AERIAL AND GROUND MEASUREMENTS OF EMISSIONS FROM AGRICULTURAL AND FOREST BURNS

PM$_{2.5}$, BLACK AND BROWN CARBON, VOCs, SVOCs (PCDD/PCDF)

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Project Vision:

To apply a unique instrument system and method for sampling and quantifying emissions from open area burns such as agricultural field burning and wild/prescribed fires. This system has been deployed on 15 sampling campaigns since 2010.

About Our Research:

Open burning of grasslands, agricultural fields, and forests is done to prepare fields for the next growing season, rid land of pests, prepare crops for harvest, and limit fire danger. Quantification of these emissions is important toward understanding how to limit the impact of these pollutants and to develop sound inventories from which policy decisions can be made.

Why are We Conducting this Research:

Wildfires and prescribed fires are one of the largest sources of particulate matter (PM) and ozone pollutants, as well as air toxics, in the U.S. Because of the inherent difficulty, cost, and hazard involved in sampling these sources, emission factor data are scant. These emission factors are used in national emission inventory calculations, climate change models, and risk assessment calculations. Data from the forest and open burning research is used to predict the magnitude of biogenic sources of global warming species and national inventories for air toxics (e.g. polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF).

Sampling Methods:

We have developed a unique instrument system suitable for safe and accurate measurements of lofted plumes. We use a helium filled balloon to lift our instruments into plumes. We employ both field sampling of burns and large scale laboratory burn simulations to determine emission factors.

Field sampling of grass fires, wheat stubble, sugarcane, waste, and forest burns is challenging to accomplish.

Burn Simulations can also be conducted in the Open Burn Test Facility.

The aerial sampler "Flyer" is used for open burn measurements in the field at prescribed altitudes.

Familiarizing You With The Equipment

The "Flyer" sampling instrument (see photo, below) is lifted into the air with a 5 m diameter, helium-filled balloon with one or two tethers. It can measure and sample a broad variety of compounds including Carbon Monoxide (CO), Carbon Dioxide (CO$_2$), Particulate Matter Small (PM$_{2.5}$), black/brown carbon, elemental/organic carbon, semi-volatile organics (Ploycyclic aromatic hydrocabons (PAHs), PCDD/PCDF), and volatile organics.
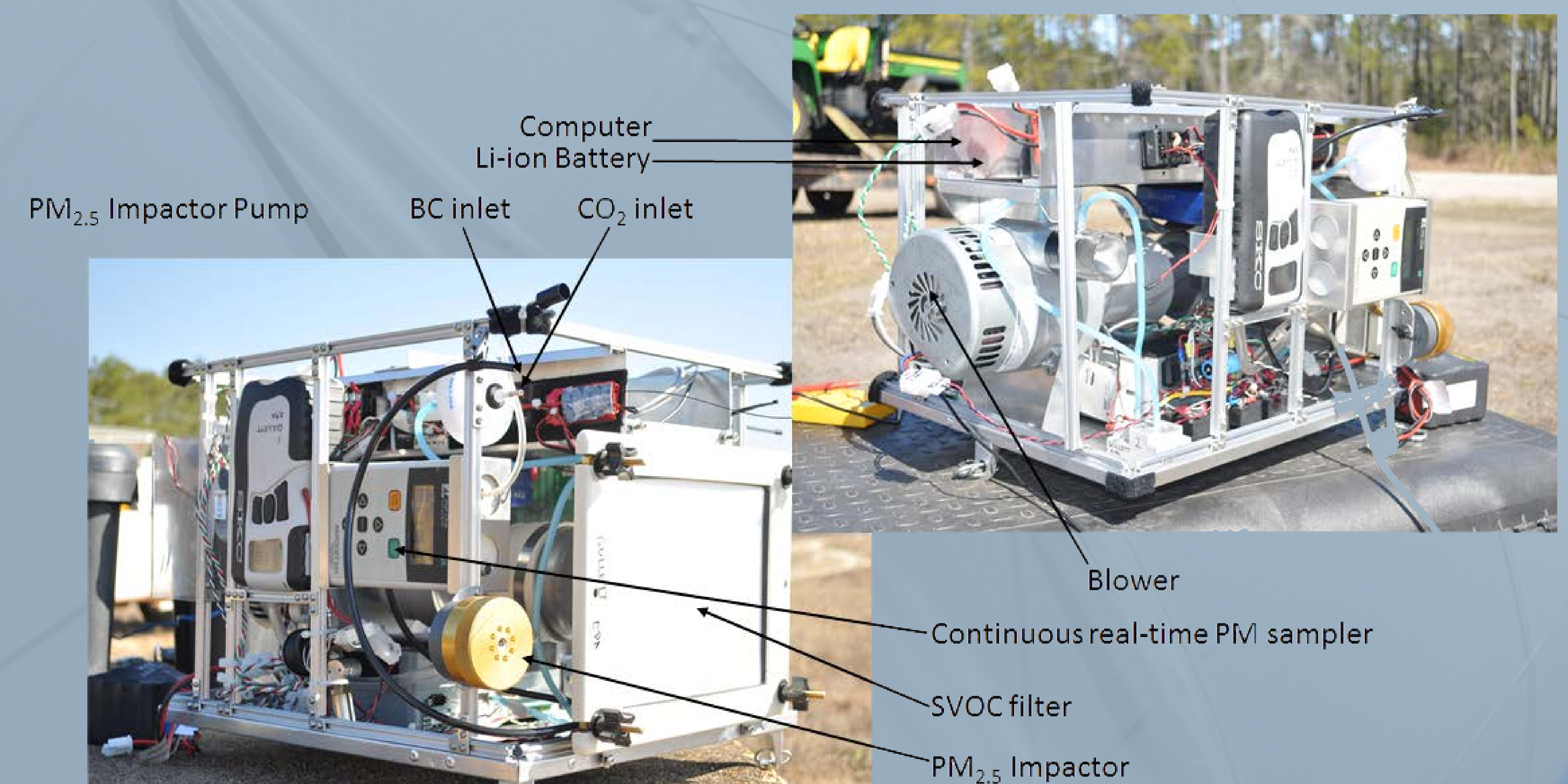
What Has Been Learned:

