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Climate of the Past Discussions

Interactive comment on "The 4.2 ka BP event in the Levant" *by* David Kaniewski et al.

David Kaniewski et al.

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Dear Referee,

We would like to thank you for having commented our manuscript. Please find our detailed answers to each comment appended below.

Comment 1 - The article is well written, and the relevant literature generally well taken into account. Unluckily the 4.2 event is not visible in all Mediterranean records. The authors decided anyway (for brevity sake?) not to consider records without the 4.2 signal in the long introduction. This was on the contrary done for the Levant, even if too much emphasis is given to pollen data in presence of human- independent proxy-records from the region.

Answer – Because this manuscript is focused on the 4.2 ka BP event, we have chosen

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Discussion paper

to not consider sequences where this climate shift is potentially "absent" or not pronounced (due to the sensitivity of the proxy used, local climate processes, contrasting outcomes due to different driving mechanisms...). This decision was taken to ensure a concise and "digestible" paper but also because we have integrated three models (Brayshaw et al., 2011; Roberts et al., 2012; Guiot and Kaniewski, 2015) that perfectly summarize this purpose. For the Levant, we have focused on every available sequence, as this geographical zone is the heart of the manuscript. Our aim was not to show why some locations have not recorded this event, but inversely, to understand where this climate shift was recorded and its driving climate mechanisms.

Comment 2 - Scarce attention is paid to the fact that chronologies of single records could be wrong and so the 4.2 event is probably not always well positioned over time.

Answer – We agree that the chronological issue is of central importance when focusing on a particular event such as the 4.2. We stress this in the conclusion. Nonetheless, this manuscript is a review and the sequence chronologies are largely discussed in the original papers. We will add a general comment in the revised manuscript concerning this particular point but it is impossible to critically revaluate each sequence. The readers must refer to the original papers if they require further information (e.g. location, lithology, sedimentology, and chronology). We would like to stress that many of the high-resolution proxies (e.g. Sharifi et al., 2015; Cheng et al., 2016) have small s.d.-s on their 14C dating and U-Th datings, and are all largely synchronous.

Comment 3 - The conclusions paragraph should be improved, it deserves more work. It's not even clear to me if this 4.2 event (clear in central Mediterranean and at least in most of northern hemisphere according to the authors - but in this case only records recording 4.2 event are used) is clear in the Levant or if it is not.

Answer – We agree that the conclusion is somewhat confusing because we wanted to outline all the parameters that could have influenced the observed signals. We wrote "At the scale of the Levant, the 4.2 ka BP event is clearly recorded" in the manuscript.

The conclusion was thus clear for us. We will rewrite this part in the revised version and we hope that the new text will be more informative.

Comment 4 - Pollen data cannot be used to assess this issue, they can just be a corollary to independent climatic proxies.

Answer – Here, we partially agree with the reviewer. See comment 6 for more details.

Comment 5 - I agree with the comment posted by Darrell Kaufman and Nick McKay on the fact that original data should be provided and be available in a public repository.

Answer – Please see our response to Darrel Kaufman and Nick McKay: "We agree that all the datasets relating to the 4.2 ka BP event must be now available through public repositories. Here, we can only provide our own datasets (Tell Tweini-Syria, Tel Dan-Israel, Tel Akko-Israel) as the other time-series belong to the authors mentioned in the original manuscripts. These datasets cannot be made available without official permission." We will thus add our datasets in the revised version of the manuscript.

Comment 6 - Please pay attention to these comments on the text lines: 51-54 Pollen is not a good proxy to attest climate changes in recent periods (Li et al. 2014, Human influence as a potential source of bias in pollen-based quantitative climate reconstructions. Quaternary Science Reviews 99, 112-121) in the Mediterranean: many vegetation changes (e.g. forest clearance!) can be human-induced in the last 5 ka.

Answer – We partially agree with the reviewer. Nonetheless, it would be a perilous "shortcut" to assume that all vegetation changes (or ecosystem dynamics) have been shaped by human impact/influence since 5 ka BP and, inversely, climate pressures. Human societies have clearly had a major influence on the environment during the last 5 kyrs, but abiotic pressures have also been of key importance in driving ecosystem dynamics. In our manuscript, we have considered cores where climate imprints were suggested/validated by the original authors, even if they were, at least partially, complemented by human impacts. The mentioned reference, Li et al. 2014, is an example

where it has been shown that using pollen as a proxy for climate can be confusing (in this particular case, in that particular zone). But, there are many examples showing the contrary. We agree with the reviewer that, sometimes, pollen cannot be used as a climate indicator, but, in many other cases, palynology is a powerful tool for palaeoclimate reconstructions.

Comment 7 - 84-86 Which climate models? Please add references.

Answer – We will add the references in the revised version. But, the models are the same as those mentioned before (Brayshaw et al., 2011; Guiot and Kaniewski, 2015).

Comment 8 - 88-107 Here the authors mix up different proxyrecords. Please note that in case of palynology the vegetation signal cannot be univocally interpreted, due to human induced changes.

