Impact of changes in slope on stream morphology: A Physical Modeling Approach

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ABSTRACT

Physical models in a laboratory setting can be used to observe and replicate the morphology of streams in nature. Throughout this research project, the Emriver Em3 Geomodel Stream Table was used to produce stream channels under different initial slope conditions. An imitation laboratory sediment is used in the table that is made of plastic and set to comparable scales as a well-sorted medium sized sand.
Before each trial, the table is set to a uniform sediment thickness of 5 cm. The initial channel is always set to a width of 2.5 cm, and an initial depth of 4 cm. The flow rate of water into the table was always set to a constant 60 mL/sec. A total of 21 trials were done at 7 different slopes ranging from 2.0° to 3.50°. We used a Raspberry Pi camera to take still photos, from which we measured the sinuosity and width of the channel from these photos and compared to those of other slopes. Comparing the sinuosities and widths of the trials at different slopes can show how the change in slope affects the sinuosity and width of the channel. Our preliminary results suggest that as the slope of the stream increases the width will increase, and the sinuosity of the channel will decrease. These results could model what would be expected to happen in a real-world situation where the slope can change from processes like uplift, erosion, or baselevel change through a change in sea-level.

INTRODUCTION

- Understanding how slope affects the morphology of a stream channel in a laboratory setting can have implications for what occurs in the real world under conditions of slope change
- The slope of a stream can change under processes like uplift, erosion, or base-level change through sea level rise or fall
- Knowing how channels react in different slopes can tell us how a landscape will change if processes like flooding occurs
- This can then inform people on what to do in the event that a landscape does change, or can help inform about what conservation measures should be taken to prevent the landscape from changing

METHODS

Data Collection:

- Used Emriver Em3 Geomodel Stream Table to simulate stream channel morphology
- 21 trials were done across 7 slopes ranging from 2.0° to 3.50°
- We used a Raspberry Pi camera to take still photos every 0.7 seconds and document the formation

Measurements:

- We took measurements of the channel width and length in order to calculate the sinuosity and to determine how the width of the channel changes with distance downstream
- We made comparisons between the measurements for different slopes to determine how each of these factors is affected by the slope

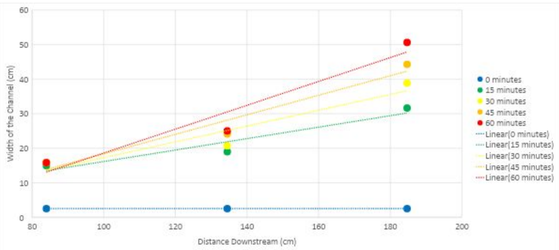

Figure 1.
Graph showing the relationship between the width of the channel and the distance downstream at a slope of 2°.

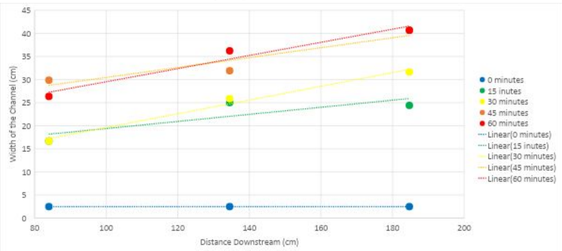

Figure 2.
Graph showing the relationship between the width of the channel and the distance downstream at a slope of 2.75°.

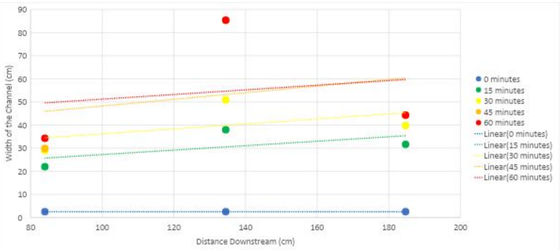

Figure 3.
Graph showing the relationship between the width of the channel and the distance downstream at a slope of 3.50°.

RESULTS

- We determined that generally across all the slopes measured, the width of the channel increases with distance downstream
- We determined that as the slope of the channel increases, the sinuosity of the channel also increases
- We found that at the lower slopes the channels are generally more meandering, and at the higher slopes the channels are generally more braided

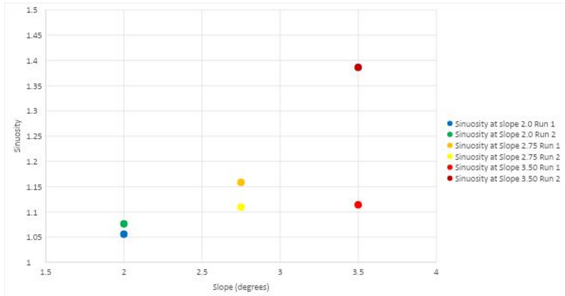

Figure 4.
Graph showing the relationship between slope and sinuosity of the channel

DISCUSSION

- We determined that as the slope of the channel increases, the sinuosity of the channel also increases
- This is not what was originally expected as results
- This could be due to the fact that the sediment used is not real sediment
- The sediment used for the stream table is an imitation laboratory sediment made of plastic
- This sediment is much less cohesive than real sediment that forms real channels
- The sediment was set to uniform conditions every run, but the sediment was not packed down like it would be in a natural system

DISCUSSION CONT.

- The fact that the sediment and the stream table do not exactly replicate real life conditions could be the reason that the sinuosity did not decrease like it was originally expected to.

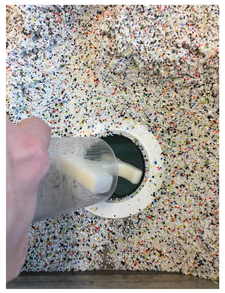

Figure 5.
Picture showing the sediment and the standpipe on the stream table

CONCLUSIONS

- Based on the data collected, it can be concluded that the width of the channel increases with distance downstream
- As the slope of the channel increases, the sinuosity of the channel also increases
- In general, the channels formed from higher initial slopes were more braided with more active channels than those formed at the lower initial slopes that were meandering

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