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Interactive comment on "North American regional climate reconstruction from Ground Surface Temperature Histories" *by* Fernando Jaume-Santero et al.

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Response to comments by Anonymous Referee 2

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We thank the reviewer for this constructive commentary.

[1] The measurement error for different temperature-depth profiles are different, and the noise of temperature profile affects the choice of the "cut-off

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value", so why retained the same number of singular values? I think using the cut-off value is more reasonable than choose fixed number of retained singular values because for different temperature data the level of singular value maybe not on a same level.

The reviewer is right. The noise level varies among measured profiles, thus the noise will affect the choice of the eigenvalue cut-off filter. In our case, we used a cut-off of 0.03 which resulted in 4 singular values being retained for all profiles except for CU-C-357 (3 S.V) measured in Cuba. We will include this information in the revised version of the manuscript.

[2] The ground thermal diffusivity is κ *= 1.0*$\times$*10*$^{-6}$ *m*^{2}*s*$^{-1}$*, being taken as a one-fit-all case.*

This is right, we set the thermal diffusivity as κ = 1.0$\times$10^{-6} for all cases. Unfortunately, thermal diffusivity measurements were not made on rock samples for most of the boreholes. We thus used an average thermal diffusivity value.

[3] In Page 4, Line 24, use T(z = 0, t), rather than T(t, z = 0)

All right, changes will be applied to the manuscript.

[4] Page 4, Line 28, references should be cited after expression of δ

We will add Jaupart and Mareschal (2011) as a reference.

[5] In Page 7, Line 24, equation (9) the discretion of 500 year in 10 time

step is questionable. According to equation (6), it is more reasonable if the distribution of temporal length is chose as some kind of exponential growth.

We agree with the reviewer, logarithmic distribution of time-steps have been used in previous studies (Pickler et al., 2016) for long-term GST histories (100000 years BP). However, for the reconstruction of 500 years, we are using this distribution to focus on the recent past. Moreover, we tested several configurations including fixed time-steps and there were not significant differences among them. We will expand the explanation in the revised manuscript by including Figure 1.

[6] In Page 7, Line 30, there is "presentpresent" in this line.

All right.

[7] In Figure 5, the large deviation of the reconstructed temperature changes may be due to the same choice of 100 m of linear regression. As the presumption of method, the reconstructed temperature changes should start around 0.0°C at 1500 years (such as in Figure 2), but the result in this figure shows large deviation to 0.0°C. The 510 borehole sites may have different type of soil or bedrock and different heat flux, maybe the choice of 100 m of linear regression is not suitable for all sites.

The linear regression of the lowermost 100 meters allows for the comparison of different reconstructions with respect the same time baseline. Moreover, we used another method with a full inversion, including T_0 and Γ_0 into the parameter vector. Similar results were obtained for the mean temperatures (Figure 1 in the present document). The reviewer is right that inverting for T_0

and Γ_0 results in a smaller deviation of the reconstructed temperatures, and a smaller jump at the start of the ground surface temperature history.

[8] In Figure 7, why the temporal lengths here is same for the near than for the remote past which are different with distributes as in equation (15)?

We appreciate the reviewer's point. In order to be compared, individual inversions are referenced to their year of measurement. Because this year of measurement spans over a range of $\sim$6 decades, it was necessary to increase the time length (50 years) for the recent past in order to obtain a regional mean temperature with a sufficient number of inverted temperatures per region.

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References

Jaupart, C. and Mareschal, J.-C.: Heat generation and transport in the Earth, Cambridge University Press, 2011.

Pickler, C., Beltrami, H., and Mareschal, J.-C.: Laurentide Ice Sheet basal temperatures during the last glacial cycle as inferred from borehole data, Climate of the Past, 12, 115–127, doi: 10.5194/cp-12-115-2016, 2016.

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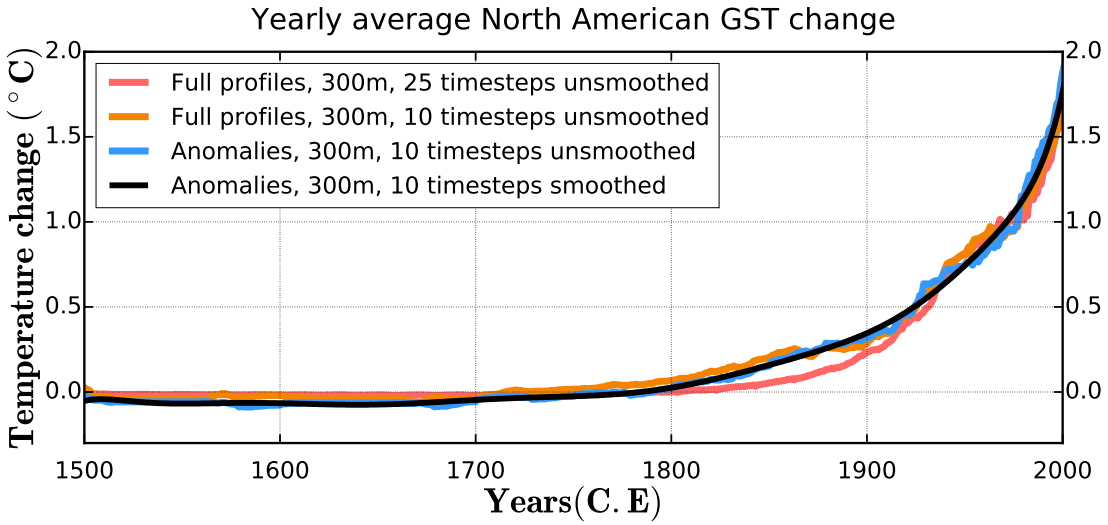

Fig. 1. Mean North American GST history obtained using different configurations.

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