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Developing a 200-year flood chronology from reservoir sediments at Thirlmere, Northwest England

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The English Lake District has experienced a number of recent devastating flood events (2005, 2009, 2015), without precedent in terms of magnitude during recent centuries. Climate projections for Northwest England have forecast intensification in frequency and magnitude of extreme precipitation, calling for a review of current catchment management practices. Flood hazard management requires precise estimates of extreme flood magnitude and frequency to better inform estimates of future risk, but are challenged by the short duration of river gauging data that often fails to capture the rarer, high magnitude events.

Methodological developments increasingly permit the high-resolution analysis of palaeoflood frequency and magnitude from lake sediments; but development of a regional database is challenged by the variable distribution of lakes. Conversely reservoirs were built extensively across the British uplands from the mid-eighteenth century and are more ubiquitous in their distribution. Attempts to reconstruct flood chronologies from reservoir sediments are limited, despite this broad distribution and there is a growing need to capture reservoir catchment histories to guide management of upland water resources. Better histories for reservoir catchment is needed, because though dam failures are rare recent examples (e.g. Whaley Bridge, Derbyshire, August 2019) highlight a paucity of hydrological data associated with these often aging structures.

Here, we investigate the sediment records from Thirlmere reservoir (Cumbria) and assess their value as indicators for flood history. A 200-year flood chronology has been interpreted from high-resolution particle size analyses and geochemical ratios diagnostic of variations in sediment grain size alongside historical documentary evidence, and a chronology has been developed through 210Pb dating. We address the following questions:

1) Is it possible to create a high-resolution flood chronology of a centennial timescale from reservoir sediments to better inform reservoir catchment management practices?

2) How similar are reservoir-based flood reconstructions to data from nearby lakes and historical records?

3) Do catchment landuse practices, for example mining activity, affect sediment delivery to the reservoir basins perturbing flood reconstruction?