Reply to the comments of the Anonymous Referee #2.

Dear Dr. Philippe Jousset,

Thank you in advance for your valuable time and help. We are very grateful for your comments. All the questions are addressed in the next pages. We took everything into consideration and we have revised the paper following your recommendations. The following format for answering the questions was chosen:

- Question/Comment (from the reviewer)
- Answer (reply from the authors)
- Changes (new/modified text added to the manuscript in **blue**)
- Additional information (references, tables and figures)

We are at your disposal for any further information and willing to improve further our manuscript by adding the considerations provided in our reply.

Kind regards,

Monterrubio-Velasco et al.

Question / comment

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.

Answer

Thank you for your appreciation, we will remark this point at the beginning where the algorithm is presented (see changes in blue). As you well note, we want to mention that our bi-dimensional approach is a first attempt to a more complex three dimensional approach. However, considering the seismicity produced in Southern California is shallow and mostly restricted to the planar strike-slip faults, the two dimensional approach can be used as a simplification.

Question / comment

From the results, it is not very clear in all figures that the parameter π_{frac} has strong influence on results. I was wondering whether it could be clearer to represent results as function of other parameters.

Answer

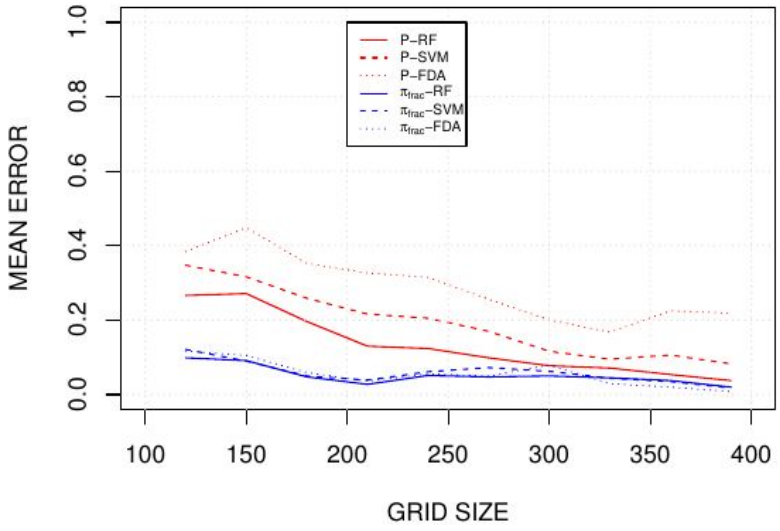
That is true, π_{frac} not always shows a strong influence in the analyzed results. But in the figures related with maximum magnitude, M_{max}, and *b*-value the results are remarkable. In this work, we focus in analyzing three parameters (N, P and π_{frac}), because we find them the most influential variables since they define the initial load configuration. In this way, we can observe how the initial spatial configuration modifies the final statistical patterns. (see Discussion)

Question / comment

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.

Answer

To justify the difference in the results related with the size of the domain, we recall the results obtained in a previous work (Monterrubio-Velasco et al., 2018). In that paper a large generation of synthetic catalogs with different size domain were done. After that, a Machine Learning model was applied to study the classification of the results as a function of the input parameters, the size N, P, and π_{frac}.
In Figure R2.1 (from Monterrubio-Velasco et al., 2018) we show the mean error of three different ML classification algorithms (Random Forest, Supported vector machine, and Flexible discriminant analysis), as a function of the domain size. We observe the results using as classification two input parameters P (in red) and π_{frac} (in blue). When we use the P parameter, we observe that the size domain has to increase in order to reduce the mean classification error, and it becomes minimum for $N \geqslant 300$. On the other hand, if we want to classify the synthetic catalogs considering π_{frac}, the figure shows that the error classification reaches a minimum value for lower grid sizes $N \geqslant 200$. So, if we consider the case of P=0, then a proper grid sizes used to model aftershocks, including faults, is for $N \geqslant 200$. (Page 13, line 24-27)



Question / comment

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 figure caption also.

