

Application of Sensor Technology to Aerial Emission Sampling

Brian Gullett

U.S. ENVIRONMENTAL PROTECTION AGENCY

Bill Mitchell¹, Xiaochi Zhou², Johanna Aurell³

¹U.S. ENVIRONMENTAL PROTECTION AGENCY,
OFFICE OF RESEARCH AND DEVELOPMENT

²DUKE UNIVERSITY, STUDENT SERVICE CONTRACTOR, U.S. EPA

³UNIVERSITY OF DAYTON RESEARCH INSTITUTE



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EPA/ORD Aerial Emission Sampling

PURPOSE: Quantification of emissions from open area sources

- Aerostat-lofted emission sampling system
- Developed in 2010 to sample open burning and open detonation of military ordnance
- Applied to 11 field campaigns
 - 3 OB/OD measurements at Tooele Depot, UT
 - At-sea measurements of burning BP oil, Gulf
 - 4 prescribed forest fires at Eglin AFB, Camp Lejeune, Ft. Jackson
 - Open burning of wastes (“burn pit” simulation) for USAF
 - Agricultural field burning in ID and WA
 - OB/OD for Canadian Department of Defence, Saskatchewan
 - Selected for Bagram Air Base burn pit measurements

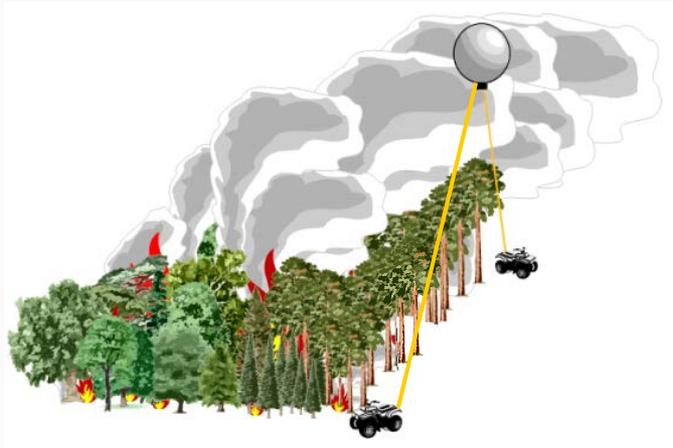
Emission Sampling Platform: The “Flyer”

- Total weight ~ 21 kg (46 lb), Flight time 4 h
- Onboard computer with data transmission
- User-set CO₂ triggering of samplers
- GPS, CO₂, CO
- Semi-Volatile Organic Compounds (SVOCs)
- Volatile Organic Compounds (VOCs)
- Black carbon (BC)
- Brown carbon
- PM by filter (PM_{2.5}, PM₁₀)
- Continuous PM_{2.5}, PM₁₀
- 3D-anemometer



The Aerostat Method

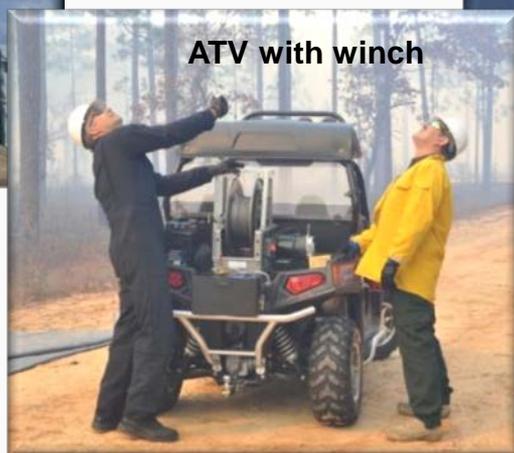
4.9 × 4.0 m (16 × 13 foot) in diameter
Two layer
Polyurethane inner layer
Rip-stop nylon as outer layer
Helium filled



Sampling Campaigns



Maneuverability of Aerostat and Flyer



Single or double Spectra tethers on electric, remote control winches

The use of tethers and ATVs can create challenges for positioning (e.g., trees) and equipment (e.g., shrapnel) as well as limit plume residence time and, hence, the ability to collect sufficient sample.



