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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Chemical properties of rain events during the AMMA campaign: an evidence of dust and biogenic influence in the convective systems" *by* K. Desboeufs et al.

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We thank the referees for his/her kind and constructive comments. We will change the technical and language corrections as suggested. For the more substantial concerns and questions (in italic), our replies are given below.

Referee 1:

- A more concise title would have been: "Chemistry of convective rain events in West Africa"

Authors: Indeed, the title is a little bit long. However, the notion of "chemistry of rain"

is usually limited to the composition in dissolved species of rainwater in the literature that is not the case of this paper. Moreover, we want to emphasize our conclusions on the influence of dust and biogenic species in the rain composition. We have changed the title by "Chemistry of rain events in west Africa : an evidence of dust and biogenic influence in the convective system"

- Page 15268, Line 25: It would be informative to also provide in the ion balance estimates of alkalinity/acid neutralizing capacity.

Authors: We considered that ion balance of alkaline and acid species need severe approximations, notably for inorganic ions and hence not pertinent in this study. A part of Ca2+ and SO42- concentration could be originated from gypsum dissolution. In the same way, chloride and nitrate could be partially present in a neutral form in minerals and not as acid.

Referee 2 :

- Abstract & later: The Harmattan layer and the Harmattan winds are mentioned, but not explained. It has to be briefly mentioned in the introduction what the Harmattan layer is.

Authors: The Harmattan is a dry and dusty West African trade wind. It blows south from Sahara into the Gulf of Guinea, next to the surface in winter and in altitude in summer. In order to clear the description of the Harmattan winds, we have added the term "Harmattan" in the Introduction in the part on the wind circulation in the West Africa. However, we consider that the description given in the section 3.1 is sufficient to explain the Harmattan winds and Harmattan layer: "the ITD (Inter-Tropical Discontinuity), which is the confluence of the south-westerly monsoon winds with the north-easterly dry Harmattan winds, is positioned between 15°N and 20°N. The surface monsoon winds extending in Niger up to 15°N-20°N are overlain by Harmattan winds, transporting dust above 2000m in the Saharan Air Layer (Bou Karam et al., 2008; Lothon et al., 2008)".

- Abstract & later: What are "diatoms"? It is never explained.

Authors: Diatoms were unicellular algae inhabiting the fresh waters of the Mega-Lake Chad, now dried out. They are encased within a unique cell wall made of silica called a frustule. They now make up the surface of the Bodélé depression and are the source material for the dust. We have added a sentence to Section 3.2 explaining this.

- Page 15267, line 27: give model number of the Grimm OPC

Authors: Precision on the model number of the Grimm OPC will be given in the revised version.

- Page 15272, line 6-8: "However, the comparison of our results on the estimated mass percentage with others works based on other methods of mass calculation could be biased." What reasons do you have that lead to this assumption?

Authors: In order to estimate the elemental mass percentage, it is so necessary to know the aerosol mass on studied filters. The direct measurement of aerosol mass by weighing is difficult due to the low mass loading on the filters. In consequence, several approachs exist to estimate elemental mass percentage: by using the sum of major oxides (Formenti et al., 2008; Lafon et al., 2006), the sum concentration of main elements (Rajot et al., 2008 and this work) or by approximation of the mass from Al total content and the mass % of Al in the terrestrial crust (8.3%) (Paris et al., 2010). Thus, the use of elemental ratio is an usual point of comparison between different studies. Moreover, several cited studies provide exclusively the elemental ratio (Chiapello et al., 1996; McConnell et al., 2008).

- Page 15276, line 3-4: "A potential contamination of the dissolved phase by fine dust particles could explain this disequilibrium". I don't understand this argument. Also the fine dust ions should be neutral. You can argue that in this case NH4 should be more important than Mg and Ca, but since you measured NH4, the ion balance should be neutral.

Authors: In fact the presence of fine dust affects only the measurements by ICP-AES, i.e. the cations analyses. In this analytical technique, the samples are directly introduced in the plasma flame and hence the fine dust could be atomized in the plasma and analysed. Consequently, the dissolved cation concentrations could be overestimated. On the contrary, the composition of particulate fine dust is not determined during the analyses of dissolved anions by ionic chromatography since the samples are re-filtered on-line. In order to clarify this point, a sentence will be added in the revised version in Section 3.3: "Indeed, these particles are analysed for cations in ICP-AES, but not for anions in IC."

Page 15276, line 6-8: I don't understand the meaning of this statement on the rain pH. How can the rain be "usually alkaline" while it is neutralized by CaCO3? Do you mean "Precipitation pH in Banizoumbou is usually alkaline (median pH around 6) but is partly neutralized by carbonates (CaCO3) from mineral dust: : :" ?

Authors: In fact the correct sentence is "Precipitation pH in Banizoumbou is usually alkaline (median pH around 6) via neutralisation by carbonates (CaCO3) from mineral dust (Galy-Lacaux et al., 2009)." The term "neutralisation" means that the pH is increased by the dissolution of carbonates, and hence becomes alkaline. Maybe it is a problem of language, "alkalinisation" is clearer? but we have usually read in the litterature the word "neutralisation " in this sense.

Referee 3:

It seems that in certain cases the dust particles are highly prone to take up gaseous organic acids such as formic and acetic which then govern the acidity of the precipitation and perhaps assist in cloud nucleation of fine dust particles. My only concern with this paper is that such gas-to-particle interactions are not considered explicitly in the discussion: only in-cloud scavenging is mentioned (Page 15278 Line 24) which may not be so important for such volatile acids which have very low Henry constants.

Authors: Indeed, we have neglected the process of heterogeneous chemistry between

dust and gaseous organic acids in the discussion. However in the present case, the surface air masses rich in organic gas mixed with Harmattan dust layer in the convective cloud implying that their interaction is mainly related to the cloud processing.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 15263, 2010.