

# GC-MS-FID System as a Tool for Biogenic Volatile Organic Compounds Analysis

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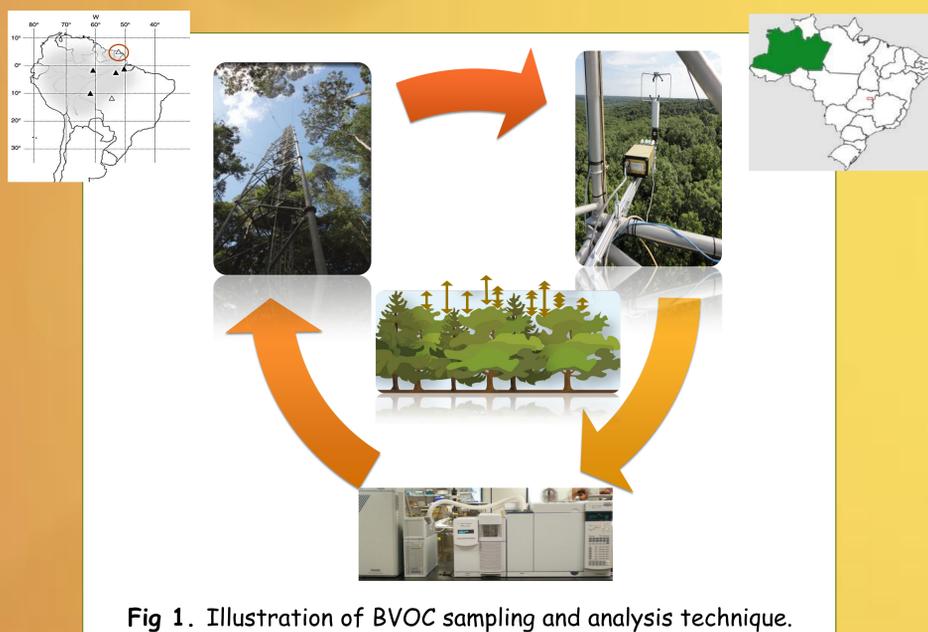
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## OBJECTIVE

The aim of this research is to identify and quantify by GC/MS-FID system some significant biogenic volatile organic compounds (BVOCs) ranging from  $C_5$  to  $C_{15}$  measured in wet tropical forests in Brazil and French Guiana.

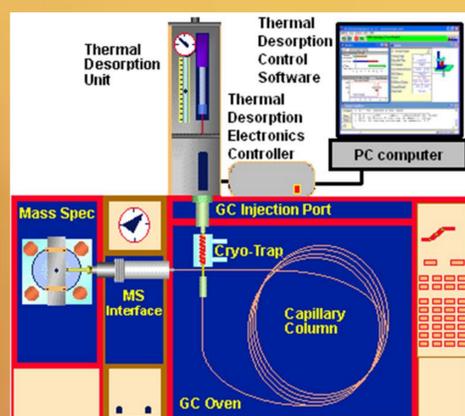
## EXPERIMENTAL PROCEDURES

- Measurements from 2009 to 2011 (in French Guiana)
- June to December of 2013 (in Brazil - Amazon Forest)
- Sampling Technique → Relaxed Eddy Accumulation
- Speciation and Quantification by TD-GC/MS-FID system



### Gas Chromatography (GC)

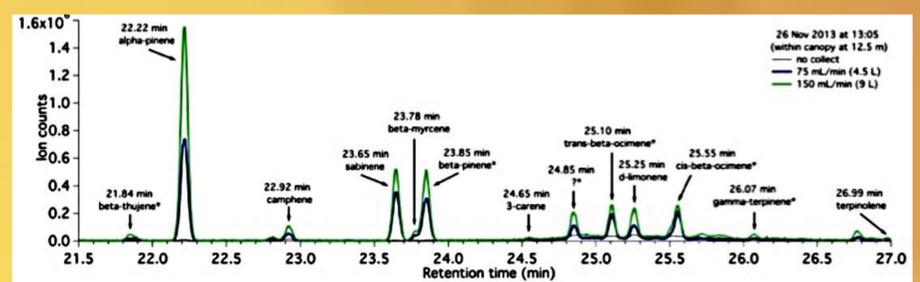
- Injection Port** → 1  $\mu$ l of solvent containing the mixture of molecules is injected into the GC and the sample is carried by inert (non-reactive) gas through the instrument, usually helium. The inject port is heated to 300° C to cause the chemicals to become gases.
- Oven** → The column is heated from 40° C to 320° C to move the molecules through the column.
- Column** → Inside the oven is the column which is a 30 meter thin tube with a special polymer coating on the inside. Chemical mixtures are separated based on their volatility and are carried through the column by helium. Chemicals with high volatility travel through the column more quickly than chemicals with low volatility.



