

General comments

A huge effort would have gone into compiling these records and the manuscript represents an important contribution to the PAGES2K network and the palaeoclimate community more generally.

My main comments relate to providing some additional information so readers can more easily assess old vs. new age-depth models and reproduce them, together with more of a critique about causes of differences and factors to be aware of. At present this is not possible, which detracts from the value of the paper. It would also be helpful to include direct links to each record that has been archived (see 2 below).

Specific comments

Abstract

Include briefly: where the best and worst coverage of sites is; the main reason(s) for the differences between old and new age-depth models; and summary of recommendations.

2 Data and Methods

As it is stated that many of the records were not publically available, were some obtained by personal communication with the original authors? If so, this should be noted in addition to NOAA and Neotoma databases. Can links to the NOAA database for each dataset in Table 1 be included? This means readers can go directly to the relevant record.

3.3 Age model updates and 4.2 Discussion of age modelling approaches

It would be helpful if the BACON settings for each model are provided (e.g. in supplementary material). This would ensure people can reproduce the age-depth models exactly. For example, values specified for thickness, accumulation mean and memory strength influence the output, and these are determined based on prior knowledge of the core and site as the authors highlight on page 8. If this information is not included others will not necessarily be able to reproduce the chronologies.

In Figure 4, can the original age-depth models be plotted on top of the new BACON-derived outputs (or at least side by side as done in Figure S2) so readers can see the differences between old and new? At present it is not possible to make this assessment. It would also be helpful if examples were provided of cores where new and old age-depth models are quite similar, and some examples where there are notable differences, together with a critique as to why.

While the authors state that the decisions by the original authors regarding exclusion of radiocarbon dates were upheld, was this also the case for the Lake Elingamite record (Figure S2)? The CLAM-model shows three dates (in red) that do not appear to be in the BACON model output. If these were treated as outliers by Barr et al. (2014) but still plotted, which is an option in CLAM, this should be noted in the figure caption to explain why the number of dates is different.

4.1.1 Lakes and wetlands.

The authors list the common factors that can have an impact on preservation of the climate signal (e.g. sediment accumulation rate, basin morphology, page 11, line 4). Human impacts, particularly since European settlement can also override potential climate signals. This can complicate the development of transfer functions/modern analogue technique models and calibration in time. This is highlighted in the 'lithics' section, but is relevant to biological proxies too.

Page 14, lines 8-10 and Supplementary Fig. 1: State which age model the BACON-derived one supports and why.

Page 15, lines 14-19: This paragraph is better suited near the start of the section before discussing the different proxies as it is general. Some references would be beneficial, in particular in relation to proxies being complex and non-linear. In addition, using a multi-proxy approach is important for being able to potentially discern climate vs. human impact vs. within lake signals.

Page 15, line 24: von Gunten et al. (2012) is an additional reference as it describes the calibration in time approach using case studies based on biogeochemistry (von Gunten L, Grosjean M, Kamenik C, Fojak M, Urrutia R (2012) Calibrating biogeochemical and physical climate proxies from non-varved lake sediments with meteorological data: methods and case studies. *J Paleolimnol* DOI 10.1007/s10933-012-9582-9).

Page 19, lines 4-7: the difference between the oldest/closest to 1 CE dates are also likely due to the amount of extrapolation between it and the previous ¹⁴C date, not just the density of dates through the core. In addition to having at least one date near the top of the core (line 8), ideally ²¹⁰Pb and/or ¹³⁷Cs would be used if the sedimentation rate is fast enough.

Figures and Tables

Figures 1 and 3

What symbol marks peat records?

Tables

It is not clear how studies are ordered, which makes it hard to search through them (also applies to Table S1)

Table 2

Just presenting the difference between top and base years in the old compared to new chronologies is useful, but does not necessarily illustrate the actual differences between the age-depth models. For example, if the lowermost 14C date is above the bottom of the core, which means the age-depth models are extrapolated, this may lead to a larger apparent difference in ages than might be the case for most of the core. To address this, figures of each site with old and new age-depth models could be included. All new age-depth model figures should already be available as part of BACON output. Doing this means the settings could be incorporated into each figure (see comment 3.3 above). Ideally the original age-depth models would be plotted on top to best illustrate differences and similarities. If this is not possible, then at least provide them side by side. This would help readers assess the differences for themselves, identify common patterns and assist their decision making when investigating these records and developing chronologies for other sites.

