



## Unmanned Aerial Vehicle low-level aerial photography of flood induced change – the 2009 Cumbria event

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Extreme floods cause complex patterns of extensive morphological change to both channels and floodplains. Between November 18th - 20th 2009 Cumbria, NW England was hit by an exceptional precipitation event producing an unprecedented total of 372 mm of rainfall. This was equivalent to a month's precipitation and set a new UK record. The flood was the biggest event recorded in this region and had major consequences for population and infrastructure over a large area, as well as involving loss of human life. Due to its system-wide impact, the November 2009 flooding in Cumbria presented an unparalleled opportunity to gain insight into the controls on, and impact of, an extreme flood. LiDAR data and conventional aerial photography of the catchment was obtained as part of a Natural Environment Research Council Urgency project along with ground-based mapping and sedimentological work.

An Unmanned Aerial Vehicle was deployed to take low-level aerial photographs (2-5 cm pixel size) after flood water subsided at key locations where peak discharge could be reconstructed, and where significant morphological change occurred. These photographs were of significantly higher resolution than the conventional platform images and were able to resolve flood limits, woody debris interactions, gravel depositional patterns and floodplain erosion marks. To utilise these data has required careful consideration of the distribution and number of ground based control points, the methods of orthorectification and detailed error analyses. The resultant images are capable of producing DEMs of high quality and high accuracy mosaics suitable for mapping. This work presents the benefits and challenges of UAV data in comparison with LiDAR and conventional aerial photography for studying geomorphic change.