

Interactive comment on “Global aridity synthesis for the last 60 000 years”

by Florian Fuhrmann et al.

Anonymous Referee #4

Received and published: 30 November 2019

→ We thank anonymous Referee#4 for his constructive and helpful review of our manuscript. All of your suggestions were answered in red within the text below.

Dear Authors,

You provide a manuscript attempting to synthesize global aridity. You select several key regions with a decent data coverage from different geoarchives. Having read your manuscript and the discussion up to date, I have a clear opinion about your manuscript.

Your conceptual idea of using suites of geoarchives to address aridity is in my opinion great and clearly worth investigating and publishing. At the same time I hold the opinion that several aspects need some work before publication. I agree with most points of other reviewers, see also comments below.

My main comments are: You mention that you focus on openly available data in Supplements to papers. The ELSA vegetation stack data is available in the Pangaea database – using also the NOAA and PANGAEA databases as source would have been appropriate. Please add a Table in Supplements where data are from (websites/databases). You screened ‘about 2000 papers’ – that is not a reproducible statement. Please ensure that your data processing is 100% transparent and reproducible. Yet I have only a decent idea how this was done. If necessary, please provide sheets and computer code in Supplements.

→ No, we did focus on data from Pangaea and NOAA-NCDC databases. In addition, we used global pollen database (Neotoma), ice core database from Copenhagen university, SISAL speleothem database and European pollen database (EPD). Most speleothem data were taken from tables of the original papers, the other data were downloaded from the mentioned databases. This is explained more clearly in the revised method section. Nevertheless, we agree on your comment and have rephrased the sentence to: “We have screened published paleoclimate literature of the last 30 years to detect and select 10 key areas...”

Uncertainty of the aridity index seems constant with time and data resolution – that clearly does not make sense. Please adjust your method of uncertainty estimation to be at least more realistic. An idea may be to use a relative reliability index, where both lowest data resolution and highest data uncertainty play a role. You do mention that different age models will have an impact on your results. It would be nice to get an idea how this impacts results in one example, but I do see that this is difficult.

→ Differences in data resolution was accounted for in our initial error estimates. For time variance we guessed the largest error for a dataset and assumed it as error for the full set, knowingly overestimating the error of younger data. To give a more detailed error development over time, we would need more information on used methods and how the probes were sampled. Those information are not available for most of the used datasets.

For Asia and Europe, more than single dust records are available in databases – please synthesize these. The presented data selection seems biased towards the authors’ work, and I suggest to compile data for several regions in a more extensive way, and maybe focus on less regions. Obvious questions

are, why are data from Tenaghi Phillipon and more Mediterranean cores not used? Why is there only 1 dust record from Asia and Europe? More are available.

→ This paper emerges from the PalMod project, that is why it is presented in this special issue of CP, which belongs to the project. One prerequisite of PalMod was to work with publically available datasets only – from the most cited papers. We had to choose the most complete, highly cited and well dated (back to 60 000 yr b2k) records with highest sample resolution, which are available for the chosen regions. Other records do not necessarily cover the same time phases and not that much records were publically available. Therefore, we have chosen the most relying records we are aware of. For example, Tenaghi Philippon data in Pangaea and EPD only cover the late holocene, although several paper present longer time series (e.g. Pross et al., 2007, 2015; Glais et al., 2016; etc.).

The data selection for several regions is problematic in my opinion: Southern Europe: Data from the Lac du Bouchet is in my opinion hardly comparable to the Portuguese Margin – two datasets from the Portuguese Margin are probably leading to a location bias here, too. This should in my opinion at least be discussed. Why are SST data from the Mediterranean not included? Why are loess data from Spain neglected? Cariaco Basin: the dust record here may actually not reflecting local dust, but African aridity (also discussed in the reference you cite) – please be more self-critical in the discussion.

→ For southern Europe, close dust records are missing. Nussloch loess profile data are not publicly accessible, the same is the case for the Spanish loess data addressed by you. Hence we had to choose the closest, reliably dated record.

→ Several other proxy data, like SST, tree rings, varve thickness, lake or sea levels etc. are not available for each region, therefore we have only chosen speleothem growth, pollen and dust.

→ Cariaco Basin Al/Ti ratio of core 1002C is controlled by fluvial input (which is obviously a local component You are right that the dust source is Africa, but the dust sources are usually further away. For example, the Asian desert areas Gobi, Taklamakan etc. are the main dust sources in the NGRIP ice core. The dust of the NGRIP core is also interpreted as a regional signal of the North Atlantic, as well as of the East Asian monsoon region (e.g. Ruth et al., 2007).

More drastically, data from New Zealand and Australia probably do not indicate the same climate system at all – combining these at least requires a more sensitive discussion. In my opinion these should not be combined for an aridity analysis.

→ We refer to our previous reply to Referee#3: We see that these archives are climatically not fully homogeneous, but drastic changes should be visible within the archives of one region. We had to choose the most complete, highly cited and well dated (back to 60 000 yr b2k) records with highest sample resolution, which are available for the chosen regions. The reality is that this has been the best possible approach to summarize the regions in as small and detailed a way as possible with publically available data.

More detailed comments are:

Please avoid abbreviations in the abstract

→ Many other paper also use abbreviations in the abstracts, for example Clark et al., 2009 or Mix et al. 2001, to name just two. By using three abbreviations (LGM, MIS, GCM) we can save about 70 characters in our abstract.

The first sentence of the introduction is in my opinion not generally true.

→ We have included a “main” before the foci: “Paleoclimate research today has two main foci:”

Unfortunately, in the area of paleoclimate research, not so many other topics are funded today.

You begin with your own data – OK, a scientific reasoning is more appropriate.

→ Rephrased to: “We start the synthesis with Central Europe:...” The scientific reason is given afterwards: p.3/110ff:

“The maar sediment cores of the Eifel Laminated Sediment Archive (ELSA)-project (Sirocko, 2016; Sirocko et al., 2016) show all Greenland Stadials (GS) and Greenland Interstadials (GI) in the time series of eolian dust content (Dietrich and Sirocko, 2011; Seelos et al., 2009). Central Europe shows accordingly the same climatic structures, which is well known in North Atlantic marine sediments (e.g. Hodell et al., 2013; McManus et al., 1994; Naafs et al., 2013) and Greenland ice cores (North Greenland Ice Core Project Members et al., 2004; Rasmussen et al., 2014; Svensson et al., 2008).”

Page 8, line 9: You mention geographic regions and China as country – please avoid such political statements → The text passage you cited lists the key regions covered in this paper with arid LGM conditions. Since one of these regions is China, which only includes records from China, it is also named so.

Page 9, Line 11f: this is not a result, but more speculation → Therefore, we have deleted this sentence according to review#2 as well.