Responses to referees (2nd round) on CP reviewed article:

Impact of terrestrial biosphere on the atmospheric CO_2 concentration across Termination V

G. Hes et al (2021)

We are very grateful to all reviewers and to the editor for their constructive remarks and comments allowing both a better analysis of our results and a clearer communication of them. We address (in blue) the suggestions of change made by the two referees on a one to one basis.

Responses to comments by the Editor

Dear Authors,

I had a careful look on your responses to reviewers and on your new version.
Your corrections seems to be adequate for me and to follow the reviewers' requests.
However, following Rev1, I would like to ask you to be clearer about the pollen counts. I know that pollen counts in marine samples are difficult because grains are scarcely represented in such type of sediments but you should specify the range of the number of pollen grains counted per sample excluding pine. Of the 200 grains counted, in any case and for my part, I understand that you have reached at least 100 grains without counting Pinus. Is this correct? Your sentence may be confusing for non-specialists in palynology.
Yes, this is correct (except for one sample with 93 grains (without Pinus)).

For a good interpretation , consistent statistically pollen counts must reach at least 100 and in a better way 150 grains except pines ones. Because you include the numbers of taxa in your sentence, readers could understand that it is 20 taxa excluded pine. Could you rewrite your sentence on counts by separating the number of grains counted per sample, Pinus grains excluded, and the fact that you counted at least 20 taxa per sample.

We have reformulated the explanation, taking into account Referee 1 comments, to make our point clearer (lines 134-143):
"In order to obtain a reliable representation of the sample compositions at site U1386, we observe both a quantity and a diversity criteria following the methodology by Jansen (1981) and McAndrews, J.H. and King, J.E. (1976). For each sample, at least 100 terrestrial pollen excluding Pinus, aquatics and spores were counted (except for one sample with only 93 pollen counts). Thus, the main pollen sum including Pinus ranges from 128 to 770. Additionally, the majority of samples is composed of at least 20 different pollen morphotypes to accurately depict the floristic diversity of the source vegetation (McAndrews and King, 1976). Rull (1987) shows that a pollen sum of 200 grains, including Pinus, is sufficient to produce reliable estimates. Indeed, for higher values there are no significant variations in the confidence interval width. It is further argued that the pollen percentages derived from a 100 grain counts (excluding the dominant taxon - Pinus here) yield a reliable picture of the

considered sample, within the 0.95 confidence limits (Maher Jr, 1981). Pollen concentrations range between ~2500 and 52000 grains.cm-3 (Fig. S2), which are typical values for deep-sea sedimentary sequences (1-2 orders of magnitude lower than for lacustrine sequences) and remain above the reliability threshold (~2500 grains.cm-3) for pollen assemblages containing deteriorated grains (Hall, 1981)".

Agreeing with Rev3, I would like to have exactly the composition of the pollen groups. That may be useful to add this information in the diagram caption. You have to be clear for the reader and bring all the information for non-specialists about their composition which helps for understanding your interpretations. Could you please add in supplementary data a table with the composition of the different groups as you use them for the reconstructions.

The pollen composition for each ecological group defined on record U1386 is clarified in Table 1. This classification is adapted from the Suc 1984 (Origin and evolution of the Mediterranean vegetation and climate in Europe).

Did you finally included the Praclaux dataset in your reconstructions, I have understood not even if the data have been provided by the reviewer in an attached file. I would like you include them as requested or justified why you did not.

The Praclaux data is now included in the reconstructions.

And please take care on the size of the names in the figures (ex diagram) to be sure they will be readable after reduction in the paper at 100% printing (perhaps it was due to the presentation in your sending document but please verify).

The text size in Figure 7 and 9 has been increased. Is it possible to provide CP with pdf figures in order to have better quality?

These are only little amendment that will be done quickly before taking my final decision on your paper. Waiting after your new document.

