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Low altitude aerial photogrammetry application to braided river systems. Example of the Buech River, Alps, France.

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Low-altitude aerial photogrammetry offers new opportunities for geomorphology and other fields requiring very high-resolution topographic data. It combines the advantages of the reproducibility of GPS topographic surveys with the high accuracy of LIDAR, but at relatively low-cost, easy-to-deploy and with the synaptic advantage of remote sensing.
In order to evaluate the potential of photogrammetry on river systems and to assess river-bed changes and erosion-accretion processes, we conducted several surveys over the period of one year on the Buech river, a gravel-bed braided river located in the French Southern Alps. The study area is located directly upstream of a gravel pit and there is an interest in evaluating its effects on the riverbed.
Our field protocol was comprised of vertical aerial photographs taken from a microlight aircraft flying approximately 300 ft above the ground. The equipment used was a full-frame DSLR with a wide angle lense, synchronised with a DGPS onboard. Fourty 40cm wide targets were placed on the ground and georeferenced by RTK DGPS with an accuracy of 2cm. In addition, close to one thousand Ground Control Points (GCPs) were measured within the different types of ground surfaces (vegetated, water, gravels) in order to assess the Digital Terrain Model (DTM) accuracy. We operated the production of the 3D model and its derived products: Digital Surface Model (DSM) and orthophotography, with user-friendly Agisoft (c) Photoscan Professional software.
The processing of several hundred pictures with 2.5 cm ground resolution resulted in a DSM with a resolution of 10 cm and a vertical accuracy within 5 cm. As is expected, accuracy was best on bare bars and decreased with increasing vegetation density. To complement the DSM in the wetted channels, we used the orthophotos to establish a relationship between water color and flow depth using statistical multivariate regressions. Merging the bathymetric model and the DSM produced a DTM with a vertical accuracy within 10cm. Subtle riverbed micro-morphologies (cm to m) not visible using classical techniques could be mapped : individual gravels, scour and deposition around woody debris, intra-bar channels, vertical bar faces etc. Multiple acquisitions combined have permit quantification of volumes eroded or accumulated during an hydrological event.
The exceptional quality of the results obtained using this technique, both quantitative and qualitative, offers exciting new prospects for fluvial geomorphic studies. The limitations surrounding this technique include : the large volume of data produced, processing time, the large number of GCPs required to constraint the model and the lack of a NIR channel for image classification.