Answer – As mentioned before, we partly agree with this comment (see comment 6).

Comment 9 - In fig. 2 no important change (i.e. 0.5 m at maximum) is recorded in the Accesa record around 4.2 ka if compared with previous lake level changes (>2 m).

Answer – We disagree that the lake-level fall at Accesa is around 0.5 m. If you carefully check Fig. 2, the drop is around 1.7 m around 4100 cal BP! As suggested by the authors (Magny et al., 2009), "The available data make it possible to recognise a tripartite climatic oscillation between c. 4300–3800 cal. BP. A phase characterised by drier conditions at c. 4100–3950 cal. BP appears to have been bracketed by two phases marked by wetter conditions and dated to c. 4300–4100 and 3950–3850 cal. BP, respectively". The drop is around 1.7 m, and a clear drier phase is recorded at this time.

Comment 10 - 99 Republic of Macedonia 111 and 121 There are other records in which the 4.2 event is not clear. They should be quoted as well even if the authors decide (line 111) not to use them.

Answer – As mentioned in comment 1, we have focused this manuscript on the 4.2

ka BP event. The records in which the 4.2 ka BP event are not transparent could be the subject of another paper, because, in each instance, one should integrate all the physical parameters (local climate effect, altitude, sheltered area, etc...). And, of course, chronological issues as suggested by the reviewer.

Comment 11 - 126-128 Floods are documented also in the Near East! See Benito et al., 2015 fig. 3 136-137 Libya is not so further East than Tunisia: Have a look also at Mercuri, 2008. Human influence, plant landscape evolution and climate inferences from the archaeobotanical records of the Wadi Teshuinat area (Libyan Sahara). Journal of Arid Environments 72, 1950- 1967.

Answer –Benito et al. (2015): the Fig. 3 corresponds to the Iberian Peninsula. We thus assume that the reviewer probably means Fig. 8. Focusing on Fig. 8, part of the figure concerns Greece and Crete (not the Near East; the authors themselves mentioned "the Eastern Mediterranean"). The other data correspond to the Dead Sea or tributaries of the Dead Sea. If someone wishes to have an up-to-date view of the Dead Sea, they should consult Kagan et al. (2015). The curve displayed in Benito et al. suggests extreme fluvial events around 3900 BP (with a very large s.d.-s on their 14C / OSL ages; cf. Fig. 8) in the Eastern Mediterranean, not before (see Fig. 9). The short-term humid peak at ∼4100 BP (Benito et al., 2015) could fit with the short rise of the Dead Sea during the same period (mentioned in our manuscript, lines 266-267), but the large s.d.-s of the OSL ages preclude any viable comparison. Libya has a western borderline with Tunisia and an eastern borderline with Egypt. So, Libya is further East than Tunisia. We have not considered the study of Mercuri (2008) in our manuscript because, even though the paper is of great importance for the knowledge of past environments in Libya, the dataset is a composite record using data from several locations, with a very limited number of samples for the period of interest (poor chronological resolution concerning the Mid-Late Holocene transition). We are not convinced that this record is appropriate for studying a short-term climate shift such as the 4.2 ka BP event.

Comment 12 - 238-241 It's difficult to rely on a climate reconstruction in this period for such region! Human impact is proved to have been overwhelming!

Answer – Here, we disagree. Even if anthropogenic pressures have been a component of vegetation dynamic since 5 ka (as suggested by the reviewer), several environmental studies strongly suggest that during periods of abiotic stresses, agricultural practices strongly declined. Taking into account our own datasets, Tel Akko and Tel Dan (Israel), during the 4.2 ka BP event, no agricultural activities are recorded in either area. Human societies cannot, therefore, be the drivers behind these vegetation changes. The same is true for Tell Tweini (Syria) or Hala Sultan Tekke (Cyprus) concerning the 3.2 ka BP event (characterized by a strong decline in agricultural practices). Human impacts are manifest, and locally important, but they are not as "overwhelming" as suggested by the reviewer before the Hellenistic/Roman period. Human impacts have become overwhelming since the Roman period and devastating since the Middle Ages.

Comment 13 - 286-287 Not all data available from other regions have been used. The 4.2 event is complex everywhere!

Answer – Some geographical zones, and particularly the Levant, depend on several climate mechanisms, probably acting in synergy (multifaceted mechanisms). Data from the Central-Southern Levant for the 4.2 ka BP event are complex compared to the northern Mediterranean (or northern Levant). We agree that southern Mediterranean climate (North African) is also complicated, but not in the same way (see our manuscript for details, lines 166-180). The Levant is a mixture of several climate influences that is perfectly reflected in its palaeoenvironmental records.

Comment 14 - 351-353 This is the first time that the "chronological issue" is considered in this paper. No mention to the fact that single chronologies can float some centuries is made!

Answer – As mentioned above (comment 2), a short paragraph will be added to the revised manuscript concerning this particular point but it is both impossible and beyond

the scope of the paper to deal with each sequence.

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