### Mass Spectrometer (MS)

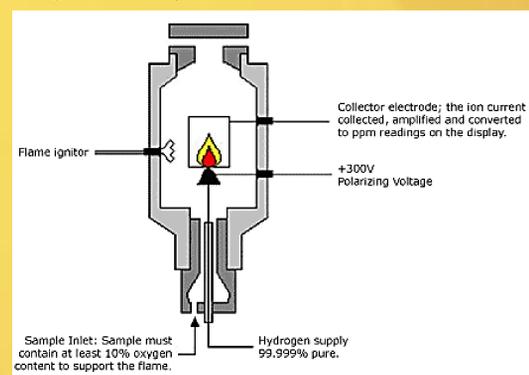
- Ion Source** → After passing through the GC, the chemical pulses continue to the MS. The molecules are blasted with electrons, which cause them to break into pieces and turn into positively charged particles called ions. This is important because the particles must be charged to pass through the filter.

- Filter** → As the ions continue through the MS, they travel through an electromagnetic field that filters the ions based on mass. The scientist using the instrument chooses what range of masses should be allowed through the filter. The filter continuously scans through the range of masses as the stream of ions come from the ion source.
- Detector** → A detector counts the number of ions with a specific mass. This information is sent to a computer and a mass spectrum is created. The mass spectrum is a graph of the number of ions with different masses that traveled through the filter



### Flame Ionization Detector (FID)

The FID passes sample and carrier gas from the column through a hydrogen-air flame. The hydrogen-air flame alone creates few ions, but when the organic compounds are burned there is an increase in ions produced.



A polarizing voltage attracts these ions to a collector located near the flame. The current produced is proportional to the amount of sample being burned. This current is sensed by an electrometer, converted to digital form, and sent to an output device.

This study was conducted using the GC to separate the compounds from each other, while the mass spectrometer helped to identify them based on their fragmentation pattern. The FID was also used to quantify them due to its higher sensitivity.

## RESULTS AND DISCUSSIONS

Results show the use of GC-MS-FID system for BVOCs analysis is a very powerful and sensitive tool. It was possible to speciate more than 20 compounds and quantify more than a dozen of them, as shown in table 1.

Compounds	Molecular Formula	MW	Ion of Interest (m/z)	Retention Time (min)
Isoprene	$C_5H_8$	68	67, 68	4,06
$\alpha$ -Pinene	$C_{10}H_{16}$	136	93	17,41
$\beta$ -Pinene	$C_{10}H_{16}$	136	93	19,05
D-Limonene	$C_{10}H_{16}$	136	68, 93	21,04
e- $\beta$ -Ocimene	$C_{10}H_{16}$	136	93	21,63
Longifolene	$C_{15}H_{24}$	204	93, 161	37,80
Triciclene	$C_{10}H_{16}$	136	93	17,00
$\alpha$ -Thujene	$C_{10}H_{16}$	136	93	17,13
Camphene	$C_{10}H_{16}$	136	93, 107, 121	17,98
Sabinene	$C_{10}H_{16}$	136	93	18,86
$\beta$ -Myrcene	$C_{10}H_{16}$	136	93	19,26
$\alpha$ -Phellandrene	$C_{10}H_{16}$	136	93	19,40
3-Carene	$C_{10}H_{16}$	136	93	20,24
$\alpha$ -Terpinene	$C_{10}H_{16}$	136	93	20,50
e- $\beta$ -Ocimenene	$C_{10}H_{16}$	136	93	21,19
p-Cimene	$C_{10}H_{12}$	132	117	22,70
p-Cimene	$C_{10}H_{14}$	134	119	20,60
Cineole	$C_{10}H_{18}O$	154	154	21,14

The higher and the lower concentration of BVOCs measured in both sites were 5  $\mu$ g/ $m^3$  and 0,3  $\mu$ g/ $m^3$ , respectively, confirming that the detector is very sensitive towards organic molecules and suitable for this purpose.

## ACKNOWLEDGEMENTS

This research was supported by CAPES and NCAR. The authors also thank INPA, LBA and Paracou staff by partnership.