Technical corrections

There are a number of typographical errors in the text. I have listed the ones I found, but recommend the authors do a thorough check. This includes the order of references within the text, which are not always consistent (e.g. Marx et al., 2011, Marx et al., 2009, page 13, line 32).

Page 1, lines 15-16: A high quality subset of 22 records across Australasia met the criteria and ~~they~~ **were** endorsed for subsequent analyses

Page 2, line 30: Low-resolution sedimentary ~~archive~~ **archives** available within Australasia include lacustrine...

Page 3, line 13: state the most recent year of publication of the records so it is clear until when the database is up to date. This is important because new records are being published (e.g. comments by Rouillard).

Page 4, line 12: a reference is needed at the end of the sentence The Australasian region includes tropical Southeast Asia because of the dynamical influences of the Indo-Pacific region on the Australasian monsoon. As two Antarctic sites appear to be included, the reason why stated.

Page 4, line 19: 'Reasonable' was defined as **by** PAGES2k as containing at least one...

Page 5, line 1: ...approach for the creation of age models ~~is~~ presented in this study...

Page 5, line 8: ~~Of~~ **Of** these 241 records...

Page 5, line 27: Should temperature be temperate?

Page 6, line 27: ...residence time within a radiocarbon samples...

Page 7, lines 26-27: Sentence is not necessary – In this study, one focus is to generate new age models for records that meet the PAGES2k selection criteria, providing consistency in the approach to age determination and uncertainty estimates.

Page 7, lines 27-29: Sentence is not necessary as it overlaps with the end of the previous paragraph. Combine it with the previous paragraph so the references are included. This study applies Bayesian age modelling across the Aus2k records, a decision that follows the initiative of the wider palaeoclimate community (e.g. Anchukaitis and Tierney, 2012, Goring et al., 2012, Hua et al., 2012).

Page 9, lines 13-14: Sentence not necessary – 661 Australasian sedimentary records spanning the Common Era were systematically reviewed for their suitability for reconstructing regional climate dynamics over the last 2000 years.

Page 9, lines 21-22: Sentence is a repeat of the previous section – Lacustrine microfossils are the most common terrestrial proxy in the Aus2k records, while foraminifera geochemistry is the predominant marine proxy.

Page 10, line 5: Missing word: A low number **of** radiocarbon dates...

Page 10, line 11: ...resolution to ~~investigate~~ **investigate** decadal...

Page 10, line 15 paragraph: This appears to be a contradiction to the start of the Discussion where the authors comment there is widespread spatial and temporal coverage of existing records across the geographic network (page 10, line 1). Please reword to clarify what is meant.

Page 10, lines 18-19: ...climate drivers including **the** El Niño-Southern Oscillation (ENSO), ~~the~~ Indian Ocean Dipole (IOD), and ~~the~~ Australian-Indonesian Summer Monsoon...

Page 10, line 32: ~~Climate~~ **Common** Era

Page 11, line 2: Cores

Page 11, line 23: Chivas et al., 1985, ~~Chivas et al., 1985~~

Page 11, line 25: Oxygen isotopes values...

Page 12, line 5: Transfer functions ~~built upon~~ **developed from** modern calibration...

Page 12, line 20: ... because of ~~the~~ their...

Page 12, line 22: ...both ~~with~~ **on** biological and statistical grounds...

Page 12, lines 22-23: this sentence is misleading (Nevertheless, the ecological dynamics of lakes are clearly governed by climate conditions) because the ecological responses in some lakes are influenced more by humans than climate (e.g. damming), or changes in the catchment that are not climate-driven (e.g. land clearing), or could just vary internally.

Page 12, line 23: ...this lake microfossils... – should 'this' be 'thus'?

Page 12, line 31: ... analysed lead waxes... – should 'lead' be 'leaf'?

