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Study of morphological changes of a gravel-bed braided river with a combined analysis of airborne LiDAR and archive aerial photographs (French Prealps)

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The recent development of innovative topographic survey technologies offers new opportunities for investigating spatial and temporal patterns of gravel-bed rivers morphological responses to flood events. In this study, multidate airborne LiDAR surveys were used to reconstruct reach-scale morphological changes of a gravel-bed braided river following a channel-forming flood event.

LiDAR surveys were acquired in October 2008 and June 2010 for a 7-km reach of the Bès River, a very active aggrading braided channel, which is a tributary to the Bléone River in the Southern French Prealps (drainage area: 234 km^2). Between these two dates, a 15-year flood occurred in December 2009, with a peakflow discharge of 171 m3 s-1. A DEM of difference (DoD) was produced by subtraction of LiDAR-derived DTM pair. Spatially distributed error in Dod was accounted with dGPS field measurement by sampling of different types of terrains (exposed gravel bars, spares and dense vegetated areas). The scour and fill maps allowed reconstructing erosion and deposition of bedforms and provide a volume estimate for calculating a sediment budget. These bedforms were described by different factors like their geometry (width, shape), their position and elevation relative to the main low-flow channel and their vegetation cover. Bed morphology was also studied by extracting different metrics at regularly-spaced cross-sections to infer information about sediment transfer in the braided channel. Final aim is to link bedform characteristics with their morphological response.

Morphological changes were also studied in a historical context with a series of aerial photographs (1948-2010) to link the present-day morphology of the river with longer term channel changes. Active channel and island area were measured at reach and sub-reach scales (50 m), as well as active channel and island widths for cross-sections (every 10 m along). These variables were coupled with landscape changes and hydrological events in order to analyze historic river corridor response according to these factors.

The analysis of multidate LiDAR surveys shows that the Bès River underwent significant morphological changes during the flood of December 2009. Morphological processes are clearly observable like bank erosion, channel scour and fill. The sediment budget is +47 091 m3, calculated by a uniform propagated uncertainty. Diachronic analysis of archive aerial photographs shows a small decrease of mean channel width between 1948 and 2010.