Review of 'Potential erosion capacity of gravity currents created by changing initial conditions' by Zordan et al. 2018.

Summary

This experimental paper employs a lock-exchange method to model saline gravity flows. Slope and flow density are varied to assess their influence on flow dynamics and morphology. The measurements and approaches taken to analyse the gravity flows are for the most part appropriate and sensible. The results appear to show a counterintuitive relationship between slope and flow speed/basal shear stress. This is attributed to a significant increase in upper surface entrainment with increasing slope.

However, currently there are some significant issues with the paper that need addressing before it is suitable for publication. These issues are outlined in detail below.

Main points

Writing style

I appreciate that English is not your first language, and am always impressed that people can write to such a high standard in their 2nd or 3rd language. Nevertheless, there are several non-sense sentences and several typos that need correcting. Please check again throughout the manuscript for these.

Structure

The aims of the paper are not clear. What is the bigger picture or generic learnings that the paper wants to address? Currently, it is difficult to pick out how the introduction links with the discussion and conclusions. This means that whilst there might be some good analysis made on your gravity flows, I don't see the point, i.e. how can the wider community use this work. This issue with structure feeds into several points below regarding methodology. For example, a major point in the paper is the analysis of entrainment dynamics, yet the introduction does not tell me why entrainment dynamics are important to understand and what key gaps in our knowledge there are.

Methodology

4.2 – ambient entrainment.

This section presents a revised method for the estimation of ambient water entrainment. However, there is no justification as to why this revised approach is needed. As the section states, there is a great deal of work that has established entrainment dynamics with Gradient Richardson numbers. It is not clear why you need to use a 'surrogate' formulation when you could just as easily use well-established methods. Make this justification explicit in this section.

Results

There is a counterintuitive relationship between slope and flow speed. This is due to the significant increase in ambient entrainment as the slope increases. I think this may well be a product of the experimental set up. In the description of the flume tank set up, you state that the flume is filled to a depth of 0.2 m. Does this mean that when you put a steeper slope into the flume the top parts of the ramp (i.e. up to where the lock box sits) are in shallower water? This would mean that the same lock-box volume is being released into the tank but the thickness of the overlying ambient water column is reduced, which would increase the velocity of the return flow. This increase in return flow velocity (due to the modification of the slope) will drive increased upper surface entrainment. This is not so much a product of the relationship between slope and entrainment but the influence of focussing a high(er) velocity return flow over the gravity current. This aspect of the experimental set up needs to be explained clearly and if this is the case, then the results require discussion in this light.

4.3 - Bottom erosion capacity

I do not understand this method of estimating erosion capacity. Bed shear stress is a measure of erosion in that it is related to the critical shear stress of particle movement (and/or flow capacity). This depends on the particle size, distribution and bed roughness parameters. You can talk about bed shear stresses changing in your experiments, and how this might influence erosion patterns but as written the discussion reads as though the flows passed over erodible beds. They don't.

Details

Typos

Figure 6,7 captions – 1st sentence '…respectively' doesn't make sense.

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