

Earth Surf. Dynam. Discuss., author comment AC1  
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## Reply on RC1

Eitan Shelef and Liran Goren

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Author comment on "The rate and extent of wind-gap migration regulated by tributary confluences and avulsions" by Eitan Shelef and Liran Goren, Earth Surf. Dynam. Discuss., <https://doi.org/10.5194/esurf-2021-11-AC1>, 2021

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We thank Dr. Beeson for the constructive and insightful review and for putting time and effort into thoroughly reviewing our manuscript. Also, we apologize for the slow response, ES was doing field work and thus we were unable to address comments earlier. Below we address the comments in detail.

Reply to review by Dr. Helen Beeson (Reviewer comments are in bold)

**This paper investigates the dynamics of windgap migration using 1-D numerical modeling. In particular, it explores how tributaries and avulsions of those tributaries influence windgap migration rate and stability. The authors present a series of simulations that show that the topology of the network plays a critical role in windgap migration dynamics, influencing the stable location of the windgap, as well as mean windgap migration velocity and how that velocity changes through time (ranging from punctuated to gradual). They show that random processes (avulsion is used here) can trigger a divide that is stable but in a non-optimal location to begin migrating towards a more energetically optimal location. This paper is well written, with a clear hypothesis and experimental design, and it is timely in that it addresses a unique case of divide migration, a subject of much recent interest in the Earth surface process community. I recommend that it be accepted with minor revisions as I have only a few simple questions and a handful of language comments.**

**Is it a given that windgaps migrate or are these channel-head on channel-head windgaps unique? I have seen many of the type of windgaps you show (there are many in the Apennines) and I agree that they clearly migrate, but I'm not sure windgaps formed by lateral capture of headwaters always do. Maybe following capture, a tributary would form and then push the windgap down the main valley of the losing basin (as in your Parlung-Siang-Lohit example), but the basin could also continue to lose area via continued lateral captures. It is clearly out of the scope of this paper to determine in what scenarios windgap migration occurs following capture, but I think it would be good to recognize this question in some way, either in the discussion or in the introduction.**

Thank you for bringing this up. To address this important point we now recognize that the

entire basin may lose area by modifying the following sentence in the discussion (L292-295) "Finally, whereas our one dimensional simulations likely capture the basic dynamics of windgap migration along valleys, they do not capture two-dimensional interactions such as drainage area exchange through divide migration along the ridgelines that bound the valley. Two-dimensional simulations might therefore reveal more detailed responses, which could depend on the 2D valley and confluence geometry." We note that side-captures of the valley itself are likely rare when the ridgelines are meaningfully higher than the valley, as in the case of the examples we explored in the Negev desert and Himalaya.

**Similarly, in the last paragraph on page 2 I think an introduction to the idea that windgaps can migrate along valleys could be added and that when they do, side tributaries are preserved.**

Thank you, to clarify this we modified L48-49: "and thus the morphology of the bounding ridge lines and the tributaries that drain them into the valley can be preserved as the windgap migrates along the valley." This is also demonstrated in figure 1.

**Are there processes other than avulsions that might have a similar effect and make this model/idea applicable to regions without alluvial fan-forming tributaries? Could ground water seeping have a similar effect but on a longer time scale? Eventually the area-gaining basin seeps enough ground water to be able to capture another tributary and advance to a more energetically optimal geometry. Another idea is capture of losing basin tributary by gaining basin tributary. I suggest adding a few sentences to the discussion on other potential mechanisms that make this concept more widely applicable (which I think it is).**

Thank you for this suggestion, we agree that other processes, such as seepage and slope failure can further advance this process and now modified L282-285 to acknowledge this "Similarly, the hillslope processes in our simulations rely on a linear diffusion approach (Culling, 1963) and do not account for the potential influence of subsurface flow (e.g., seepage) and landsliding on the migrating windgap (Brocard et al., 2011, 2012)". We also agree that other processes can cause abrupt changes in discharge across windgaps, and now address this in L289-290 "We also note that processes such as valley damming by landslides or glaciers can cause overflows across windgaps and perturb stable windgap positions".

**Make fig 7 be fig 6 (reorder) – Fig 7 is mentioned before Fig 6.**

Thank you for noticing this, this is now changed.

**Fig 6C It would be nice to see the profiles for current windgap location on here also.**

Thank you for suggesting this - we prefer not to do so as it may be interpreted as if we aim to produce a model that describes this natural topography, whereas our purpose here is to use the topology of the Parlung-Siang system to demonstrate different steady state scenarios and the effect of avulsion on transitions between them. We try to clarify this in lines 147-148 "Note that this simulation aims to demonstrate the potential influence of network topology on windgap migration in a natural setting, and not to investigate the development of the Parlung-Siang-Lohit capture specifically."

**Fig 7 (a) Should y-axis label be  $L_d/L_c$ ? Legend triangle is tilted compared to those in plot. Maybe state in caption that every marker represents the results of a single simulation?**

Thank you for noticing these mismatches in the plot. They are now fixed. We also changed the caption to clarify that every marker represents the results of a single simulation.

**7b caption needs V and Vr inserted after their explanation (I don't think what they represent is stated elsewhere).**

Thank you for noticing that - we now inserted these symbols.

**All the figure captions are quite long. They could be shortened by removing some of what is already described by legends in the figure. Also, some of them have lengthy interpretations in them that seem like they should go in the main text.**

Thank you, to address this comment, as well as a similar comment by reviewer 2, we shortened the captions of most figures, moved methodological descriptions to the SI, and describe the values of model parameters in a separate table.

**Line comments (mostly typo callouts and language suggestions)**

Thank you for identifying and pointing at these glitches and problems – below we address each:

**4 maybe “in some tectonically active regions...”**

Thank you - we changed this to: “in some tectonically affected regions...”, as not all areas are currently tectonically active.

**4-6 very biased by the study region**

Agreed, we think that changing the previous line to "in some tectonically affected regions..." as you suggested addresses this.

**6 describe the geometry as channel-head on channel-head windgap?**

**Or maybe “Channel-head on channel-head windgap geometry indicates windgap migration with distinct dynamics and potentially quantifiable rates” or something**

We appreciate the value of envisioning the channel head geometry, but we want to emphasize the role of avulsion here, regardless of the specific channel head geometry, and thus prefer to leave the text as is.

**30 maybe “rapidly eroding to the slowly eroding”**

Thank you, we modified accordingly.

**33 change “fast” to “rapidly”**

done

**37 “on the victim basin that loses drainage area”**

done

**39 lengthens**

done

**42 change "whereby" to "in which"**

done

**61 change "set" to "seek"**

done

**83 prominent should be prominent**

done

**115 Clarify that all nodes (both between and with tributaries) are given a local drainage area (if I understand correctly).**

done

**125 "these dynamics"**

done

**130 I suggest saying here at the end that you ran all three versions of the simulation (avulsions, no avulsions  $m=0.45$ , no avulsions  $m=0.55$ ) for ten different values of tributary area/ segment area. It took me a little while to understand that every point on fig 7a was a different simulation.**

Thank you for suggesting this - done

**136 "were" instead of "where"**

done

**171 "its" instead of "it's"**

done

**189 windgap misspelled**

done

**206 windgap misspelled**

done

**220 same**

done

**274 same**

done