

Interactive comment on “Borehole climatology: a discussion based on contributions from climate modeling” by J. F. González-Rouco et al.

Anonymous Referee #1

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General comments:

The present manuscript is an important overview about the potential use of borehole data to reconstruct past temperatures. In particular, a thorough review about the interface of borehole and climate model data is given, which has been lacking as far as I know. The authors provide a very useful discussion on external forcing and problems with the zero flux condition. Likewise, the discussion of the relative roles of snow cover and soil water content will prove useful.

I recommend the manuscript for publication in CP given that the authors address the minor remarks below.

The language is too diverse. There are several paragraphs with inferior English com-

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pared to the remainder of the text, e.g. page 9-12, 36, 42. Please proof-read these (and other) sections. Some suggestions are given in the specific comments below. There is also an inconsistency in labelling model simulations in text and accompanying figures. The choice of the vertical axis is less than optimal in Figs. 1c, 11 and 12b.

I suggest to remove all occurrences of "A.D." in the dates, since this is only obscuring the text - all the dates discussed here cover less than the last 2000 years.

The authors claim (page 8) that borehole profiles can deliver useful information about low frequency climate changes. Given the numerous difficulties (which all are nicely discussed in the text), it would be desirable to give an error estimate here.

The conclusions presented here are based on the use of a single model. It would be very interesting to see how other models behave in this respect. In particular, it has been shown that ECHAM4, the atmospheric model used here, behaves quite differently when run in higher resolution than T30. Are there any higher resolution simulations?

Specific comments:

Page 3, line 25/26: The correct reference is Stendel et al., 2006 (not 2005). The entry in the references is correct, but not the one in the text.

Page 4, line 11: "Research avenues" - what is that?

Page 5, line 14: Replace "Spoorer" with "Spörer".

Page 5, line 18: Replace "Burger" with "Bürger".

Page 6, line 3: Replace "of the surface crust" with "below the surface".

Page 6, line 6/7: Add "thus effectively" between "process" and "operates" and clarify which process you are talking about.

Page 6, line 7: delete "the" before "low-frequency";

Page 7, line 11: Although? I do not see a contradiction here. Please explain.

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Page 7, line 27: Add "see" before "Pollack".

Page 7, line 28: Delete ":".

Page 8, line 26: Replace "Other"; with "Further".

Page 9, line 4/5: Delete "along the next few pages".

Page 9, line 6: "For some specific purpose" - what do you mean?

Page 9, line 7 (and many other places): To my knowledge the model is called ECHO-G (not g).

Page 9, line 11: "some hypothesis" - what do you mean? Also note that it is either "some hypotheses" or "a hypothesis".

Page 9, line 24: Add "respectively" after HOPE-g (which for the same reasons as above should read HOPE-G).

Page 10, line 1: Replace "varies" with "increases".

Page 10, line 4: "were applied" - although this is correct, I would prefer "had to be applied".

Page 10, line 15: Delete "may".

Page 10, line 16: Replace "visited" with "discussed" or "addressed".

Page 10, line 17: Add "a" before "1000 year long".

Page 10, line 25: Replace "damp" with dampen".

Page 10, last word: replace "fixed" with "a constant value of".

Page 11, line 8: Replace "previous" with "these".

Page 11, line 18: What do you mean by "the largest impacts on centennial variability"? Reformulate.

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Page 12, line 6: Replace "along the 1000 years" with "over the 1000 year period".

Page 12, line 12: How long was the spin-down? Previous simulations with ECHO-G have partly suffered from too short spin-down.

Page 12, line 13: Delete "also". Page 12, line 14: Add "either" after "FOR2". Page 12, line 20: Replace "analyses" with "analyse".

Page 12, line 24: Change order of citations Gouiran, 2007b and 2007a, respectively.

Page 13, line 1 and Fig. 1: Not clear which period is meant here. Please clarify.

Page 13, line 6: Replace "(" with ",".

Page 13, line 16: Delete "the" before "depth" and "temperature".

Page 13, line 19: Add a comma just after the closing bracket.

Page 15, line 17: Replace "biasses" with "biases".

Page 17, line 19: Replace "with" with "to".

Page 18, line 9: Cut-and-paste error in "the tropical areas of America and eastern North America"? Needs to be reformulated.

Page 18, line 19: Add "cause" between "thus" and "a bias".

Page 18, line 26: "a northward shift of the hydrological cycle" - what is that?

Page 19, line 5: Delete "two".

Page 19, line 22: Replace "along" with "during".

Page 20, line 7: Replace "easy" with "trivial".

Page 20, line 12: "methodological replications" - what is that?

Page 20, line 17: Replace "of relevance" with "relevant".

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Page 20, line 20: Replace "subjected" with "subject".

Page 22, line 11: Replace "decimated" with "reduced". Same on line 24.

Page 22, line 25: Replace "were closer" with "resembles".

Page 23, line 25 and at several other locations: Replace "bellow" with "below".

Page 23, line 27: Replace "loosing" with "losing" and delete "some" on the same line.

Page 24, line 4: Add a comma after "200 m".

