

Thank you for the opportunity to comment on this manuscript. It concerns a sound data set of great value to the palaeoecological community as it comes from a region where such data for this period are scarce. Overall, I think the work is good and should be published in CPD but there are a number of important details that need to be considered and corrected first. In many instances these are related to terminology, definition of terms and ambiguity or circularity in the phrasing. One important example of this is the use of the term "steppe forest" without definition or explanation. Another is the use of marine isotope stage names to refer directly to intervals identified in the pollen record with no explanation for how that equivalence was established (even once an explanation is given, MIS terms should not be used directly for terrestrial intervals - see further details below). There is occasional circularity and a lack of clarity as to what was used to infer what but this is usually a question of the phrasing, and not a fundamental problem with the argument (examples below). I think that to make a convincing argument, the basis of both the stratigraphy and the chronology should be outlined in more detail (even if they are described elsewhere) so that the paper can stand alone. Without this, it is difficult to assess the validity of statements about the relative timing of events in the Lake Van pollen record and global scale climatic events. The vegetation reconstructions/inferences (particularly those involving trees) I think need to be more clearly described and the basis for the inferences better founded (e.g. with reference to modern pollen-vegetation studies, where possible). Also, I think there IS succession where the authors have suggested there is not... this could do with some more consideration.

These issues are detailed below along with suggestions for grammatical corrections. In addition there are numerous minor grammatical errors (especially plural/singular, tenses) (not all are listed below).

#### Comments

Page	Line	Comment
1	11	"effective moisture" needs some qualification (high, low?) otherwise the meaning is not clear
1	12	"forest" ought probably to be qualified with "open" since this is "steppe forest"
1	12	I think the conventional term for the biome is "wooded steppe" (e.g. Allen et al. 1999, Nature 400, 740 – 743). If "steppe forest" means something other than this, then it must be defined (and in any case, a reference is needed).
1	13	"The warmest stage..." The previous sentence suggests moisture is the main limiting factor. If temperature is important too, then need to make it clear that both are involved throughout the text (i.e. avoid summarising warmer/wetter as "warmer").
1	13	"in terms of" I think this should read "as indicated by"
1	13	"amplitude" Double check – do you mean amplitude, or duration (or both)? Please clarify this.
1	14	Insert "... the tree population maximum associated with..." before "MIS 7"
1	17	Clarify presence or absence of trees in this instance of "steppe"
1	19	Replace "more" with "higher"
1	21	The mild conditions inferred here are also in agreement with pollen records from

elsewhere in southern Europe.

- 1 25 Insert after “subdued oscillations”: “... as in other records of this interval from southern Europe.” E.g. MD01-2444 and I-284.
- 1 27 Clarify what it is that indicates cooler and wetter conditions (it’s not the identification of MIS 6e!)
- 2 36 Could you say what the resolution was in that study?
- 2 41 Replace “allow” with “have allowed”
- 2 45 Replace “is not being” with “has not been”
- 2 49 Replace “already available” with “existing”
- 2 57 Replace “this presented study” with “our”
- 2 57 Delete “want to”
- 2 58 Change to past tense
- 2 61 Change to past tense
- 3 67 “meter” should be plural
- 3 77 “latitudes” should be singular
- 3 88 It would be helpful to know whether these forest and shrub formations represent the “natural” state of the vegetation versus the result of human impacts (e.g. pastoralism).
- 4 99 “those” is ambiguous... can you say what “those” refers to? (Existing pollen data?)
- 4 101 Chronology section – perhaps the explanation of how (at least this part of) the Lake Van sequence has been aligned to the marine isotope stratigraphy belongs here?
- 4 114 How were the age control points identified – in which proxy record?
- 3 127 Insert “group” after “taxonomic”
- 5 131 “percentages” should be singular
- 5 133 Should be “lake surface”?
- 5 137 Replace “was” with “were”
- 5 142 Insert “were made” after “measurements”
- 5 157 “deciduous forested” ... I think you need to specify whether this is closed or open forest because the implication of following this with “open steppic landscapes” is that the forest was closed canopy which, given the low AP%, is unlikely. Which leads to the next comment...
- 5 159 With low AP % values, I’m not sure “forested” gives the right impression. It sounds a bit too, well, “forested”! Is there an alternative term that would be a better representation of the open landscape with few trees that the pollen data seem to represent? Ideally, this would have its basis in modern pollen-vegetation work.

