Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., author comment AC3
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Reply on RC1

Mark Jessell et al.

Author comment on "Automated geological map deconstruction for 3D model construction using *map2loop* 1.0 and *map2model* 1.0" by Mark Jessell et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2020-400-AC3, 2021

Response to reviewer's comments RC1

We would like to thank the reviewer for their careful reading of the text and numerous suggestions, most of which we have incorporated into the manuscript. Specific responses are included below.

Line numbers after each comment refer to the line numbers of the new clean version of the manuscript.

R.M. Harrap Review

Scientific Specific Comments and Requests for Clarification

Some of these are quite minor points, some may reflect me misunderstanding the paper (which says something) and some are fairly technical. The format is line number or range followed by the point, however large or trivial.

30: Why say deformed? Doesn't it work on flat-lying strata?

The references we refer to here are specifically focused on deformed rocks, so flat-lying strata are the pre-cursor geometries but not the focus of these authors' works.

35: The point of this work (I'm the author) was consistency checking both during and after map creation and especially when large, complex compilation maps were being created and to focus on areas where a legend contradicts map relationships. This was implemented at one point in an unpublished MSc thesis and it worked. The point here is that workers such as Brodaric and Harrap were always interested in tools used during mapping as well as during compilation and not simply in analyzing others maps. Not sure this requires any change in the paper, but I thought it interesting to point out given the long and slow history of developments of tools in this area!

Interesting, I have used some of your text here to better define the original aims (from line 33 of clean version).

43: I'm not sure what irreproducible means here.

Clarified in text to refer to two geologists building models of the same area from the same data, or one geologist at different times (Line 57)

46: Is that transformation unique? Or is it an interpretation especially in cases where legends are being adapted? Brodaric, and Coleman-Sadd (iirc) did some work on reconciling maps where sub-maps had different authors and different emphasis during mapping.

Non-uniqueness highlighted here and reference to Coleman-Sadd paper added. (Line 63)

51: As well as for use in other studies?

Corrected (Line 74)

54: … lack stratigraphic information. This reads oddly since drill holes in non-hardrock terrain would never lack stratigraphic information? Perhaps I'm misunderstanding here.

Clarified that most non-basin drillholes lack strat information (Line 78)

55: The 3 types specified here – might be expanded with one sentence of more detail on each? And why (just) these three? As you'll see below I have comments about others though you address that very well in your Discussion in the end.

Examples for each type are now given. (from Line 102)

58: Combine direct with conceptual?

What is knowledge from nearby areas?

Tectonic history (okay, you cover this)

What about base scientific knowledge? How granites behave?

(you might just note that you discuss this in the discussions but… I think it is important to point out what forms of conceptual knowledge that geologists use are NOT in your model here…)

This section has been expanded (from Line 102).

60: A cross-section is an artefact of us working with a-c reasoning for a good enough (the A.I. term is satisficing) 3d model. It feels like you are stumbling over 2 fundamentally different kinds of constraints: this unit has "this place and this geometry" versus "this unit

is younger than that unit." The kinds of inference / constraints used in geological reasoning are well studied e.g. for the case of how people map and how they interpret data (e.g. Bond and students, etc. etc.). I don't expect a huge change here but flag something about what is in and what is not for your discussion later asper the previous comment?

Added text clarifying specific and generic constraints (From Line 104)

63: Do you really want to reproduce them? Or get the same or better resulting outputs with reproducibility?

Good point, changed to inspired by… (Line 114)

67: Are you capturing stuff people don't "bother" to do or stuff that is intractable to do manually at all?

Good point, text modified to suggest that the work is not often carried out… (Line 119)

70: Is the summary human readable? Further to my general comment, would that be desirable for human AI model development? Mostly addressed, but…

Yes it is and this is explicitly stated now (Line 124)

94: Given the point about modeler 'in the head' knowledge and 3d Models I might say 'un-related to 3d Modelling as currently practiced'? Not sure…

Clarified this statement

100-104: Was there any co-evolution of these libraries and your stuff as your project went on or are you totally arms-length?

No co-evolution, this is explicitly stated now. (Line 93)

114: I think you need to cite something on the geology of the area? A report?

Reference added (Line 137)

118: Confusing. I read this as you saying the Jupyter notebook hits those layers and then provides a human-in-the-loop UI/Configuration file writer / process? Consider putting the "there are currently" sentence first for clarity?

A new figure 2 explaining overall workflow and showing the automated part of the system

has been added. (Fig 2)

122: It feels like you are saying this is a legend-language style depiction but I think you are actually saying it is a recoded _map_ in a unique chronostratigraphic order. So … someone has to 'do' that first…?

Clarified so it is clear I am talking about polygons with stratigraphic attributes. (Line 662)

133-43: How do you / can you deal with adjacent map sheets with different levels of detail? Or are you 'one map only' or would a prelim recode be required? Perhaps in discussion or not at all.

We can't and the ref to Coleman-Sadd et al., 1997 is added to cover this possibility earlier in the section. (Line 64)

145: Was this map chrono… suitable or did you recode?

