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Quantification of river channel change using archival digital image analysis

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Historical archives of river channel imagery are extensive. Extracting quantitative data from these, such as water depth, can be difficult as thet rarely come with suitable calibration data. In this paper, we present and test a methodology to extract detailed quantitative information from archival grey-scale imagery. Extracting elevation information from rivers is additionally difficult as they are associated with a low relative relief (+/- 2 m); the area of interest may be commonly extensive (e.g. active channel widths $>$ 500 m in large braided rivers); the rate of change of surface elevation is generally low except in the vicinity of individual braid channel banks where the rate of change is very high; there is the complication that comes from partial inundation; and there may be an added complication in the presence of vegetation. Here, we couple archival photogrammetric techniques with image processing methods and test these for quantification of sand-bedded braided river dynamics, focusing upon a 500m wide and 3 km long reach of the Saskatchewan River, Canada. Digital photogrammetry was used to quantify dry areas and water edge elevations. A novel methodology was then used to calibrate the spectral signature of inundated areas the associated images using a combination of two media digital photogrammetric methods and image matching. This allowed the determination of detailed depth maps for inundated areas for combination with the dry area data and the creation of complete surface elevation models. Error propagation was used to determine the levels of change that could be detected from sequential digital elevation models. The result was a series of elevation models that demonstrate the potential for acquiring detailed and precise elevation data from any historical aerial imagery of rivers without the need for associated calibration data,

provided that imagery is of the right scale.