Leveraging UAS Advances For Real-Time Horizontal Noxious Gas Profiling

While fixed air monitoring stations provide valuable data relating to conditions at ground level, researchers have known that ozone levels are much higher within a few hundred meters of the surface. Methods of obtaining atmospheric profiles above the ground have typically relied on vertical profiling through the use of multi-rotor UAS or weather balloons (Figure 1).

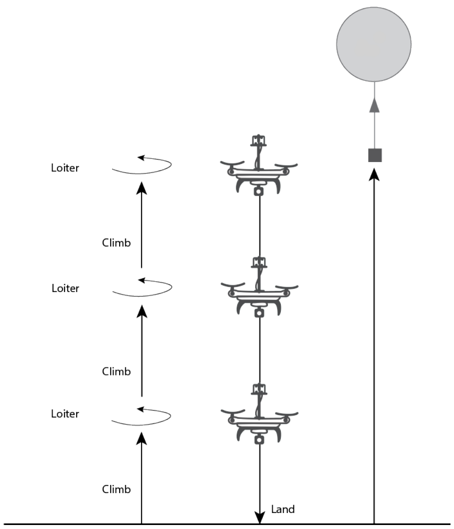

Figure 1: Vertical profiling using multi-rotor UAS or balloons.

While these methods of profiling deliver relevant information, that data is limited to a vertical column and fails to provide a more thorough snapshot of atmospheric conditions, or gas profiles, over a broad area of interest.

For EN-SCI, a leader in scientific ozone measurement, vertical profiling represents the majority of the work they conduct for their customers around the globe. Yet Jonathan Harnetiaux, EN-SCI's president, is quick to point out, "Monitoring noxious gas in the first 500 feet is incredibly important in understanding the impact these gases have on people's lives. But finding a cost-effective way to capture a wider profile that measures the existential threat in the ozone layer is now more essential than ever."

> "This type of horizontal profiling is critical in the understanding of air quality and sustainability moving forward."

In his search for an effective way to conduct horizontal studies Harnetiaux discovered an engineering firm located just 10 miles from his office in Westminster, Colorado. The company, Black Swift Technologies (BST), manufactures purpose-built scientific aerial platforms used around the globe for specialized atmospheric research missions. He was intrigued to learn how this company had developed a fixed-wing UAS piloted by their own flight management software. This software enables the aircraft to autonomously fly over active volcanoes while conducting horizontal volumetric profiling of trace gases (Figure 2) at pre-determined altitudes. He immediately saw correlations between BST's capabilities and EN-SCI's requirements.

After contacting Black Swift Technologies, Harnetiaux discovered that not only did they engineer the aircraft and related software, but BST incorporated a unique, modular payload system (Figure 3) unlike anything he had seen. BST's design positions the sensors in front of the propeller, completely enclosing the sensor suite and associated hardware within the nose cone. While this approach not only ensures clean and uncontaminated atmospheric measurements, the Black Swift S2™ UAS (the aircraft that EN-SCI selected) features a unique modular field-swappable payload system enabling rapid changes of the payload in the field without any specialized tools.

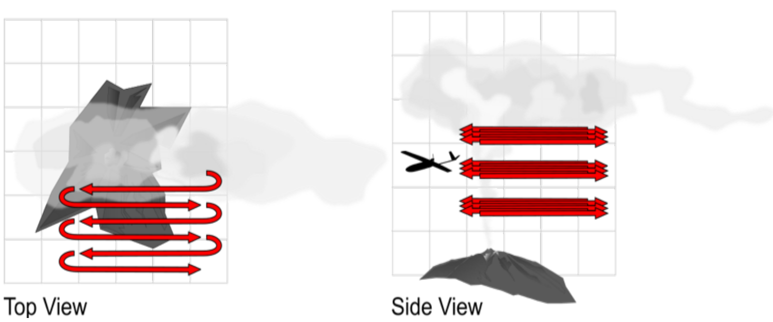

Figure 2: BST's sUAS accurately measured gases safer and more repeatable than surface methods.

“We really like Black Swift’s platform,” says Harnetiaux. “Personally, I was most intrigued by their modular payload structure. The way that the nose cone pops off allowing you to have another one ready to install is quite unique. Four bolts on and back to flying with a new battery. It’s so simple and easy to trade out payloads, even in the field. That’s what I find so attractive about the whole Black Swift approach.”

Yet it wasn’t simply the modular payload system that appealed to the team at EN-SCI. Ease of flight planning and the accuracy of the flight paths are equally important in order to precisely monitor and measure ozone layers at defined altitudes.

“The fact that Black Swift created their own software allowing them to control the aircraft from front to back makes things so simple and intuitive to use” Harnetiaux states. “It seems like they designed the entire solution for the field technician, which is huge to me. The reality is the data we obtain is only as good as the team that can get it for us. Black Swift understands data collection and makes it easy to get a good clean data set collected.”

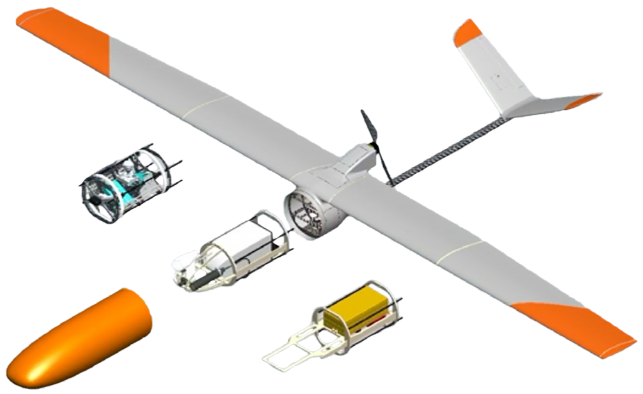

Figure 3: BST’s modular field-swappable payload system.

As part of their research, EN-SCI and BST flew the S2 in a volumetric sampling pattern automatically generated to collect data by only having to specify the area of interest, altitude bounds, and flight track spacing. For this particular application grid mapping was performed at 200 feet, 300 feet, and 400 feet AGL (above ground level). Upon reviewing the data collected the team noticed a spike in one corner of the coverage area. It turned out that corner of the box pattern was closer to a well site.

“Real-time measurements of ozone or NOx at precise altitudes in a horizontal pattern would result in invaluable information,” Harnetiaux emphasizes. “This type of horizontal profiling is critical in the understanding of air quality and sustainability moving forward.”