European River Restoration Conference
Featuring the IRF Riverprize

Celebrating Successes and Addressing Challenges
5th edition | 11-13 September 2013 | Vienna

SESSION 07
RIVER RESTORATION TECHNIQUES

USING VIRTUAL LANDSCAPES FOR RIVER RESTORATION

Helen Reid (Environment Agency, Geomorphology Technical Service, United Kingdom, helen.reid@environment-agency.gov.uk)

Introduction: The ability to capture high resolution, accurate spatial datasets which describe river form has developed at an exponential rate during the past decade. These 'virtual landscapes' provide unprecedented detail into fluvial forms and processes, and are key to designing relevant, process-based restoration schemes. In addition, these techniques further our ability to monitor channel response to restoration, offering greater insights into the mechanisms behind successes and failures. However, these tools and data are currently under utilised within restoration schemes. Partly, this reflects the incremental increase in cost and expertise associated with generating and processing these highly detailed and accurate datasets (Figure 1). This poster provides a brief overview of three examples where 'virtual landscapes' have been used at different stages along the restoration process, to enable better design or monitoring of restoration schemes. This aims to start the discussion of how we can better utilise the new data rich world and maximise the geomorphological and ecological benefits of restoration.

When and how do we use technology?

Scoping for restoration schemes

Case study 1: 3-D models

Project design

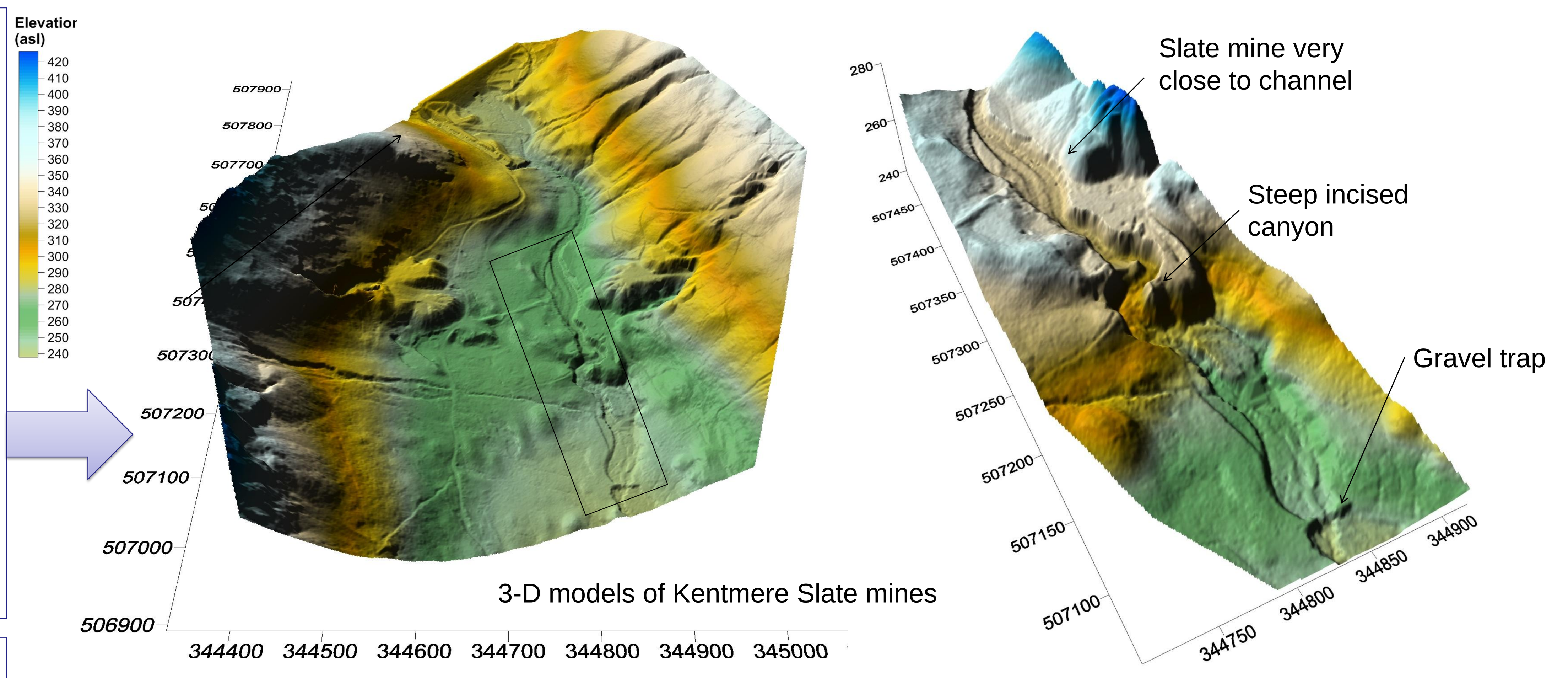
Case study 2: Detrending LiDAR

Monitoring

Case study 3: TLS scanning

Case study 1: 3-D model of Kentmere Slate mines

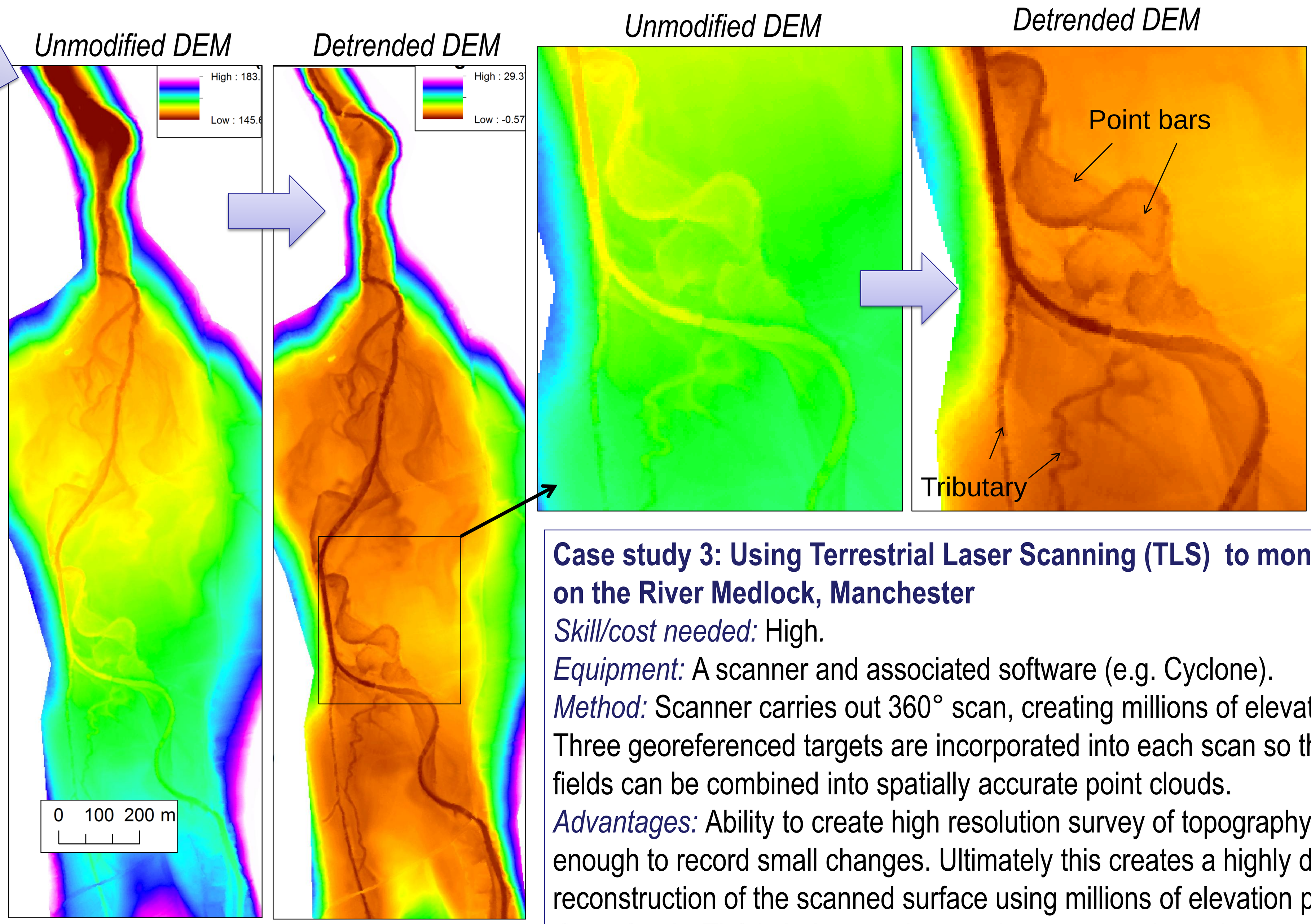
Skill needed: Low.
Data: LiDAR and relevant software, e.g. Surfer.
Method: Clip DEM and import into 3-D viewer software, e.g. Surfer or ArcScene.
Advantages: 3-D models can make elevation data come alive, enabling a greater understanding of landscape dynamics, particularly lateral connectivity.
Case Study: The 3-D image of the Kentmere mines was used to highlight the close proximity of the spoil heap to the channel, the volumes of sediment in storage and the high energy nature of the confined canyon reach.