Page 13, line 5: Does not make sense – The Lake Keilambete grain-size derived is very commonly used for validation and comparison of ~~palaeoclimate~~ **palaeoclimate** records in the region

Page 13, line 8: ...accelerator mass spectrometry...

Page 13, line 18: ...could be influenced ~~d~~ by climate...

Page 13, line 19: ...lake cores are...

Page 13, line 31: ...assumed to ~~be~~ have been...

Page 14, lines 11-17: This paragraph does not belong here as it discusses an archive, not a proxy. It would be more suitable at the start of section 4.1.1. and the title adjusted to include peat.

Page 14, line 27: ...impacts...

Page 14, line 29: ...highly cited ~~d~~ records...

Page 15, line 7: Herbert

Page 16, line 9: ...this intensifying... – should 'this' be 'thus'?

Page 16, line 26: ...in seas-surface...

Page 17, line 24: records

Page 18, line 8: climate

Page 18, line 11: shows ~~n~~

Page 19, line 33: ...number **of** chronological...

Page 20, line 20: ...demonstrate that ~~that~~ **this** criterion...

Page 20, line 10: ...with regards **to** age-depth...

Page 20, lines 17-18: Sentence is not necessary

Page 20, line 32: records ~~s~~

Page 21, line 6: ...this providing... – should 'this' be 'thus'?

Page 21, line 6: Dieffenbacher-Krall et al., 2007 should be Dieffenbacher

Page 21, line 9: ...used to **reconstruct**...

Page 21, line 25: ...unknown complications; ~~€~~conversely, modelling...

Page 22, line 17: Sentence starting 'However' is not clear.

Page 22, line 19: ...used **as** an anchor...

Page 22, lines 27-29: Provide an Australian and ideally New Zealand reference at the end of the sentence.

Page 23, line 12: ...limited by **the** short length...

Page 23, line 26: ...reconstructions **where** proxies...

Page 24, lines 2-4: Sentence starting 'For example' is not clear.

Page 24, line 14: ...signals in **a** regional palaeoclimate...

Page 24, line 30: ...vital importantce for...

Page 25, line 4: ...strength of **a** climate...

Page 25, line 24: ~~diversity~~ **diversity**

Page 25, line 25: ...Aus2k ~~records~~ network.

Page 25, line 31: ...model comparison, and...

Page 26, line 3: 'for Common Era research' is not necessary

Page 26, lines 6-7: Do the authors mean 'high-resolution' or 'low resolution'?

Page 26, line 7: ...recognized...

Supplementary material

Figure S1: Make axes the same units and scales

Figure S2: Make axes the same units and scales

References

There are a number of references missing from the reference list or text. Below are the ones I found.

I recommend the authors check through all text, references and supplementary material to make sure all references are included and there are no typographical errors.

The following references are missing from the reference list:

Browning and Goodwin 2014

De Deckker et al. 2011

Emile-Geay and Eshleman, 2013

Gingele et al., 2007

Goring et al. 2012

Gouramanis et al. 2010

Grant 1985

Jones et al. 1998, 2001

Kershaw 1982

Martin et al. 2014

R Development core team 2013

Schaefer et al., 2009

In the reference list:

Typo: Bowler, J. M. & Hamada, T. 1971. Late Quaternary stratigraphy and radiocarbon chronology of water level fluctuations in Lake Keilambete, Victoria. *Nature*, 232, 330-&.

Please recheck the references for the correct format of surnames. Below are the ones I noticed.

D'costa should be D'Costa

McTainsh (Hesse, P. P. & **Mctainsh**, G. H. 2003. Australian dust deposits: modern processes and the Quaternary record. *Quaternary Science Reviews*, 22, 2007-2035)

Mcdonald should be McDonald

Mcfadgen should be McFadgen

Mcglone should be McGlone

Mckay should be McKay

McMillan (Fairchild, I. J. & **Mcmillan**, E. A. 2007. Speleothems as indicators of wet and dry periods. *International Journal of Speleology*, 36, 69-74)

LeGrande (Lewis, S. C. & **Legrande**, A. N. 2015. Stability of ENSO and its tropical Pacific teleconnections over the Last Millennium. *Climate of the Past*, 11, 1347-1360)