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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Long term precipitation chemistry and wet deposition in a remote dry savanna site in Africa (Niger)" *by* C. Galy-Lacaux et al.

Anonymous Referee #2

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General comments

The authors describe the precipitation chemistry and deposition and its variation from 1994 to 2005 at a site representative of the semi-arid savanna in the Sahel. This is an interesting research in order to document the biogeochemical input fluxes for the subtropical African region where such studies are scarce. Furthermore, this research is part of a wider international effort in Africa (projects AMMA and SAC-CLAP) and the interaction between these projects may produce a better understanding of arid and semi-arid environments. It attempts to distinguish the human impact from the natural variability in the components of the precipitation. The comparison of the precipitation

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chemistry and wet deposition fluxes for a transect from dry to wet savanna is one of the interesting points of this work.

I have some comments on the text layout:

1) In general, the text is too verbose. An effort should be done to synthesize the ideas in shorter and more concise terms. For example, the aims of the work (para 5 in page 5766) should be more concisely stated. Also, there are several repetitions that are not necessary (I give this as an example but more can be found in the text. For example, the statement that “11-yrs of rain chemistry are at Banizoumbou are analyzed”). The description of the ionic composition could be much shortened by a concise ranking from higher to lower components.

2) There is a need of re-organizing the sections. For example, the heading 4 Precipitation chemical composition and wet deposition, should be considered as 4. Results. Precipitation chemical composition and wet deposition. Some of its contents (description of estimation of VWM concentrations, wet deposition calculations and marine contribution) are procedures of calculation and should go to Methods. On the other hand, Figure 2 and its discussion (mean rainfall and its variability) should go to the Results section. Figure 2 is confuse: I recommend that percentage difference respectoto the mean is included in Table 1 and the figure deleted.

3) Some parts could be deleted. For example, in page 5772, a PCA is mentioned but the results of such an analysis are not further developed.

4) Figures 6 and 8 are very confusing. The individual components cannot be identified. A clearer picture will be obtained by presenting the variation for groups of ions, e.g. terrigenous, nitrogenous, marine ions.

Specific comments:

In the Method section, the different analytical procedures are described. However, I have not found a description for the carbonate analysis. What is tcarbonate in Table 3?

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In page 5774, HCO3- is included in the sum of terrigenous ions. Is HCO3 analyzed ?

Also, I have a concern about the mean pH value given in Table 3 and discussed throughout the paper. The usual procedure to calculate the mean pH for a series of precipitation samples is to weight the corresponding H concentration, obtain a VWM H concentration and recalculate its pH value to give a VWM pH value (this is the way is calculated here, page 5778). But this is conceptually incorrect for samples with pH values ranging from the acidic to the alkaline side ($>$ 5,6) which is here the case as the authors state that 1% of the precipitation was above pH 7, and that most of the precipitation events present pH higher than 5,6” page 5779. This error is because the H concentration is not conservative and therefore it cannot be averaged when acid and alkaline rains alternate. This issue is fully described for rain samples in Liljestrand 1985, Atmos. Environment 19, 487-499; Young et al. 1988. J. Environ. Qual, 17, 1:26. The correct conservative variable is the net acidity or its inverse, the net alkalinity. This conservative variable can be averaged to give a mean acidity (or alkalinity), and with the appropriate equation solution, it provides the VWM mean pH value.

Here, alkalinity will be the sum of tcarbonates and the dissociated fraction of organic acids analyzed. A quick calculation of the mean pH with the above considerations gives a mean pH of 6,75! The same can be said for the pH values of the sites in the transect, although the more acidic the rains are, the less is the difference between the “correct” and “incorrect” method. In fact, when all pH values are below 5,6, the H VWM averaging method is perfectly correct.

Alternatively, because what is incorrect is averaging, one could circumvent the problem by giving median pH values. The median, by giving the value at which 50% of the data are below, is a good descriptor of the pH distribution and as such can be employed for comparison of temporal trends or for the comparison of different sites.

Technical comments

Finally, a better use of verb tenses is necessary: use the present tense for gen-

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eral scientific knowledge, and past tense for results of this particular research (it was found…, the mean concentration was…). Capital letters should be used for geographical descriptors (Sahelian corridor, African desert area…). Some errors are repeated in the text: closed for close, golf for Gulf.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 5761, 2008.