**Climate
of the Past
Discussions**

Interactive comment on "Surface thermal perturbations of the recent past at low latitudes - inferences based on borehole temperature data from Eastern Brazil" *by* V. M. Hamza et al.

Anonymous Referee #2

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Comments on: Surface thermal perturbations of the recent past at low latitudes - inferences based on borehole temperature data from Eastern Brazil V. M. Hamza, A. S. B. Cavalcanti, L. C. C. Benyosef

This paper presents an analysis of past climatic variations from geothermal data for Brazil. The fact that some of these data are new, and originating from an important area in the global climate context, which is not well covered in the borehole climatology database, makes this paper a potentially valuable contribution. However, the analysis needs significant improvement because the data appear to have been over-interpreted. The manuscript needs some changes before it is considered for publication.

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The main point that needs to be addressed is that of the criteria for justifying the choice of model for the inversion. Figures 3a-3c and Figures 4a-4c show the temperature profiles and subsurface temperature perturbations in each of the regions analyzed. Only three of the temperature profiles shown in Fig. 3 reach near 300 m. In Figure 4 only one of the temperature anomalies reaches that depth. Most data appears to be less than 200 m in depth. Such depths would not retain a significant signal from the half millennium included in the model, such that the results from the inversion of each one of the individual temperature logs would not be comparable.

The inversion procedure itself is problematic because of the excessive temporal extent. For example, Fig. 5a shows the ground surface temperature changes from about 6 temperature depth profiles from southeast Brazil. However, Table 1a shows the depth for some of the boreholes (some are missing) used in producing Fig. 5a. The deepest temperature profile is 214 m, not enough to yield the surface temperature changes of the last 500 years. Furthermore, the loss of resolution by heat diffusion is significant and increases towards the past, such that the comparison of the magnitudes of the cooling or warming periods retrieved from inversion are not supported.

The cooling episode during the 17th and 18th centuries with magnitude of less than 1C discussed in the text is not visible in any of the temperature anomalies shown in Figure 4a-4c. So where is this cooling period coming from?. Likely this is an artifact of a poor choice of model for the inversion. The shape of the temperature anomaly contains all the information that can be reconstructed from an inversion for the skin temperature of the ground. In fact, most of what an inversion does is to "transform" depth into time, and the magnitude of underground temperature anomalies into a skin temperature change history. In Fig. 4b for example, the temperature anomaly for Seropedica shows a positive anomaly (i.e. ground gained heat at all times) all the way from 200 m to the surface, but in the inversion analysis for Seropedica, the site shows a cooling from 1500 to about 1850 of at least 0.5 K. This is clearly an artifact.

I suggest that the authors redo their analysis with a model spanning a shorter time in-

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terval and check for consistency between inversion results and temperature anomalies.

Other comments: - The list of references is very out of date. Some of the most recent and important works are missing from the reference list.

- I suggest that the authors show all data or provide the raw data as an appendix. Since most data appears to have been published in theses already this should not be an obstacle.

- The description of Brazil's climatic zones is not really used in the interpretation of the results. It should be either deleted or placed into a proper context when analyzing the results.

- What is the so-called conventional (CVL) method of acquiring temperature data?

- Line 26, page 506: What are shallow depths according to the authors?

- Section 3 line 17: 150 m is not deep enough to determine the equilibrium profile generally. How deep is deep enough depends on the specific history of the ground surface temperature at each location.

- The section on forward model is superfluous in my opinion, and is not needed since the data are analyzed by inversion in section 6.

- line 25: the figure number is missing.

- Page 515, line 4: The resolving power of the inversion method cannot be improved by simultaneous inversion. On the contrary, sometimes inclusion of a noisy log decreases the resolution. However, joint inversion for repeated logs of the same borehole over a sufficiently long period of time may improve the resolution. - Page 518 , line 7, Please define "reasonable agreement."

- I suggest you merge all tables into one.

- I suggest you merge all of each part of Figures 3 and 4 into two figures.

- Table 2a, Do you really have 5 year resolution in 1877 and 1852? See column 6 in this table.

- In the same table: How can the rms be so small? (column 7) 4.4mK. I believe this is below the precision of thermistors and below the accuracy of temperatures measured in boreholes.

- Same comments apply to Tables 2b and 2c. and Table 3.

- Figure 1 is not really used. Delete or use it.

- Figures 6a, 6b, and 6c are not needed.

- Figure 6d is unjustified from the present analysis.

- Figure 7. Is this comparison the result of inverting data from each of this locations for the same model parameters and a priori conditions?. Is this a comparison from published analysis done with different models, and different filters?. Were these Brazil inversions here recalculated for a 300-y model? Or are these the same as in Figures 5 but truncated?

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