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Climate of the Past Discussions
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# *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 commenting on our manuscript. Please find our detailed answers to each comment appended below.

Comment 1 - The article by Kaniewski et al. reviews the available high-resolution paleoclimate data from the Levant for the 4.2 ka event. The authors are probably among the most appropriate researchers to provide such review. They seem to embrace the available literature, report and discuss the last articles published in the literature, and I encourage the publication after minor modifications.

Answer – We strongly thank the reviewer for this comment.

Comment 2 - I agree with comments performed by Reviewer 1, and instead of suggest-



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ing improvements on the science in itself - which is slightly off my own scientific topic - I'll comment on details that hit me while reading the manuscript.

Answer – We partly agree with Reviewer 1's comments and we have detailed why in our answers-to-comments.

Comment 3 - Along with uncertainties associated with the chronological details pointed out by the Reviewer 1, I think the authors should reformulate parts of their statements regarding uncertainties on the Y-axis. In fact, I personally found that many records presented in Figures 2 to 4 do not always seem, at naked eye, to follow the idea suggested in parallel in the text while commenting on one particular dataset. There are probably 2 reasons for that: (i) some low-resolution datasets seem to have been interpolated when some others don't, which is - unless I miss an important point - not always clearly justified, and (ii) the authors seem to be, sometimes, too eager to dismiss the fact that particular datasets do not contain evidence for a ∼4.4 ka climate anomaly as much as the authors would like to see.

Answer – The curves (Figs 2-4) were directly drawn using the initial values (when the data were available in OA repositories) or extracted from the original publications when the raw data were not available. The original datasets were not interpolated; we merely extracted data which were not available in OA repositories using the software package GraphClick (which scans the original curve). Whatever the technic used, the shapes of the curves are exactly the same as those in the original publications, with no distortions. To standardize the contrasting proxies, we transformed all of the datasets into z-scores.

All the datasets discussed in this paper contain evidence for the 4.2 ka BP climate anomaly, which is more or less pronounced depending on the location. What is striking is that, even if the climate shift may be less intense in certain locations (compared to other areas), the event is still present. Therefore, we are not extrapolating or exaggerating any data, merely comparing and critically contrasting existing datasets.

Comment 4 - (i) If I'm not mistaken, at least on figures 2 lower panel, 3 middle panel

and 4 lower panel - and possibly other -, the authors apparently interpolated data between the raw data values. Hence it is difficult to evaluate whether the climate anomaly discussed in the text is due to an outlier or not. I noted many statements in the text with which I was seriously puzzled after having a look at the figure, and thought sometimes you overstated what data actually say.

Answer – Fig. 2 lower panel corresponds to Lake Dojran (Macedonia/Greece). According to the authors "At Lake Dojran, Francke et al. (2013) identify a phase of drier conditions and lower temperatures around 4000 yr BP and observe a general trend toward environmental instability in the early late-Holocene, which is in agreement with our proxy records showing significant changes during the middle-Holocene to late-Holocene transition." (Thienemann et al., 2017). And "In the early late-Holocene, we observe a brief phase of decreased anthropogenic activity possibly triggered by climatic perturbation, for example, aridity, around 4000 yr BP" (Thienemann et al., 2017). This is consistent with what we have written, even if the data were interpolated by our software. The curve has exactly the same shape and values as the one published by Thienemann et al. (2017; see Fig. 2).

Fig. 3 middle panel corresponds to Qameshli (Syria). Once again, the number of dots is due to our software but the shape of the curve is exactly the same as the one published by Fiorentino et al. (2008, please see Fig. 5). As the authors mentioned "What emerges from this model is a huge regional crisis in the rainfall regime between the III and II millennium B.C.". In accordance with what we have written. Even if this model was criticized by H. Weiss (see comments in this section of Climate of the Past), we believe that it must be cited and commented upon, because it is published and available in the literature.

Fig. 4 lower panel corresponds to the Dead Sea (Isreal). The authors mentioned "At $\sim$4.4 ka cal BP, the lake dropped sharply based on gypsum deposition in the Ein Gedi core" and later "The low lake levels of the Intermediate Bronze Age continued for a short time into the Middle Bronze Age. . ." (Kagan et al., 2015). Even if, once

again, GraphClick produced more data points when scanning, our interpretation is near identical to the one published by the authors, with no distortion. In sum, we have not overstated what the original data are saying.

