

***Interactive comment on* “Environmental factors controlling lake diatom communities: a meta-analysis of published data” by S. Blanco**

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Two anonymous referees have presented a detailed review of my discussion paper “Environmental factors controlling lake diatom communities: a meta-analysis of published data”, Biogeosciences Discuss., 11, 15889-15909, doi:10.5194/bgd-11-15889-2014, 2014.

Reviewer #1

One of the referee’s major concerns is a possible bias in the selection of papers included in the meta-analysis. I agree that, during the last decades, many more calibration datasets have been published, including studies for areas underrepresented in the manuscript. However, it must be noticed that the analysis does not intend to cover all

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available studies but, as explained in the methodology, only those following a particular methodology (CCA followed by a Monte Carlo test), which, despite being one of the most common approaches, is far from being universal. Besides, many studies had to be discarded since they presented an insufficient number of variables in common with the others. Finally, several papers were eventually removed because they presented the amount of variance explained by each predictor in different ways (e.g. not as percentages, or combining different variables, see below). With these restrictions, the dataset presented in this analysis is near exhaustive.

The reviewer states that the main reason why pH or TP explain a large portion of the variation is the fact that a lot of the studies were aimed at developing diatom-based transfer functions for these variables. On the contrary, only four studies out of 40 (Chen et al., 2008; Dixit et al., 2002; Enache and Prairie, 2002; Gunn and Keller, 1990) aimed specifically at developing pH transfer functions. With respect to trophic gradients, there were only 9 papers focused on TP, nutrients or eutrophication (while considering also other variables). For instance, despite 63% of the studies taken into account TP, only 12% of them considered eventually TP as the most important explanatory factor (Table 1). Thus, the probability of parameter-biased results in the meta-analysis is very unlikely.

Some sentences were added to the Introduction explaining why it is important to study the effect of different variables along geographic and climatic gradients. The paper in fact adds new insights to the existing knowledge by providing a world-scale re-analysis of previous results. As stated in the text, to date no attempt has been done to determine diatom-environment relationships worldwide within paleolimnological studies.

English expression had been checked by Elsevier Language Editing. More details are available to the referee upon request.

The referee suggest naming lake depth and other variables as physical limnological (and not physiographical) variables. Throughout the manuscript, I refer three classes

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of variables: physical, chemical and physiographical; the first two referred to the physical/chemical characteristics of the water, while physical factors of the lake (depth, elevation, location) are treated here as physiographical variables, following the criterion of Appleby et al. (1995), Rukhovets and Filatov (2010), Arp et al. (2013) and many others.

The referee proposed also to summarize the main findings of the paper in the abstract, these appear in L22-29.

It is asked whether if there is another approach than paleolimnology for reconstructing past environmental changes in lakes. Some modelling approaches such as MAGIC (Battarbee et al., 2005) and ecosystem recovery studies (e.g. Gunn and Keller, 1990; Havas et al., 1997; Keller et al., 1992) are not considered paleolimnological techniques *sensu stricto* by their authors (see Tropea, 2008).

Concerning the sentence “a number of studies have used assumptions about the distribution of diatom taxa based on ecological preferences inferred from different world regions, leading to speculative interpretations” (p. 15891, L.25-27), I am quoting Shineman et al.’s (2009) paper who state that “without a quantitative reconstruction tool based on detailed knowledge of the modern relationship between the biology and chemistry, interpretations are speculative. Lacking a quantitative regional calibration set, these and other studies have used assumptions about the distribution of diatoms based on their ecological preferences in North America or based on correlation with other lake core proxies”

Sentences in the first paragraph of p. 15892 are different. The second one specifies one of the methods (ordination in reduced space) used in many paleolimnological studies. The criticism on CCA pointed by the reviewer is now addressed on this paragraph.

The requested supplementary table with the original predictor and criterion matrices has been added to the manuscript. Besides, the reviewer asks for more details on the calculation of the data presented in the predictor matrix: in most cases, papers

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reporting results on several systems presented only average values for each variable (thus preventing the use of sample size-weighted averages, which were added here to the predictor matrix; otherwise average values were calculated from the tables or supplementary materials accompanying the papers. This is now clarified in the text. Averaging data is presumably the only feasible methodology in this case, and is a common practice in similar meta-analytic studies (Bloom et al., 2003; Hagen et al., 2012; Montagna et al., 2008; Ruehl and Trexler, 2011). Data averaging has been recommended to minimize undue influences of particular studies (Rosenthal and Rubin, 1986) and to avoid spatial autocorrelation (Elvik, 1998; Gurevitch and Hedges, 1993).

It is requested to repeat the statistical analyses without substitution of missing data. Unfortunately this is not possible since multivariate methods used require complete datasets. Casewise/pairwise deletion of missing data would have led to an insufficient number of observations, and statistical software used handles by default these data by average substitution, which is incorrect for variables not following normal distributions (Legendre and Legendre, 2012). Note also that this substitution only concerned multivariate (and not bivariate) statistical analyses, as now made explicit in the text. The percentage of papers where each variable was recorded is now reported on table 1.