- 6 166-7 “The highest concentration peaks occur during forest intervals”. Please rephrase this to remove the circularity. (How do we know these were forested intervals? Partly, because of the high pollen concentration!).
- 6 171 Add a brief comparison with the pollen record here (to be consistent with the next sentences about *Pediastrum* which are compared with the pollen).
- 6 181 Is the amplitude exceptionally high? This phrasing suggests you have made comparisons with other records... if so, please indicate broadly which records (or kinds of records) it is high relative to.
- 7 197 Please say how you define stadial and interstadial here OR avoid using these terms here and make the correlation between particular peaks in the isotope curve and particular stadial-interstadial transitions (defined in other records) later on. I think the same applies for Termination III (since you haven’t yet clearly justified the identification of TIII in the lake Van record).
- 7 204 This should read “marked” not “remarkable”
- 7 205 Does “here” refer to this study? If so, the “generally considered” does not make sense. Please clarify.
- 7 206 The sentence starting “This general pattern...” is ungrammatical. The warm phases alternate with the cold phases. Please rephrase. Also, it is interesting that you do not mention changes in moisture availability here. There either needs to be a justification for that (deliberate?) omission, or both climatic parameters need to be considered.
- 7 207 There is something odd about the line of reasoning here. On what basis did you establish the equivalence between the phases with more trees and MIS 7e, 7c and 7a if not by comparison of the pollen record with a marine isotope record (such as that used in the stratigraphy of Martinson et al. 1987) directly or indirectly? (I.e. “comparable with the marine classification by Martinson...” does not make sense). Also, take care with using the language of marine isotope stratigraphy to directly refer to intervals recorded by the pollen record – it is not strictly correct to do that (though of course we all do it informally). Ideally, wooded intervals in the AP% curve should not be directly aligned with the (apparently) equivalent MIS stages; there are significant offsets (and uncertainties) in the timing of the beginning and end of forest intervals on land relative to the beginning and end of warm marine isotope stages. Marine pollen records, from the Iberian margin and elsewhere, which combine marine isotope stratigraphy with a terrestrial vegetation signal are the only records in which the relative timing can be established directly (and these show significant offsets).
- 7 214 Should “abrupt” be “brief”? In this context, “abrupt” doesn’t really make sense.
- 7 217 Rephrase: link the sentence starting “It is clear...” to the previous one and remove “it”, which is unclear.
- 7 217 “... vegetation communities changed.” State what kind/direction of changes this refers to.
- 7 219 When discussing events in the past, not stratigraphy, the terminology is “start” not “base”
- 7 222-3 The inference of “oak steppe-forests where summer-green *Quercus* rises consistently above 20%” needs a few words of explanation and justification, and a reference.
- 8 233 “this” should be “their” as in “their hypothesis”, but it would also be helpful to have a brief re-statement of that hypothesis here.

