SAND2016-10757C

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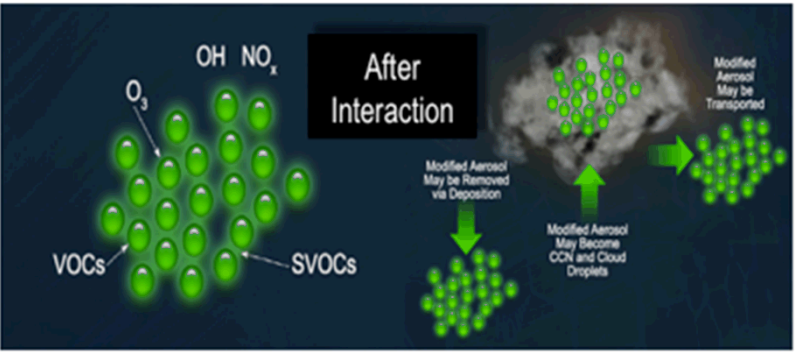

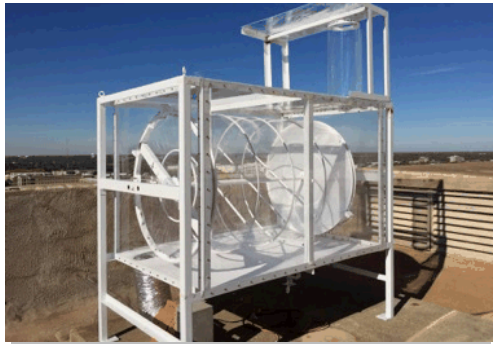

Changes in the single particle fluorescence of biological particles exposed to outdoor environments and the its relationship to the atmospheric chemistry

Joshua L. Santarpia, Sean Kinahan, Andres L. Sanchez, Don R. Collins, Yong-le Pan, Steven C. Hill, Shanna Ratnesar, Thomas Hawkyard

U.S. DEPARTMENT OF ENERGY | NNSA

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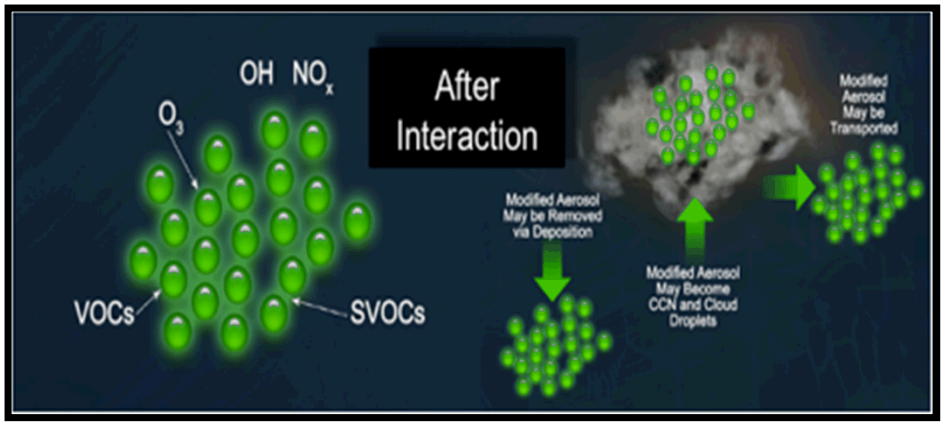
Overview

- Project Objectives
- Background
- Previous Work
- Current Progress
  - Instrumentation and Methods
  - Lab Studies
  - Field Studies
    - 2015
    - 2016
- Future work
  - Wrap-up of Current Project
  - Next Steps

Background



- Primary Biological Aerosols (PBA)
  - May undergo chemical or physical changes in the atmosphere via differing processes
  - Open Air Factor (OAF)

- Atmospheric Processes
  - Ozone, UV, RH, SOA, Pollutants, Free Radicals
- Changes
  - Viability
  - Size distribution
  - Morphology
  - Detection/Spectroscopic
  - Infectivity
  - Resuspension

Single Particle Fluorescence Spectrometer (SPFS)