Issues



We can solve the payload issues:

EPA/ORD is testing and verifying the performance of commercial gas sensors.

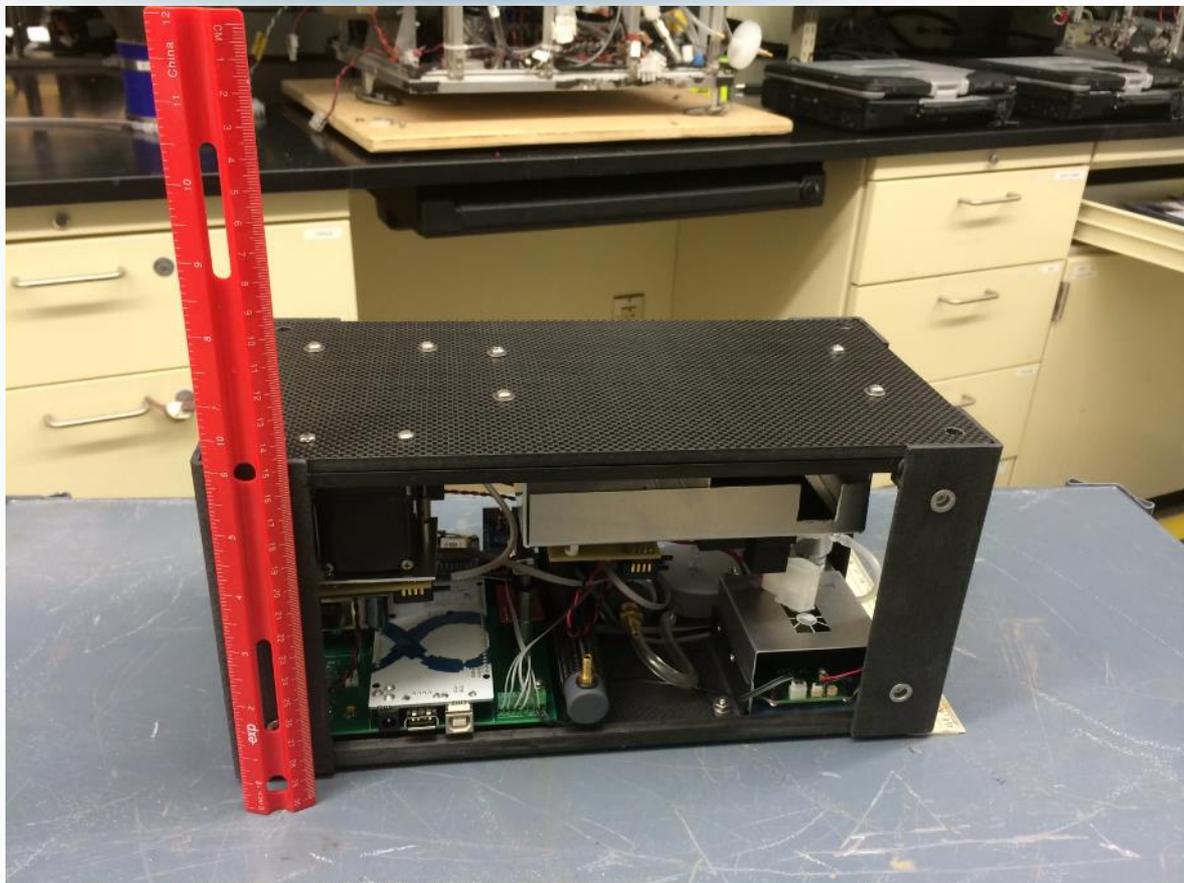
These lightweight sensors can replace larger emission monitors for certain applications.

We are also developing miniature samplers.

We have produced a replacement for the Flyer instrument package...



