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Interactive comment on “Seasonal trends of dry and bulk concentration of nitrogen compounds over a rain forest in Ghana” by F. Fattore et al.

Anonymous Referee #1

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This study tests experimentally a hypothesis that is already supported in previous studies (Chen et al., 2010, *Global Change Biol.*, 16, 2024-2038): savannah fires could be a source of nitrogen compounds for African tropical rain forests located in Southern position, thanks to regional wind circulation. The main objectives are (1) to quantify the magnitude and seasonal variability of concentrations of N compounds (NO₂, HNO₃, NH₃, NH₄⁺, NO₃⁻), and (2) to relate their seasonal variability to trends of local and regional winds and rainfall, and to variations of fire events in the region. Although not much new science in the paper, it is worth to be published considering the scarce of such data from this region and the measurement method used which is different from other studies in African ecosystems. A few points are provided below when considering revising the paper.

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General comments

The paper presents an original dataset in a remote tropical forested site (National park of Ankasa, Ghana). However the period of measurements including only 1 year (October 2011 to October 2012) is not enough to actually follow seasonal variations and to fully understand the sources contributions to rain, gas and aerosol composition. In general, the paper is well written and data are clearly presented in tables and figures of good quality. In the paper, the mean seasons are not clearly determined, thus it is difficult to follow and understand the seasonal variability on figures. The authors should take into account the position of the ITCZ and monthly mean recorded rainfall to determine clearly the mean dry and wet seasons, not only the peak of rain season. Thus, they could quantify the magnitude of the dry/wet seasonal concentration of N compounds. It will be necessary to place this study in an international context with valuable references, with a focus on references available on the tropical forests. For example, by comparing the measurement results to those obtained with other methods in Adon et al. (2010) for gases (NO₂, HNO₃, NH₃) and in Sigha et al. (2003, J. Atmos. Chem., 46, 173-198) for bulk concentrations (NO₃⁻, NH₄⁺). The precision of the sampling technique and detection limits for each trace gas have to be précised. The conclusion of this study is too limited. The authors should complete it, for example, by giving the seasonal or annual values of nitrogen compounds measured.

Specific comments

P15226, L3; L18: “NE” and “North Eastern”. First, you should write the whole word before acronyms thereafter.

P15229, L13-15: Could we assume that the rest of months represent the dry season? Please add a sentence to specify the mean dry and wet season when presenting the studied site. P15230, L15-18: Please, could you indicate the reproducibility (i.e the covariance) of the two denuders for the sampling of each gas.

P15230, L24: Please, would you precise the detection limits from field blanks for each

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trace gas?

P1523, L1-2: Are collectors rinsed after each sampling? How filters were stored immediately after sampling and during transport?

P15234, L5-6: “the amount of N present. . .peak”. This information is not useful at all since concentrations are expressed in $\mu\text{g.m}^{-3}$ and not $\mu\text{gN.m}^{-3}$. The comparison of N quantity present in form of NO_3^- or NH_4^+ could lead to confusion since it is observed on figure 1 that NO_3^- concentrations are higher than NO_4^+ . In a case of a study of N dry deposition ($\mu\text{gN.m}^{-2}\cdot\text{s}^{-1}$), this comparison could be understandable.

P15234, L8-10: “SO₂. . .exception of the period between mid-november 2011 to Mid-January.” The period 11/09/12-22/10/12 must be included in the exception period since SO₂ concentration ($30 \mu\text{g.m}^{-3}$) is of the same order. “mid” and “Mid” must be written in the same way throughout the text. Sampling periods: To specify the sampling period, sometimes the authors used the whole month or “mid-month”, second half of the month or first half of the month. It would be better to choose one designation.

P5234, L15-20 It would be interesting to compare NO_3^- and NH_4^- concentrations in rainfall with those measured in a tropical forested ecosystem of Cameroon (Sigha et al., 2003, J. Atmos. Chem., 46, 173-198) in this section or discussion session.

P15237, L1-7: “The West. . .rainfalls”. This paragraph is rather an introduction and it is a repetition (see P15229, L1-10).

P15238, L29-L3 (P15239): “The concentration of NO_2 . . .are comparable. . .burning season”. I disagree with this comparison. Please, I checked but I didn’t find these values (0.80 and $1.3 \mu\text{g.m}^{-3}$) in Adon et al. (2010). In fact, Adon et al. (2010) reported that seasonal mean concentrations are 1.1 ppb ($2.1 \mu\text{g.m}^{-3}$) at the forested ecosystem of Cameroon (Zoetele) and 1.6 ppb ($3.0 \mu\text{g.m}^{-3}$) at the equatorial forest of Congo (Bomassa) in the dry season, i.e the burning season. The mean monthly concentrations can reach a value of 2.4 ppb ($4.5 \mu\text{g.m}^{-3}$) in the dry season at Bomassa. The NO_2

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concentrations measured at about 3 m from soil surface in Adon et al (2010) are higher than those measured at 45 m (20 m above the canopy) in this study. A large part of NO₂ (from NO soil emissions) under the canopy could be captured by the leafy plant density (Jacob and Bakwin; 1991, Am. Soc. Microbiol., Washington, DC, 237-253 ; Sparks et al., 2001, Oecologia 127, 214-221).

There is no discussion about the values of NO₃⁻ and NH₄⁺ (bulk concentration) in the discussion section. As already mentioned above, the authors could compare the values with other tropical forests (Sigha et al., 2003).

P5241 “conclusions”: The conclusion is too short. You could complete it by giving the seasonal or annual values of nitrogen compounds measured in this study. It is already known in previous studies that savannah fires represent a source of N for tropical rain forests. Limit conclusion to this statement is not useful and interesting.

Technical correction

P15226, L25: “. . . see water” or sea water?

P15227, L9-10: Âñ Lewis et al. (2009) has. . . Âž Please, change “has” by “have”

P15232, L5-11 : Please, precise the units of variables.

P5237, L10: “Yobouè” Please, write rather “Yoboué” or simply “Yoboue” without an acute accent.

P15247: “Tabé1” Please, precise if the mean values of the period 18/07/12 to 11/09/12 represent the average concentrations of two months.

P15248, fig1: It should be interesting to superimpose monthly evolution of precipitations (in histogram) on the monthly concentrations in order to distinguish the seasons.

P5250: Please indicate (a) and (b) on the figure 3. Figure (a) is named “. . . anions” but NH₄⁺ is not an anion.

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P5252: “Fig. 5” The legend is not clearly visible, please put it horizontally under the figures

P15246, L10, Please, add “focus” at the end of the journal to avoid confusion between “Water, Air and Soil Pollution” and “Water, Air and Soil Pollution. Focus.”

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