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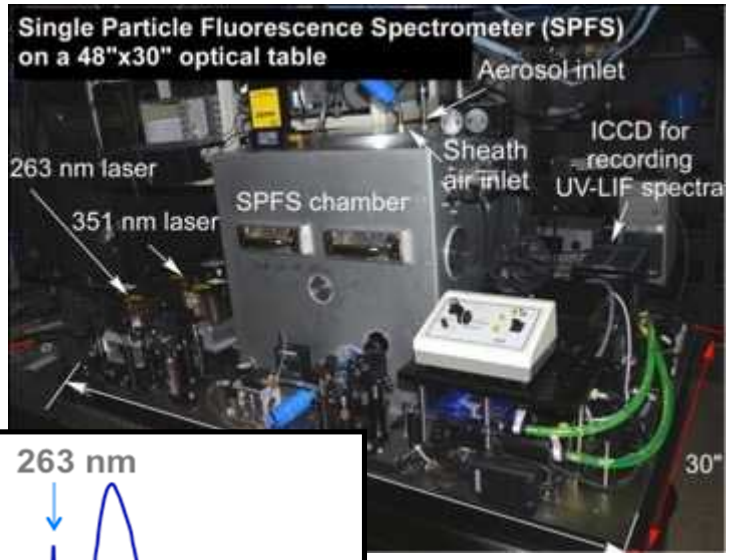
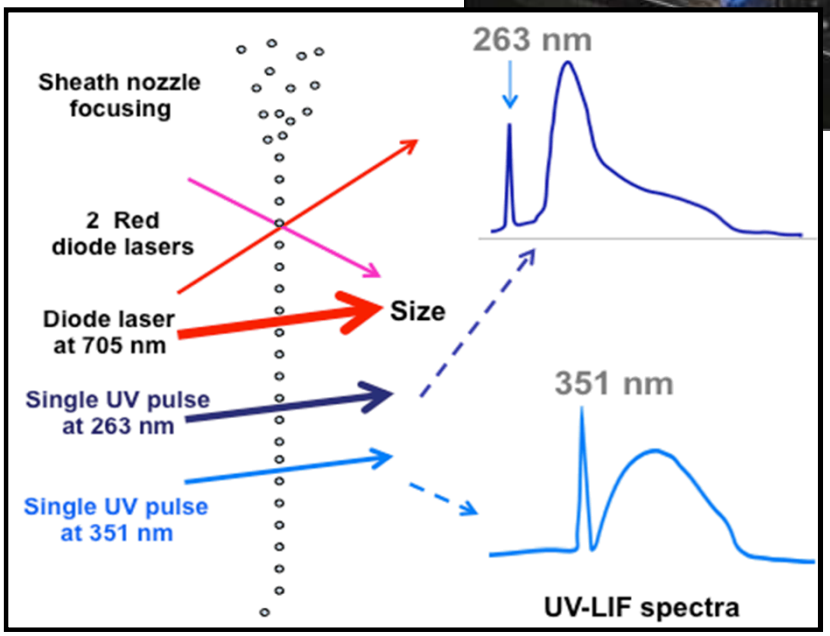
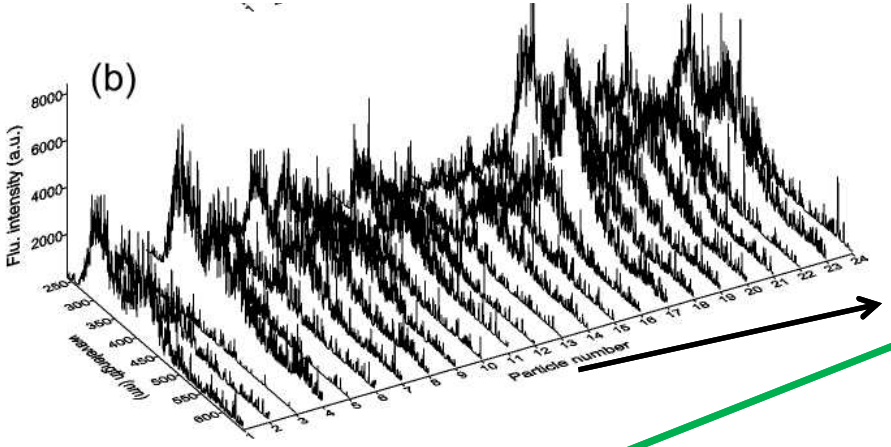
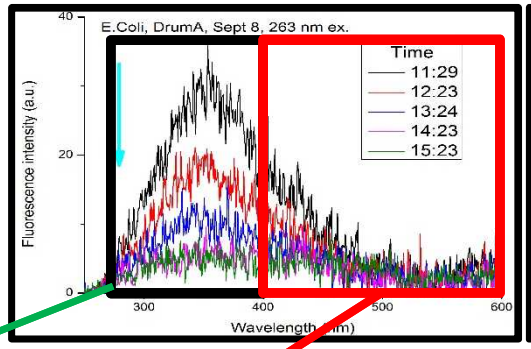
- Army Research Laboratory
  - Current system developed from over a decade of research
  - Fluorescence excited at 263 and 351 nm
  - Spectra measured each wavelength
  - Particle size from optical scattering

