Response to Reviewer #1:

This paper presents another approach to handle the problem of lacking three dimensional training images for multiple-point geostatistical simulations. The authors explain the differences between their approach and previously existing ones and perform thorough sensitivity analyses on the new parameters required by their implementation. However, they take some prior important decisions that go unchallenged, such as the choice of the probability aggregation methods, and the parameters used in them. A sensitivity analysis of these decisions would provide a more solid basis for the usage of the new approach.

We are grateful for your insightful and constructive comments and suggestions. In order to more clearly present the probability aggregation strategy proposed in our paper, we moved the description of two existing formulas used in our work to a new section Background Information in the revised version (see P5L18-26 and P6L1-11). Thus the section 3.2 mainly focuses on the strategy for aggregating the pdfs from local sub-sections proposed in this work (see P9L7-22 and P10L1-13). The choice of the probability aggregation methods is described in P9L13-20. The sensitivity analysis of the weights of the probability aggregation formulas has been done in section 4.1.3 (see P18L2-16).

My major criticism is on the tests performed during the benchmarking. They are purely statistical, yet this is a journal very much related to surface and subsurface hydrology. Readers of HESS and potential users of this method would be more appealed to use it if the benchmark would include, for instance, some solute transport simulations.

Although this manuscript mainly focuses on the algorithm principle of reconstructing 3-D models of subsurface structures by using multiple-point geostatistical techniques, several data sets in hydrology or hydrogeology are used to test our methods, such as pore structure of sandstone (see section 4.1), folds in subsurface aquifers (see section 4.2), and a synthetic example: 3-D reconstruction of hydrofacies (see section 5). Therefore, we think that our method can be used to reconstruct 3-D models of complex heterogeneous structures in hydrology or hydrogeology and it meets the scope of HESS.