Best regards
Nathalie Combourieu-Nebout

We want to bring to your attention the fact that the pollen database and resampled data is under review at Pangea.de and therefore we are currently waiting for a doi number as mentioned line 670:
"The IODP U1386 pollen record and the pollen database across Termination V documented here are available on the 30 PANGAEA data repository at https://doi.pa"ngaea.de/10.1594/PANGAEA.939160 and *DOI number yet unavailable* respectively.

<u>Responses to comments by Referee 1</u>

The authors have made many changes, but they have not increased the sums of the pollen samples. This is a pity and decreases the reliability of their work, otherwise interesting.
The increase in the number of sites (14 to18) is a welcome improvement.

Line 40: is it possible to show on a graph where you make TV finish? As another reviewer highlighted, it seems that what you define as termination is extremely long. Perhaps in SI, provide a graph of the oxygen isotopes and insolation for the whole of MIS11?

The duration of TV is already shown by a blue bar on Figure 3 (answering to a previous comment).

Line 122 and following: provide the volume or the weight of the sediment sample on average.

The minimum, maximum and average volume of sediments was provided. The volume of each sample is also available on the published data on the Pangea repository (https://doi.pangaea.de/10.1594/PANGAEA.939160).

Lines 133, 134: when you write "excluding Pinus", does this bear on the number of morphotypes or on the sum? If it is on the sum, the number of pollen grains counted becomes extremely low and with a low statistical value, especially for the taxa with a low representations (that you use as seen in table 1). Please precise and increase your counts if necessary. I note that reviewer 3 is also not entirely satisfied by the extremely low sum.
The concentrations are sufficiently high to provide you with a residue large enough to make slides to reach a reasonable pollen count.
The sums used for the percentages need to be clearly provided in this paper (as well as on the Pangea server if published). Your data need to be transparent (immediately available to the reader) at this stage.

Lines 133-142 have been modified in order to clarify our methodology and to show how it is supported by previous work:
"In order to obtain a reliable representation of the sample compositions at site U1386, we observe both a quantity and a diversity criteria following the methodology by Jansen (1981) and McAndrews, J.H. and King, J.E. (1976). For each sample, at least 100 terrestrial pollen excluding Pinus, aquatics and spores were counted (except for one sample with only 93 pollen counts). Thus, the main pollen sum including Pinus ranges from 128 to 770. Additionally, the majority of samples is composed of at least 20 different pollen morphotypes to accurately depict the floristic diversity of the source vegetation (McAndrews and King, 1976). Rull (1987) shows that a pollen sum of 200 grains, including Pinus, is sufficient to produce reliable estimates. Indeed, for higher values there are no significant variations in the confidence interval width. It is further argued that the pollen percentages derived from a 100 grain counts (excluding the dominant taxon - Pinus here) yield a reliable picture of the considered sample, within the 0.95 confidence limits (Maher Jr, 1981). Pollen concentrations range between ~2500 and 52000 grains.cm-3 (Fig. S2), which are typical values for deep-sea sedimentary sequences (1-2 orders of magnitude lower than for lacustrine sequences) and remain above the reliability threshold (~2500 grains.cm-3) for pollen assemblages containing deteriorated grains (Hall, 1981)".

For sake of transparency, we provide the link to the counted pollen data (including the sums) stored on the open access Pangea repository: https://doi.pangaea.de/10.1594/PANGAEA.939160

Line 187: wouldn't it be possible to transform concentration in percentages rather easily? (a suggestion only)

Yes it would be possible, but in the case of de Vernal and Hillaire-Marcel (2008), we don't have access to the precise composition of the pollen concentrations (arboreal pollen or simple shrubs).

Table 3: I would prefer to see this table with the oldest zone at the bottom and the most recent one at the top. Additionally check carefully the spelling of the Latin names. This table still has many typos, see pdf file.

We believe that this change is not fully needed and that it would require changing the numbering of Figure 5a) in order to be consistent. A classification into forest groups rather than date of publication makes sense because this is how we analyze the data in the rest of the article.

Lines 246-247: add a sentence to indicate that the pollen concentrations are good and are provided in SI.