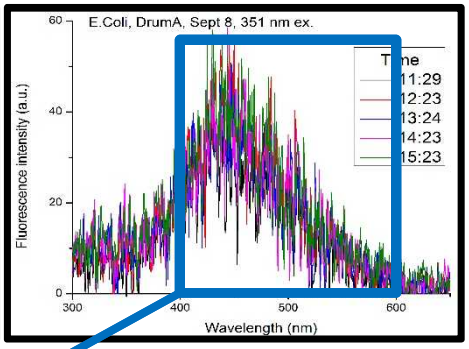


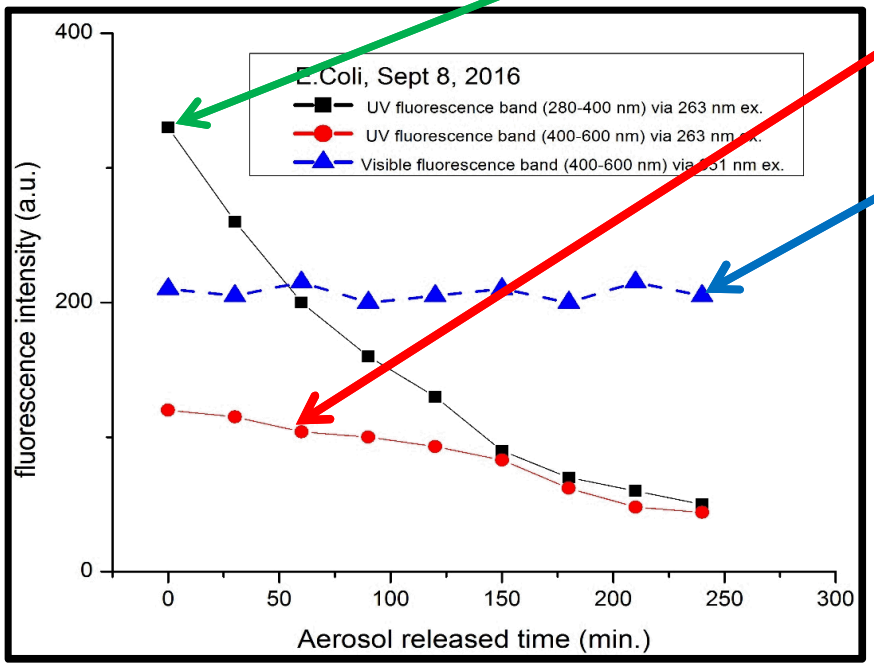


SPFS Data Analysis









- Several hundred single particle spectra are averaged together for each measurement time
- Spectra are examined on their own and by integration into 3 bands
  - UV263, Vis263 and Vis351
- Fluorescence degradation analyzed by band