Answer

Yes, you are right, we modify them.

Details comments:

The details commented by the referee are considered and modified in the manuscript.

1. P1. Line 2. I would replace “difficult” by “challenging”
Done, P1 Line 2

2. P1. Line 12 and 13. Give the definition of π and P also here. This will make the abstract clearer.
Done, P1 Line 14-16

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.
Done, P2 Line 33

4. P3. line 18. In equation (1), I did not find κ and σ explained.
P3 Line 23-24

5. P3. line 24. Please explain the notation U[0,1).
P4 Line 7-8

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.
We move the equation to the right place. P4 Line 17-19

7. P4. Line 18. Do you mean "...lost at each time step"?
No exactly because is not a "time" step, if not a discrete step. P5 line 24

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 thought 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.
P4 line 23

9. P4. Line 28. Could the method be used for mainshocks and foreshock? If yes it would be interesting to mention more clearly.
P6 line 19

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?
P5 line 4-9

11. P5. Line 7. Please indicate why not all cells that exhibit exceeded load are authorized to fail. Again, what would be the effect of allowing them to fail as well?
P5, line 1-2

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.
P6 line 12

13. P5. Line 24. It is a long time you have not describe $\pi(x,y)$. Therefore, I suggest you write again their meaning as you did at line 8 recalling and P.
P6 line 7

14. P5. Line 28. You are referring to figure 2, but no citation to figure 1 occurred as yet.
Yes you are correct, we changed the figure order.

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, . . .?
P7 line 13-20

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.

P7 line 21

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

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.
P8 ine 3-5

19. P7. Line 8. I suggest to replace “afterwards” by “later” in this case.
Done, P8 line 26

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.
Done, P9 line 15

21. P7. Line 26. You may recall in brackets what P is.
P9 line 16

22. P8. Line 2. Is this the place to refer to figure 5?
P9 line 24

22. P8. Line 11-12. The sentence needs to be rephrased. As is, it is unclear!
P10 line 1-3

23. P8. Line 15. I guess there is a typo. Fig. 6a instead?
Yes, you are right. P10 line 17

24. P8. Line 18. How do you know the magnitude are overestimated? Could this be an effect that 3D effect are not modelled?
P10 line 5-6

25. There is no reference to figure 8. Either remove or reference it.
P10 line 10

26. P9. Line 8-9. I would put this sentence in the figure caption. It does not bring anything here.
Ok (See Fig. 9)

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 addito0n make reference to figure 9 clearer. Fig 9a or 9b?
P11 line 20

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.
P12 line 4-6

29. P9. Line 32. Reference missing.
Ok, we modified it

30. P10. Line 25. once again, this is neglecting 3d fault geometry, especially at depth. You should again say it.
P13 line 2-4

31. P11. Line 11. Reference typo.
Ok, we modified it

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.
P14

33. P12. Line 8. Yes! Finally! You should mention this much, much earlier. Thus 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?
P2 line 23-28

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

Dc (Do) it is one of the most studied fractal dimension for the spatial distribution in earthquakes (epicenter and hypocenter), also we are interested in evaluating the capacity of the spatial distribution to occupy the space in which it is embedded. Future research could consider a multifractal analysis for synthetic and real series
P15 line 2-5

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.

It is clear that when q = 1, we have an indetermination. However, in the present work, we are evaluating only q = 0, and if it were necessary to estimate more levels of q, we would use the proposal of Márquez-Ramírez et. al. 2012.
P15 line 2-5

36. P13. Line 1. Reference not clear.
Ok, we modified it

37. P14. Line 18. Many variables are not explained.
P17 line 4 and line 6

38. P15. Line 7. I would introduce “time” in “. . . for each time step...”
It is not time step is a discrete step, P17 line 19

39. P20. Line 31. I did not find a call to this referenced
P4 line 14

40. P21. Line 1. I did not find a call to this reference.
P3 line 27

41. P21. Line 27. I did not find a call to this reference.
P2 line 17

42. P22. Line 12. I did not find a call to this reference
P9 line 1