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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: "Quantitative stratigraphic analysis in a source-to-sink numerical framework" by Xuesong Ding et al. is a clearly written and thoughtful submission that can be a strong contribution after significant technical clarification is included. It might also be better titled, considering the content is dominated by a comparative analysis of alternate sequence stratigraphic interpretation methods using manual and automated means to compare the fit of results with pyBadlands Stratigraphic Forward Model (SFM) input and output. The approach used is novel, applying different interpretation techniques on the output of a SFM and comparing the results of each technique against time-dependent SFM inputs and outputs. Unfortunately, there are flaws in the analysis that stem from a blurring of observations that are the foundation of interpretation

methods and the forcing mechanism inferred to drive them. âĂć Firstly, a β-factor of 1 to 2.5 over 150 km produces a subsidence profile which increases so much toward the basin that 10 million year duration, 50m "eustasy" cycles don't produce basinward shifts of facies (depositional sequence boundaries) resulting from negative shelfal accommodation that is a key factor to interpretation with either shoreline trajectory (ST; Helland-Hansen and others '94-'09) or accommodation succession (AS; Neal and others '09-'16) methods. âĂć Application of ST method is disadvantaged as presented because the SFM produces a trajectory the authors had to invent ("descending transgressive trajectory class" or DTTC) in order to fit geometries with known sea-level conditions. This is a limitation to methods that are explicitly linked to sea-level change. âĂć The AS method explicitly avoids sea-level requirements and focuses on stratal terminations at key surfaces that bound different stacking patterns. This method allows interpretation to adjust to dipping strata that was initially horizontal (clinoform topsets – coastal plain aggradation) âĂć ST method builds from the assumption of trajectory from horizontal, so differentiating relative to AS is artificial (a function of forcing it to fit the sea level curve). THIS is the actual insight from Ding et al.'s paper – apply ST or AS methods but do not force them to fit a sea level curve. We don't observe sea level in stratigraphy, we infer it. We observe stratal terminations, shoreline trajectories, vertical and lateral stacking of facies associations, and key bounding surfaces that record significant changes in these observations. âĂć The erosion feature of pyBadlands produces interesting 2D truncation geometries updip (but this was not demonstrated in the Wheeler diagram (fig. 5c) and might produce more interesting relations in shoreline trajectory if β-factor were reduced. For scaling comparison, I suggest you refer to the physical flume model and resulting interpretation published in Martin et al. 2009 (Martin, J., Abreu, V., Neal, J. Sheets, B. 2009. Sequence stratigraphy of experimental strata under known conditions of differential subsidence and variable base level. AAPG Bulletin, 93, 503–533.) âĂć In summary, there are ways this experiment could be run that would make a better comparison of interpretation methods or the paper could more directly highlight shortcomings of interpretation methods that are explicitly

linked to sea-level change. The approach in Ding et al. is innovative for using SFM to volumetrically quantify δA/δS or (δA - δS if you wish) and I encourage the authors clarify their purpose (change the model or change the conclusions and application) so this good work is more on target.

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