Wideband Integrated Bioaerosol Sensor

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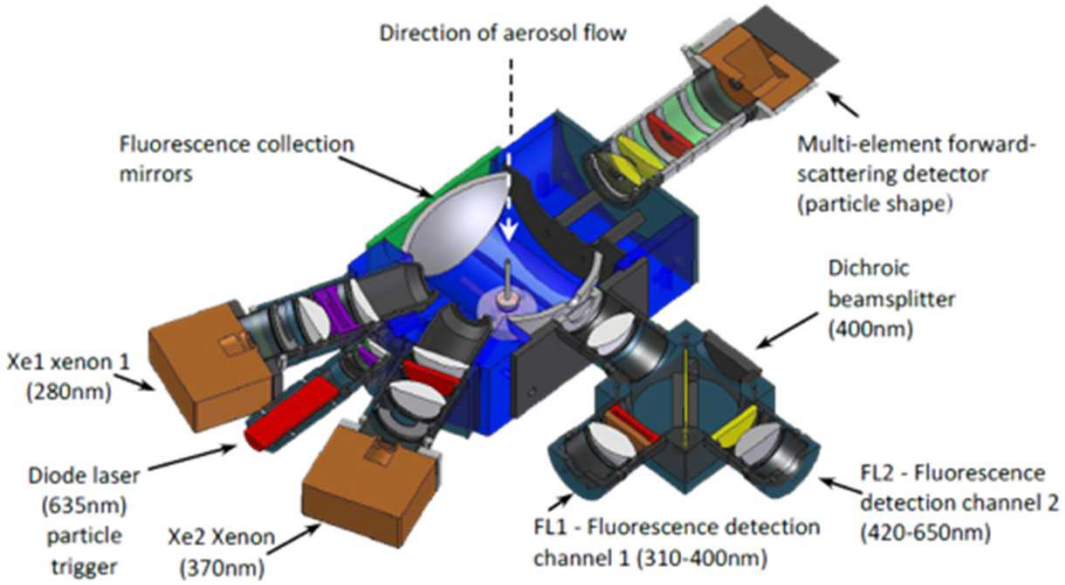
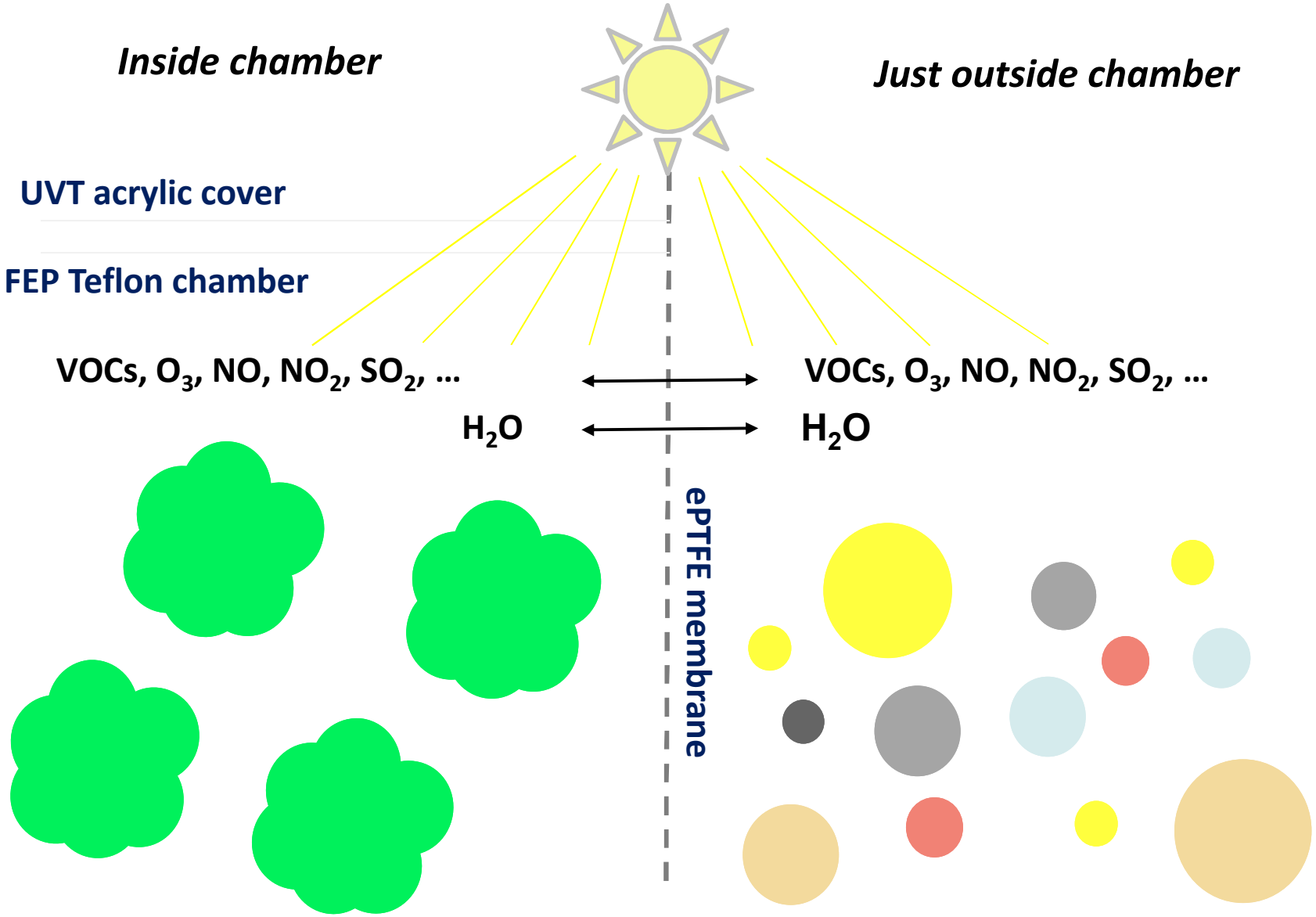
- 280 nm and 370 nm excitation
- 310 to 400 nm and 420 to 650 nm emission bands
- Particle Size (geometric from scattering)
- Asymmetry factor



