POSTER SUMMARY

ATMOSPHERIC NITROGEN DEPOSITION: WHAT DOES IT TELL YOU?

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Abstract

The negative impacts that the seepage of nitrogen into natural ecosystems has on the environment, are well known. Nitrogen from the atmosphere is a significant contributor of N to the environment; it can be transported over long distances and puts pressure on ecosystems. Amounts of 15 to 20 kg N/ha/annum have been established as critical values for shifting natural ecosystems (Bobbink and Roelofs, 1995). Measurements in South Africa are still rare. In Mount Edgecombe, measurements of the bulk deposition were first taken in 2007/08. This poster will provide an introduction to forms of atmospheric deposition, as well as the results of the Mount Edgecombe measurements.

Keywords: nitrogen, environment, atmospheric nitrogen deposition, sources

Introduction

Nitrogen accumulates in the atmosphere because of environmental pollution (traffic, industry and agriculture). Intensive agriculture with high N fertilisation encourages NH_3 pollution, which is rapidly converted to NH_4^+. Nitrogen oxide emissions (NO, NO_2, NO_3^-) are caused predominantly by traffic and industry. Different measurement systems exist for various forms of deposition. Depositions of the wet form of N (NH_4^+, NO_3^-, N_{org}) are measured with the so-called 'wet-only' samplers. These open by means of a moisture sensor and thus capture only the wet forms of N. Measurements of gaseous N depositions (NH_3, NO, NO_2, HNO_3) are done with passive samplers with and a 15N marked substrate. The most common way to measure bulk N deposition, the wet deposition plus the solid deposition (dust particles: NH_4SO_4, NH_4NO_3, N_{org}) is by means of simple open vessels.

In Europe, measurements of atmospheric bulk N deposition are done routinely as part of environmental monitoring programmes. Values between 20 and 60 kg/ha bulk N deposition per year have been reported in literature (Böhme *et al.,* 2002). As part of the International Geosphere Biosphere Programme, N deposition was measured at 10 sites in Western and Southern Africa from 1998 to 2000. The values ranged from 8 to 19 kg N/ha per year (Galy-Lacaux *et al*., 2003). To elucidate the quantities of nitrogen deposited in the Mount Edgecombe area, measurements were first taken in 2007/08.

Methods

The South African Sugarcane Research Institute (SASRI) at Mount Edgecombe (longitude: 31°04' 29", latitude: 29°43'20") is situated in a congested urban area bordering the cities of Durban, Verulam and Phoenix. Three bulk (passive) samplers were set up adjacent to the weather station at SASRI to ensure that the collected water could be validated with actual

rainfall records. Rain water, containing dust particles, was collected in simple vessels (2 L brown glass bottles, each equipped with a funnel with a collection-end diameter of 105 mm). To avoid the entry of soil particles due to splash in the event of heavy rain the vessels were placed on stands 1.5 m above the soil surface. To reduce gaseous N losses, the samples were removed shortly after each rainfall event and stored at 4ºC. Mineral N (ammonium-N = NH_4-N and nitrate-N = NO_3-N) was analyzed monthly by steam distillation. Bulk N deposition was calculated in mg/m^2 and per day using the formula described by Mehlert (1995):

$$N_{(B)} = \frac{NC_{(B)} * V * 115.5}{d}$$

$N_{(B)}$ = Nitrogen in the bulk deposition in mg*m^2*d^{-1}
$NC_{(B)}$ = Nitrogen concentration in the sample in mg*l^{-1}
V = volume of the sample in l
115.5 = conversion factor for calculating the vessel surface to 1 m^2
d = number of days of the sampling period

Results and Discussion

In the first year (November 2007 to October 2008) the measured bulk N deposition amounted to 35.7 kg N/ha at the Mount Edgecombe site, which is much higher than the critical loads defined for natural ecosystems. Of the total, 46% was NH_4-N and 54% NO_3-N. As expected, the percentage of N present as nitrates exceeded that of ammonium, because the main source of atmospheric N in urban areas is from industry and traffic.

The monthly results for bulk N deposition for this period are presented in Figure 1; NH_4-N and NO_3-N are indicated separately. It is observed here that a close relationship exists between the rainfall and the deposited amounts. In the dry period from May to June the N deposition values are far below 2 kg N/ha and per month. However, after a dry period the deposition values increase drastically (compare August to September), showing that a lot of particles have accumulated in the atmosphere which are washed down with the first rains.

For most of the months the measured NO_3-N was higher than for NH_4-N. However, in the period from January to April 2008 the NO_3-N deposition (43%) was lower than the NH_4-N deposition (57%). It is assumed that, because this is the period during which sugarcane is not burnt, a relationship exists.

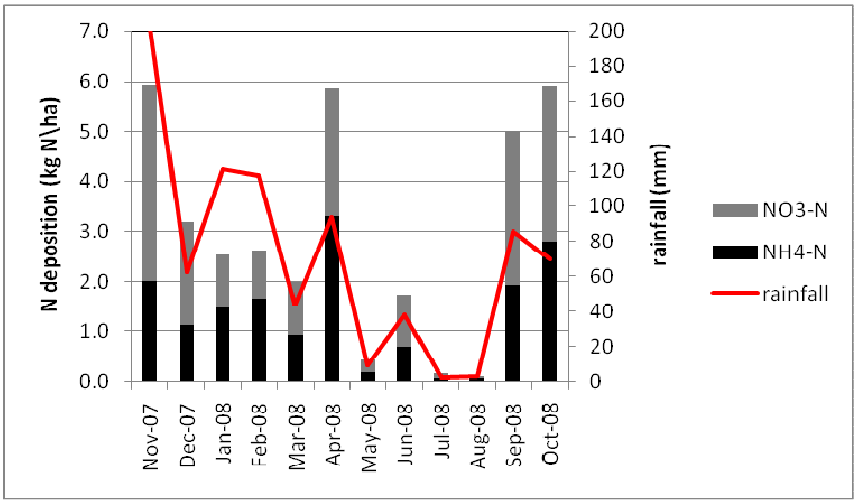

Figure 1. Monthly nitrogen deposition (kg N/ha), Mount Edgecombe (November 2007 to October 2008).

Conclusion

High nitrogen values were expected, because the collection site is situated in a congested urban area. Measurements will continue in order to validate results. For comparison purposes, measurements have recently started in a rural area.

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