Evaluating the suitability of discrete-depth individual foraminifera analysis applied to deep-sea sediment archives for the reconstruction of ENSO-like climate variation.

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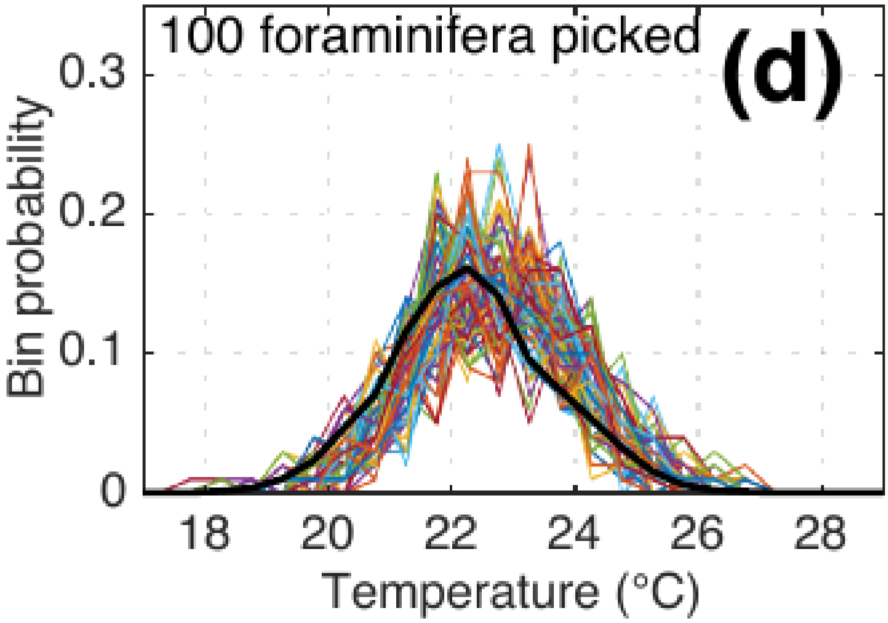
Individual foraminifera analysis (IFA) of discrete sediment depths retrieved from deep-sea sediment archives is a potentially valuable tool for reconstructing past variability in sea-surface temperature (SST) caused by El Niño Southern Oscillation (ENSO). However, IFA reconstruciton of SST variability is clouded by a number of of environmental, biological and logistical issues, in the water domain (pre-deposition), sediment archive domain (post-deposition) and laboratory domain (post-retrieval). In the water domain, foraminifera species abundance varies through time, and species sensitivity to temperature may induce a bias in IFA-derived reconstructions of past SST variability. In the sediment archive domain, systematic bioturbation can mix foraminifera from vastly differing periods of climate history into the same sediment interval, thus clouding interpretations of past SST variability that are focussed on a specific time window. In the laboratory domain, logistical and financial constraints limit feasible sample sizes, while measurement uncertainty adds further error to the process.

Here, we quantify possible errors and biases which may be produced when producing IFA-derived reconstructions of past ENSO. We carry out a holistic hydroclimate-to-sediment-to-laboratory transient modelling approach using an offline coupling of two transient models: a single-foraminifera enabled sediment accumulation and bioturbation simulator (SEAMUS; (Lougheed, 2020)) run at a monthly timestep resolution, forced with monthly SST from the TRACE21ka climate model (He, 2011). We carry out a number of representative best-case sediment core scenarios for an ideal core site located centrally within the *Niño 3.4* ENSO region. After running 100 ensembles for each scenario we find, in the case of some representative scenarios typical of the current state-of-the-art, low reproducibility from one ensemble run to the next. Furthermore, we find that a foraminifera species' temperature response function can systematically bias IFA-derived ENSO reconstructions. Our work highlights the scope for improving IFA-derived ENSO interpretation by replication studies in the field, coupled to the development of an *a priori* representation of bioturbation and foraminiferal species abundance (and associated uncertainties).

Keywords: modelling, foraminifera, paleoceanography, ENSO


100 foraminifera picked
(d)
Bin probability
0.3
0.2
0.1
0
18
20
22
24
26
28
Temperature (°C)