Reprinted from DMT website

CAGE Concept



System Set up at Army Research Lab in Maryland for Field Study

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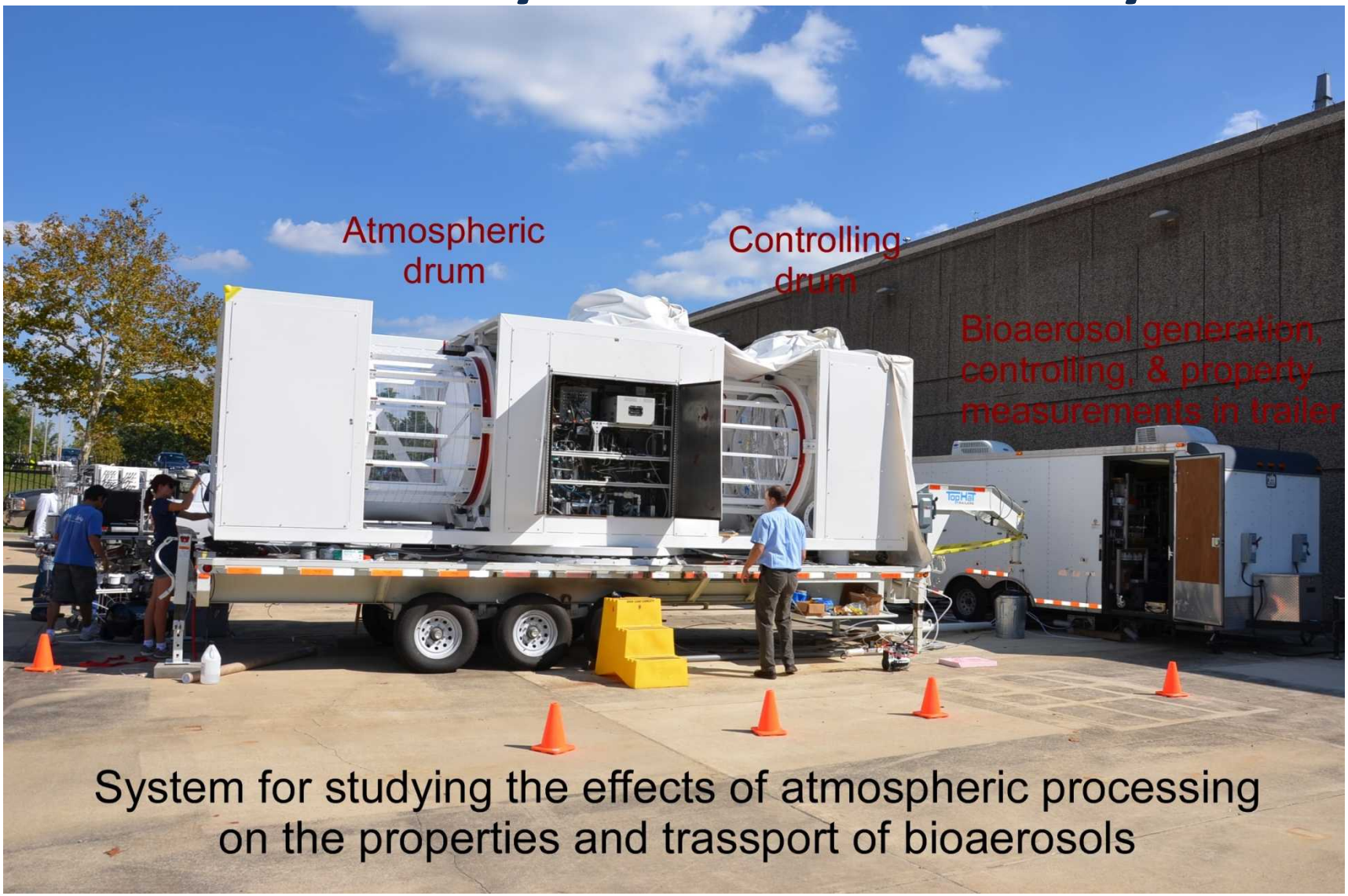
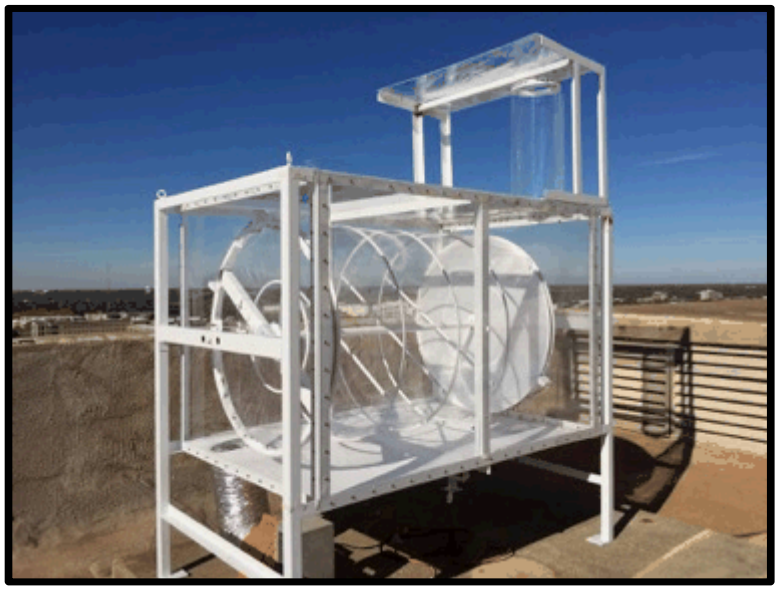


