

Interactive comment on “Last Interglacial sea-level proxies in East Africa and the Western Indian Ocean” by Patrick Boyden et al.

Anonymous Referee #1

Received and published: 6 January 2021

Boyden et al., “Last Interglacial sea-level proxies in East Africa and the Western Indian Ocean”

Summary: Boyden et al provide a nice compiled dataset of Last Interglacial sea level indicators for the eastern African margin. The authors provide a nice, albeit cursory overview, of the field sites and sea-level indicators (I did appreciate this brief site/stratigraphic descriptions and figures). Currently manuscript is lacking in precision (i.e., complete and detailed methodological information) and the database is incomplete in many sections (i.e., missing values). These are simple to address, and are requisite for the dataset to be useful, significant and have longevity. This should be a useful dataset for researchers but does need a clearer explanation of age determination and a very short statement regarding the rationale for a “landform” approach (it’s

C1

not that I disagree, rather this should be more explicit for no-specialist end-users). Subject to the comments below, this manuscript and accompanying data would fall within the scope of the journal and make a good contribution to the sea-level and palaeoclimate communities.

MAIN COMMENTS (Manuscript): Insufficient, detailed description of methodology, in particular how elevation measurement and age errors were dealt with. As this is a stand-alone paper to accompany the data, you should include a summary of your methods (and it can be very brief) to reassure readers what data quality control has been done and to confirm that users are able to compare like-with-like. I found this at the very end of the document, and Section 5.4 should be moved to earlier in the manuscript (i.e., before the discussion of the sites).

Currently it is unclear whether the ages in the data are (1) comparable, or (2) are reliable. For example, comparability of the U-series dates: a) are all the ages recalculated assuming a closed system and using the same decay constants? b) do they include the decay constant error? Given that these fields are blank in the database (“RSL from single coral” sheet) – I take it not? Why not? c) Are they benchmarked (e.g., to 1950), or are they reported w.r.t. the year of measurement?

Rectifying this would only require a couple of paragraphs (max.) to the manuscript, as well as completing/tidying up the database.

With regards to the second (reliability), screening criteria are not discussed, despite their widespread use within the community. Establishing a reliable age is crucial for our understanding of sea levels during the Last Interglacial, and yet this is not dealt with in sufficient detail in sections 3 or 5 of the manuscript. Given that this is a paper/dataset concerns the Last Interglacial, but many of the ages quoted in the text (and in the dataset) are outside of the canonical age for the Last Interglacial (and MIS 5e), a very short discussion of age reliability is needed, particularly to help non-specialists appreciate some of the subtleties of the stratigraphy and age data (screening only

C2

mentioned in passing around line 349).

Further, some clarification is needed on age determinations (e.g., U-series dates) and RSL indicators, for example the discussion of the Seychelles data. You need to specify how these replicate ages have been averaged (and screening criteria to give “accepted ages”, line 283) to give the age of the unit.

Tectonic setting – it would be very useful to stress that most(?) (hard to tell from the database, data largely missing and this is known rather than unavailable) of the sites are tectonically stable, or to highlight those that are considered largely stable within your short site summaries in the manuscript.

The inclusion of the Gulf of Aqaba (Red Sea, Bar et al 2018, Yehudai et al 2017) within the geographic region is curious - what is the rationale for this given the different (tectonic and oceanographic) setting of the Red Sea? The region is also not discussed in the manuscript. It's fine, but the you have not included several key studies from the region on the Last Interglacial terraces (dates and elevation). Why are these not also included? An oversight perhaps, especially since the manuscript lays out the historical context for many of the study sub-regions. I appreciate that the dating of these reefs is difficult (they are often diagenetically altered) but it is curious that some of these studies are included (i.e., in the north, Bar, Yehudai, all highly recrystallised) and others not. Can you explain? Please include, for example, the Eritrean (Walter et al., 2000; Bruggemann et al., 2004), Egyptian (Plaziat et al., 2008, 1998, 1995), and Yemi (Al-Mikhlaflafi et al., 2018) Red Sea Last Interglacial terraces (see also the references within Lambeck et al., 2011), as well reference the marginal basin method (Red Sea) record (Siddall et al., 2003, 2004; Rohling et al., 2008, 2019; Grant et al., 2014). The latter doesn't need discussing, since it won't be included in your database, but it should be referenced if this region is included in the current compilation. Given the difficulty in unraveling the (potential) tectonic and age difficulties of the preserved fossil terraces, I would simply remove the Bar and Yehudai studies from your compilation.