A general question about this point. In field geology we use 'established, inferred, assumed' language for contacts. I'm assuming that you just have one contact type. This becomes VERY important in your discussion and conclusions when you talk about issues because not all contacts are fixed. Some are topologically required but can be 'safely' moved as they are under cover / underconstrained. So… is the 'fixist' logic HERE a problem later when you might want to reconcile some of your issues by shifting a boundary in the map because it is 'unbound' or 'unconstrained?'

In answer to the question, the map was suitable and this point is made, and the point about inferred contacts was added to the discussion.

191-3: I find this confusing. The way it is worded L167 filtered by… implies that it is done FIRST as data prep. But is it happening along the way? During the run? It feels like you should discriminate things that are done 'totally before' form those that happen during… Yes, I'm being a bit picky here but I'm trying to understand the workflow (e.g. general comment about what the experience of using it is like).

The Figure 2 workflow clarifies this.

217: Not sure this is meaningful because I'm not reading your code, but would it be possible to modify Figure 4 to show what is map2model and what is map2loop, or is the back and forth too complex to make that meaningful?

Clarification added to figure caption.

220: DTM is online only whereas other data can be local?

This point is clarified. (Line 222)

231: What about lenses in stratigraphic sequences that pinch out? Can you handle that topology?

This point is discussed. (Line 271)

255: Is the unique fault name auto-generated if the fault was not named in the source data?

This point is clarified. (Line 297)

325: 3.2 Need to remind us what these are, how they are stored? Sentence here feels like it should actually start 3.2.1 and not be a general section intro?

Section intros added to clarify meaning of position, gradients, topology.

330: Overrides – implies you either would do this before, or during, or after and rerun, or??? Clarify the workflow please!

Workflow clarified in Figure 2.

380: This is an area where I hoped in the discussion there would be more … discussion … about how you validated your tool as you worked on it? As in, more discussion of running with different map types, geometries etc. It is a bit too succinct there for my liking but perhaps you are at a length limit for the paper…

Discussion has been expanded to include comparison with manual data extraction, choosing the data to model, different geological terranes and lack of contact information. The discussion section has been expanded and several discussion-like points have been moved from main body here as well. (from Line 540)

390: At this point I think a high level description would help. Something about 'first we do the stratigraphy, then the intrusions, then the faults, then the…. I struggled reading this trying to decide whether you were using stratigraphy as a catch all term or just for… stratigraphy. Your language is a bit ambiguous here, and a very short intro on the process would help to say what is covered and what is not.

Clarification that extraction of igneous, fault and stratigraphic contacts all take place. (Line 438)

414: It feels like this could be a parallel combinatorial approach; mostly addressed in the

discussion.

Yes, a specific point is made highlighting this. (Line 425)

427: is the graph exportable/ usable?

Yes, and this is now mentioned. (Line 467)

439: Again, the workflow. Is this process interactive? Iterative? Black box? Is the human in the loop? Especially given the statement below (geoscientist in minutes etc). Expose your workflow more clearly!!!

Workflow clarified in Figure 2.

449: (perhaps) one sentence on what geophysics would add?

Done. (Line 648)

514: No map… Actually as you hint at later, there are MANY situations where a human can make a map using regional knowledge, stated assumptions, theory, potential field data… The interesting thing is the gap between formally decidable maps and what a geoscientist would be comfortable to handle. There is abundant literature on this e.g. in field mapping and in interpretation (Bond, as you cite). Is the gap large? What are those humans DOING? Are they nuts? Brodaric has talked a lot about this as have the cognitive scientists who study the mapping process. There is a fairly interesting philosophy of geology topic you're going to hit if you continue in this direction (as an aside, this has been examined in the case of highly constrained geotechnical 3d modeling, but only at the very local scale and for a few unconstrained parameters). There is a huge gap between a provable and a plausible model.

Agreed, and added to discussion in section 6.2.1.

550: Fascinating topic. Could something like a generative adversarial network approach be used (build a procedural simulator, like Noddy on steroids, that then subsets it's outputs to feed into map2loop which can then be verified since … the full inputs were known).

We have actually developed a Noddy multi-million model suite for training CNN algorithms, now referenced here. (Line 711)

565: This is the combinatorics I was referring to. Specifically, the work that has been done on combinatorial possible worlds (this is just an aside…)

No change needed

A general comment, I was surprised that Varnes' paper doesn't show up in your early intro as it was the source of a lot of early thinking. Not a requirement, but it is an interesting read!

Added to introduction (Line 31)

Technical Corrections

All technical corrections fixed

50: … and to extract …?

52: Commonly… often… two in the same sentence seems a little wishy-washy. 53: or, if available, logged well data…?

55-56: Feels like 34d category should be in same sentence? Feels like an edit error here. 67: Not previously available. (missing .)

68: … from GIS layers stored locally or online servers? 80: One too many) ?

81: these packages?

84: and so this necessary toolset will not be discussed further here? 361: A single item list?

366: Compare reference at 335 to that here and make your style consistent with journal standards?

389 / 834: Perrin reference is incomplete? I didn't go through them all very carefully but…

Reference fixed, and all references checked.