Motivation
Pyroclastic Density Currents (PDCs) are hot clouds of rock and gas that are denser than air. They pose hazards to life, health and property. The shape of a PDC, the distance it travels, and whether it lifts off are controlled by entrainment, the rate at which air mixes into the current. Understanding how entrainment controls PDC behavior can help us anticipate and mitigate this hazard.

Results
Entrainment (\(e\)) is the rate at which air is mixed into the current over the velocity at which the current is moving. Entrainment in PDCs cause buoyancy reversal and liftoff, forming ash plumes.

Parameter Space Explored

<table>
<thead>
<tr>
<th>Initial Mass (g)</th>
<th>1000</th>
<th>1500</th>
<th>~2300</th>
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Mean temperature differences within the currents range from 0.1 to 7.6°C. TEb/KE ranges from 0.03 to 6.4.

Representative Experiments

Both experiments have a duration of 50 seconds. a-c. 1000 g at 150°F d-e. 1000 g at 30°F

Discussion

- Bulk entrainment rates range from < 0.1 to > 0.7 prior to current liftoff
- Bulk entrainment does not show simple systematic variation with Ri or TEb/KE
- Bulk entrainment increases with Mass Eruption Rate
- Eruption duration appears to control bulk entrainment: short eruptions have higher entrainment than longer eruptions
- Different parts of PDCs have different entrainment rates
- Current heads entrain air very efficiently: > 0.5
- Current bodies entrain air less efficiently but at rates comparable to previous predictions: ~ 0.1

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