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Validating and optimising palaeoclimate estimates by Multi-Proxy Consensus

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Biological proxies such as foraminifera, ostracods, diatoms, chironomid larvae, molluscs and pollen are widely used to estimate palaeoclimatic parameters, most commonly palaeotemperatures. Indicator species, Mutual Climatic Range (MCR), Modern Analogue Technique (MAT) and transfer function approaches are based on the ecology and distribution of living taxa, while geochemical techniques measure and interpret trace elements and stable isotope ratios preserved in, e.g., ostracod shells or foraminiferal tests. Any single proxy method will yield a result, often a plausible one, but the arguments used to justify the results are often inadequate and there is a need for more rigorous, multi-proxy comparative testing to validate such methods. The Mutual Ostracod Temperature Range (MOTR) method is an MCR approach for non-marine ostracods; if it is any good then it should provide true palaeotemperature estimates – a statement that can be applied to any proxy method. It follows that two or more proxy methods applied to the same interval at the same site should yield results that, if not identical, are at least consistent; if they do not, the validity of at least one (and potentially all) of the methods is called into question. The Multi-Proxy Consensus (MPC) approach not only tests two or more proxies against each other in order to validate (or not) their results, but also (subject to validation) enables a more precise palaeoclimate determination to be obtained from, e.g., the range of mutual agreement between two or more overlapping palaeotemperature ranges. Examples will be provided of using the MPC approach to test the MOTR method against beetle MCR, chironomid transfer function and other proxy methods in Quaternary assemblages. Problems that impede the MPC approach, such as the non-equivalence of samples, will also be discussed.