Hydrology and
Earth System
Sciences
Discussions

Interactive comment on "Locality-based 3-D multiple-point statistics reconstruction using 2-D geological cross-sections" *by* Qiyu Chen et al.

Anonymous Referee #3

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This paper presents a locality-based MPS approach to reconstruct 3D geological models based on easily available 2D training images. To fulfil the objective, the MPS search engine roams over only several local sub-sections closer to the simulated node, instead of using a full training image. The authors also perform a parameter sensitivity analysis and the performance comparison with other previous 3D reconstruction techniques, illustrating the effectiveness of their approach using synthetic and real geological data. The results identify better performance both in portraying complex heterogenous structures and in CPU cost.

All together a very good paper, well written and showing a clear and valuable contribution that deserves publication. However, a number of significant issues need to be addressed for this manuscript to be publishable. Therefore, the authors are neverthe-

less invited to consider carefully the following comments to improve their manuscript.

General comments:

1. I am not totally convinced with the overall contribution of this method compared to s2Dcd. This needs to be explained in detail how the proposed technique differs from s2Dcd, which is now lacking in the introductory part.

2. The MDS shows slight improvement in terms of MP simulations using the proposed scheme. The computational benefit only appears with abundant sections available in each direction, which is in practice seldom existing and also mentioned as a limitation in the manuscript. Moreover, the improvement with reproduction of non-stationary patterns might have sampling effect as only one realization is considered from each method.

3. Overall, I am struggled to understand the flow of the methodology section, e.g. how the multigrid concept is implemented in searching the neighborhoods, or am I missing something in the workflow of the algorithm? I would also like to see the effects of using various number of multigrid in the form of sensitivity analysis.

Specific Comments:

1. P7 L2-3: Rewrite the sentence.

2. P12 L12: the connectivity 'becomes'

3. P12 L14: I would prefer to see an example of artifacts clearly visible on a section of the reconstructed model (maybe with the example of 6x6x6 model in Figure 5), to have the feeling of how bad it is and also to justify the logic behind not using too many cross-sections.

4. P12 L18: it 'is' related

5. Figure 5: Describe the black and gray lines by adding legend or in figure caption. I think the black lines represent the reference model? Also add the axes labels in

variogram and connectivity plots.

6. P14 L8-10: Rewrite the sentence as it's hard to follow in this format.

7. P14 L14: 120? or 160 or 320?

8. P 17 L19: analyze 'the' performance.

9. P 17 L21: our method

10. Figure 8: Caption is incomplete

11. Figure 9: The proportions of the facies in the 3D reference could be added as well in the plot for comparison.

12. P 20 L15-16: A brief summary of all other optimized parameters would be helpful for the readers.

13. Figure 13: The figure is redundant as all these numbers are already in the tables.

14. P 21 L9: s2Dcd uses DS as an external MPS engine as mentioned in P17 L15-16, therefore s2Dcd also runs on 4 processors, I believe. However, the authors claimed the opposite here. Please clarify.

15. P 22 L6: parts 'of' subdomains

16. P 23 L5-6: Figure 17 compares the dissimilarity between the sections extracted from the realizations and the informed sections, and I am guessing the sections are selected as random and the authors avoid the sections those are already used as training images?

17. P 23 L11: Figure 17 instead of Figure 16.

18. P 25 L1: The segments in Figure 17b are chosen from three local models, so is there any sampling effect when you select the sections to compare the reproduction of non-stationary patterns? What if you take an ensemble of sections from few realizations to compare the techniques?

19. P 25 L11: 'extracted'