Earth Surface Dynamics Discussions

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Comment on esurf-2021-11

Fiona Clubb (Referee)

Referee 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-RC2, 2021

This is an extremely well-written paper which tackles the interesting problem of windgap migration with a rigorous methodology. Given the interest and recent attention to drainage divide migration in the Earth surface processes community, I think this paper will be of great interest and lead to more studies exploring divide migration in valleys. I have some relatively minor comments, but after these are addressed, I think the paper is very suitable for publication in ESurf. I look forward to seeing the final version published!

The avulsion of tributaries at windgaps is a really interesting concept for windgap migration. I was wondering at the ability of this process to occur in vegetated landscapes: the examples shown in Fig 4 all seem to be from arid regions with large alluvial fans where avulsions can happen frequently. What would happen in vegetated regions where the tributary channels may be more fixed in their original course? Would you end up with a windgap in a stable position relatively close the original capture point, as shown in the simulations with no avulsions? While I think simulating this is beyond the scope of the paper, it would be good to see some discussion of the types of landscapes where the fixed confluences vs. avulsions scenarios might be applicable.

Following on from this, in agreement with reviewer comment 1, I also think it would help the manuscript to acknowledge in which scenarios wind gaps are likely to migrate and where they may be stationary (either in the introduction or discussion).

For the landscape evolution modelling, I think you ran all your scenarios with n = 1? I suggest running a sensitivity analysis to test the variation where n is not equal to 1 and there is therefore a non-linear relationship between erosion rates and slope, similar to your tests on the scaling between erosion rate and drainage area. This might have an impact on windgap migration rates if some tributaries are steeper or if there is migration through a shallower part of the main valley.

Would the junction angles at tributary junctions influence the rate of windgap migration? It would be interesting to explore whether, if the junction angles in the victim catchment are larger (more perpendicular to the trunk channel), there is less variation in migration rate across a tributary junction. Perhaps for a future paper!

The results of the modelling seem to show that windgaps like to form a stable position at tributary junctions. Is this borne out by results from real landscapes? The earlier figures in the paper show a lot of detected windgaps across the Himalayas and Appalachians. It seems like it would be relatively simple to detect if these are located at major confluences, which would help to strengthen the conclusions of the modelling by showing a nice correlation with observations.

I find it odd that the simulations with avulsions shows a steadier migration rate of the divide compared to the ones with no avulsions (e.g. Figure 5c). I would expect that, if you have a sudden increase in the discharge to the aggressor basin and a corresponding increase in erosion rate, you should have an increase in migration rate with each avulsion? Is there an explanation for this steady rate of migration in the simulations with avulsions?

Line-by-line and figure comments:

All figure captions are quite long and have a lot of methodological detail which would be more suited to the main text. I would prefer having the model parameters as a table for reference rather than in each individual caption.

Line 37: small typo, should be “loses” rather than “losses”

Figure 1: this is a nice figure to illustrate the differences in the tributary network between the gradual divide migration and valley divide scenarios. I think the points explained in the caption would perhaps be clearer if the network and/or divides were coloured by the stream order of the tributaries? This would make it clearer that divide 1 was originally a zeroth order divide in panel c and has become a higher order divide in panel d. It would also highlight the changing stream orders of the networks in panels a and b, compared to c and d where the stream orders should stay the same after divide migration.

Figure 2: In the text, Fig 2 is referenced as showing the location of windgaps along structurally controlled valleys. Although the figure clearly shows there are a lot of wind gaps in these regions, I found the relationship to the trend of the valleys difficult to see, especially in Fig 2a as it’s too zoomed out. This would be more convincing if the location of some wind gaps were shown in relation to the strike of valleys/faults.

Figure 3: The thin line showing the initial windgap location is quite difficult to see. Can you make this more obvious?

Figure 7: what is V/Vr?

Line 189: windgap misspelled