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Climate of the Past Discussions

Interactive comment on "On the validity of foraminifera-based ENSO reconstructions" *by* Brett Metcalfe et al.

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I have not been assigned to be a reviewer on this manuscript, yet a previously published paper authored by my colleagues and I entitled "Statistical constraints on El Niño Southern Oscillation reconstructions using individual foraminifera: A sensitivity analysis and me." (Thirumalai et al. 2013) is quite pertinent to this study. I wanted to point out some flawed rationale in this discussion paper especially considering the explicit lack of utilizing subsampling in their arguments concerning ENSO skill, seasonality, and individual foraminiferal reconstructions. I hope the authors are open to my comments and I would like to state that I am a big proponent of studies such as this one and that I support the FAMES approach.

- The authors' conception of reconstructing ENSO variability versus reconstructing mean state conditions in areas influenced by ENSO is critically flawed, especially with regards to commenting on and inferring changes in variability using individual foraminiferal analysis (IFA). Regardless of using Anderson-Darling statistical tests to assess whether subsampling occurs from their forward-modeled δ18O and temperature histograms, their analyses completely discount that ENSO events are seasonally synchronized to the annual cycle, and much of the variance of subsampled IFA distributions across the Pacific Ocean represents this power. Foraminiferal reconstructions are sensitive to absolute temperatures and NOT to monthly anomalies of temperature. This has been clearly demonstrated previously (e.g., see Thirumalai et al. 2013) and also underpins that discussion of IFA is incomplete without discussing uncertainties in sampling (e.g., White et al. 2018). Thus, their arguments and results (as well as the abstract) need to be significantly revised with this in mind. If the authors want to comment on ENSO and foraminifera (as in their title), they MUST incorporate subsampling uncertainties and how this interacts with the seasonal cycle.

- By definition, the authors state that "FAME uses the associated temperature and δ18Oeq at each grid cell to compute a time averaged δ18Oc and Tc for a given species". In other words, the authors have shown in their analyses that ENSO events strongly alter the temperature and δ18O in much of the tropical Pacific and that foraminiferal histograms (or foraminiferal distributions) are able to capture mean state conditions by sampling from these altered distributions (i.e., based on the utility of the Anderson-Darling test to account for histogram subsampling). Both of these aspects are well known. This, by no means, demonstrates a calculation of skill or validity of IFA-based ENSO reconstructions. Thus the title of the manuscript is inaccurate and misleading. For a demonstration of calculating ENSO skill in reconstructions, please read the literature: Carré et al. 2013, Emile-Geay and Tingly, 2017, Ford et al., 2014, Hereid et al. 2013, Khider et al. 2011, Tindall et al. 2017, Thirumalai et al. 2013, and so forth (only two of which are cited and not discussed). If this paper is proposed for revisions in this journal, I would strongly contend that the title of this paper should be

revised in addition to the recalculation or revision of their text wherein IFA-based ENSO skill is referred to (as opposed to mean state conditions that are influenced by ENSO.)

- The manuscript mischaracterizes Thirumalai et al. 2013 and does not refer to the advances contained therein appropriately. As one example, the authors write in their conclusions: "Overall, our results suggest that foraminiferal δ18O for a large part of the Pacific Ocean can be used to reconstruct ENSO, especially if an individual foraminiferal analysis (Lougheed et al., 2018; Wit et al., 2013) approach is used (Ford et al., 2015; Koutavas et al., 2006; Koutavas and Joanides, 2012; Koutavas and Lynch-Stieglitz, 2003; Sadekov et al., 2013; White et al., 2018), contrary to previous analysis (Thirumalai et al., 2013). " Firstly, considering that their analyses do not account for sampling uncertainty or ENSO skill in IFA-based reconstructions due to the lack of separation from the seasonal cycle as well as decadal and higher forms variability, their conclusion is not supported by their findings. Second, we demonstrate that, in fact, ENSO sensitivity is high (with minimal influences from seasonality) according to forward-modeled IFA (with uncertainty) in the subsurface Eastern equatorial Pacific and the surface-ocean in the central tropical Pacific Ocean (see Figs. 5-6 as well as Discussion). From the conclusions of Thirumalai et al. 2013: "Our results show that the IFA approach is insensitive to ENSO frequency changes (<20% probability) but nevertheless indicate that changes in ENSO amplitude or seasonal cycle amplitude (or a combination of both) can be detected depending on the ratio of interannual-to-annual variability at the location of the study."

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