3-D models of Kentmere Slate mines

Case study 2: Detrending LiDAR to identify paleo-channels at Barnskew, Eden Valley

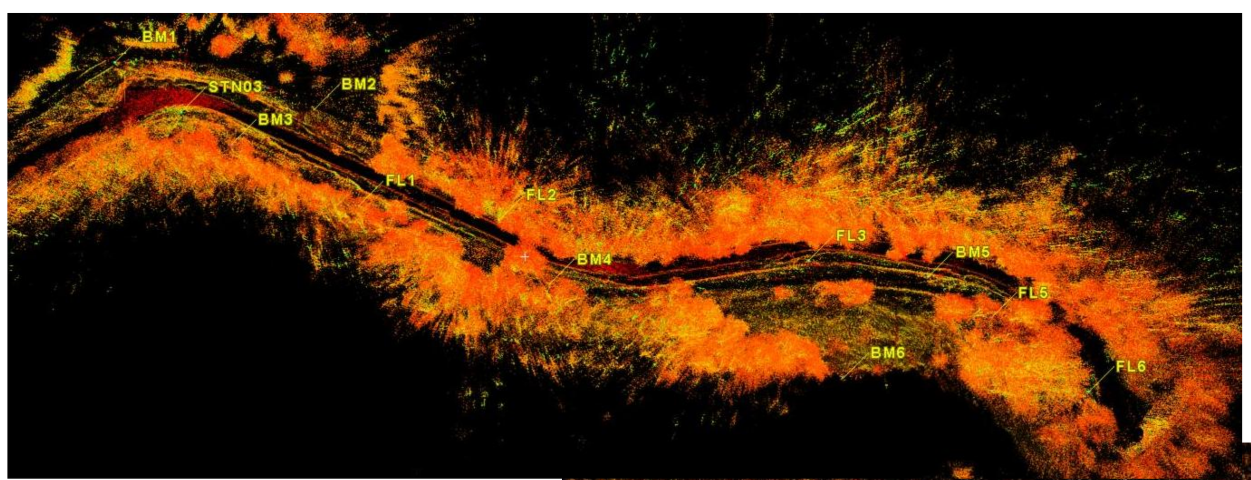
Skill needed: Moderate.
Data: LiDAR and ArcGIS.
Method: Create a TIN (Triangulated Irregular Network) of the water surface elevation, and subtract from elevation DEM (Digital Elevation Model) so that the detrended DEM displays the elevation of features above water level.
Advantages: Provides detail into the relative heights of paleo-channels. Picks up subtle differences in floodplain topography and fluvial features.
Case Study: The detrended DEM at Barnskew was used to identify the most relevant and best connected paleo-channels for restoration and to compare the height of different floodplain features/surfaces.



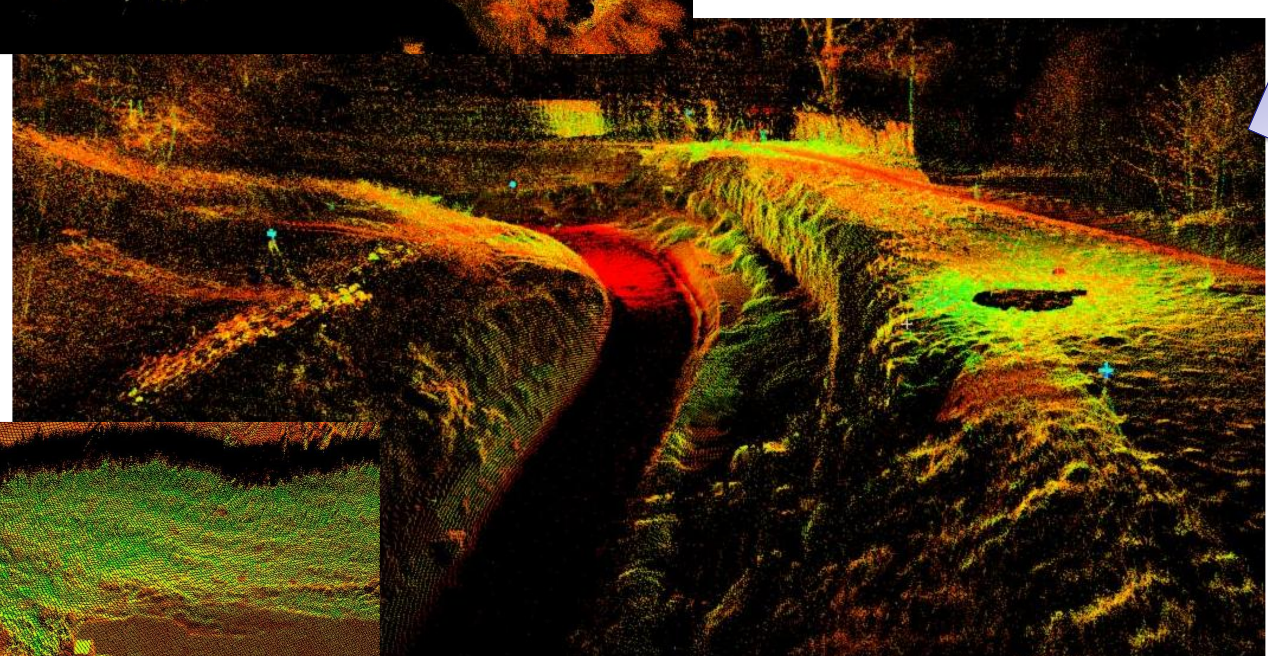
← The detrended image accentuates the different fluvial features such as point bars and tributary alignment pre-straightening