We have added the following sentence in the Method section which is dedicated for this purpose (line 143-145):
"Pollen concentrations range between ~2500 and 52000 grains.cm^{-3} (Fig. S2) which are typical values for deep-sea sedimentary sequences (1-2 orders of magnitude inferior than for lacustrine sequences) and remain above the reliability threshold (~2500 grains.cm^{-3}) for pollen assemblages containing deteriorated grains (Hall, 1981)."

Line 567: carbon stock: add a call to reference explaining how it is calculated exactly here; or provide details in the method section (but not just in the caption of figure 8). Where do the GtC values come from?

Figure 9 a and c: Is the explanation of what a fraction of the total carbon stock provided anywhere?
The caption of figure 9 contains some methodological information that it probably better to move to the Method section of this manuscript.

An extra sentence was added to section 2.3.1:
"We estimate the terrestrial biosphere carbon stock as the sum of above- and below-ground carbon (e.g. green biomass + structural biomass + slow Soil Organic Matter (SOM) + fast Organic Matter SOM) derived from the net productivity computed for each continental grid following Brovkin et al., (2002)."
Additionally, a short explanation remains below figure 9: "The simulated carbon stock is derived from the net productivity computed over each continental grid (Brovkin et al., 2002, see section 2.3.1). "

See several minor comments directly were made on the main ms pdf and the SI pdf. More attention to details is still required.

Changes have been made accordingly.

Responses to comments by Referee 3

This is the second time I review the manuscript submitted by Hes et al., and in my view, this revised version is considerably improved. I would like to thank the authors for considering

my previous comments carefully and revising the text in critical parts to achieve clarity for the readers (e.g., on the duration/definition of Termination V). I also appreciate their efforts to look for the suggested raw data to expand their analysis, and I would like to let the authors know that I am also disconcerted by the fact that previously published datasets are not available to the scientific community. My recommendation is to accept this manuscript for publication in Climate of the Past after the authors consider the following minor comments:

1. The data from Praclaux have been for long available in the European Pollen Database without any restrictions. I here attach the dataset that I downloaded in the past so as the authors can include this key site in their analysis.

Thank you for providing the pollen sequence. It has been added to our analysis (see Table 2, Figure 5).

2. The authors should also consider the high temporal resolution pollen data from Lake Ohrid in their analysis published in Kousis et al. 2018, and Koutsodendris et al. 2019, which can be found online in the PANGAEA database. These datasets are of four times higher resolution than the Wagner et al. (2019) study considered in the manuscript, hence they will substantially improve the statistical output. The authors seem to have overlooked this comment that I already made in my first review.

Thank you for bringing to our attention these interesting papers here. Unfortunately, the Koutsodendris et al. 2019 paper focuses on MIS12 and does not extend earlier than 420 kyr BP. This is the reason why we don't integrate this paper in our compilation of deglaciation records.
The Kousis et al., 2018 does cover the relevant period for our study. However, replacing Wagner et al., 2019 arboreal pollen data by the higher resolution of Kousis et al., 2018 doesn't change our results because all pollen records are anyways resampled with a 2-kyr time step which erases the sub-millennial details. We would like to remind that the focus of this paper is not the millennial variability but rather the forest evolution across the 30 kyr deglaciation.

3. Please add the reference Turner and Hannon (1988) to justify the inclusion of Populus and Salix in the Mediterranean Forest Group to avoid confusion of the readers because of the broad expansion of these trees in the European continent.

We believe that Turner and Hannon (1988) is not the appropriate reference to explain the inclusion of Populus and Salix in the Mediterranean Group but rather Polunin and Walters (1985) and Castro et al. (1997). We clarify this point line 156:
"The Mediterranean Forest (MF) is a broader group including the Mediterranean taxa group together with all temperate and moisture-loving tree (*Populus* and *Salix* are included here following Polunin and Walters (1985) and Castro et al. (1997)) and shrub taxa excluding *Pinus, Cedrus, Hippophäe, Helianthemum* and Cupressaceae."