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Climate of the Past Discussions

Interactive comment on "A Late Pleistocene sea level stack" *by* R. M. Spratt and L. E. Lisiecki

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Referee #1 comment:

"A comparison and a meta-analysis of the continuous sea-level records analyzed here are highly valuable. However, the current meta-analysis suffers from two significant flaws, one critical. The critical flaw is that there appears to be no treatment of the uncertainty in the underlying records. These uncertainties are not negligible (indeed, the authors state that one of their goals is to reduce the signal-to-noise ratios seen in the individual records). For example, as the authors note, the sea water oxygen isotope-derived records uncertainties have 1-sigma errors up to about 20 m and the inverse ice volume model derived records has a 1-sigma error of 12 m. (These errors are, more over, not fully uncorrelated and should not be treated as such, when they are treated.) But the authors appear to beworking with simply the mean estimates of each

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of the underlying records. It is therefore impossible to assess the robustness of their composite curve. If they retain their current meta-analysis methodology, a bootstrap assessment of errors would seem like a minimal necessary statement."

Authors' reply:

"Thank you for your considered response to our study. One form of uncertainty analysis included in the manuscript is a comparison of the individual records by calculation of standard deviation for each highstand and lowstand estimate (Tables 2 and 3). Additionally, we will address the reviewer's concerns in revision by incorporating the suggested bootstrap assessment of errors."

Referee #1 comment:

"The second significant flaw, which I view as serious but not critical, is that PCA is a bit of a slightly odd methodological choice for this analysis, as it ignores a key piece of prior information. All of the records are (supposedly) independent measures of a common signal. There are reasons to think that, say, the relative sea-level records will be less correlated with total ice volume change (which I think may be what the authors actually mean by 'eustatic sea level') than measures of ice-volume derived from open-ocean d18O, but that relationship is more complex than the simple scaling provided by a weighted average. So why do the authors think that the scalings associated with PC1 provide a better estimate of their target than an unweighted mean of the records? If they don't, why are they throwing out the prior information that tells them they are all noisy measures of a common underlying signal?"

Authors' reply:

"Actually, we do not assume that all records are "independent measures of a common signal," and this is why we choose to use PCA instead of an unweighted mean. While all records should contain a strong ice volume signal, some of the "errors" (ie, non-ice

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volume signal) would most definitely be expected to be correlated with one another. For example, as the d18O of ice in the ice sheet changes, the conversion from d18Osw to ice volume will be systematically biased. Additionally, changes in the hydrological cycle may induce changes in the spatial variability of d18Osw as measured at different locations in the ocean. In fact, we argue that PC2 and PC3 are indicative of these kinds of correlated biases in the records.

Other paleoclimate papers (e.g., Huybers and Wunsch, 2004; Clark et al, 2012; Gibbons et al, 2014) also use PCA (or equivalently EOF) for the creation of stacks or quantifying the common signal contained in core data. We will additionally address the reviewer's concern in our revised manuscript by comparing PC1 to an unweighted mean of all the records as another metric for evaluating uncertainty."

Referee #1 comment:

"A minor note (p. 3711): the MIS5e sea-level estimate is usually (and appropriately) quoted as 6-9 m. The analysis in Kopp et al. (2013) of the well-resolved post-129 ka highstand stated, "within the LIG period, it is extremely likely (95 percent probability)/likely (67 per cent)/unlikely (33 per cent)/extremely unlikely (5 per cent)that the highest peak GSL well resolved by observations exceeded 6.4/7.7/8.8/10.9m", and is in agreement with a coral-record from the Seychelles, corrected for GIA and fingerprint effects, indicating a peak of 7.6 $\pm$ 1.7 m (Dutton et al., 2015,doi:10.1016/j.quascirev.2014.10.025)."

Authors' reply:

"We quoted 8-9.3 m as the +/- one standard deviation estimate from Kopp et al (2009), which is most comparable to the 1-std error estimates provided by the authors of the 7 records included in the stack. 6 to 9 m would be an unusual way to quote the uncertainty range since it does not match either the 2-sigma or 1-sigma range. (Specifically,

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the 5th percentile is 6.6 m while the 67th percentile is 9.4 m.) If the reviewer prefers the most recent estimates of Kopp et al (2013), we could quote a 2-sigma range of 6.4-10.9 m."

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Interactive comment on Clim. Past Discuss., 11, 3699, 2015.