Dear Editor,

Please find below our responses to comments by referee #2 in bold italics.

Thank you

Review of Ballantyne et al. for Biogeosciences

Ballantyne et al. present an interesting paper to Biogeosciences readers. This paper presents evidences on how changes in dust deposition in two alpine lakes, with contrasting catchments, affect mineral nutrient ratios (N:P) with consequences for diatoms community. They discuss their results exclusively in the context of the increasing dust deposition in the western US. In my opinion, this paper presents valuable results to be published in Biogeosciences, although the authors should revise the literature in more detail and discuss their results beyond San Juan Mountains. The increasing of dust deposition is not just a regional issue, on the contrary, it is a major change at a global scale (see for instance Prospero & Lamb (2003) and Mulitza et al. (2010)). I think the authors should discuss their results in this broader context. My only major objection of this paper is that the literature revision performed by the authors was very limited and local.

This point is well taken. We originally presented these results in a regional context but really changes in dust emission are a global phenomenon and the Southwestern US just happens to be a regional hotspot. We have thoroughly revised both the introduction and the discussion to compare our results with previous work. Hopefully, by putting our work in a global context we have highlighted the previous work that has been done on this topic and made our research more relevant to a broader audience of researchers who read Biogeosciences. We also thank you for the full list of citations, most of which have been included in the most recent draft of this paper.

Minor objections:

1) Page 8726 lines 3-4. I disagree completely with the authors. There are very detailed works about changes in P and N deposition and how N and P deposition affected both phytoplankton and bacteria, especially in high mountain lakes. I recommend the authors that read at least the literature for other high mountain lakes (e.g. Morales-Baquero et al. 2006 and Reche et al. 2009).

This has been revised to highlight many of the recent studies in Southern Europe, such that:

'However, much less research has focused on the extent to which changes in P deposition have altered ecosystem processes (Morales-Baquero et al., 1999). Several recent studies have investigated the impacts of dust deposition on modern ecosystem processes. Alpine watersheds located in Southern Europe receive large amounts of N in wet deposition and high amounts of P in dry dust deposition from the Sahel (Morales-Baquero et al., 2006). This enhanced P deposition from dust has been shown to increase primary productivity and alter species composition in many Mediterranean lakes (Morales-Baquero et al., 2006;Reche et al., 2009). In contrast, regions of Eastern Europe have some of the

highest rates of N deposition due to cumulative emissions across Europe (Dentener et al., 2006). These different sources of N and P deposition have resulted in strong N:P gradients that explain much of the surface chemistry and N:P availability in alpine lakes across Europe (Camarero et al., 2009). '

2) Page 8730 lines1-2. The authors should state the first time that appear Sr, Sm, and Nd their corresponding element denomitations (Strontium, Samarium, Neodymium). They can also explain, briefly, the Samarium-neodymium dating for determining the age of rocks and meteorites. These knowledges are no familiar for everyone, even if they are readers of Biogeosciences.

We have clarified how these rare earth elements and isotope were used to determine the provenance of dust, not for dating:

'A subset of sediment, dust, and bedrock samples were also analyzed for isotopic composition of Strontium (Sr), Samarium (Sm), and, Neodynium (Nd) to identify potential sources of allochtonous material to lake sediments. These rare earth elements often have unique concentrations and isotopic compositions in different geologic substrates and can be useful in distinguishing between allochthonous calcareous dust and autochthonous granitic bedrock. '

3) Page 8733 lines 9-16. This paragraph should be moved to discussion section

This paragraph has been moved to the discussion.

4) Page 8734, lines 9-10. The mechanisms driving increases in organic matter in sediments can derive from: 1) direct increases of organic matter deposition linked to dust (see for instance Mladenov et al. 2009) and 2) indirect increases in primary and bacterial production due to fertilization by mineral nutrients carried by dust (see for instance Morales-Baquero et al. 2006 and Reche et al. 2009).

These two mechanisms are presented in the discussion section. In the context of these two lakes it is not possible to definitively determine whether it was an increase in organic deposition or an indirect increase in response to mineral fertilization. However, ancillary data (carbon isotopes) suggest an increase in primary productivity in response to mineral nutrients. Here we are just pointing out the differential response between these two lakes with one lake accumulating all elements at a higher rate, probably due to its larger watershed area (as explained in the discussion).

5) Page 8734 last line, page 8735 lines 1-7. I think this paragraph is more appropriate in the method section.

This paragraph has been moved to the methods section.

6) Page 8736 lines 25, 28. Change Fig. 7 for Fig. 8.

This has been changed.

7) Page 8737 lines 2, 4, 8, 9,18. Change Fig. 7 for Fig. 8.

Text now refers to the correct figure.

8) Page 8738, discussion. Please see the budgets performed by Mladenov et al. (2009) for organic carbon and Pulido-Villena et al. (2006) for Ca. Both papers included catchment´s area.

These papers are definitely relevant and have been added to the discussion section.

9) Page 8739, discussion. Please see Morales-Baquero et al. (1999, 2006) for N and P

deposition and their ratios and catchment influences.

Both papers by Morales-Baquero have been added to the paper and are compared with our results in the discussion section.

10) Page 8740, lines 19-20 (please see the paper by Pulido-Villena et al. 2006 about Ca

deposition).

This paper has been added to the discussion as well.

11) Page 8741, lines 10-11. This sentence is meaningless and unnecessary.Please delete it.

This sentence was incomplete and now reads:

'Thus dust deposited in the SJM is consistently enriched in certain cations, such as Mg and Ca, certain heavy metals, such as Cr, Ni, and Cu, and may be enriched in important nutrients, such as P and Fe.'

12) Page 8742, line 14. Lawrence´s reference is incomplete.

Lawrence reference has been replaced by the original reference reporting weathering rates for this region.

Figures:

I want also to point out that quality of Figures was poor. Numbering and titles were too small-

Figures have been updated with larger font for clarity.

List of references suggested:

-Prospero & Lamb. 2003. African droughts and dust transport to the Caribbean: climate change

implications. Science 302: 1024-1027.

-Mulitza et al. 2010. Increase in African dust flux at the onset of the commercial agriculture in the

Sahel region. Nature 466: 226-228.

-Morales-Baquero et al. 2006. Atmospheric inputs of phosphorus and nitrogen to the southwest

Mediterranean region: Biogeochemical responses of high mountain lakes. Limnology and Oceanography 51: 830-837.

-Reche et al. 2009. Effect of Saharan dust inputs on bacterial activity and community composition in Mediterranean lakes and reservoirs. Limnology and Oceanography 54: 869-879.

-Mladenov et al. 2009. Alpine lake optical properties as sentinels of dust deposition and global change. Limnology and Oceanography 54: 2386-2400.

-Pulido-Villena et al. 2006. Significance of atmospheric inputs of calcium over the southwestern Mediterranean region: High mountain lakes as tools for detection. Global Biochemical cycles 20: doi:10.1029/2005GB002662.

- Morales-Baquero et al. 1999. The nitrogen : phosphorus relationship in high mountain lakes: Effects of the size of catchment basins. Can. J. Fish. Aquat. Sci. 56: 1809–1817.