Atmospheric nitrogen deposition budget in the wet savanna of LAMTO in Côte d'Ivoire.

Guillaume Ossohou[1], Corinne Galy-Lacaux[2], Véronique Yoboué[1], Marcellin Adon[3], Eric Gardrat[2]

[1] Laboratoire de Physique de l'Atmosphère et de Mécanique des Fluides, Université Félix Houphouët-Boigny, Abidjan, Côte d'Ivoire.
[2] Laboratoire d'Aérologie, Université de Toulouse, CNRS, UPS, France
[3] Université de Daloa, Daloa, Côte d'Ivoire

E-mail: ossohoumoney@gmail.com and corinne.galy-lacaux@aero.obs-mip.fr

Abstract

In the framework of the International Network to study Deposition and Atmospheric chemistry in Africa (INDAAF), a nitrogen (N) atmospheric deposition budget including wet and dry processes was calculated in Lamto, a wet savana ecosystem in Côte d'Ivoire. For the first time, we performed for a rural tropical African site, a trends study of the N deposition fluxes over a period of 16 years (2000-2015). Annual N deposition budget for this ecosystem is estimated to be 8.21±1.92 $kgN.ha^{-1}.yr^{-1}$ that should be considered as an important natural input, close to the critical load of 10 $kgN.ha^{-1}.yr^{-1}$.

Keywords: nitrogen budget, wet and dry deposition, humid savanna, trend, Africa

1. Introduction

In the humid tropical african region, very low nitrogen (N) contents are observed in the soils, making the ecosystems vulnerable to increases of nitrogen deposition due to anthropogenic pressure over the african continent. Biomass burning and agricultural activities are the main sources of nitrogen (N) coumponds in rural areas of tropical Africa. In the framework of the INDAAF (International Network to study Deposition and Atmospheric chemistry in Africa) programme, we performed the analysis of a unique long term database including N gaseous, precipitation and aerosols chemical composition.

2. Context - site description and methodology

The soudano-guinean savanna of Lamto (Côte d'Ivoire, 06°13' N, 05°02' W) is considered as an ecosystem of reference in the tropical humid zone. Quality controled measurements using the INDAAF international protocols include: N gaseous coumpounds (NH_3, $HN0_3$, NO_2) since 1998, inorganic N content of precipitation (NO_3^- and NH_4^+) since 1994, and N content in aerosol (pNO_3^- and pNH_4^+). since 1995. Dry deposition fluxes were estimated using the inferential method that combines N gaseous and aerosols concentration measurements and modeling deposition velocities. Wet deposition is directly measured. Trends are evaluated using the Man-Kendall statistical tests.

Fig 1. Geophysical station of Lamto, Côte d'Ivoire.

3. Nitrogen total atmospheric deposition budget and trend analysis

Total annual nitrogen deposition (dry + wet) at Lamto from 2000 to 2015 is 8.21±1.92 $kgN.ha^{-1}.yr^{-1}$ with a contribution of 57%, 40% and 3% for wet deposition, gaseous dry deposition and particulate dry deposition, respectively. Annual reduced nitrogen deposition (pNH_4, NH_4-Rain, NH_3) represents more than half of the total with 5.55 $kgN.ha^{-1}.yr^{-1}$.

The trends analysis over the 15 year period showed decreasing trends for dry N deposition: -2.41%.$month^{-1}$ and -3.68%.$year^{-1}$. To the opposite N wet deposition of NO_3^- and NH_4^+ showed increasing trends: +2.38%.$month^{-1}$, +3.25%.$year^{-1}$.

4. Discussion and conclusion

Biomass burning and agricultural activities are the main N sources contributing to the N deposition budget of the Lamto wet savanna. Results showed that the critical nitrogen load of 10 $kgN.ha^{-1}.yr^{-1}$ is almost reached and the trends analysis indicated statistically significant increasing trend in the total N deposition at Lamto. The impact of nitrogen management and deposition in the tropical humid zones is largely unknown and nitrogen critical loads are poorly assessed. This study should help in the establishment of a Nr emission/deposition regional budget.

Acknowledgements

This study is supported by the CNRS/INSU (Centre National de la Recherche Scientifique / Institut National des Sciences de l'Univers), the ACTRIS-FR Research Infrastructure and IRD (Institut de Recherche pour le Développement).