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Using LIDAR and UAV-derived point clouds to evaluate surface roughness in a gravel-bed braided river (Vénéon river, French Alps)

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The present research is focused on the Vénéon river at Plan du Lac (Massif des Ecrins, France), an alpine braided gravel bed stream with a glacio-nival hydrological regime. It drains a catchment area of 316 km2. The present research is focused in a 2.5 km braided reach placed immediately upstream of a small hydropower dam.
An airbone LIDAR survey was accomplished in October, 2014 by EDF (the company managing the small hydropower dam), and data coming from this LIDAR survey were available for the present research. Point density of the LIDAR-derived 3D-point cloud was between 20-50 points/m2, with a vertical precision of 2-3 cm over flat surfaces.
Moreover, between April and Juin, 2015, we carried out a photogrammetrical campaign based in aerial images taken with an UAV-drone. The UAV-derived point-cloud has a point density of 200-300 points/m2, and a vertical precision over flat control surfaces comparable to that of the LIDAR point cloud (2-3 cm).
Simultaneously to the UAV campaign, we took several Wolman samples with the aim of characterizing the grain size distribution of bed sediment. Wolman samples were taken following a geomorphological criterion (unit bars, head/tail of compound bars). Furthermore, some of the Wolman samples were repeated with the aim of defining the uncertainty of our sampling protocol.
LIDAR and UAV-derived point clouds were treated in order to check whether both point-clouds were correctly co-aligned. After that, we estimated bed roughness using the detrended standard deviation of heights, in a 40-cm window. For all this data treatment we used CloudCompare.
Then, we measured the distribution of roughness in the same geomorphological units where we took the Wolman samples, and we compared with the grain size distributions measured in the field: differences between UAV-point cloud roughness distributions and measured-grain size distribution ($\sim$1-2 cm) are in the same order of magnitude of the differences found between the repeated Wolman samples ($\sim$0.5-1.5 cm). Differences with LIDAR-derived roughness distributions are only slightly higher, which could be due to the lower point density of the LIDAR point clouds.