The “Kolibri”



The Kolibri is 3.56 kg and measures

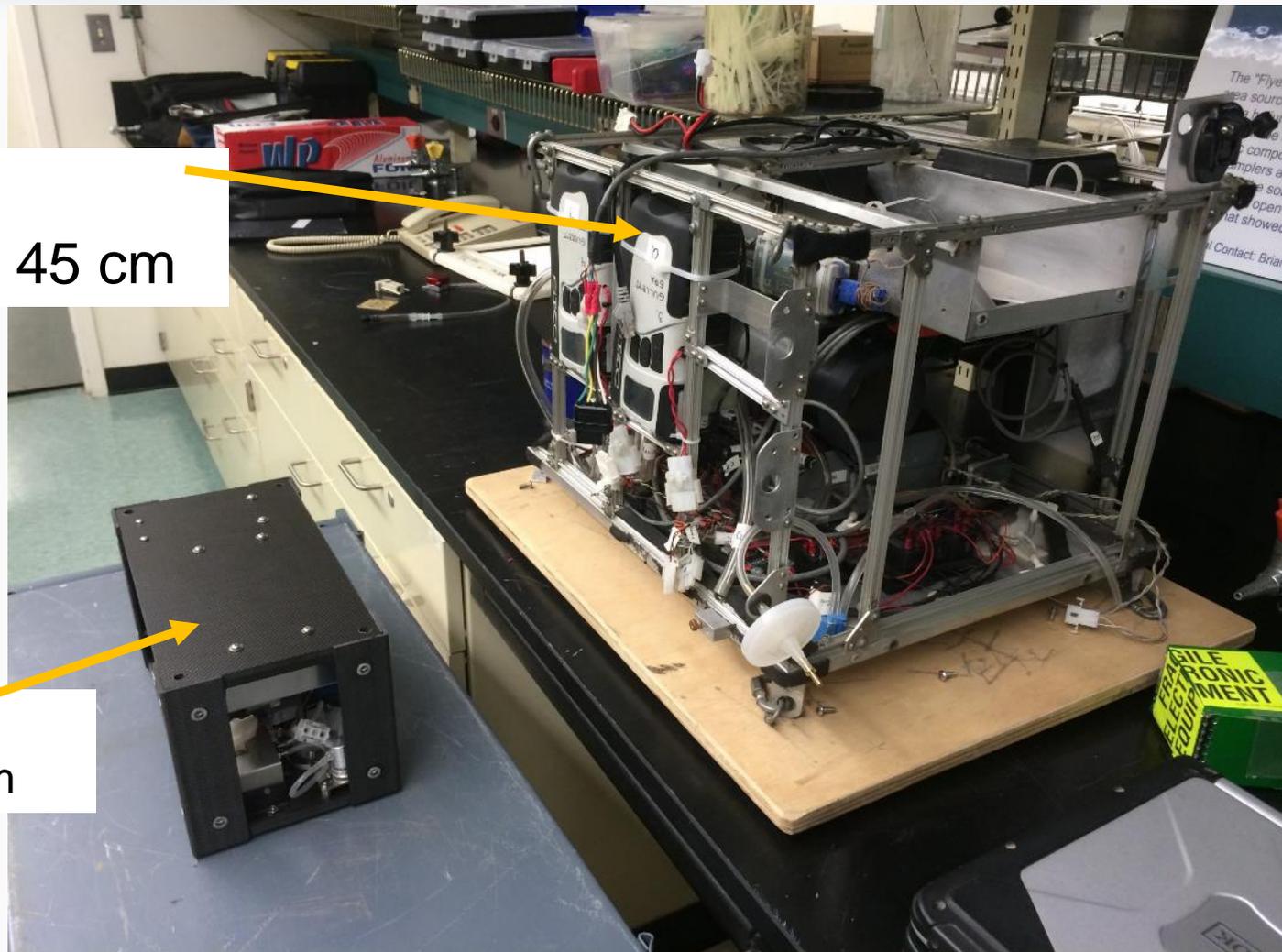
- CO₂,
- CO,
- PM_{2.5},
- Volatile organics
- Black Carbon,
- Brown Carbon.