C3

Walter, R. C. et al. Early human occupation of the Red Sea coast of Eritrea during the last interglacial. *Nature* 405, 65–69 (2000).

Bruggemann, H. J. et al. Stratigraphy, palaeoenvironments and model for the deposition of the Abdur Reef Limestone: context for an important archaeological site from the last interglacial on the Red Sea coast of Eritrea. *Palaeogeogr. Palaeoclimatol. Palaeoecol.* 203, 179–206 (2004).

Plaziat, J.-C., Reyss, J.-L., Choukri, A. & Cazala, C. Diagenetic rejuvenation of raised coral reefs and precision of dating. The contribution of the Red Sea reefs to the question of reliability of the Uranium-series datings of middle to late Pleistocene key reef terraces of the world. *Carnets Géologiques / Notebooks Geol.* 4, 2008/04 (2008).

Plaziat, J.-C. et al. Mise en évidence, sur la cote recifale d'Egypte, d'une regression interrompant brievement le plus haut niveau du dernier interglaciaire (5e); un nouvel indice de variations glacio-eustatiques a haute frequence au Pleistocene? *Bull. la Societe Geologique Fr.* 169, 115–125 (1998).

Plaziat, J.-C. et al. Quaternary changes in the Egyptian shoreline of the northwestern Red Sea and the Gulf of Suez. *Quat. Int.* 29/30, 11–22 (1995).

Al-Mikhlaflafi, A.S., Edwards, R.L., Cheng, H. Sea-level history and tectonic uplift during the last-interglacial period (LIG) inferred from the Bab al-Mandab coral reef terraces, Yemen. *J. Afr. Earth Sci.* 138, 133-148 (2018).

MINOR COMMENTS (Manuscript): Line 91: strange phrasing, unclear what you mean by “. . .external irreproducibility that can be puzzling high. . .”. Please clarify and consider rephrasing.

Line 212: can you explain the discrepancy between the elevation reported in the original publication (i.e., + 10 m) and that given in your database? This just needs a few words of clarification as to why the community should use your revised elevation for this indicator.

C4

Line 141: terraced near Merka – is this thought to be of Last Interglacial age? What's its elevation, and reference for the stud- Carbone and Accordi (2000)? Please clarify.

Line 184: fix the "(missing citation)" in the text.

Lines 192-3: not sure I follow the logic of this sentence about erosion surface age and erosion rates now and during the Last Interglacial – could you clarify, please.

Lines 220 to 222: remove "slight" from "slight issues", and insert "of the age" to "underestimation of the age of the aeolianite sedimentation". Is the inference here that the notch is therefore older than MIS 5e? Please clarify.

Lines 222: Is there any other useful information in the Hobday (1977) work – are they thought to be Last Interglacial? What elevation?

Line 320: add age given in Veeh (especially as there is only one)

Line 364: note, a fall in sea level was also suggested by Israelson and Wolfarth, (1999).

Figure 2 caption: granitic does not need to be capitalised.

MAIN COMMENTS (Data): Missing values: A considerable number of the fields are blank, including the basic site descriptions ("Nation", "Region") – is this because this data doesn't exist (e.g., % calcite determinations for the U-series ages), not applicable (e.g., uplift rates for stable locations), or incomplete data entry (e.g., blank "indicator descriptions" in the "RSL proxies" sheet, "Screening", "Location", "Site" in the "U-series (corals)" sheet). For users, it's vital to know which of these (not exist, not applicable, incomplete) these blanks are, especially as it could have an impact on how data is 'seen' for subsequent data analysis (e.g., training and validation in machine learning in R, Python etc.). As the author of this compilation, end users will rely on you to be clear as to whether these blanks are meaningful (rather than just incomplete data entry) and to stipulate what that meaning is. Please consider this carefully (sentinel i.e., -9999 or masking i.e., none, null – missing data or NA – not available, and NaN – not a number, recognised by most systems - might help but would need to be documented some-

C5

where – project schema perhaps?), AND address those that arise from incomplete data entry (location, tectonic setting etc.).

