

# EPA Aerial Emission Measurements Using the Drone-Based “Kolibri” System

Innovative Science for a Sustainable Future

## Kolibri

Researchers at the U.S. Environmental Protection Agency (EPA) are developing and demonstrating the Kolibri, an air emission sensor/sampler instrument, for use on small uncrewed aircraft systems (sUAS) and ground-mobile applications. The instrument can remotely and safely sample emissions from a variety of open area sources such as wildland fires and industrial plumes.

## Instrument Measurement Capabilities

The Kolibri sensor/sampler instrument is a shoebox-sized, lightweight system that weighs up to four kilograms. It can be used to sample a comprehensive suite of gas and particle emissions, including:

- Carbon dioxide (CO<sub>2</sub>),
- Carbon monoxide (CO),
- Nitrogen and sulfur oxides (NO<sub>x</sub>/SO<sub>x</sub>),
- Hydrogen Fluoride, Hydrogen Chloride, Hydrogen Cyanide (HF/HCl/HCN),
- Volatile and semi-volatile organic compounds (SVOCs, VOCs),
- Per- and polyfluoroalkyl substances (PFAS)
- Polycyclic aromatic hydrocarbons (PAHs),
- Particulate matter (PM),
- Bioaerosols,
- PM metals, and more.

## Features

- The Kolibri includes an array of air sensors and other miniature measurement instruments that provide real-time and cumulative data. The types of samplers used on the platform can be customized for specific measurement needs.
- The Kolibri is self-powered and has a microcontroller that operates the sampling pumps, records data, and transmits data to the ground operator through a telemetry system.
- Data can be viewed by the operator in real time and batch samples can be sent to the laboratory for further analysis.
- The Kolibri can be placed on an sUAS or on mobile vehicles, enabling sampling at the emission source and in the immediate area surrounding the source.



*Kolibri systems attached to sUAS*

## Applications in the Field

The Kolibri is being used in multiple applications in the field to characterize the chemical and biological composition of emissions. The Kolibri can be applied to various challenging open area scenarios such as fires, lagoons, flares, and landfills as well as forest and agricultural burns and industrial plumes.

The novel air sampling instrument offers the capability to obtain a comprehensive suite of emissions data from sources where data do not previously exist because of accessibility limitations and/or safety issues for personnel. The system further provides a significant tool to characterize emergency situations for air emissions and provide data for plume dispersion modeling.

Researchers have used the Kolibri to study emissions during wildfire-like prescribed burns with the U.S. Forest Service, emissions of oil burns on water with the U.S. Department of Interior, emissions from open detonation demilitarization operations with the U.S. Department of Defense, emissions from grassland prairie prescribed burns, emissions from wildland fire prescribed burns with the U.S. Forest Service and Department of Defense, and methane emissions from bogs with the U.S. Geological Survey.

The system is operated by EPA's Office of Research and Development (ORD) and has been deployed on 34 field research applications across the United States and Canada since 2016.

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*sUAS-based emission sampling during stand replacement burns in Fishlake National Forest, Utah. Jess Juchtzer, Desert Research Institute, used by permission.*



*Sampling emissions from an oil spill burn on icy waters.*

## Highlighted References

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*sUAS-based emission sampling from prescribed prairie burns at Konza Biological Research Station, KS.*