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Climate of the Past Discussions

Interactive comment on "A 900-year New England temperature reconstruction from *in situ* seasonally produced branched glycerol dialkyl glycerol tetraethers (brGDGTs)" *by* Daniel R. Miller et al.

Anonymous Referee #2

Received and published: 27 May 2018

The authors of this paper examined the sources of brGDGTs in a small lake in Maine USA, by comparing the distribution of these compounds in (i) soils around the lake, (ii) suspended particulate matter collected at different seasons and water depths and (iii) surficial sediments. BrGDGTs were shown to be mainly produced in situ, preferentially in fall. Then, brGDGTs were analysed in a sediment core covering the last 900 yrs. Temperature estimates inferred from brGDGTs were interpreted using available paleoclimate data in the region.

This is an interesting and comprehensive study based on organic compounds increas-

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Discussion paper

ingly used as temperature proxies in continental settings. Nevertheless, some improvements are required before publication:

- The interpretation of the brGDGT data along the sedimentary core is only based on the MBT5Me index. Absolute temperatures based on the calibration developed by Sun et al. (2011) or Russell et al. (2018) are comparable (difference of ca. 1 °C, within the range of the uncertainty associated with brGDGT calibration) and should be provided in the main text, all the more as it does not change the interpretation of the data.

- I would be very cautious about the preliminary calibration between MBT derived from SPM samples and temperature, as it is based on only 4 samples.

- A local calibration between seasonal temperature (fall temperature, when brGDGTs are preferentially produced in this New England lake) and brGDGT distribution should be developed and used for temperature reconstruction along the sedimentary core.

- The discussion section, especially the comparison of the present record with other regional ones, is sometimes difficult to follow, as some explanations are missing and all the data necessary for the understanding of the reasoning are not presented. I recommend a more careful and more detailed interpretation of the data.

- Several lipid biomarkers were analyzed in the lacustrine sediments and revealed some variations in the lake productivity over time, related to anthropogenic influence. Nevertheless, the authors should better discuss the potential human impact on the brGDGT signal. Disentangling natural and anthropogenic signals in lacustrine records is a key question which should be addressed.

Other detailed comments are given below.

Page 2

Line 18. Late fall rather than early spring.

Line 20. De Jonge et al., 2014 instead of 2013.

Lines 25-30. Please also add some recent papers examining the distribution of 5- and 6-methyl brGDGTs in lakes : Russell et al., 2018 and Dang et al., 2018 both in Organic Geochemistry.

Page 3

Line 21. How long were the cores kept refrigerated? What about the evolution of organic matter (and especially brGDGTs) during storage?

Line 29. All samplings were performed after a period of 28 to 40 days, except the last point. What is the reason for such a long accumulation time (264 days)?

Page 4

Lines 5-6. These 5 dates should be specified once again in the present manuscript to make easier the reading of the manuscript.

Line 9. According to Fig. 1, 20 soil samples were collected around the lake, which is not consistent with the number given in the text. This should be corrected.

Lines 14-17. Why were the TLE from SPM/soils on the one hand and lake sediments on the other hand separated differently?

Line 19. Please specify here the different algal biomarkers which will be analysed.

Lines 21-26. Please specify if the GC injections were made in split or splitless mode.

Page 5

Lines 1-10. A short introduction of 5- and 6-methyl brGDGTs and the related indices should be added. Were some samples injected in duplicate/ triplicate? What is the analytical uncertainty on the MBT, CBT and IR indices?

Lines 20-25. The relative abundances of brGDGTs in all the samples (soils, SPM, lake sediments) should be given in a supplementary table. Acyclic and cyclic brGDGTs (Ia, Ib and Ic; IIa, IIb and IIc; IIIa, IIIb and IIIc) cannot be distinguished in Fig. 2. The

figure should be modified to take this comment into account. The different types of green are difficult to distinguish in Fig. 2. Please choose more contrasting colours. The brGDGT distributions are not consistent through the four collection periods: the relative abundance of GDGT I decreases from June 2014 to January 2015, in contrast with brGDGT III.

Page 6

Lines 4-5. These sentences are redundant with those in lines 1-3.

Lines 24. These concentrations are not present either in a Fig. or a Table. Please provide the bulk data as Supplementary material.

Lines 27-29. These multidecadal events are difficult to distinguish.

Page 7

Line 1. Please add also the recent paper by Russell et al. (2018) to the list of brGDGT lacustrine calibration.

Lines 9-13. The different arguments provided here are not convincing. The recent lacustrine calibration by Russell et al. (2018) could be applied to the NE US lakes, with all the caution needed (not the same region, difference in terms of stratification/mixing etc.). This is indeed the only calibration based on the recent analytical method proposed by Hopmans et al. (2016) allowing the separation of 5- and 6-methyl brGDGTs. Furthermore, as shown in Supp. information, the temperature variations inferred from the Russell et al. calibration are similar to those derived from the calibration by Sun et al. (2011). Therefore, the different calibrations provide different absolute temperatures (still very close, ca. 1 °C difference) but similar trends.

Line 18. Only group I and III brGDGTs can be distinguished, not the individual compounds. CBT'5Me and MBT'5Me were inverted in Fig. 6.

Line 22. Lower instead of higher.

Page 8

Lines 1-6. This is redundant with the sentences above.

Lines 6-10. In addition to the brGDGT distribution, the brGDGT concentrations in soils, lake and SPM should also be compared.

Lines 11-12. I would be very cautious about the MBT'5Me/temperature local calibration, as it is based on only 4 points.

Lines 13-14. Where are the water temperature data?

Lines 25-26. Such a calibration should have been developed in the present study and then applied to the downcore brGDGT reconstruction.

Line 31. These concentrations should be provided as Supp. Material.

Line 33. Please remove the last sentence which is not useful.

Page 9

Line 9. Please be more explicit about similarities and differences between pollen and MBT'5Me reconstructions.

Line 16. Please provide some references here. Are hydrogen isotopes from leaf waxes not mainly used are hydrological proxies?

Lines 16-21. This paragraph should be more developed. How are temperatures reconstructed from delta D of leaf waxes?

Line 28. Where are this information derived from? Fig. 7d?

Lines 29-32. The conclusion about the predominant human impact on fires remains speculative and is difficult to apprehend.

Page 10

Lines 13-15. The similarities between Basin Pond reconstruction and other northern

hemisphere reconstructions are difficult to visualize.

Page 11

Line 2. What do the authors mean by “not a strong cross correlation? Please provide r and p values. Lines 13-14. This trend is difficult to visualize.

Lines 17-18. What is the interest of presenting local data since the authors consider them as inaccurate? I would only present statewide trends.

Lines 24-27. This is a little too short. What are exactly the mechanisms which could explain the lower MBT’5Me values in surficial sediments? Some of these “mechanisms” may be lake-/region-dependent.

Page 12

Lines 4-16 / Fig. 9a. The different algal biomarkers are difficult to distinguish in Fig. 9a. Please use contrasting colours for each biomarker.

Supplementary information

Page 1

Line 17. Where is Table S1?

Line 27. Where are the fall measurements?

Page 2

A MBT’5Me-temperature calibration should have been developed in the present study. The correlation presented in Fig. S1, based on only 4 scattered points, is not reliable.

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