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Cumulative probability functions and their role in evaluating the chronology of geomorphological events during the Holocene

Richard Chiverrell (1), Varyl Thorndycraft (2), and Thomas Hoffmann (3)

(1) University of Liverpool, Geography, Liverpool, United Kingdom (rchiv@liv.ac.uk, +44 (0) 151 7942866), (2) Royal Holloway University of London, Geography, Egham, United Kingdom (varyl.thorndycraft@rhul.ac.uk, +44 (0)1784 472836), (3) University of Bonn, Geography, Meckenheimer Allee 166, 53115 Bonn, Germany (thomas.hoffmann@uni-bonn.de)

Cumulative probability functions (CPFs) for large numbers of radiocarbon age determinations are increasingly being used by scientists as a methodology to discern environmental histories. Whilst the compilation of regional databases of the radiocarbon dating control for fluvial sediment sequences in discrete regions has been beneficial for identifying gaps in knowledge and stimulating new research, there remain considerable problems in the interpretation of these CPFs as sensitive hydroclimatic proxies. These problems relate to a number of facets: 1) Some of the databases of ages incorporate a mixed array of types of environmental changes that were dated, whereas this should be held constant in an individual CPF e.g. measurements for horizons that indicate geomorphic stability or a discrete flood; 2) There are also differing chronological relationships between the 14C measurements and the dated events, with pre-dating, dating or post-dating chronological control all mixed together in the same CPF analysis; 3) The radiocarbon ages from individual case studies need to be more robustly tested before being incorporated into regional databases, e.g. through Bayesian approaches, during which it is likely that many dates would be rejected owing to the widespread incorporation of materials not contemporaneous with the geomorphic event in the measured materials; and 4) If a CPF approach is still considered valid then the interpretation should avoid a focus on peaks, particularly in the absence of clear quem relationships, and principally because emergent peaks are related to steep sections of the calibration curve and hence solar variability. None of the methods used to correct for impact of radiocarbon calibration appear to satisfactorily correct for the structure they impart on CPFs. A more cautious and conservative approach to interpretation of these CPFs as sensitive hydroclimatic proxies is clearly warranted.