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Discussions

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Interactive comment on "Low-resolution Australasian palaeoclimate records of the last 2000 years" *by* Bronwyn C. Dixon et al.

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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 It would also be helpful to include direct links to each record that has been archived (see 2 below).

Response: This identification and assessment of non-annually resolved Australasian

palaeoclimate records has been underway since 2009, and has been the focus of both post-doctorate research and a PhD project. We are pleased to present the outcomes of more than eight years of work, and hope that the scientific community can benefit. Original and updated age models and datasets will be available through NOAA World Data Center at:

ftp://ftp.ncdc.noaa.gov/pub/data/paleo/pages2k/dixon2017australasia/

This link will become active upon publication of this manuscript.

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.

Response: The abstract will be updated to include a brief summary of i) areas of densest and sparsest record coverage, ii) the main reason(s) for differences between initially published and updates age-depth models, and iii) recommendations for future improvement of palaeoclimate research and records in Australasia.

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.

Response: Sources of pre-existing records will be updated to include 'a general inquiry to Australasian Quaternary Association members' and 'personal communication with authors'

Can links to the NOAA database for each dataset in Table 1 be included? This means readers can go directly to the relevant record.

Response: Links to the NOAA URL for originally published datasets will be included in Table 1. A link to the comparison of originally published and updated age models will

be included in the 'Data availability' section at the end of the manuscript.

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.

Response: A supplement of all code and settings used to construct updated age models will be included in the supplementary information, for the purpose of transparency and reproducibility of methods presented in this study

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.

Response: Figure 4 will be updated to show the four example age-depth models side-by-side with the originally published age models so that differences can be observed. Each pair of old/new age models will be provided in the supplementary information, so that readers can see examples of similar and divergent age models. Further discussion of reasons for differences in age model outcomes will be included in section 4.2

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.

Response: The dates presented in red in Barr et al., (2014) have indeed been excluded by this study because of their previous identification as outliers. This will be clarified in the caption of figure S2.

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.

Response: The sections on biological proxies will be updated to appropriately communicate the impact of site-specific feature and land use change on biological proxies in Australasia. Relevant supporting literation will also be included.

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

Response: This section will be clarified and expanded upon to indicate which published model is preferred, as indicated by the BACON-derived age model, and why BACON is a useful tool for choosing appropriate age models.

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.

Response: This paragraph will be shifted to the beginning of the section (page 11, line 7), and will be edited to prevent repetition with the existing introductory paragraph

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(page 11, lines 2-7). Supporting literature will be added to support the complex and non-linear nature of palaeoclimate proxies in lake and wetland environments.

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, Fujak 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).

Response: Information from this reference will be incorporated into page 15, line 24, and the paper will be added to the reference list.

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.

Response: The degree of interpolation will be discussed in the possible reasons for large chronological uncertainties. References will be supplied to support this point. The authors agree that 210Pb and/or 137Cs would be ideal for constraining the top of sediment cores in Australasia, and these radionuclides have has been used in previous studies. The use of 210Pb dating for constraining upper-core ages is included in the 'chronology' section of the discussion (page 22, line 27).

Figures and Tables

Figures 1 and 3 What symbol marks peat records?

Response: Peat records are included in the lake/wetland category, which is represented by the purple markers. The figure captions will be changed to clarify the types of proxies included within each archive category.

Tables It is not clear how studies are ordered, which makes it hard to search through

them (also applies to Table S1)

Response: Records within all tables will be reordered by archive type (i.e. lake/wetland, marine, speleothem, marine), then by state/country, for the sake of easy searching by readers.

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.

Response: A comparison figure displaying overlain old and new age models for each of the 22 sites will be constructed and included in the supplementary material. Table 2 will be removed and readers will be directed to the supplementary information.

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 are were endorsed for subsequent analyses

Page 2, line 30: Low-resolution sedimentary archived 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 in presented in this study...

Page 5, line 8: Or 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 micro-fossils 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 intestigate 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.

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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 palaeocliamte palaeoclimate records in the region

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

Page 13, line 18: . . .could be influencesd 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 is 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 citesd 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: showsn

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

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

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

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

Page 21, line 25: . . .unknown complications; Cconversely, 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: diervisty 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: . . .recognizsed. . .

Response: All highlighted typographic errors will be corrected, and all coauthors will contribute to careful editing of the manuscript for the sake of identifying and correcting any additional errors.

Supplementary material Figure S1: Make axes the same units and scales Figure S2: Make axes the same units and scales

Response: The axes and scales for both figure S1 and S2 will be equalised.

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

Response: Each in-text reference will be checked to ensure that it appears correctly in the reference list.

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)

Response: The format of references will be checked and brought into line with the journal style requirements.

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Interactive comment

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Discussion paper