(Re)calculated ages?: (see also previous comments) within the database, it is apparent (only after some digging) that some of the ages have been recalculated and others not (no information given in the manuscript); there is a mix of originally reported ages (some of which are detrital Th, or open system corrected) and recalculated (closed system?) ages. This inconsistency is confusing to the user, especially as this is not dealt with in sufficient detail in the accompanying manuscript. At the moment, non-specialists would find it difficult to decipher which age to use (and how reliable that age is) from the various sheets in the spreadsheet (even in the "Summary of RSL datapoints" it's unclear). Similarly for the age reliability (see comments above), there is a very opaque mention of a "flexible protocol" in the "Screening" column of the "RSL from a single coral" sheet of the database but no details as to what this refers to. Please clarify. You need to be very careful on this point to ensure the utility of your compiled dataset, and reduce the potential for confusion (particularly for non-specialists). One way in which you could deal with these concerns is to include within your "read me" sheet, or as a separate sheet or appendix to the manuscript, a table which describes in detail all the fields within the database..? That way, this becomes a stand-alone piece of work that has enough detail, without burdening the non-specialist with unnecessary detail.

You might consider some ranking system for the reliability of the indicator (cf. Shennan), and this is what you seem to have in the "AK" and "AL" columns of the "Summary" sheet, but why is the data entry incomplete? Where is the information on these criteria (no mention in the datafile, nor the manuscript)? End users currently have no idea what the numbers (the scale is hidden in a footnote of table 4) in these fields relate to. This needs addressing. Is there some over-arching schema from the WALIS project that can be referenced here and in the manuscript (ditto age recalculation)? If not, it might be worth considering producing one given that it would provide a permanent object

C6

(doi?) to which you could refer in subsequent publications.

Consider adding a “tectonic setting” field to the summary (see comments in section above). This is vital information, and it was excruciating to have to flick between the various sheets to find the info, and even then it was largely missing (i.e., incomplete data entry) in the “RSL proxies” sheet. Please complete the data fields and consider adding this field to your summary.

The “chronostratigraphy” sheet is a nice addition.

I am not qualified to comment on the luminescence data.

Some language may be unclear for non-native English speakers, for example, “sketchy” (I grasp what you are driving at, but there is also an implicit value judgement) in elevation comments. Consider revising to e.g., “uncertain” or “unclear”.

Journal requirements: Manuscript: Data/methods new: no but appropriate (although needs more details in the paper and accompanying metadata) Potential for reuse: yes - high Methods described in sufficient detail: no but only requires only relatively small additions to the manuscript Refs appropriate/missing: yes; suggested additional references for the Red Sea region (if retained) Structure: Mostly clear and well written (only a couple of instances that may need some reworking, see comments above). Would recommend moving section 5 to earlier in the manuscript and adding more methodological details.

Data quality: Accessible (i.e., author provided identifier): yes Complete: no Error estimates and sources of error discussed: no (see comments above re description of methods) Are methods/data processing state of the art: yes Data set useful and significant: yes

Article and dataset: Inconsistencies, problems, errors: The treatment of U-series dates is currently opaque to end-users (reliability, averaging etc.). This should be dealt with in the manuscript (discussion can be very brief and methodological) and noted within

C7

the “READ ME” or accompanying metadata. Ease of reuse (i.e. format/info conducive to statistical testing etc.): multiple sheets in the spreadsheet is not ideal for reuse, and it takes some time to orient yourself as to what data is where (and what each of the fields are – perhaps add simple table/appendix with a detailed description of each of the fields). This might be an artefact of the fields called in the database when the data is extracts. It’s not fatally flawed but it’s not intuitive or easy to use. High quality dataset: yes (mostly)

Presentation quality: Data usable in current format and size: yes Metadata appropriate: no, requires further (brief) explanation

Rating (1 to 4, excellent to poor): Manuscript 2 (good but needs some minor revisions); Data 2 (good but needs some minor revisions) Uniqueness: part of a fantastic larger project to collate data for the Last Interglacial building on older compilations and including new regions and data. Usefulness: extremely useful Completeness: mostly complete but some of the fields within the database are incomplete and should be addressed. This is a relatively small dataset – could you combine with the Indian Ocean data, or that for southern Africa? (note, this comment is here as the journal criteria asks about ‘salami-slicing’ of data).

Interactive comment on Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2020-349>, 2020.

C8