Case study 3: Using Terrestrial Laser Scanning (TLS) to monitor restoration on the River Medlock, Manchester

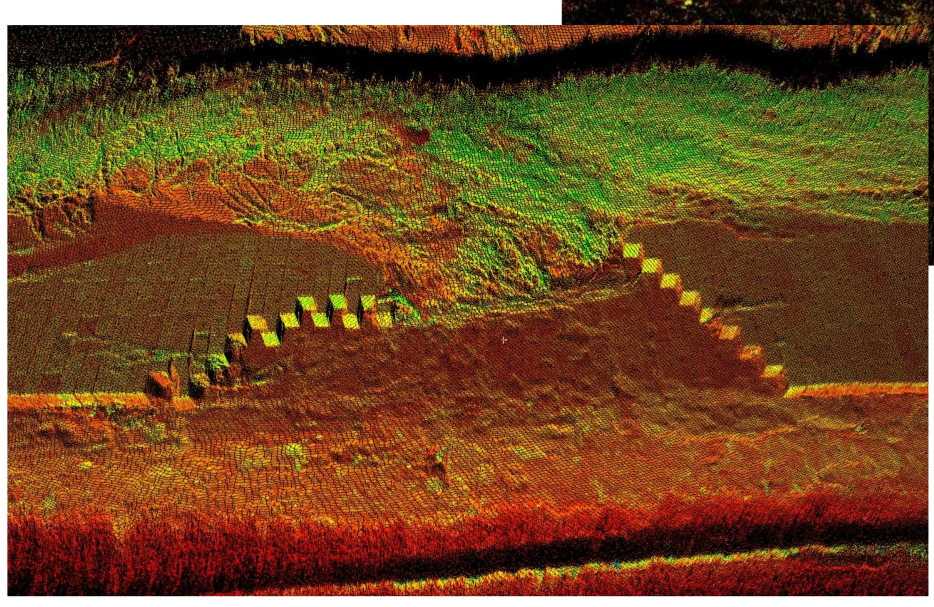
Skill/cost needed: High.
Equipment: A scanner and associated software (e.g. Cyclone).
Method: Scanner carries out 360° scan, creating millions of elevation points. Three georeferenced targets are incorporated into each scan so that multiple scan fields can be combined into spatially accurate point clouds.
Advantages: Ability to create high resolution survey of topography, sensitive enough to record small changes. Ultimately this creates a highly detailed reconstruction of the scanned surface using millions of elevation points.
Case Study: TLS is being used to monitor a restoration scheme of a bricked channel in urban Manchester. This will document how the channel adjusts its morphology in response to the new boundary conditions to enable better understanding into channel response to restoration.



↑ Total point cloud of the River Medlock pre-restoration scan which consists of 217 million spatially referenced elevation points, created by combining 12 scans.



↑ Reach scale view of the Medlock pre-restoration showing the inset brick channel with vegetation patches developing on the margins.



← Close up of the bank where the brick is being eroded, illustrating the detail contained within the scans.

