Examining Grain-Scale Dynamics of Sediment Transport in Experimental Rivers

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Earth and Marine Sciences
Introduction:

- Rivers help shape the landscape
- Sediment is only transported less than 10% of the time
Introduction:

- Bedload: when large grains roll or slide along the bottom of a riverbed
- For a grain to move: promoting force > opposing force
Real World Applications

- Affects health of river ecosystems
- Erosion rates and construction
- Examining ancient bedload structures
Areas of Focus

Main Question: How will low flow periods affect riverbed structure when no transport occurs?
Experimental Set-Up:
Experimental Set-Up

- **Initial**: before water runs over riverbed
- **Conditioning**: subthreshold velocity, no sediment is transported
- **Transport**: over threshold velocity, sediment is transported moves.
Flume Running Movies:

Conditioning-Low Flow

Transport-High Flow

Water Flow Direction
Data Analysis: Protrusion

- Using Agisoft we made high resolution 3D models of flume bed each for initial, conditioned, and transport phases.
- Future project: calculate grain protrusion, overall slope of the bed, mean elevation and standard deviation of the riverbed
Data Analysis: Imbrication

- Measured long axes and orientations of grains in GS photos to measure imbrication, used ImageJ, Matlab, and Adobe photoshop.

Imbrication Prep:

1) **ImageJ**: converted photos to 8-bit images
2) **Matlab**: wrote script to choose 100 grains at random to measure
Data Analysis: Imbrication

- Imbrication Analysis:
  3) Photoshop: long axis measurements for 100 grains
  4) ImageJ: used again to measure grain orientations, compiled into an excel spreadsheet to be analyzed.
Data Analysis: Statistics

- Calculated median, standard deviation and percentage of grains between 45-135°
Data Analysis: Orientation

- Measured orientation using rose diagrams and histograms
- $90^\circ$ are downstream
- $0$ or $180^\circ$ are cross-stream
Correlation between median angles and the amount of sediment that moves with time.
Conclusions

- Grains reorient themselves differently in high and low flow periods:
  - Low flow: grain's’ long axis faces perpendicular to the flow (cross stream)
  - High flow: grains’ long axes face parallel to the flow (downstream)
- Presenting poster with findings from this project at the 2016 American Geophysical Union Fall Meeting!
Thank you!