System for studying the effects of atmospheric processing on the properties and trassport of bioaerosols

New Outdoor Chambers

- The CAGE chambers were designed to meet a wide range of experimental demands.
  - Much of their complexity stems from the requirement that both pressure and temperature be controllable.
- The complexity of CAGE has made it difficult to completely control under the circumstances of these experiments.
- New chambers were designed and constructed started during project year 1 and the first part of year 2.
- The cylindrical chamber support frame and rectangular outer support frame are shown in figure below.
- Similar to CAGEA
  - internal volume of about 1 m^3
  - rotate at roughly 1 rpm
- All surfaces in contact with the chamber air are FEP or PTFE Teflon.
- The outer frame is enclosed in UV-transparent acrylic to act as a wind block.



Trace Gases Inside and Outside the Chamber

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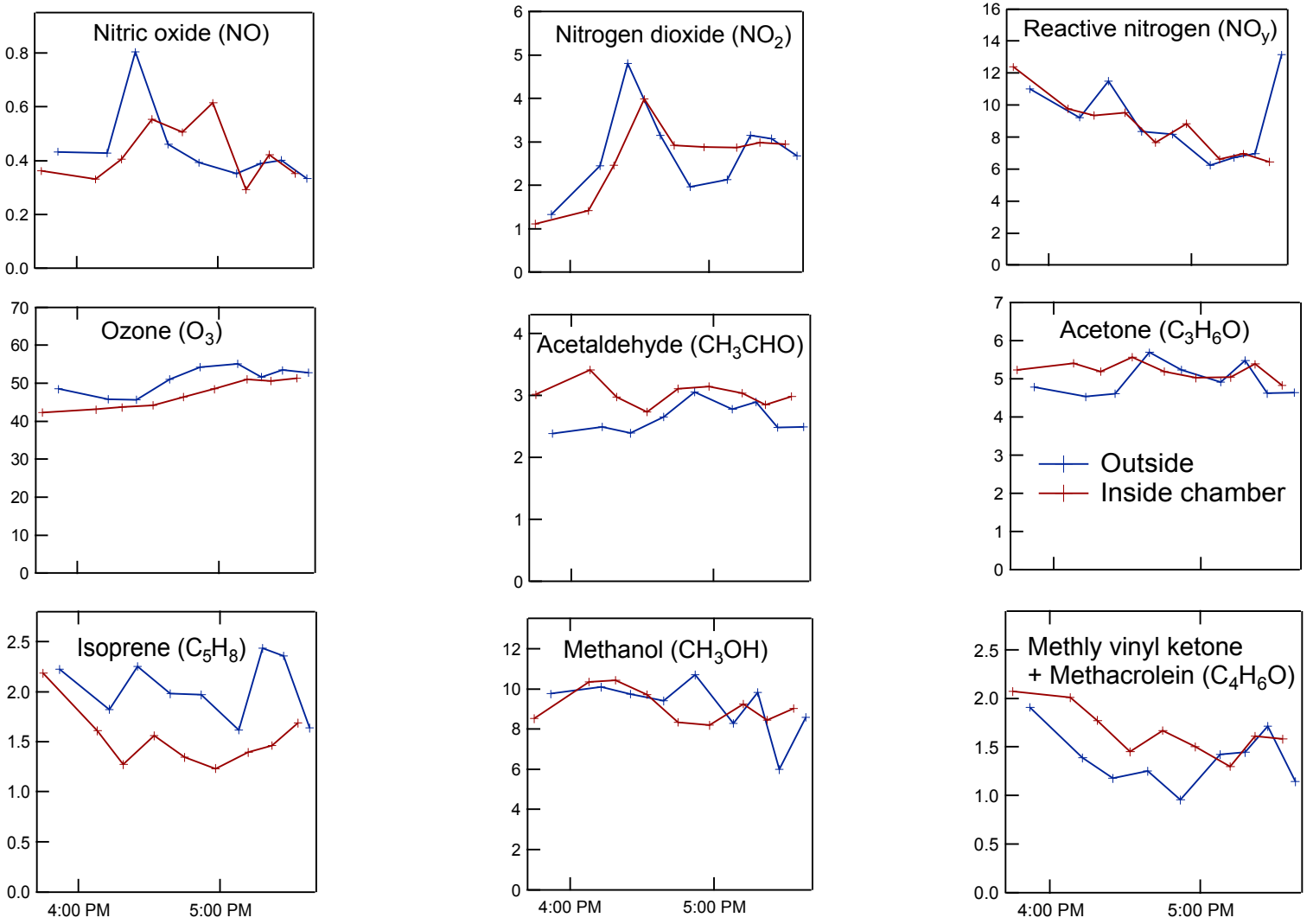
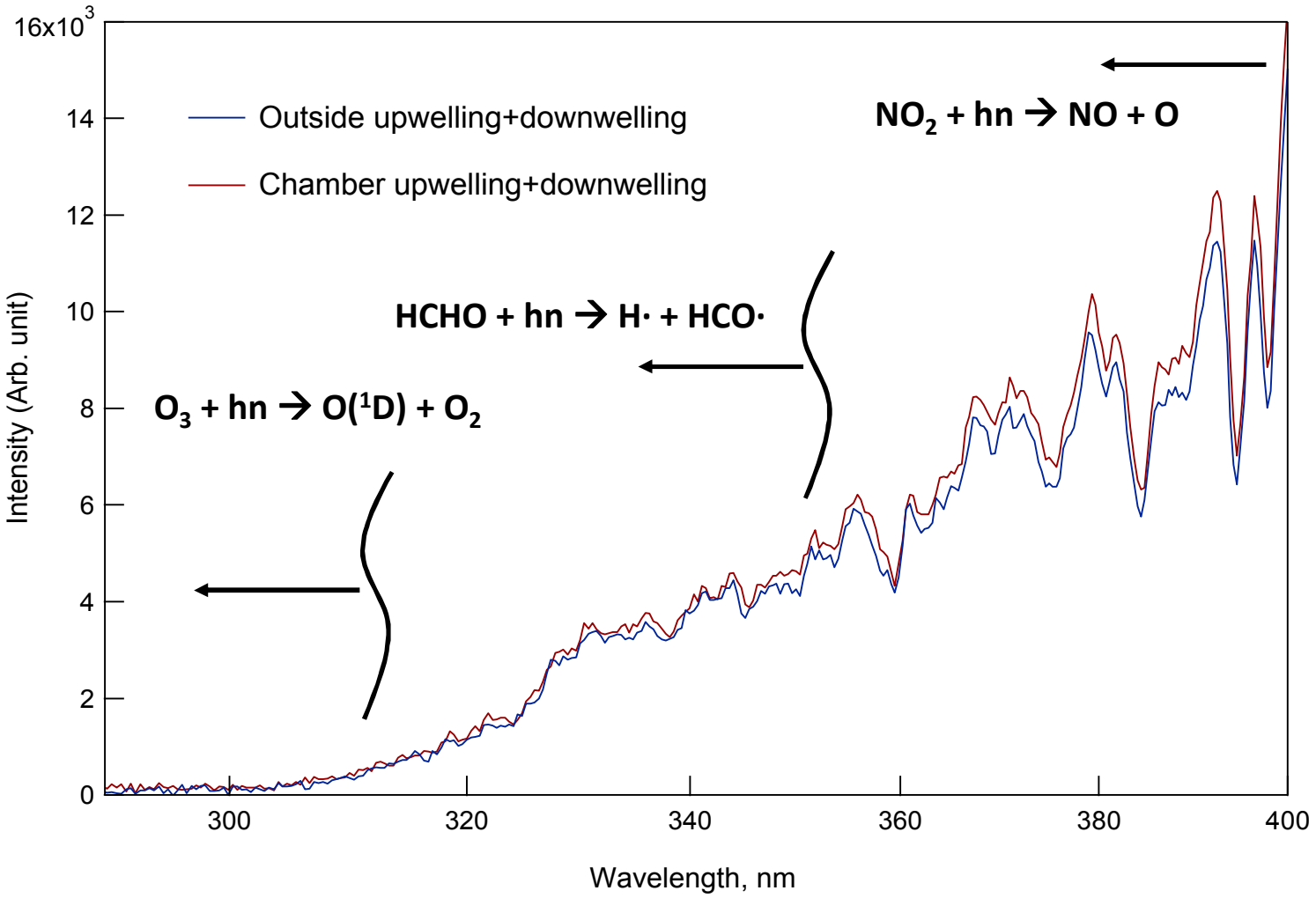