- 8 241 I think there needs to be a clear statement of how these records were aligned – i.e. how do you know that the vegetation changes (that you interpret to represent cooling/drying) recorded in the Lake Van sequences occurred BEFORE “... ice accumulation is evident... in MD01... “?
- 8 241 The linking phrase (“In light of these insights...”) does not work because the insights just described are not what suggests a shift from temperate to coniferous taxa.
- 8 248 Why “re-expansion” not just “expansion” (implies a second expansion)?
- 8 253 The persistence of relatively large tree populations through the period equivalent to MIS 7b was noted at Lac du Bouchet and at Ioannina; please cite this work here.
- 8 263 MIS 7c is not an interstadial... unless you want to define it as such at Lake Van (but then this must be explained and justified).
- 9 263-266 All good reasons listed here for not calling MIS 7c an interstadial.
- 9 273 Which other tree taxa are missing, besides Pistacia, from the succession... I couldn’t see any others. If only Pistacia is missing from the wooded interval equivalent to MIS 7c, this is not sufficient to say there is no succession. I think there is: as in the “7e” interval the “7c” tree population expansions begin with Betula, continue with Quercus and this is followed by expansion of Pinus populations.
- 9 275 Ensure the phrasing reflects the fact that you are describing conditions in the region of lake Van and that the same conclusions may not apply elsewhere (i.e. include reference to the region to which your conclusion applies).
- 9 277 Don’t need BP with ka, conventionally.
- 9 277 Along with the intervals that have more trees, the open (treeless) intervals also need to have their equivalence to the marine isotope stratigraphy justified. To repeat – it is not good practice to refer directly to intervals identified in a terrestrial pollen record with the MIS nomenclature (you need to demonstrate the basis for the correlation, and even then, I would still say “the interval broadly equivalent to MIS...” or similar wording).
- 9 277 Related to the comment above, replace “MIS 7d” with “pollen record between ... and ... ka” or use zone names. There are numerous other places in the manuscript where MIS terminology is used where it is not appropriate.
- 9 290 Please give references (after “... Lebanon and southern Europe.”)
- 9 293-4 This description of the vegetation during the interval equivalent to MIS 7b is not consistent with the description of this interval above (where 7d and 7b, to use the informal shorthand, are described together as having “extensive steppe vegetation... [and] inhibited tree growth...”
- 9 297 Why is higher in ‘...’? (another occurrence in line 304: ‘high’)
- 10 299 Delete “arboreal”
- 10 300 “i.e.” should be “e.g.” here
- 10 305 Check – if CO<sub>2</sub> was higher in 7b, it is more likely to have been warmer than 7d.
- 10 308 Consider using past tense in this section as it discusses events in the past rather than the record of those events.  
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- 10 315 Delay relative to what...?
- 10 318 Replace “due” with “indicated by”
- 10 324 “However...” doesn’t make sense here.
- 10 327 Reference required (to support observation about range of ecological requirements within the Quercus genus).
- 10 328 There seem to be some logical steps missing... can this be explained more clearly? Make clear that both abundance and composition of tree populations differs. Also, it is necessary to reconcile this argument for wetter/cooler conditions with the presence of Pistacia close to the start of the “forest” interval corresponding to MIS 7e.
- 11 335-6 This assumes that the “climate optimum” is equivalent to the “terrestrial temperate interval” – either justify this equivalents or use “terrestrial temperate interval” both times.
- 11 341 Replace “evident” with “suggested” or “indicated”
- 11 343 The “rapid decline in temperate trees” does not make sense... which decline does this refer to?
- 11 350-351 “... resembles the pattern of interstadial to stadial stages.” - as defined by what?
- 11 359 A landscape cannot be “less extensive”
- 11 360 “greater” would make more sense than “great” here.
- 11 362 Replace “values” with “populations” as this is about inferred vegetation now, rather than the pollen record.
- 12 370 Should also cite Margari et al. 2010 for the Iberian margin marine pollen record of MIS 6.
- 12 379 ... and this pattern is also recorded at Lake Van?
- 12 385 Which transition does this refer to? Or should it read “transitions”?
- 12 394 At face value, this should not be the only reference given for the DO events 17 to 12.
- 12 396 Not clear what is meant by “compared to”... do you mean “comparable with” or “similar to”? Or something else?
- 12 397 “Intensities” is ambiguous... should it be amplitude?
- 13 403 “is supported by” should be “suggests” if the pollen forms the basis of this climatic inference.
- 13 409 “... points to a general picture of cold but ‘wet’ conditions during MIS 6e than experienced during MIS 3.” This is not grammatically correct.
- 13 426-7 It is not clear to me what this vegetation formation would look like. Which aspect was “dense”? I think the term “steppe” is incompatible with the term “dense forest” unless the two kinds of vegetation occurred simultaneously in different areas (e.g. open steppes with discrete areas of dense forest... but that wouldn’t be called a “steppe forest”)

- 13- 431-2 “...strong thermal and hydrological seasonal contrasts during the last interglacial, and a  
14 higher humidity during the Holocene climate optimum...” are not discussed in the rest  
of the manuscript. If they are to appear in the conclusions, they need to appear earlier  
in the text as well.
- 15 453 Check spelling of Miriam...
- 20 Fig 2 Please add an indication of the basis on which the taxa shown were selected  
(ecological importance, abundant... ?). It would be helpful to know how many AP taxa  
are not included (and what proportion of the sum this represents). A curve for “other  
AP” would demonstrate this (if they are too rare to show, then this needs to be said).  
The same point applies to the NAP.  
  
Also, the curves are black (the fill is white).
- 21 Fig 3 Please indicate on what basis the MIS equivalents are assigned. Even if this is  
addressed in another paper, for this paper to make a convincing case, it needs to be  
said here too.
- 22 Fig 4 Add a statement to explain on what basis the interglacials illustrated here (MIS 5e, 7e)  
are defined (because under some definitions, 7c could also be an interglacial).
- 23 Fig 5 Inclusion of AP-PJB% from Ioannina (as well as AP%) would have been more  
informative as this signal is more sensitive to climatic fluctuation and picks out a very  
similar pattern to that in lake Van... e.g. the minor decline of temperate tree  
populations associated with MIS 7b and a post-MIS 7a millennial scale oscillation.  
  
Caption: Is it a “correlation scheme” if each curve is presented on its own timescale?  
There are some pronounced offsets in the timing of major vegetation changes which  
seem too large to be real and are likely to be exaggerated by age uncertainties. Could  
you clarify how this diagram was constructed (in the caption if not in the text), where  
timescales align NECESSARILY (because of the way the age models have been  
developed, for example) and where timescales are the original published ones (and  
the sources for those age models... for example, have you placed the I-284 curve on  
the GL synth timescale, or on the timescale published in 2008?). Without this kind of  
information, it is difficult for the reader to understand the significance of apparent  
alignments and offsets.