Comment 5 - (ii) In the same vein, other high-resolution records, interpolated or not, do not seem to be drastically affected by the 4.2 ka event. For example, your discussion on the ‘’Wshape” climate anomaly is not convincing at all, when the magnitude of the anomaly discussed relies on a very small excursion within the 4.2 ka event time window: as long as you have at least 3 (4) points within this window you likely (certainly) get a data point defining an anomaly, the magnitude of that anomaly being likely associated with noise if it is small and defined by a limited number of data points.

Answer – The W-shaped event is attested at several locations in the Levant. Focusing on the Dead Sea and the period under consideration, the authors wrote after the sharp drop of the lake at 4.4 ka BP “At the Ze’elim Gully (ZA3 section), in the middle of this time period, there is a 40-cm sequence of lacustrine detrital sediment representing a short lake rise. This event is also reflected in the Ein Gedi core lithology” (Kagan et al., 2015) and later “A significant increase in olive pollen in the Ein Gedi core and the Ze’elim Gully corroborates this event” (Kagan et al., 2015). They ended with “Then, at $\sim$4.1 ka cal BP, the lake level dropped, depositing gypsum and pebbles at the Ein Qedem site (415.5 m bmsl; Stern 2010) and shore sediments at the Ze’elim Gully section” (Kagan et al., 2015). We believe that this is not merely “noise”, as suggested by the Reviewer. The same W-shaped event is also attested at Soreq Cave ($\delta$18O, Bar-Matthews et al., 2003; Bar-Matthews and Ayalon, 2011), and is also observed in the Sea of Galilee (Langgut et al., 2013; Schiebel and Litt, 2018), at Tel Dan, and Tel Akko (Kaniewski et al., 2013, 2017). All of this evidence suggests that the W-shaped event is not “noise” but a regional phenomenon, at the scale of the Central-Southern Levant. This is why we argue for a “complex event” (see Referee 1 comment 13). Here, we suggest that drought was disrupted by a short humid period (a W-shaped event, such as the 3.2 ka BP event).





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Comment 6 - Also, some records do show a climatic excursion at 4.2, which does not appear as extraordinary as many other climate excursions occurring before or after the 4-4.5 ka time window, but the magnitude of the 4.2 climate anomaly is not always discussed in parallel with those other climate phenomenon. Sometimes, the 4.2 time window represents more a shift in the climatic background than a single event, too. Those aspects, along with uncertainties on the X-axis and the fact that many records are discussed without showing the data, leads the reader to doubt about the text as a whole that has been crafted nicely enough to cradle the inattentive reader.

Answer – We are surprised by this comment... First, there is insufficient space to accommodate all of the curves/datasets mentioned in the manuscript (and arguably this is not the aim of a review). The original articles are all available online and can be referred to by the reader. "The fact that many records are discussed without showing the data" is an unfair statement because a simple internet search provides direct access to the original papers and datasets (when they are not displayed in our manuscript).

As mentioned by the Reviewer "uncertainties on the X-axis": this comment was already made by Reviewer 1. In answer to this: "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."

The last point raised by the reviewer is: "a climatic excursion at 4.2, which does not appear as extraordinary as many other climate excursions occurring before or after the 4-4.5 ka time window". We agree that other climate excursions occurred before and

after this time (see Figs 2-4), and that the magnitude of the 4.2 ka BP event could be compared to these other variations. Nonetheless, when one carefully checks the curves/datasets, it is striking that all these other climatic variations are not all synchronous and they are not uniformly present in each curve. When we mention “an event”, we mean that the same shift is observed in different places, with different proxies, during the same period (according to the chronology). We can thus compare the magnitude of the 4.2 climate anomaly with the other variations, but this could be only done site by site, and curve by curve. Once again, we are not sure that it is the aim of this review.

Comment 7 - Then I simply suggest the authors to pay more attention the terms used, and eventually reformulate some of them. For the sake of integrity I let the authors decide themselves which statements could have been overstated.

Answer – In the revised version, we will endeavor to pay more attention to the terms used. We will better justify each statement so that they do not overstate the data.

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