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Coupling records of fluvial activity from the last interglacial-glacial cycle with climate forcing using both geochronology and numerical modelling

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River systems are a critical component of the landscape. An understanding of their response to variations in the Earth's climate is vital in light of the expected changes in global climate (e.g. 1.8 to 4.8°C temperature rise) that are forecast to occur over the next c. 100 years. Over the longer term, it becomes increasingly likely that the changes we will see may even be of a magnitude for which the most appropriate analogue we have is the glacial-interglacial scale (c. 10°C temperature change) and other climate changes typical of the Quaternary period (last 2 million years). Therefore it is crucial to apply our understanding of climate-driven changes during the Quaternary to future projections of both climate and landscape change, especially since landscape instability is a key characteristic of the Quaternary.

Linking river activity to climate requires both the recognition of potentially climate-driven changes within the fluvial sedimentary record and the linkage of these to external climate records using various geochronological techniques. To this end, this paper firstly presents results from the Welland catchment, Fenland Basin where climatically-driven phases of river activity have been identified using detailed sedimentological analysis and palaeontological environmental reconstruction. Dating of these using radiocarbon and optically-stimulated luminescence dating has shown broad correspondence to external climate fluctuations at a marine isotope substage scale over the last interglacial-glacial cycle (MIS 5d onwards). The precision and accuracy of the two different age techniques varies in different parts of this time period and this will be discussed.

Limitations in the precision of these geochronological techniques have prompted the use of a further, complementary to improve understanding of these sequences, i.e. ensemble numerical modeling. The rationale behind this approach is that river response to climate can be traced within the model and validated against the known geological record. If the known geological record can be replicated, then the detailed linkages between climate and river activity shown in the model can be used understand to the relationships between climate change and river activity more clearly. This paper will present the results of three-dimensional cellular automata modeling of the Welland catchment, compare them to the geological record, and draw out what this means for our understanding of earth surface processes.