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Earth Surface Dynamics Discussions

Interactive comment on "Topographic controls on divide migration, stream capture, and diversification in riverine life" *by* Nathan J. Lyons et al.

Anonymous Referee #2

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General comments:

The authors present results from a new macroevolution model coupled with a landscape evolution model, examining how variation in geomorphological parameters drive drainage reorganization and, through drainage reorganization, speciation and extinction. Overall, the manuscript is clearly written and I was able to follow the authors' logic section to section. The problem of coevolution of drainage networks and the aquatic species that populate them is interesting and important and the authors' work on the SpeciesEvolver component is a strong contribution. If this manuscript is intended to introduce to the SpeciesEvolver model to geomorphologists and demonstrate an appli-

cation alongside other Landlab tools, then it works pretty well. However, if the modeling results presented here are intended to say something substantive about the relationships between geomorphological parameters, drainage basin reorganization, and the evolution of species that inhabit them, I think there are some significant problems. First off, I think it needs to be more clearly stated whether the authors' goal is the former or the latter. If the goal is to say something meaningful about speciation and topography and not just "check out the cool experiments you can do with the tool we made", then there should either be some sort of field data incorporated (which would be really difficult) or some of the unrealistic conditions associated with these model runs need to be changed or at least convincingly addressed in the text.

More specific comments:

Page 3 Line 7: I don't think a landscape evolution model that neglects mass wasting will realistically represent divide migration where total relief is as high as it is in many of the simulations. I think it would be more meaningful to stick to relief ranges where diffusion could reasonably be assumed to be the dominant hillslope process if landslides aren't to be included.

Page 3 Line 21-Page 4 Line 6: The description of the SpeciesEvolver component needs more depth. The ESurf readership is going to be mainly geomorphologists. Speaking for myself, I hardly know anything about speciation and extinction and even less about the considerations involved in modeling these processes. It's an interesting tool and it deserves a lot more than two paragraphs included here. I don't understand very well how it works or why I can trust that it describes natural processes accurately.

Page 7 Line 5: Is it realistic for a species to occupy all parts of a stream network? The relief of some of the modeled landscapes described here definitely would give you different climate zones.

Page 7 Line 19: How is a perturbation of 0.1 m going to do anything to really modify the landscape, if we're interested in the divides? Along the same lines, why include

scenarios with a modeled fault displacement of 100 m when that's so much larger than anything observed in nature? If we're just trying to shake things up and see what happens, why keep other parameter values within empirically observed ranges?

Page 7 Line 22: Shouldn't knickpoints matter to the modeled species? Since knickpoint migration is what's transmitting the perturbation to the divides, I would think you'd need to account for the knickpoints' influence on aquatic life in order to accurately model what happens when the knickpoint makes it all the way upstream.

Page 8 Lines 6-7: Maybe I'm missing something, but why would D go extinct just because its river has been captured by C?

Page 8 Line 18: Does this mean that the divide percent change response only records whether a divide moved, and not how much it moved?

Page 9 Line 7: Will species in the north-draining rivers be more likely to go extinct due to loss of drainage/habitat area, or do they only go extinct when all drainage area is lost?

Page 9 Line 25: Why allow parameter combinations that lead to relief structures that are impossible to produce under Earth conditions? I just think it undermines the results a bit.

Page 10 Line 10-11: Does changed here just mean that they moved or that they were incorporated into a different drainage network?

Page 11 Line 5: Does 3% seem like a reasonable value compared to real landscapes? There seems to be evidence for stream capture all over the place. I think it would help me to understand better what's going on in the model landscapes if I had a better idea what the distribution of relief was. Maybe they're mostly very low.

Page 12 Line 1: Is this the formation of endorheic basins?

Page 13 Line 5: It doesn't seem like there are all that many landscapes that commonly

experience perturbations resulting from fault slip or base level fall where the perturbation magnitude approaches the relief magnitude. Again, I just wonder whether these model scenarios are realistic enough to provide meaningful insights in a lot of the iterations.

Minor nit-picks: Page 8 Line 16: Should say species diversification?

Page 12 Line 25: Reads better if the sentence doesn't begin with "Although"

Page 12 Line 29: This is the first time I've seen "lineage response" in this paper.

Page 13 Line 8: Should say "Cross-divide difference in relief"?

Page 13 Line 9: relief, thus

Page 13 Line 13: landscapes, although topographic relief

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