- An aerial sampling method was developed that safely enables collection of a "whole event" sample rather than a less representative, smoldering-only sample.
- Emission factors for numerous sources with poorly characterized or absent data can now be determined.
- Laboratory tests have observed that pollutant amounts are often related to combustion efficiency: in general, poorer combustion leads to higher emissions.
- Both biomass type and combustion efficiency are important toward determining emissions.

What Have We Accomplished:

- Development and vetting of an instrument system comprised of sensors and samplers that measure a broad array of climate, visibility, inhalation, and toxic-related pollutants.
- Creation of an aerostat-lofted method for deploying this instrument system into over 15 campaigns since 2010, including agricultural burning, military detonations, trash burning, and oil fires at sea.

What is Next:

The research team is working hard to deploy a small, lightweight emissions sampler for use on small aerial platforms.
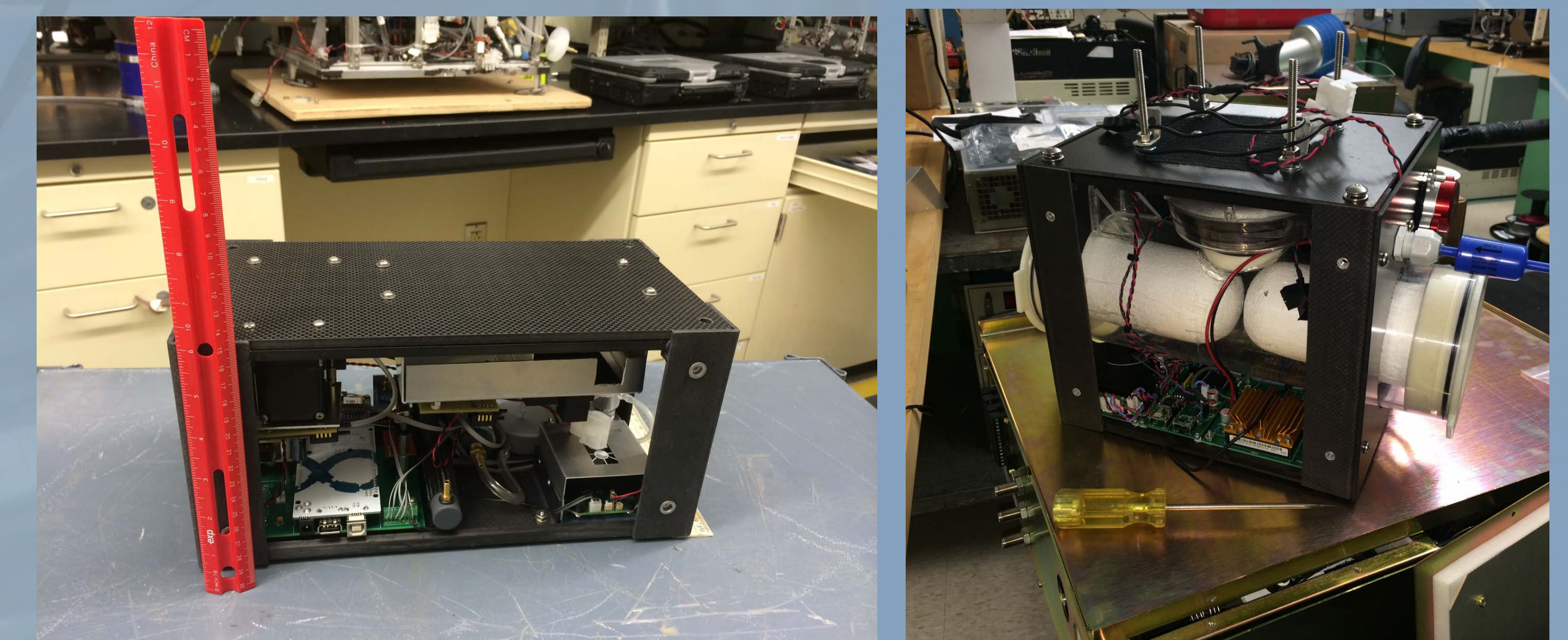
Collaborators:

– U.S. Forest Service
– U.S. EPA Region 10, Washington State, Immediate Office
– Oregon Department of Forestry
– DWH Disaster
– Canadian Department National Defence

– U.S. DOD, SERDP
– Camp Lejune
– Fort Rucker
– Eglin Air Force Base