



# Processing of Atmospheric Nitrogen by Clouds in a Forest Environment

## 1. Overview

Forest growth is usually limited by nitrogen availability, so an enhancement in nitrogen input to trees can fertilize and boost a forest's ability to take up  $\text{CO}_2$ , potentially influencing global climate change. Wet deposition by precipitation and fog accounts for 80-95% of total nitrogen deposition. Clouds over forest environments may provide reaction surfaces and act as photochemical reactors for water-soluble nitrogen compounds, altering the amounts and species of nitrogen deposited to the forest. This study will investigate the role of clouds and cloud chemistry in the nitrogen cycle in a forest environment through the use of aircraft-based cloud water sampling and cloud water analysis. The quantification and speciation of nitrogen in cloud water and in the air within a cloud will expand our understanding of the ways clouds process nitrogen and remove it from the atmosphere.

## 4. Methods of Analysis

1. Collect cloud water using a slotted rod cloud water collector mounted vertically on the roof of an aircraft (Figures 2 and 3)
2. Measure gas-phase concentrations of  $\text{NO}$ ,  $\text{NO}_2$ , and reactive nitrogen inside and outside of clouds, using a chemiluminescence detector
3. Analyze cloud water for Organic Nitrogen, Nitric acid, and Ammonia content

## 2. Cloud Chemistry

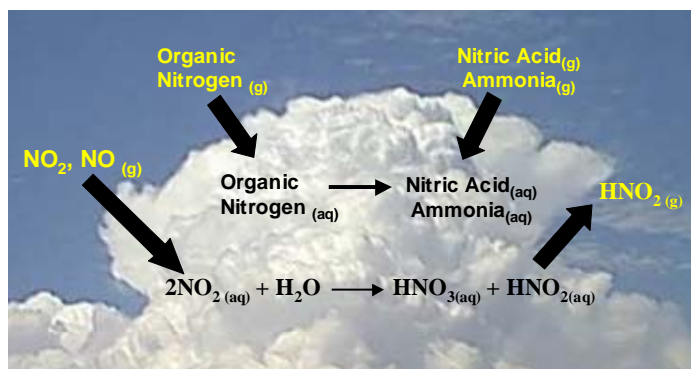


Figure 1: Nitrogen Chemistry in Clouds



Figure 2: The cloud water collector

## 5. Impacts

Before understanding the influence of nitrogen on the carbon cycle, we must identify and quantify all available sources of nitrogen to a forest.

The goals of this study are:

1. To quantify the amount and types of nitrogen in clouds
2. To quantify processing of atmospheric nitrogen in clouds to determine its contribution to the nitrogen cycle

## 3. Research Objectives

- Studies of gas and liquid cloud nitrogen composition will be conducted over a forest environment using an aircraft.
- Cloud water analysis will reveal the relative importance of various nitrogen species in a forest environment (organic nitrogen or nitric acid and ammonia) (Figure 1).
- Measurements of gas phase nitrogen concentrations inside and outside clouds will allow us to observe changes in concentration, such changes being indicative of nitrogen processing in clouds (Figure 1).
- Studies will be conducted at the University of Michigan Biological Station (UMBS) in Pellston, MI as part of the BEACON (Biosphere Exchange of Atmospheric Carbon and Odd Nitrogen) project.

<http://aoss.engin.umich.edu/PROPHET/Vision/BEACON%20Vision.htm>



Figure 3: The research aircraft, a Beechcraft Duchess