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Geoscientific Model Development Discussions

Interactive comment on "Quantitative stratigraphic analysis in a source-to-sink numerical framework" *by* Xuesong Ding et al.

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General comments

This paper describes the results of a numerical experiment focusing on erosion and sedimentation along a continental margin and the stratigraphic analysis of the model deposits. Unlike most previous modeling studies, the erosional evolution of the sediment source area is coupled with sedimentation along the coast. I think it is overall well-written, nicely illustrated, to the point, and, most importantly, an interesting and valuable contribution to the modeling and sequence stratigraphic literature. It illustrates well the power and elegance of the pyBadlands modeling package. In addition, it is hard to overestimate the value of having easy access to both the modeling software

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Discussion paper

and the scripts that were used to generate the model in the paper.

Specific comments

Although I think the paper is a valuable contribution as it is, there are a number of points that could be addressed to make it more comprehensive:

1. Although the authors convincingly show how the trajectory analysis and accommodation succession approaches can be applied to the model results, both manually and in an automated way, and they conclude that the accommodation succession method is more robust, they do not spell out suggestions for practitioners of stratigraphic interpretation. Is a manual approach good / reliable enough? Is it possible to automate the interpretation of actual sections, not just model sections? Should the idea of using dA/dS (as opposed to, let's say, dA-dS) be entirely abandoned? Is it acceptable to talk about dA and dS without specifying what they exactly mean and quantifying them? There seems to be a good opportunity to expand on these issues in the Discussion section.

2. In many, maybe most cases the purpose of stratigraphic interpretation is not just subdivision into meaningful units, but a reconstruction of different forcing parameters / signals. How do the models and analysis shown here perform in this regard? E.g., can the dA-dS curve (Figure 7d) be used as a proxy for sea level? What is the significance of the ~2 Ma phase shift between the two? This could be the subject of another paper, but it is probably worth exploring it briefly here as well.

3. The analysis assumes that a single cross section through the model is representative of the whole model / continental margin. The model setup makes it likely that this is indeed the case, but it would be useful to show how similar / dissimilar are other cross sections. Would the analysis of s different section come up with a very similar result? What if there are a significant number of delta lobe avulsions? Again, I realize that a detailed investigation of this could form the subject of another paper, but this question should be addressed. In its current form, this study seems to wholeheart-

edly encourage sequence stratigraphic interpretation based on single dip sections; yet many real-life deltas are highly three-dimensional and single cross sections do not record the history of the entire system.

Technical corrections

Page 1, lines 2-4 (and throughout the paper): I am not sure that it is worth reiterating the idea of dA/dS as a key parameter in stratigraphy. You end up using dA-dS anyway; and dA is defined here as the rate of relative sea level change, dS as sedimentation rate. Why not refer to the actual parameters used?

Page 2, line 8 – 'tectonics' instead of 'tectonic'

Page 2, line 9 – cut 'to stratigraphic interpretations'

Page 3, line 2 – 'automate' instead of 'automatise'

Page 3, line 6 – 'interpretation' instead of 'interpretations'

Page 3, line 12 – 'designed the trajectory analysis technique'

Page 4, line 3 – 'First,' instead of 'Firstly'

Page 4, line 8 – 'the topographic contour that corresponds to sea level'

Page 4, line 9 – 'a critical slope of 0.025 degrees.'

Page 6, lines 7-9 – probably should mention that the model setup focuses on sea level changes, as both climate (precipitation) and subsidence patterns are kept constant. Sediment input increases through time, but it does not vary periodically as sea level does.

Page 6, line 10 – 'sequence development' instead of 'sequences development'.

Page 9, figure 5 – what is the horizontal scale in (b)? Tickmarks do not match those in (c). Stratigraphic columns in (d) do not seem to match the ones in (a).

Page 9, line 2 – ‘three stratigraphic cycles’ (?) instead of ‘three cyclical vertical stacking’

Page 9, line 3 – ‘apparent in’ instead of ‘apparent on’

Page 9, lines 4-5 – cut ‘the vertical stacking pattern’

Page 10, line 1 – ‘Interpretation’ instead of ‘Interpretations’

Page 10, line 2 – ‘both the trajectory’ instead of ‘both trajectory’

Page 10, line 7 – ‘difficult to pick’ instead of ‘difficult to be picked’

Page 10, line 9 – ‘According to lateral and vertical shifts of the shelf edge through time,’

Page 10, line 29 – ‘We call this trajectory type the “descending. . .’

Page 11, figure 6 – is the first segment of the first ATC trajectory really ascending in (d)? Seems descending to me.

Page 12, line 2 – ‘Next, we. . .’ instead of ‘We then. . .’

Page 12, line 5 – ‘. . .clinoforms do not develop with these model settings.’ instead of ‘clinoforms are not well generated in this model setting.’

Page 12, line 7 – ‘progradational (P)’ instead of ‘progradation (P)’

Page 14, line 3 – ‘from the final output’ instead of ‘from final output’

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