

BG manuscript review

Title: A Holocene record of mercury accumulation in a pristine lake in Southernmost South America (53°S) – climatic and environmental drivers

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General comments.

This paper entitled “A Holocene record of mercury accumulation in a pristine lake in Southernmost South America (53°S) – climatic and environmental drivers” is well-written but rather incomplete on some aspects. It proposes a novel and interesting way of increasing our comprehension of the biogeochemical drivers of Hg transport in lake systems using paleo-records. As reconstruction of environmental and climatic change is often used to provide insight on future change, this work is of interest in mercury research. I particularly appreciated the part on Hg accumulation and lake sediment history (3.4) and think that previous results and discussions section (3.2 and 3.3) could be improved. So, I have some general and specific comments that are listed below. I think that this article should be revised before publication.

In the materials and methods section, I didn't get how you ended up with a 1414cm core. Could you provide more precision on sediment recovery ?

You also mention in the materials and methods that plankton, terrestrial plants, rocks and soils were sampled but it lack a lot of information on how and where this samples were collected. The revised manuscript should precise this information as terrestrial plant for example could be very heterogeneous in C and Hg concentration. Is the sampling occurred within the watershed at several sampling stations or very close to the lake ? What kind of terrestrial plant has been collected, what part ? Precise also what do you mean by soil samples (Organic and inorganic horizons ? Humus ?...)

What do you mean by carbonate-free samples ?

PCA is generally used to explore a large set of variables or observations to highlight correlation between them and to highlight the most important factors explaining the variance in the data. Your paragraph on this analysis is unclear and should be rewritten in order to explain how you “extracted” geochemical signatures” from this analysis.

In the results and discussion section, the C/N ratio has been used as a proxy to trace back the source of sedimentary OM. However, when used in linear mixing equations the C/N ratio yields the fraction of terrestrially derived organic N. The N/C ratio should be used to indicate the fraction of terrestrially derived organic carbon when compared with C_{AR} . The authors need to revise the manuscript even if the results and their interpretation maybe quite similar. (see Perdue 2007 Est, Coast. Shelf Sci. 73: 65-72). In this section you don't consider diagenesis to explain C/N change along the core.

p.6561 : line23-25. How can you conclude that sediments composition is almost exclusively OM ? Please provide a reference on the link between OM content and %C. In this sentence, are you referring at section I (line 24) or section III ?

p6563. Line 13. It is unclear why you refer to mean value and then median value.

Line 15. How about algae productivity increase, with increasing temperature and nutrient transfer from the watershed?

p.6565. Lines 17-23: I'm not convinced by your explanation. How you can conclude on C/N, %C variation during 5000yr, only by your observations during a single sampling mission? Can you provide more details (maybe adding literature) on what is happening above Mt. Burney tephra?

p.6566. I wonder how you can compare the 3-5 enrichment factor calculated in very recent years (hundred of years) with a record of several thousands years?

Paragraph 3.4.3. I wonder why you didn't start this paragraph with the PCA analysis as done in the two above section? This structuration change is a bit confusing.

Still, I think that results presented in this manuscript are of great interest but some aspects of the manuscript could (easily) be improved.

Specific comments.

- A graphic representation of the PCA could be nicer...
- p6564. Line 26. "Weather" or "whether"?
- I think references should be cited chronologically in the text e.g. (Lamy et al., 2010; Markgraf et al., 2003; Waldmann et al., 2010; Moy et al., 2011)
- P6567. Line 10-11. "must have caused ~~the Hg~~ the pronounced Hg enrichments"