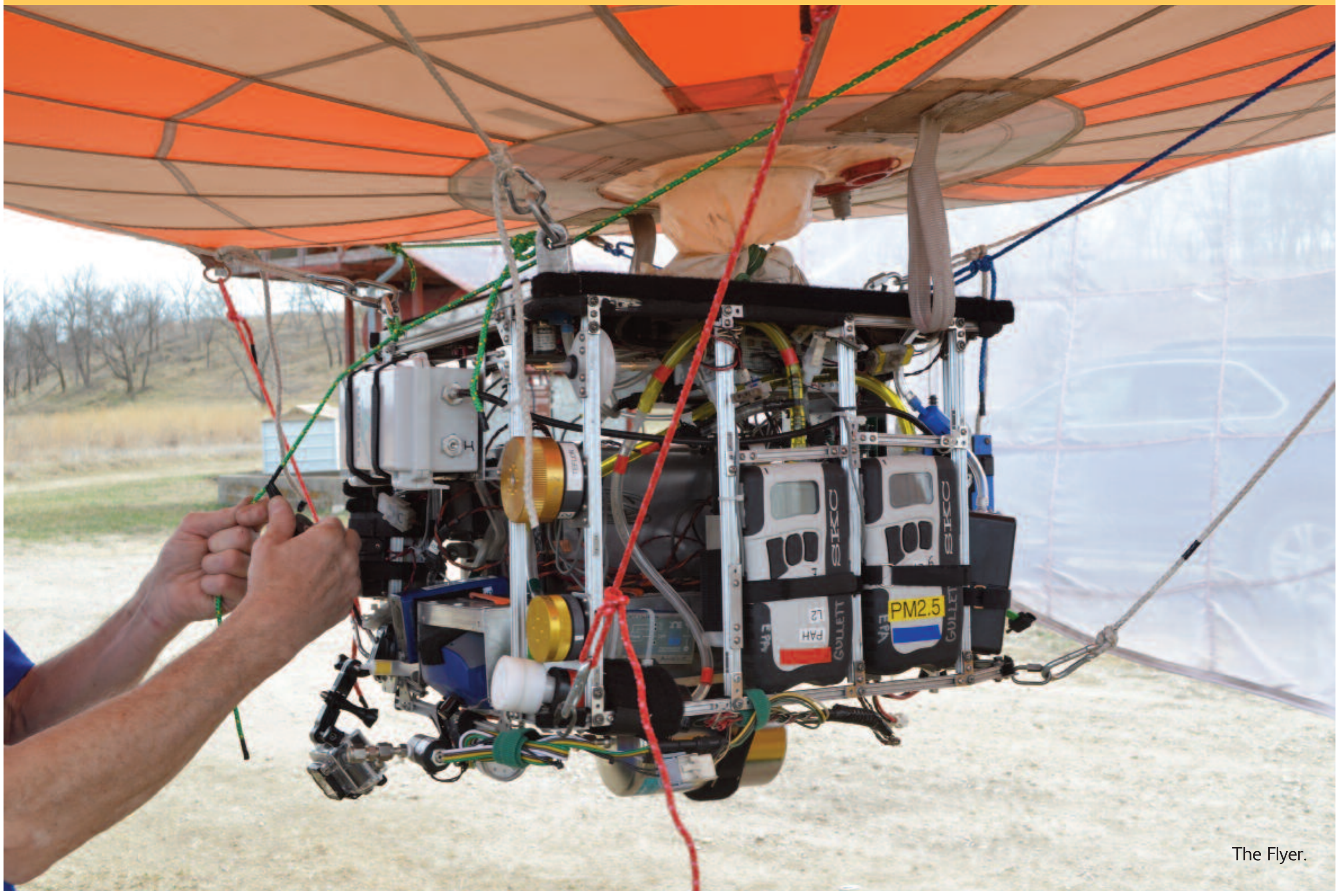

The Flyer.

Novel Air Measurement Technology
Supports Smoke Management Practices for Prescribed Burns

by Ann Brown

A team of EPA researchers recently traveled to the Flint Hills region of Kansas to take air measurements during prescribed burns of prairie land that will be used to better determine the impact of smoke in nearby communities.

Central Kansas is home to the largest remaining tallgrass prairie in North America with five million acres in Kansas and portions of Nebraska and Oklahoma. Fires were once a natural occurrence, but now they are intentionally set during prescribed burns, primarily in the spring. The fires burn the invasive plants and rejuvenate the soil, which encourages growth of native grasses. This, in turn, benefits farmers and ranchers who graze cattle and bison on the land. However, the downside is that smoke plumes can contribute significantly to air pollution in nearby communities and farther downwind, sometimes as far as the East Coast, particularly when burning is concentrated during the short spring season.