Combined Intensity in UV Range



Study Location – ARL in Adelphi, MD

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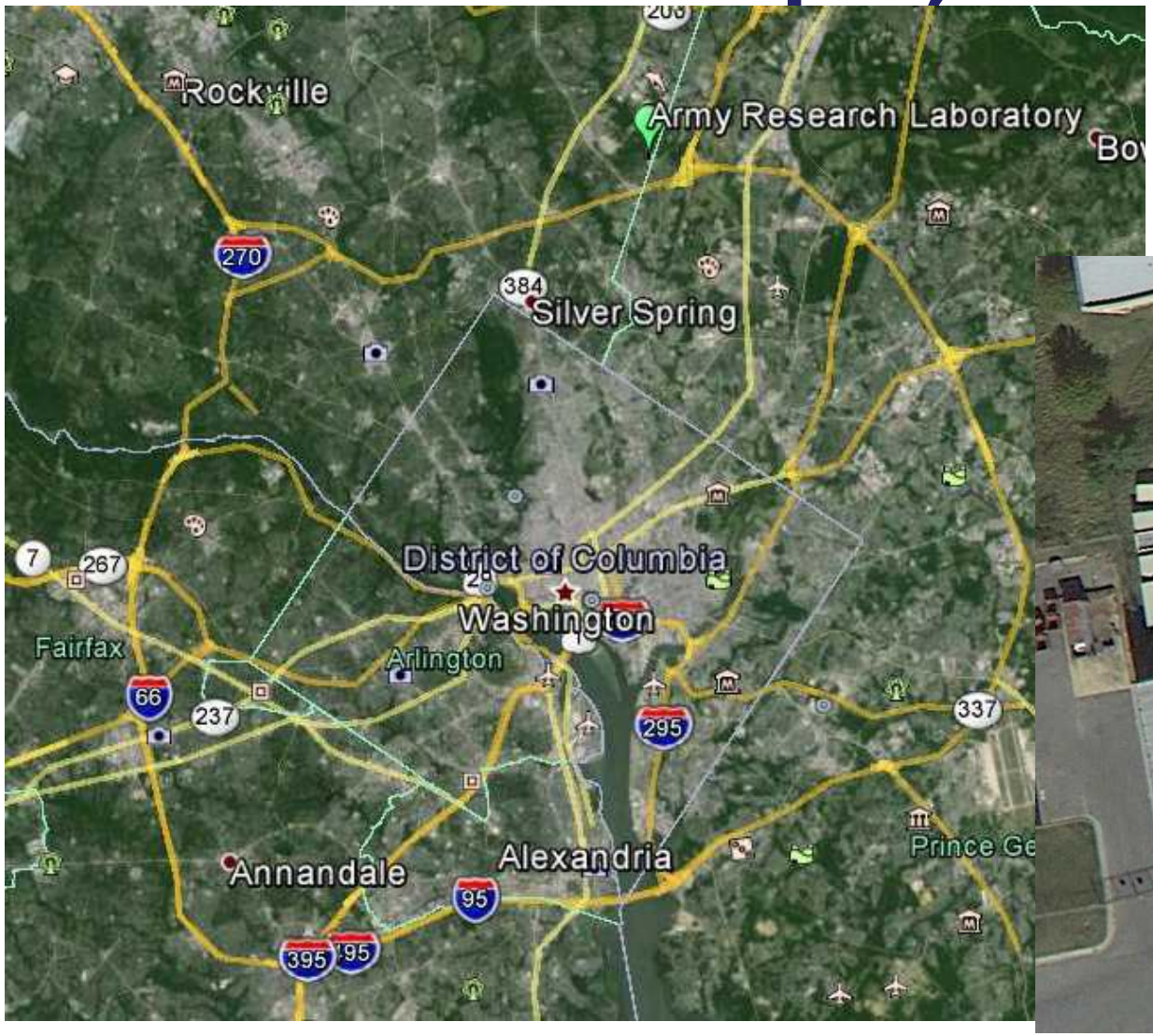

Images from Google Earth