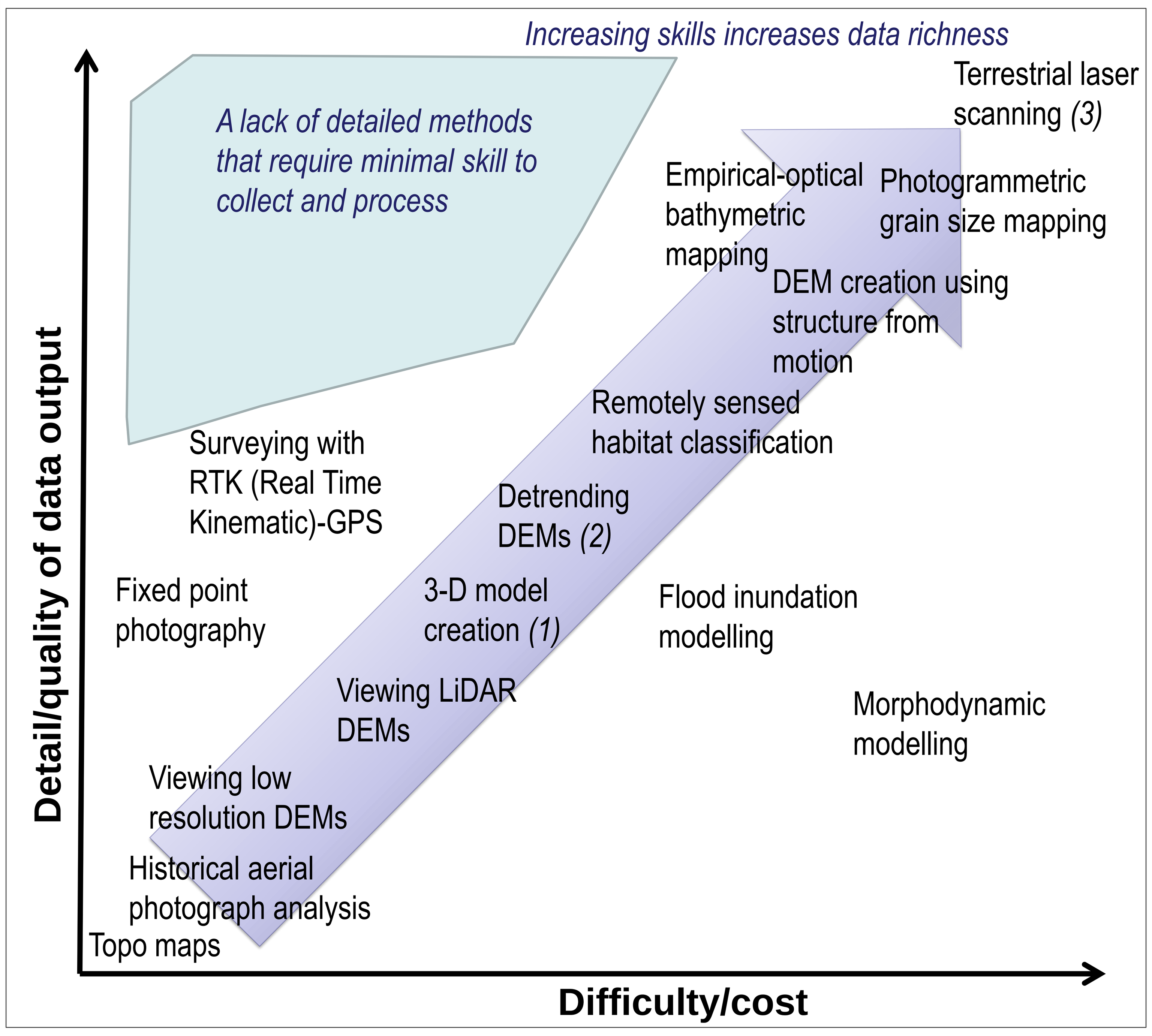


Figure 1: The relationship between data quality and difficulty for techniques which create 'virtual landscapes'. Numbers in brackets refer to case study numbers.

Conclusion: Maximising the ecological benefits of river restoration schemes, relies on restoring *appropriate* morphology and processes. Creating 'virtual landscapes' provides an essential technique for obtaining the geomorphic understanding underpinning necessary to create restoration schemes, which *work with* the geomorphic processes of a specific site. This can be done through greater use and interpretation of existing datasets (i.e. LiDAR) or acquisition of new data using novel technology (i.e. TLS). Figure 1 illustrates that the difficulty and associated costs of analysis increases with data quality and richness. This highlights a gap in the need for easily applicable tools which can be utilised by river restoration practitioners to make these detailed datasets more accessible. Until this is achieved, restoration schemes will have high costs associated with obtaining novel datasets or will continue to under-utilise the datasets currently available. Increasing successes from restoration is reliant on finding new and innovative techniques to maximise the benefit of available data and utilise this new data rich world.