U.S. Environmental Protection Agency (EPA) researchers are supporting best smoke management practices for prescribed burns of prairies to reduce the impact of smoke in nearby communities and those much farther away. Last November, the research team traveled to the rolling prairies of Flint Hills, KS, to take air measurements during the planned fires using a novel air sampling system developed in the laboratory.

Researchers had previously visited the area in March 2017 during the traditional peak burn season to take air samples. They will use the two data sets to see if there are any differences in smoke plume emissions from spring and fall.

"This effort used the latest advances in open fire emissions sampling technology to assist the state's agricultural and environmental interests," says Brian Gullett, lead scientist for the study.

Smoke from prescribed burning contains air pollutants—notably particles—that can impact health. During burns, air pollution levels can sometimes exceed federal limits. People who are most vulnerable to these pollutants, such as those with lung and heart problems, are at greater health risk. The smoke can also cause the general population to experience irritation of the eyes, nose, and throat and cause visibility problems.

The Flyer air sampling system.

The Flint Hills study is providing air emissions data needed to better predict the best times, locations, and conditions to burn. To get measurements in the smoke plume, researchers use both ground-based and aerial sampling systems to measure levels of particulate matter (PM), black and brown carbon, and volatile organic chemicals (VOCs), as well as impacted background ozone levels.

These data will provide information specific to the Flint Hills region for prescribed grassland burning that can be used in models to better predict where smoke plumes will go and how much pollution may disperse downwind and impact communities. Better forecasts of smoke impacts will allow for better selection of days to do burning and better modeling tools will allow for more sophisticated understanding of regional pollution impacts from these types of burns.

"It takes broad partnerships, from ranchers and researchers to downwind-communities and regulators, to understand the benefits and challenges associated with the complex practice of the management of five million acres of tallgrass prairie in our nation's heartland," says Josh Tapp, Deputy Director for the Environmental Sciences and Technology Division in EPA's Region 7 Office in Kansas City. "It is through these Flint Hills partnerships that common-sense practices can be refined and implemented to ensure the protection of public health while promoting sustainable agriculture and protecting an endangered ecosystem."

Open Burn Research Program

The Flint Hills project is one of several open burn studies conducted in the field and at EPA's laboratories over the past 15 years by EPA's Office of Research and Development. Not only has the research expanded knowledge of emissions from prescribed forest burns and agricultural field burns, it has assisted in characterizing emissions from other sources of air pollutants. Researchers used the technology to provide air quality data during the Deepwater Horizon oil spill in the Gulf of Mexico in 2010. Another project involved sampling emissions from simulated overseas military burn pits for the U.S. Air Force, and others were conducted to characterize emissions from open burning and open detonation during demilitarization operations for the U.S. Department of Defense.

There are a number of challenges researchers must overcome in order to efficiently and safely sample smoke plumes to characterize emissions. These include: getting into the plume, having the correct equipment to measure every pollutant of interest, ensuring sample quality, and minimizing the proximity hazards for people and equipment especially when dealing with fires.

The Flyer

To overcome these obstacles, EPA researchers have designed a variety of air emission samplers and modified commercially bought sensors to fit specialized needs in burn emission sampling. One of these is the aerial sampling system called the Flyer, which was used in the Flint Hills study. This system, developed by Dr. Gullett and his team, enables researchers to safely sample the chemical composition of smoke plumes. The instrument platform, attached to a 16-foot-diameter, helium-filled balloon (aerostat), includes interchangeable sampling instruments that allow for continuous and batch measurement of particles, light carbon gases, metals, volatile and semi-volatile organics, temperature, global positioning, and others. An on-board computer system allows for wireless control of the samplers and data transfer to the ground.

Kolibri

Another sampler used in the study is the Kolibri, a lightweight air sampler that weighs up to eight pounds and can be used on an unmanned aerial system (UAS, or drone) to measure emissions. EPA has placed its Kolibri system on UASs owned and operated by other agencies to provide data for the U.S. Department of Defense and others. Its advantage over the Flyer is in its freedom of positioning in a manner and speed not possible with the tethered aerostats. The Kolibri is controlled by a microcontroller, which can record and transfer data in real time through a radio module. The Kolibri can also measure and sample a broad variety of compounds. Due to its dynamic sensor response, the Kolibri system can be applied to various challenging open area scenarios such as fires, lagoons, flares, and landfills as well as forest and agricultural burns.

Results from these studies using this innovative technology have been published in leading scientific journals and are being used to improve the science of open burning characterization. The findings are also being used by EPA and states in burning plans in an effort to minimize potential health impacts. **em**

More Information

A list of EPA journal articles is available on the **Wildland Fire Research** page.

Learn more about EPA's **Wildland Fire Research**.

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