**Flow Discharge Measurements Using Small Unmanned Aerial Systems**

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**INTRODUCTION**
- Measuring discharge during flood events is difficult and dangerous
- Drones provide a unique opportunity to obtain timely velocity data without compromising the safety of the field technician
- If velocity index can be calculated, discharge could be remotely estimated... but is it better than just using 0.85?

**THE PROCESS**
- "Seed" the river surface by distributing particles (rice cereal)
- Fly the drone directly over the water surface, record video of seed moving with flow of water
- Track movement of particles using Large Scale Image Velocimetry (LSPIV) to obtain velocity distribution
- Use velocity distribution to estimate surface velocity and turbulence dissipation rate using 1-D velocity spectra
- Estimate friction velocity from turbulence dissipation rate
- Estimate velocity index from Manning's equation and use that to estimate river discharge.

**RESULTS**
- Calculation of the velocity index overestimates discharge
- Velocity index = 0.85 underestimates discharge
- On average, calculating velocity index does not improve discharge measurements over the 0.85 approach.

**DISCUSSION**
- There is a high correlation ($r^2=0.89$) between the depth-averaged velocities and the surface velocities (this plot includes all 8 study sites)
- The calculated velocity index increases significantly towards the walls of the river (this is for the river shown to the left). This same pattern is seen in all other study sites. The velocity index values were averaged in the middle third of the river (pink line above) to estimate discharge.

**Source of drone image:** [https://www.stickpng.com/img/electronics/drones/4k-hdr-parrot-anafi-drone-flying](https://www.stickpng.com/img/electronics/drones/4k-hdr-parrot-anafi-drone-flying)