Concerning the paper reporting results from a single sample (Page 15894 L.10), this study (Kirilova, 2009) actually analyzed different diatom sub-samples from a single integrated sediment trap located in Sacroweer See, Germany, which cannot be regarded as spatially separated samples. The referee suggests also to add some papers on African and Antarctic systems to the dataset. Gasse et al. (1995) did not perform a full partition of the variance but considered the percentage explained collectively by “anions”, “cations”, etc. Similarly, Jones & Juggins (1995) gather all nutrients under the unique variable “trophic status”, and do not present measured values for any variable. This prevented the inclusion of these and other similar papers in the dataset. I could not find the reference “Verleyen et al. (2003) Antarctic Science”

The sentence about outliers in fig. 2 was corrected. Two point appearing as outliers

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correspond to two different studies in the same lake, hence only two lakes are mentioned.

It is stated also that the gradient in TP was small, while it is comparable to that observed in other meta-analysis (e.g. Darch et al., 2014), being only half of that observed in a similar worldwide study (Faithfull et al., 2011).

With respect to Fig. 3, the cutoff value of 10 studies was incorrect, the correct number is 5. A liberal criterion of >12% of valid values per variable was accepted, similar to that used in other studies (e.g. Abdul-Aziz et al., 2010; Carafa et al., 2011; Lidelöw and Lagerkvist, 2007). The paragraph starting on page 15897 L.21 discusses the effect of the conditional variance explained by other factors on the amount of variance related to lake depth. The reference to Shinneman et al. (2010) is now omitted, as the referee noted it was incorrectly quoted.

According to the reviewer, geographical factors are not relevant in paleolimnological reconstructions. Here I follow the broad-scale study of Rühland et al. (2008), who state that a wide range of differences in geographic settings affects the temporal and spatial consistency of biological responses to climatic changes. These authors observed a geographically asynchronous large-scale pattern of ecological change analyzing 200 diatom-based paleolimnological records in the world (see also Wigdahl, 2012). Fritz (2008) evidenced the presence of spatial structures in paleolimnological records. With respect of subfossil Cladoceans, Sweetman et al. (2010) showed greater unique effects of spatial than environmental variables. Nilssen and Sandøy (1986), Whiteside and Swindoll (1988) and Brock et al. (2006) emphasize also the importance of geographical factors in paleolimnological reconstructions using different proxies. The referee also asks for a full discussion on climatic effects on diatom communities. Being this a meta-analysis (and not a review) on published data, this would fail out of the scope of the manuscript, which aims at assessing the amount of variance captured by different predictors across environmental and geographical gradients. Finally, L20-23 on this page try to explain the confounding effects observed between variables, as

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seen in the present and other studies, which, according to Dong (2010), will become better understood once more long-term datasets become available.

All other minor corrections suggested by the referee were introduced.

Reviewer #2

Concerning the possible bias in the analyzed dataset, see the corresponding answer to Referee #1. The central question of the paper is addressed on 15892 L25ff. Despite many attempts have been made up to date to relate diatom assemblages to abiotic factors, nothing is known about this relationship beyond a local scale. The paper tries to answer the question “which is the main driver of diatom communities in lakes irrespective of the geographic location of study sites”? In my opinion, this question can be explored by means of a worldwide meta-analysis of (comparable) published data, introducing the geographic coordinates as a predictive variable. This approach may help to understand many apparently contradictory results found in the literature reporting different variables as the main environmental factors explaining the structure of diatom datasets. I suggest (e.g. fig. 3) that the relative influence of these variables may be latitude-dependent or behave synergistically with other factors (15896 L20ff).

The importance of the relationships between diatoms and climate and geography and the applicability of the findings reported is addressed in the conclusions. The abstract sentence “lake diatoms give a robust indication of past and present environmental conditions” is already well known, but it actually corroborates the results presented in the manuscript.

The justification for the selection of specific datasets and the way the datasets were examined is commented in the answers to Referee #1

It is questioned if it is appropriate to analyze disparate datasets together. It must be noted that the analysis described gathers different datasets, not different quantitative models or transfer functions. Provided the conditions described to consider different

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datasets as comparable (see above), I consider justified their comparison in this meta-analysis. The referee asks also whether it is appropriate to examine the effect of environmental variables with negligible influence compared to primary drivers. As explained in the text (15893 L.10), in most studies the data had been previously screened to remove environmental variables that had little or no influence on diatom distributions. Besides, the amount of variance explained by a given variable is comparable between different studies (e.g. Ding et al., 2015; Eldaw et al., 2003; Prudhomme and Reed, 1998).

Concerning the question about how climatic and geographic factors affect diatoms, it is answered in the response to Referee #1 (last paragraph). The words “environmental factors” in the title are necessarily general because the study gathers many different factors (physical, chemical, physiographical). Finally, the requested supplementary table with the original predictor and criterion matrices has been added to the manuscript.

Acknowledgements

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