

# Urban Dispersion Program (UDP) and Subway-Surface Air Flow Exchange (S-SAFE) Program

By

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# Introduction

- NYC one of the most popular tourist destinations in the world ( > than 40 million)
- Melting point of American Culture (Theater district, Museums, Art Deco buildings)
- Mecca of business in America (Financial district, Wall street and NY Stock Exchange)
- Destruction of World Trade Center (911) created awareness of vulnerability to infrastructure
- Tourism-related businesses second highest losses after Financial industry
- Last quarter of 2001 tourism reduction in US of 22.6% (Belau, 2003)
- Australia (-21%) arrival (Blake and Sinclair, 2002)

# Why the Need for Sustainable Tourism?

- Impact on Tourist Industry (143k jobs lost per month and \$2.8b in wages)
- 911 highlighted the vulnerability of City's economy
- Over 400K people suffering from PTSD as a result of 911
- 911 impact sharply increased governmental focus on security and tourism
- One Major concern city officials – Dispersion of biochemical agents released in NYC
- DHS birthed – one goal was to implement preventative measures to minimize on terroristic acts
- Planning and cooperation of multilevel agencies begun to address NYCs concern in context of Federal law – Intelligence Reform and Terrorism Prevention Act (IRTPA)
- Outcome UDP and later S-SAFE

# Urban Dispersion Program (UDP) and Subway-Surface Air Flow Exchange (S-SAFE) Program

- The UDP was the 1<sup>st</sup> extensive tracer and meteorological field study investigating outdoor-indoor-subway dispersion in a large Metropolis like Manhattan, NYC
- Second of 3 studies designed to predict how chemical and biological pollutants will disperse throughout a large city environment
- Over 200 scientist, engineers, technicians, and students
- Medgar Evers College (MEC) one of 5 CUNY schools involved with project
- MEC 15 trained STEM Majors and 1 instructional staff member for the UDP and 12 students and 2 instructional staff members for the S-SAFE experiment
- MEC and other students monitored the concentration of the gas at sampling locations along the entire subway system and at some above ground sites. Some 75,000 air samples were collected.

## Four main areas of airborne transport

1. Exposure to tracers of individuals (tourist) moving in and around urban areas
2. Infiltration of an airborne tracer through the subways
3. Infiltration of airborne tracer in an office building
4. Movement of airborne tracers throughout the streets and around tall buildings

## Urban Dispersion Program (UDP) and Subway-Surface Air Flow Exchange (S-SAFE) Program

- Three Intensive Observation Periods S-SAFE
- Six Intensive Observation Periods (IOPs) UDP from 6am to 12 noon
- During the IOP 6 safe inert gaseous PFTs and SF<sub>6</sub> simultaneously released from different locations and subway
- Tracer measurements were made using 158 tracer samplers and 9 tracer analyzers
- Meteorological conditions during an IOP – warm and humid with temperatures between 20 to 30 degrees with winds at or below 5m/s

## 6 Inert gases released 1m AGL and SF<sub>6</sub> 2m AGL

1. PDCB – Perfluorodimethylcyclobutane (C<sub>6</sub>F<sub>12</sub>)
2. PMCH – Perfluorocyclohexane (C<sub>7</sub>F<sub>14</sub>)
3. Oc-PDCH– Perfluoro-1,2 dimethylcyclohexane (C<sub>8</sub>F<sub>16</sub>)

1. PMCP – Perfluoromethylcyclopentane (C<sub>6</sub>F<sub>12</sub>)
2. i-PPCH – Perfluoroisopropylcyclohexane (C<sub>9</sub>F<sub>18</sub>)
3. PTCH – Perfluorotrimethylcyclohexane (C<sub>9</sub>F<sub>18</sub>)
4. SF<sub>6</sub> – Sulfur hexafluoride (SF<sub>6</sub>)

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## PFT Sources



PFT sources from left to right:  
PDCB, PMCP, PMCH and OC-PDCH



## Why PFTs and SF6?

- **PFTs** because of the ability to release small amounts ( 1 to 1.5mg/s) and analyze using common analytical systems
- **SF<sub>6</sub>** because of the dependability and precision of sampling methods and the ability to measure (3 to 5 g/s) in real time

## SF6 Release Site During IOP 1 and IOP 3



# Sampler - Capillary Absorption Tube Samplers (CATS)

CATS



Capillary Adsorption Tube Sampler (CATS) before Sampling

## Capillary Absorption Tube Samplers (CATS)

- Sampler consisting of 64 mg Ambersorb 347
- Used to absorb air which surrounds it
- Absorbs PFTs in surrounding air along with any other vapors at given location

## Students Posing with CATS Before Sampling



## Sampler Hung on Street Lightpole





# Sampler Hung in Manhattan, NYC

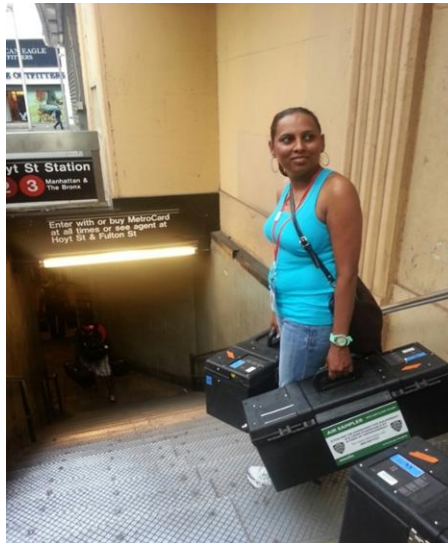


# Sampler - Brookhaven Atmospheric Tracer Sampler (BATS)





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# Mobile Air Unit placed in Subway station post S-SAFE Program



# Conclusion

- The completion of the UDP and the S-SAFE contributed significantly to urban dispersion research (improve on models)
- Advanced knowledge about movement of contaminants in and around large cities, and into and within buildings and subway
- Aids first responders, emergency managers in enhancing NYCs emergency response capabilities (installation of a state of the art meteorological network in NYC)
- Raised awareness of geosciences among STEM majors
- STEM students were able to demonstrate competency in presentation skills and research skills