Atmos. Chem. Phys. Discuss., 8, S1645–S1649, 2008
www.atmos-chem-phys-discuss.net/8/S1645/2008/

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.

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Received and published: 15 April 2008

General:

The paper reports very important findings on long term rain chemistry data from dry remote savanna site in Africa. The interesting part of observations is that the site has unique characteristics regarding chemical composition of rain water. In most of the temperate regions where acid rain is common phenomenon, the acidity is mainly reported due to very high non sea salt SO42-. The major role playing ions in such regions are H+, SO42-, NH4+ and NO3- whereas in dusty regions like India, Ca2+, SO42-, NH4+ and HCO3- ions are major chemical components of rain water (Rodhe

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et al., 2002). In India, calcium carbonate which is contributed by wind blown dust, acts as buffering agent for the acidity generated by sulphate (Kulshrestha et al., 2003). But in dry Savana region as reported in this paper, it is interesting to note that the calcium carbonate is acting as buffering agent for the acidity generated by organic acids. This is something new knowledge contributed by this paper.

The other important finding which I found very interesting in this paper is that the rain chemistry is influenced by rainfall amount and intensity of rain. I agree with the authors about such statement. In tropical regions, the chemistry of rain very much depends on the convective systems, antecedent period, duration and intensity of rain. Kulshrestha et al. (2008) also noted similar observations. It is observed that wet scavenging of particular size ranged aerosols depends on the intensity of rain.

In the manuscript, the authors present and discuss about average values during different years but I do not find any remarks about statistical significance among annual mean differences. I would suggest that the authors should attempt statistical test analyses to reveal whether the annual mean differences are significant or not?

Below are my comments on various sections of manuscript-

Abstract:

Last sentence-It is not clear which wet fluxes have opposite gradient. It needs to be clarified whether 'on an average for all' or 'in general'???

Measuring procedure and analysis:

The use of passive samplers is very economic to carry out measurements at number of sites as compared to active samplers. But the meteorological conditions i.e. temperature, solar flux, wind speed and RH can affect the life (in terms of absorption efficiency) of coated material. Is there any report available to support that even after the exposure of one month, the sampler was unsaturated or the concentration obtained after one month was not really a result of only 4-5 days exposure? Sometimes, sampler can

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get saturated within a few days of exposure which may give rise to wrong time (t) in calculation.

Page 5770-line 20- Sentence is confusing. How the reproducibility between duplicate was achieved? I believe, it may be 'agreement' between duplicates. Sentence needs to be modified accordingly.

Chemical analysis:

Authors mention about carbonates which were analyzed by ion chromatography. It needs to specify what is 't carbonates' in Table 3.

Results and Discussion:

My major concern is that authors have noticed very high Ca2+ and carbonates in rain water even then the average pH is around 5.6 which is very much surprising to me. I suggest that authors should provide median of pH instead of mean which will reflect how many samples had pH higher than 5.6. Carbonate concentration as reported in Table 3 should give pH of rain water around 6.6 which is acceptable range with such high Ca2+ and carbonates. This site of measurements resembles (except for organic ions) with the sites reported in Jain et al (2000) where range of chemical components is also similar or higher. At these sites, Ca2+ and bicarbonate represented most of the weight among other analyzed ions with an average pH more than 6.3. Hence, the calculation of average pH needs to be revised which should be used for further discussions.

Page 5772- Authors mention about PCA was applied to data but there is no description found on PCA in the manuscript.

Page 5779- It will be more appropriate to show frequency distribution of pH including all ranges of variation i.e below 5.6 and above 7.0. It is not clear why authors state that low annual pH is due to neutralization effect. In my opinion, any neutralization effect will increase the pH of rain water (Ca2+ and NH4+ are major neutralizing agents for

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rain water).

Page 5781- Authors have described biomass burning as a source based on K+ and oxalate. But in Table 2, it seems that NH4+, NO3-, acetate and oxalate together are indicator of biomass burning. NH4+ and K+ are referred as general indicators of biomass burning. It would be more interesting if the discussion is modified in this direction.

Page 5782- second para is not clear, needs to be reframed.

Page 5789- authors mention about soil contributions especially for NOx. What about direct contribution of NO3- from soil suspension during dry weather conditions? It will be more interesting to see pH and chemical composition in the region.

Figures 6,7 and 8- Need to be re-drawn so as to be seen clearly. These need to split into anions and cations separately.

Table 3 can be transformed into figures showing trends of some of the major ions during 1994-2005.

Minor comments:

Manuscript requires editorial assistance at several places to improve fluency in reading and to rectify typographical errors.

At a few places, repetition is seen which should be avoided in the final manuscript.

References:

Jain M, Kulshrestha U C, Sarkar A K and Parashar D C (2000). Influence of crustal aerosols on wet deposition at urban and rural sites in India. Atmospheric Environment, 34, 5129-5137.

Kulshrestha M J, Kulshrestha U C, Parashar D C and Vairamani M (2003). Estimation of SO4 contribution by dry deposition of SO2 onto the dust particles in India. Atmospheric Environment, 37 (22), 3057-3063.

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Kulshrestha U C et al. (2008). Wet scavenging of major chemical constituents of PM10 aerosols and role of rain intensity in Indian region. (Manuscript under preparation).

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