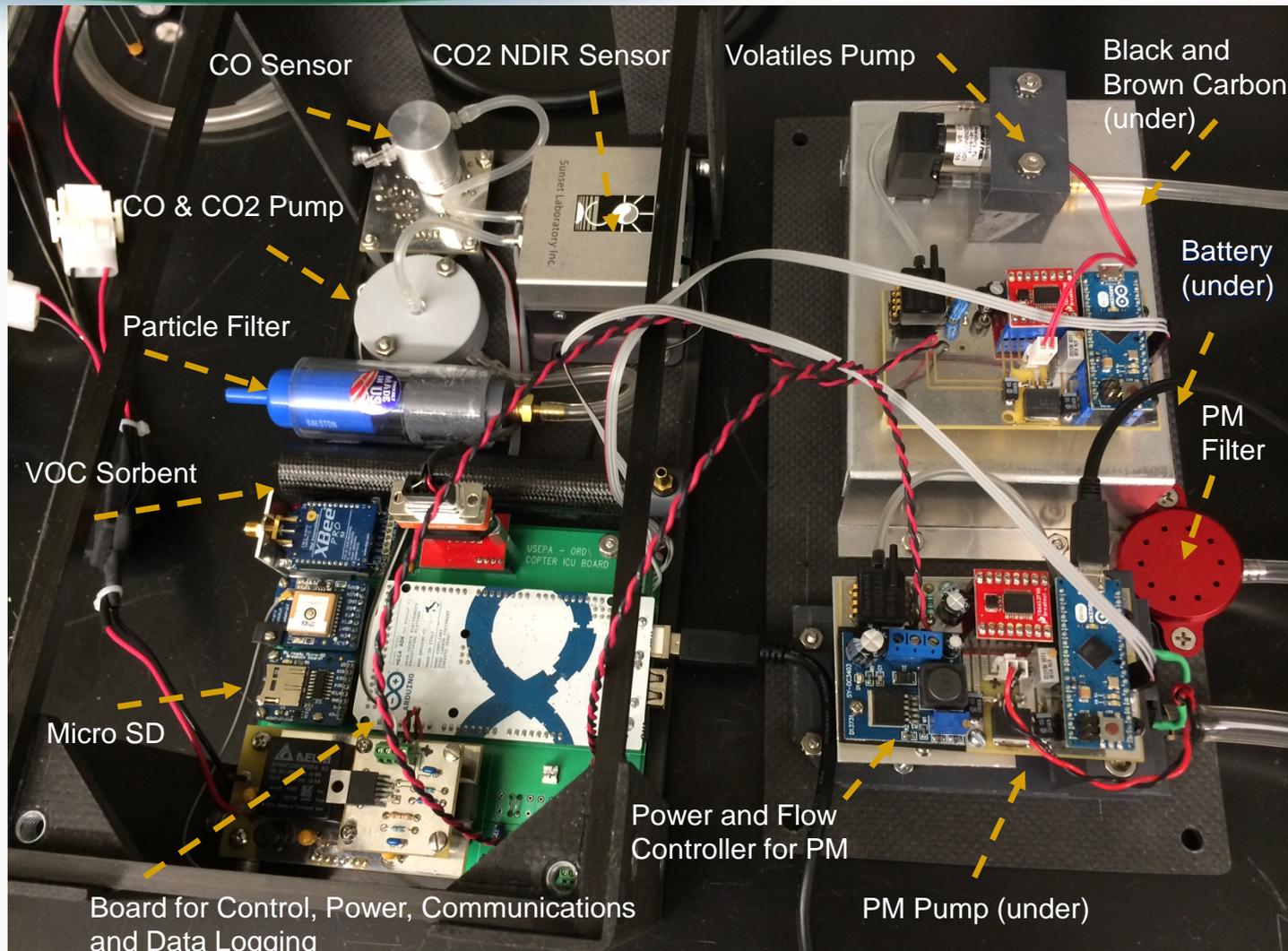
Kolibri vs. Flyer

>21kg,
55 x 50 x 45 cm

3.56 kg,
15 x 15 x 30 cm



Split Halves of the Kolibri





Other Environmental Applications

- Vegetation identification and management
- Oil spill detection
- Fire monitoring
- Algal bloom identification
- Landfill emissions
- Disaster response emission monitoring
- Community air toxics monitoring
- Industrial emission characterization



Status

- Kolibri is laboratory-tested



SUMMARY

- EPA has developed a lightweight sensor and sampler system for quantification of emissions
- This system will be utilized in our on-going aerial sampling efforts