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Reply on RC2

Dirk Nikolaus Karger et al.

Author comment on "CHELSA-TraCE21k v1.0. Downscaled transient temperature and precipitation data since the last glacial maximum" by Dirk Nikolaus Karger et al., Clim. Past Discuss., <https://doi.org/10.5194/cp-2021-30-AC3>, 2021

CHELSA-TraCE21k v1.0. Downscaled transient temperature and precipitation data since the last glacial maximum", Karger et al.

General comments:

This manuscript presents a method of downscaling climate model data, using an algorithm, with objective to create high-resolution global monthly climatology for precipitation and temperature for the period of last 21000 years. The manuscript consists of description of the method, evaluation of obtained results and an example of potential use of created high-resolution climate data set in paleo-ecology to detect refugia of plant species at the end.

The final product of this research, in format of high-resolution climate data set, presents an important result, that should hopefully find its application in several scientific fields. I highly appreciate efforts to get the final data set, which, I believe, was a difficult, time-consuming and very technical task. That technical part is well presented and documented within the manuscript. However, I find that the rest of the manuscript has serious shortcomings, especially the evaluation of the obtained data set, what is expected to be the central part of this research. There are also serious issues in manuscript structure. Some figures are presented without any deeper analysis, while on the other hand there are chapters that describe validation of the obtained data set, but without figures, that actually follow in subsequent chapters, which affects significantly the readability of the manuscript. At the end, there is a well described chapter about potential application of the high-resolution data set, however, without clear connection with the rest of the manuscript. It could represent a highlight of this research and be a crucial proof for efficient application of the data set, but it is not even mentioned in the main objective (although it exists in abstract and is mentioned in introduction). There are also inconsistencies in use of terms and symbols throughout the text that, for example, lead to confusion in understanding of some parts of the manuscript, of some figures and even in understanding of correct name of the algorithm in the abstract.

This manuscript has some good material and important results, but it requires significant improvements and better structure in order to be considered and at the end accepted for publication in this journal. Therefore, I would suggest a major revision, to give the authors a chance to improve it, but with caution to stay within the scope of this journal. My further specific comments are listed as follows:

Response: Thank you for your judgment on the value of the generated climate datasets. The generation of this dataset was our main aim, and the evaluation of its usefulness will be improved.

Specific comments:

Line 9, Line 14: What is the name of the algorithm? Is it "CHELSA-TraCE21k downscaling algorithm" or "CHELSA V1.2 algorithm"? Please, be consistent in using specific terms throughout the text. In Line 17 it says "CHELSA TraCE21k output" (without hyphen), which leads to confusion since the very beginning. In addition, in the title of the manuscript it says: "CHELSA-TraCE21k v1.0", and that part "v1.0" does not appear at all in any part of the manuscript.

Response: Will be made more consistent by better explaining the terms and by cleaning the text accordingly.

Lines 26-29: There are several applications mentioned, where temporal and spatial variability of temperature and precipitation matter. I would like to see at least one more of these applications described in detail, where your high-resolution data set can be used. I believe it could demonstrate the added value of created high-resolution data set. However, that would probably lead to writing of a completely new manuscript, possibly out of the scope of this journal.

Response: It seems odd that this is mentioned here, as we gave one application an entire chapter (Chapter 6). We are not sure how we can add more here. What we can add is a short paragraph on possible other applications. Actually performing such applications would render the manuscript too heavy and hard to read. It would deviate readers from the main aim of the manuscript.

Line 58: How do you end up with the year 1990, when you start from 21K BP and use 100-years time steps? And, please, do not use hyphen in "21K BP", it is not correct, unless it is an adjective.

Response: This is based on the timesteps of CCSM3 TraCE-21k. The last timestep for the 20th century goes until 1990. We will clarify this in a revised manuscript.

Lines 60-72: What is the main reason to use exactly this model? Please, justify.

Response: The model is transient and can therefore also be used for dynamic modelling, as for example highlighted in chapter 6.

Lines 67-72: If you say in Lines 66-67 that CCSM3 is global climate with coupled ocean, atmosphere, sea-ice and land surface components, then try to maintain the same order of the Earth system components when you describe characteristics of each one, in order to maintain consistency.

Response: Will be changed.

Line 74: What is CHELSA? Is it a data set or an algorithm? It is very confusing. What does this acronym stand for?

Response: Climatologies at high resolution for the earth's land surface areas. It's both the name of the output dataset and the algorithm. Will be explained in a revised version.

