G-3 Ambient Concentrations of Biogenic Hydrocarbons in a Southeastern Pine Forest

Jo-Chun Kim · Eric R. Allen[1] · Eui-Chan Jeon
Department of Environmental Engineering, Dongshin University
[1]Department of Environmental Engineering Sciences, University of Florida

I. Introduction

The effect of biogenic non-methane hydrocarbons (NMHCs) on ozone formation (Chameides et al., 1992) has been a topic of interest for several decades. It is well known that terpenes and their derivatives are emitted from various species of plants around the world. On a global scale, biogenic NMHC emissions are estimated at 1150 teragrams (Tg) of carbon (C) per year, more than seven times the estimated anthropogenic emissions of hydrocarbons at 150 Tg of C per year (Guenther et al., 1994).

The principal objectives of this research are as follows:

1. To investigate seasonal variations in ambient terpene concentrations in a forest.
2. To study possible relationships between local concentrations of ozone and total monoterpene in ambient air at a forest site.
3. To investigate possible relationships between total ambient monoterpene concentrations and ambient temperature.

II. Research Methodology

2.1 Locations

The research site is located at the Austin Cary Forest, within a 2 hectare cleared area surrounded by commercial pine plantations. The samples collected in the field were analyzed in the University of Florida (UF) air pollution laboratories.

2.2 Sampling

Ambient air samples were collected about 20 m away from the air quality monitoring shelter and at a height of 1 m above ground. Ambient air sampling was conducted during the day time only. The sampling train used for collecting ambient air samples is shown in Figure 1.

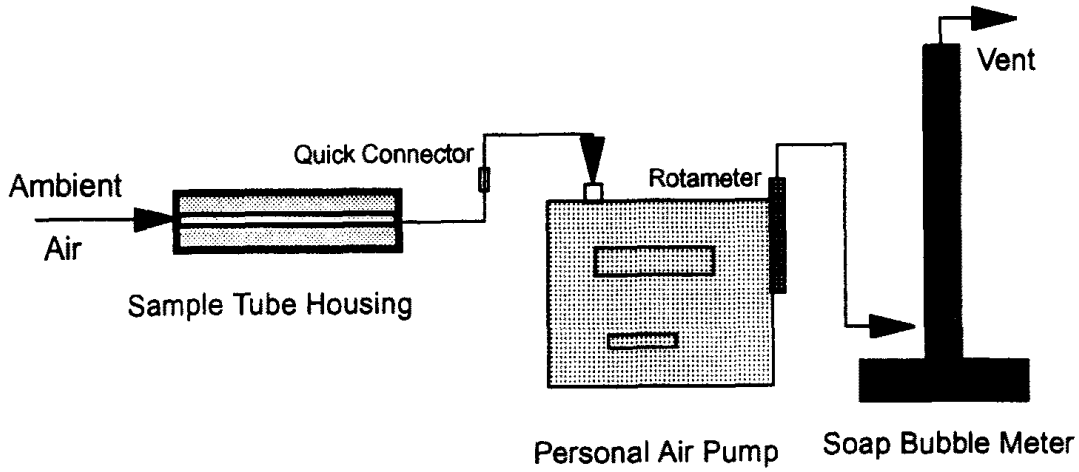

Figure 1. Sampling train used for collecting hydrocarbons in ambient air at the Cary Forest site.

The sampling train adaptor was cleaned in the UF laboratory before use. A personal air sampler was used for drawing ambient air through a sample tube housing which contained a Tenax TA sorbent. The initial and final time was recorded on a formatted sheet for ambient air sampling. The flow rate of air was obtained from a soap bubble meter and recorded on the data sheet with weather condition. The sampling flow rate was checked again before completing collection of the air sample. The sampling flow rates less than 250 liters per minute were used during the sampling periods concerned.

2.3 Analysis

Both the gas chromatograph-flame ionization detector (GC-FID) and GC-ITD(ion trap detector) analytical systems were equipped with Tekmar Model 5010 sample introduction systems enabling automated transfer of the biogenic hydrocarbons from sorbent traps to the GC.

III. Results

Monoterpene compounds ($C_{10}H_{16}$) that were characterized in ambient air samples from the Cary Forest site included; α-pinene, β-pinene, d-limonene, β-phellandrene, and p-cymene, where the latter two compounds were usually below method detection limits. Isoprene (C_5H_8), a highly reactive natural diene, was also found in ambient air samples. Alpha-pinene (61%) and β-pinene (37%) were found to be the most abundant monoterpenes in the forest air.

It was observed that ambient monoterpene levels during winter were lowest (mean=78 pptv). The Ambient monoterpene levels after winter increased slowly through the spring (mean=271pptv) and summer seasons (mean=300pptv). After September the ambient terpene levels decreased as average ambient temperatures decreased slowly following similar declines in terpene emission rates from pine emission sources at the site (Kim, et al., 1995; Kim, 1995).

It was found that total monoterpene concentrations were negatively correlated with ozone during the spring, fall, and winter seasons. However, a positive correlation between terpene and ozone was observed only for summer afternoons.

It was also observed that there were positive correlations between the ambient temperature and monoterpene concentrations during the spring, fall, and winter except summer.

References

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