Page 24, line 11: "obtention" - never heard of... What do you mean? I assume you want to say "prior to obtaining the spatial average"?

Page 24, line 14: Replace "in the real world applications there is availability of instrumental or reanalysis data" with "in the real world, instrumental or reanalysis data are available".

Page 28, line 16: Replace "Lower" with "Smaller".

Page 29, line 25: In my version of the text, something is wrong with the references (they are not marked in colour).

Page 30, line 17 and Fig. 8: Here two different geographical positions are given, as well as there is reference to two model runs. Please check for consistency between text and figure caption.

Page 35, line 7-11: Even though the authors present an overwhelmingly extensive list of references, they are actually missing one. In the approach by Stendel et al. (2007), boundary conditions are provided by a GCM to an RCM, and the RCM output is used to drive a sophisticated permafrost model on the same grid as the RCM. The authors demonstrated that this approach is superior to using only GCM data.

Page 36, line 16: It would be helpful to have the coordinates of Fargo and Cape Hatteras in the text, not only in the figure caption. It would also be helpful to express

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western longitudes by "90°W" or "-90°" instead of "270°E".

Page 36, line 18: Replace "between -30°C in winter to 30°C in summer" with either "between -30°C in winter and 30°C in summer" or "from -30°C in winter to 30°C in summer".

Page 36, line 20/21: Delete "reached during some winters (summers)".

Page 36, line 21: Replace "hinders" with "prevents".

Page 36, line 23 and 24; Replace "bellow" with "below".

Page 36, line 24: Replace "seldom" with "rarely".

Page 36, line 25: Add "a" between "example of" and "site".

Page 37, line 27: "These under- and slight over- estimations" - cut-and-paste error?

Page 38, line 5/6: Add "which is" before "larger than" and delete "being".

Page 39, line 13/14: "face shift" - hopefully not! Replace with "phase shift".

Page 39, lines 16 and 27: Replace "bellow" with "below".

Page 40, line 14: Replace "de" with "the".

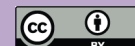
Page 41, line 8: "extrange" - I have no idea what you are talking about here.

Page 41, line 16: Replace "latxlon" with "in latitude and longitude" or leave out altogether.

Page 41, line 17: What do you mean by "IPCC scenario ISP2a"? I strongly assume you are talking about scenario A2?

Page 41, line 25: What do you mean by "healthy discussions"?

Page 42, line 6: What do you mean by "climate change detection orientation"? I assume you mean an approach?

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Page 42, line 10/11: Replace "beyond the possibilities of text" with "beyond the scope of this paper".

Page 43, line 2: Replace "deep into the ground" with "into the deep ground".

Page 44, line 1: Replace "At 2100 AD" with "In 2100".

Page 44, line 3: Replace "compatible with" with "comparable to".

Page 44, line 7: Replace "comparatively" with "much" or "considerably".

Page 44, line 14: "facies" - I have no idea what you are talking about.

Page 44, line 27: Replace "reported and discussed about" with "reported about and discussed".

Page 45, line 2: Replace "none" with "no".

Page 45, line 4: Explain what you mean by "elsewhere" or delete altogether.

Page 45, line 14/15: Replace "apply" with "be the case".

Page 45, line 17: Replace "which could in extreme cases lead" with "which, in extreme cases, could lead".

Page 45, line 19: Delete "past".

Page 46, line 14: Replace "may influence significantly" with "may significantly influence".

Page 46, line 19: Replace "to" with "with".

Page 49, lines 26 and 28: Replace "Buerger" with "Bürger".

Page 50, line 22: Replace "temproal" with "temporal".

Page 51, line 18: Replace "baja" with "Baja".

Page 53, line 11: Replace "ECHO-g" with "ECHO-G".

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Page 53, line 29: "Engg." - is this correct?

Page 58, line 18: Replace "Amman" with "Ammann".

Page 59, line 17: Replace "Moelders" with "Mölders".

Page 61, line 15: Replace "Raisanen" with "Räisänen".

Page 62, line 11: Replace "Dumenil" with "Dümenil".

Page 62, line 14: Replace "fuer" with "für".

Page 64, line 30 to page 65, line 4: Change order of these two references.

Page 68, Fig. 1: Personally, I don't think an offset of 0.05 K in Fig. 1C is helpful, at least not if the y-axis covers 3 K.

Pages 69 and 70, Figs. 2 and 3: Which period is covered in Fig. 2a and 3a, respectively?

Page 71, caption to Fig. 4: "the represented time interval" - is that 1700-1900?

Page 72, caption to Fig. 5: Replace "ECHO-g" with ECHO-G".

Page 75, Fig. 8: See my comment to page 30, line 17.

Page 76, line 2: Delete "the real locations of".

Page 79, Fig. 12: What does the blue stippled line mean? I know it is in the text, but it also needs to be given in the caption.

Missing reference: Stendel, M., V.E. Romanovsky, J.H. Christensen and T. Sazonova, 2007: Global warming and permafrost: Closing the gap between climate model simulations and local permafrost dynamics. *Glob. Plan. Change* 56, 203-214.

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