Lines 245-248: Very confusing, at the end, I don't understand what is presented in Figure 1. Especially due to use of hyphen in the figures, that gives impression it is a "minus" (22k-BP). Please, avoid that in all other figures, too. Also, there is no any discussion about that figure, only the statement in the legend that it shows "exceptional climate dynamics". Please, avoid use of such strong words, especially if they are not supported by any explanation.

Response: Will be changed.

Lines 258-264: It is not very clear what is shown in this figure. Did you calculate difference of all mentioned 100-year BP periods from 1990 year only? Or from some annual mean of 1960-1990 period, or 1900-1990? Also, there is no any discussion about this figure and the same comments stand as for the previous one. In addition, I see some strange separation in anomaly sign in southern hemisphere, approximately around 10 S and 40 S. Is there maybe some problem with the downscaling algorithm for that region? Or there is some physical explanation for this pattern?

Response: The anomalies are actually taken directly from the CCSM3-TraCE21k dataset and therefore cannot be caused by the downscaling approach.

Lines 265-359: I would suggest to reorder and rewrite chapters 4.1, 4.2, 4.3, 5.1, 5.2 and 5.3. In a current form, it is difficult to follow. It would look much better and improve readability if you could merge 4.1 with 5.1, 4.2 with 5.2 and 4.3 with 5.3.

Response: Thank you for the suggestion. We will reorder the manuscript accordingly by merging the respective chapters.

Line 266: What is the resolution of GHCN? Is it comparable with your data set?

Response: GHCN consists of point measurements.

Lines 360-409: This whole chapter does not seem to have a good connection with the rest of the manuscript, although it gives an important application of the obtained high-resolution data set. A suggestion could be to remove it from this manuscript and to try to improve the rest with more profound and more comprehensive evaluation of the data set. Current chapter could be used with several other examples of potential applications of the high-resolution data set with objective to create another manuscript.

Response: In the beginning you stated that a potential highlight for an application would be needed. The chapter is included to show exactly such a use case. The application also serves as a plausibility check of the downscaled data. If the glacial refugia cannot be modelled correctly, the downscaled data might be wrong, which is not the case here.

Technical corrections:

Line 25: Spatial resolution should not be expressed in square kilometers. I would rather say "at spatial resolutions lower than 1 km", for example

Response: Will be changed.

Lines 73 and 78: Repeated chapter number

Response: Will be changed.

Line 76: Acronyms ERA and GPCC are mentioned for the first time in manuscript, therefore, it is expected to write their meaning.

Response: Will be changed.

Line 177: It seems there is an extra space between the words "level resulting"

Response: Will be changed.

Lines 184, 186, 195, 196: Please, use the hyphen when you have number, followed by unit when it is an adjective (4-km grid resolution, 3-km grid cell) and spacing when you have number and unit when it is not an adjective (1 km, not 1km). Try to maintain consistency throughout manuscript in all other similar cases.

Response: Will be changed.

Line 210: It is not understandable, is it a continuation of the sentence, that should be separated by comma and followed by small letter or something else?

Response: Will be changed.

Line 215: One "being" extra, please, remove it.

Response: Will be changed.

Line 216 and 240: 30-arc sec. resolution/grid

Response: Will be changed.

Line 229: windward-leeward equations

Response: Will be changed.

Line 234: Are these 2 dots instead of comma? Please, correct it.

Response: Will be changed.

Line 245: 1-km paleoclimatic dataset

Response: Will be changed.

Lines 255 and 263: Why is it written "8.2 kiloyear", when in all other cases you use only "k"? Please, maintain consistency in use of symbols throughout the manuscript.

Response: Will be changed.

Lines 282, 344, 373, 380, 395, etc.: 18k PB and 1k PB. Please, maintain consistency

throughout the manuscript by correcting other similar cases

Response: Will be changed.

Lines 302-303: Another different way of writing 18k BP and 1k BP; 1-km resolution

Response: Will be changed.

Line 305, 308 and 316: It is RMSE, not RSME.

Response: Will be changed.

Line 320: Taylor diagrams; typing error with an extra "f"

Response: Will be changed.

Lines 328-343: "CHELSA_TraCE21k model", "CHELSA_TraCE", "TraCE21k", "TraCE", "CHELSA-TraCE21k time series data", "CHELSA V2.1" - so many similar and confusing names in this short paragraph, that it is impossible to follow. Please, rewrite it and try to be consistent in using specific terms.

Response: Will be changed.

Lines 354-359: ice sheet, not ice shield

Response: Will be changed.

Line 390: Typing error "the"

Response: Will be changed.

Line 420: "comparably well when compared". Please, try to find better words

Response: Will be changed.