Quantifying geomorphic change using drone-based lidar

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Lidar data has revolutionized the geosciences by allowing high-resolution (< 1-5 m), repeat data that can resolve both vegetation and bare-earth elevations. These lidar data are usually collected by plane-based (airborne; tens of km^2 with ~10 points/m^2) or ground-based (terrestrial; tens of m^2 with thousands of points/m^2) instruments. Here, we overview the use of a third, intermediate technique: drone-based lidar (~km^2, with ~100 points/m^2). We will explain and illustrate this novel method and how it differs from existing methods for measuring topography. We will illustrate the power that drone-based lidar offers geoscientists through case examples from our own research into landscape dynamics: When a tree falls in a forest, can a drone detect it? How does a catastrophic dam failure impact downstream river morphology (Fig. 1)? What can we learn about river mechanics with a high spatial-temporal dataset of an actively migrating river meander? We will summarize the ways that we have benefitted from this rapid-response, low-cost, and high-resolution imaging technique as applied to our research on hillslopes, natural disasters, and river geomorphology.

Figure 1: Oblique view of a point cloud collected by drone-based lidar showing a dam break three weeks post-failure. The dam used to run parallel to the power lines, and flow is now toward the bottom-left, having removed a wide swath of trees as escaping floodwaters formed a new channel.