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Interactive comment on "Climate changes in interior semi-arid Spain from the last interglacial to the late Holocene" *by* Dongyang Wei et al.

Anonymous Referee #2

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This paper presents a new quantitative climate reconstruction based on the pollen record of Villarquemado in eastern Spain. The study represents a very valuable contribution to the understanding of glacial climate in the Mediterranean region. The most important feature of the work is the application of a physiologically robust correction for low atmospheric carbon dioxide concentrations which have not traditionally been accounted for in pollen-based reconstructions (excluding inverse modelling approaches). This shortcoming of many previous studies means that glacial aridity may generally have been over-estimated by pollen-based reconstructions for the Mediterranean. The implications for the understanding of past climates and environmental impacts are therefore very wide – and the paper will be of interest to the wide community of researchers working on climate reconstructions from different proxies. It is

also encouraging to see this development of a WA-PLS approach incorporating a large modern training set, which may help to overcome problems with non-analogue vegetation communities which are a weakness of the modern analogue technique.

Overall, the paper is clear, methodologically robust, well-written and effectively illustrated. My recommendation would be to revise the paper for publication in Climate of the Past with minor revisions, with attention to the following areas which may impact on the interpretation and discussion:

Age control and stratigraphy – at present only a summary statement is provided in the introduction describing the age control. While the manuscript generally avoids reliance on very detailed chronological questions (the discussion of orbital patterns of temperature extremes is well founded, for example, as shown in Figure 5) – there are some places where the attribution of specific D-O cycles is suggested. For example, lines 331-334 report changes that correspond to D-O events, and line 404 highlights again the link to cycle D-O 9. Confident attribution of fluctuations in the reconstruction to individual millennial-scale events such as D-O events in a record with a complex stratigraphy and without a continuous pollen record must be very tentative. In general, the manuscript could discuss further, and help the reader to assess, the chronological uncertainties and consider the stratigraphical complexity of this very dynamic environmental setting (changes between lake/mudflat/alluvial fan, etc) which must also bear on the uncertainty of the age-model. So, two comments: the age model with uncertainties should be shown to allow the reader to assess the temporal uncertainty of the reconstruction, and comments about very specific D-O events should be checked and revised to reflect realistic caution about the attributions.

Palaeoecological significance – some further links between the reconstructed climate changes and the vegetation changes recorded in the pollen sequence could usefully be developed. Specifically, a paradoxical indication of a transition from high Lateglacial moisture index to increased Holocene aridity is shown in parallel with the development of Holocene forest/woodland. This would seem to contradict previous interpretations of

multiproxy evidence for arid conditions in the eastern Iberian Peninsula extending from the Younger Dryas and into the early Holocene, with a regional transition to higher moisture availability from around 10-9 ka (e.g. Morellón, M., Aranbarri, J., Moreno, A., González-Sampériz, P. and Valero-Garcés, B.L., 2018. Early Holocene humidity patterns in the Iberian Peninsula reconstructed from lake, pollen and speleothem records. Quaternary Science Reviews, 181, pp.1-18). Given that forest development in dry sectors of the Mediterranean is generally considered to be limited by moisture availability, the authors should comment on why the lowest moisture availability is reconstructed for the interval with highest Mediterranean taxa and why the vegetation transition from xerophytic grassland steppe to forest development would imply reduced moisture availability.

Supplementary Figure 3 showing the impact of moisture index correction for CO2 against time is one of the major findings of the study, and could usefully be incorporated in the main paper – possibly as a two panel figure with the main text Figure 6?

Other minor comments: Line 61. The record cannot really be described as "continuous" in light of several intervals with poor pollen preservation and hence no reported pollen spectra (e.g. lines 207-208). Line 197. Is the local evergreen oak Q. ilex subsp ilex or Q. ilex subsp rotundifolia? The ecology of these subspecies (or species, depending on the authority) is different, more oceanic vs more continental, respectively. Line 197. Q. faginea is generally classed as a deciduous (or marchescent) species, rather than evergreen Line 207-208. Round ages to nearest 10 or 100 years Line 423-424. This statement seems a bit too strong – the recent work at Padul provides a pollen record that is arguably more complete (i.e. not containing pollen hiatuses), and could ultimately provide a valuable comparison data set for climate reconstruction (see Camuera, J., Jiménez-Moreno, G., Ramos-Román, M.J., García-Alix, A., Toney, J.L., Anderson, R.S., Jiménez-Espejo, F., Bright, J., Webster, C., Yanes, Y. and Carrión, J.S., 2019. Vegetation and climate changes during the last two glacial-interglacial

cycles in the western Mediterranean: A new long pollen record from Padul (southern Iberian Peninsula). Quaternary Science Reviews, 205, pp.86-105.)