. P9. Line 28. I understand the need to study the off-faults regions. However, in your 2D configuration, looking only at the surface epicentres, off faults region are possibly no really off faults, if faults have a dip and hypo-centres on the fault may map as epicentres off-fault. . . Therefore I would make it clear that your interpretation may

be biased. Once again, I understand that this study is a step forward toward a more satisfactory 3d approach. Do no hesitate to recall it: this makes you current study more focussed with clear limitations, then greater impact.

29. P9. Line 32. Reference missing.

30. P10. Line 25. once again, this is neglecting 3d fault geometry, especially at depth. You should again say it.

31. P11. Line 11. Reference typo.

32. P11. Line 23. No. You are no incorporating the fault geometry. You should mention the surface geometry and discuss the fact that it is not the true geometry, that it could affect the results, etc. You have a proof of this at line 31, when you mention that when π is removed you find the previous results when you did not take geometry into account. So the 3D structure matters. . . no reason why not.

33. P12. Line 8. Yes! Finally! You should mention this much, much earlier. Thius is the power on your manuscript. An improvement from your last paper, and s step towards the 3D. So why not present it like this from the introduction?

34. P12. Lines 15-18. You expose several dimensions. Why did you choose Dc? Did you try others?

35. P12. Line 23. I have a problem for this formula„ when q=1. The exponent get as 1 divided by 0. . . Can you explain? In addition, last sentence of the page is not clear. . . please clarify.

36. P13. Line 1. Reference not clear.

37. P14. Line 18. Many variables are not explained.

38. P15. Line 7. I would introduce “time” in “. . . for each time step...”

39. P20. Line 31. I did not find a call to this reference.

40. P21. Line 1. I did not find a call to this reference.

41. P21. Line 27. I did not find a call to this reference.

42. P22. Line 12. I did not find a call to this reference.

43. Figure 1 not called. Indicate what blue circles are.

44. Figure 2. Add the term “Map”, to indicate that you are dealing with epicenters.

45. Figure 3. Figure unclear. Between a and b, what is the difference between y-axis? If similar, call them similarly. In c,d,e, pleas explain y-axis. The figures are too small, hard to read axis. In addition you need to explain the legend terms. In the caption, indicate what the Hurst exponent is (reference to your appendix, for example).

46. Figure 4. You need to refer to a, b and c for the different sub-figure. More explanation describing what is represented is required. Remind here what P, N and D0 are.

47. Figure 5. Idem as figure 4.? Could be grouped? What is MLE?

48. Figure 6.Idem as figure 4 and 5. Could be grouped?What is Mw?

49. Figure 7. Not referenced in the text.

50. Figure 8. Nozt cleat what is what. Name all symbols.

51. Figure 9. typo in reference to figure 9a. What is black line? Describe what MO is. Font between axis are different. There need to be coherence!

52. Figure 11. Good attempt to group, but it can be improved. This is quite confusing figure.

53. Figure 12. The quality of the figure is bad – too much pixelized. Check it. In addition, much more explanation need to be put in. what are the different circle sizes?

54. Figure 13. What is GR?

55. Table 1. please indicate what A1, A6 are. Add “eq”, and in the caption translate “eq=equation”.

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