

Geosci. Model Dev. Discuss., referee comment RC2  
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## **Comment on gmd-2021-66**

Guillaume Duclaux (Referee)

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Referee comment on "Spatial agents for geological surface modelling" by Eric A. de Kemp,  
Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-66-RC2>, 2021

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Review of "Spatial Agents for Geological Surface Modelling", by Eric de Kemp.

This manuscript presents an innovative contribution to the challenging task of generating 3D surface model of complex geological terrains. The generation of 3D models (in the sense of 3D maps and not 3D thermo-mechanical models) is of considerable interest to the broad structural geology and tectonics research community studying the geometry of geological units/objects and contacts in deformed regions, and is also of economic significance for the resource industry. The author presents here a new surface modelling/meshing method based on spatial agents which has the potential to overcome some of the limitations inherent to the more classical implicit methods used in 3D geological modelling. The spatial agent methods have been used now for about a decade for modelling features in a wide range of fields outside of Earth sciences, but such methods, here involving structural agents, have never been used specifically for resolving complex geological geometries in 3D by satisfying contacts and structural observations.

The paper first introduces the agent method and briefly reviews published literature on agent applications in various fields. The second section of this contribution presents the challenges faced when applying current geological surface modelling techniques to complex geological structures with sparse control points. Section 3 presents spatial agents example and how they can be used for solving surface modelling problems in structural geology in order to insure that surface topology is sound and verifies fabrics observations. The 6 main structural agents programs presented by the author represent building blocks that could be combined to eventually generate complex surface geology models. Section 4 discusses the future of such methods. This work doesn't claim that spatial agents are the ultimate solution for resolving complex surface models, but it provides solid evidence that used in conjunction with other Loop 3D tools it could definitely improve the surface model building workflow and insure structural observations are respected. The limitations of the current implementation are explicitly presented in the conclusions, which keeps this contribution honest.

The manuscript is well written and articulated. It contains 7 figures and 3 appendices.

some figures should be better called in the text. I do not have any major concern with respect to this contribution that seems to represent a solid proof of concept and tile the path for future applications of spatial agents for 3D geological modelling. This work is of broad interest to the community, and especially relevant to the those interested in 3D structural mapping, tectonic interpretation of complex terrains, and the community involved in 3D surface modelling in general. As such it seems worth publication in GMD and well suited for this special issue on Loop 3D modelling. I recommend accepting the manuscript with minor revisions and a few technical corrections (see minor comments below).

Minor comments:

- + NetLogo-3D: this seems to be the correct spelling. It changes throughout the manuscript (starting in the abstract). Could you please insure spelling is correct and consistent? (p5, p13, p17, p27, p28)
- + p2, line 13: there is a typographical error for "conductivity"
- + p4, line 24-25: I would suggest the author edit slightly the last sentence of the page. I believe a model never reconciles all the data... Remembering Box famous aphorism "All models are wrong, but some are useful" we can safely say that no model will reconcile and respect all data. I would possible write down : "[...] explanatory model that aims to reconcile and respect all the available data".
- + p5, line 4: section 1.4 title could be revised a bit... in fact it rather presents the outline of the paper. Maybe something like "Outline and demonstration code" ?
- + p7, Figure 1: I would love to see what surface model spatial agents would generate using the data provided in a). Could the structural agents programs presented here resolve this surface in a way that satisfies the control structure in b)?
- + p8, line 23: the notion of continuity for spatial agents is not very to me, even when looking at Fig 4. I believe the author should explain what is meant in more details.
- + p11, lines 3-4: I reckon an UML diagram or some schematics illustrating agents interaction would be helpful to those like me who are not familiar with such functions.
- + p12, lines 11-12: a reference to Figure 1 would be great here.
- + p12, line 12-14: I totally agree! Geophysics alone is definitely not designed to assess the surface geometry of complex 3D geological structures.
- + p14, line 4: please add the missing "." in the caption between "data" and "Depending"
- + p14, line 15: please add some comas : [...] the program, its intended behavior, and the main [...]
- + p15, line 2: a reference to Figure 2 should be added here.
- + p16, line 2: a reference to Figure 3 should be added here.
- + p29, line 21: What is the polarity of the rock unit is unknown? High grade metamorphic rocks generally have no evident markers for polarity. Is it set to 0? NaN?
- + references formatting in the text need to be formatted according to the journal guidelines. Comas are missing between author names or et al. and the year. Some references have typos (i.e. p3 line 22 "Motieyan. and Mesgari", or p13 line 14 "from dekemp").

Guillaume Duclaux  
Nice, 05/08/2021