

Anonymous Referee #1, 25 Feb 2022

The paper is technically sound and generally well-written. It proposes and showcases tools for the assessment of geological models in the minerals industry, from the green-field scale to the mine scale, therefore it is of interest to the readership of Geoscientific Model Development.

Answer: We thank the referee 1 for his/her review and useful comments.

I recommend publication subject to the following revisions:

Main comments:

1) Lines 30-31: when the authors refer to measurement errors, what about geological mapping or logging errors (due to the geologist's criterion, for example) that may not cancel out after replication of the measurement? Some comments on this issue would be welcome.

Answer: When a measurement involves human criteria, such as the choice of specific locations for geological mapping or some interpretation in lithological classification or in the identification of boundaries, the sampling error can be characterized in repeating the mapping or logging by independent geologists. In other words, bringing in more geologists turns it into an expert elicitation exercise, which can be a valuable way of reducing uncertainty. The text has been updated with "repetitive independent sampling".

2) Line 197: isn't it too strong to assume "isotropy"? I believe that anisotropic variations are common in geological modelling

Answer: The general formulation as given line 198 assumes anisotropy. h could be a vector rather than a distance to deal with anisotropy. Directional semi-variograms are also a way to deal with anisotropy. Anisotropy will affect the shape of an omnidirectional semi-variogram. Here, to keep the dissimilarity measure simple, we assess the omnidirectional semi-variogram. Complementary details have been added in this section.

3) Lines 207-208: the experimental variogram is not always well-behaved at short distances, to the weighting may render the indicator in Eq. (3) highly sensitive to the short-distance behavior and nugget effect.

Answer: This is true when dealing with sparse spatial data such as borehole or well data. Here, as we compare fully populated voxets, we are not concerned by this issue. A comment has been added for the reader in the corresponding section.

4) In addition to the presented indicators, would contact relationships between lithocodes (measured through transition probabilities, transiograms or cross-to-direct indicator variogram ratios) be worthy of interest? Again, some comments would be welcome.

Answer: Indeed, these could be interesting topological indicators. As stated in the discussion, the proposed indicators are non-exhaustive and remain a subjective choice. To integrate this suggestion, the corresponding paragraph has been updated in the discussion.

Minor comments

1) There is a mix of US (e.g.: "minimize", "summarize") and UK ("summarises", "anonimised", "modelling") English

Answer: This has been corrected.

2) I am not familiar with the word "voxet" (seemingly, a set of voxels): this could be defined to avoid confusion

Answer: A definition has been added in the introduction.

3) Line 41: the date of the reference is 1978, not 1976

Answer: This has been corrected.

4) Line 45: there is a question mark before Sambridge

Answer: This has been corrected.

5) Lines 72-72: what/where are the Centre for Exploration Targeting, Loop researcher and related networks?

Answer: We have added a few urls to give more details: <https://www.cet.edu.au/personnel/>, <https://www.cet.edu.au/members/>, <https://loop3d.github.io/loopers.html>, <https://www.linkedin.com/groups/6804787/members/>.

6) Figure 6: does the fourth row represent the "average normalized range and standard deviation", or the "average squared normalized range and variance" (the caption of the subfigures is not consistent with the figure caption)

Answer: This is the "average normalized range and standard deviation". The subfigure titles show a /2, not a square.

7) Line 167: can be computed

Answer: This has been corrected.

8) Lines 196-199: "s" is a vector, but is "h" a distance or a vector? Is Z a "random variable" or a "random field"? Notation should be revised for consistency

Answer: Z is a random field. h is a vector in the more general case, but can be viewed as a distance in the isotropic case. This has been clarified in the text.

9) Line 203: inside the norm, it should be $s_j - s_k$, rather than $Z(s_j) - Z(s_k)$

Answer: Thanks for spotting this mistake. This has been corrected.

10) Line 236: considered classes

Answer: This has been corrected.

11) Figure 10: the caption in the top right subfigure should be $\Gamma(p)^c$

Answer: This has been corrected.

12) Line 324: overlap

Answer: This has been corrected.

13) Lines 526 and 533: who are "et al."?

Answer: This has been corrected.