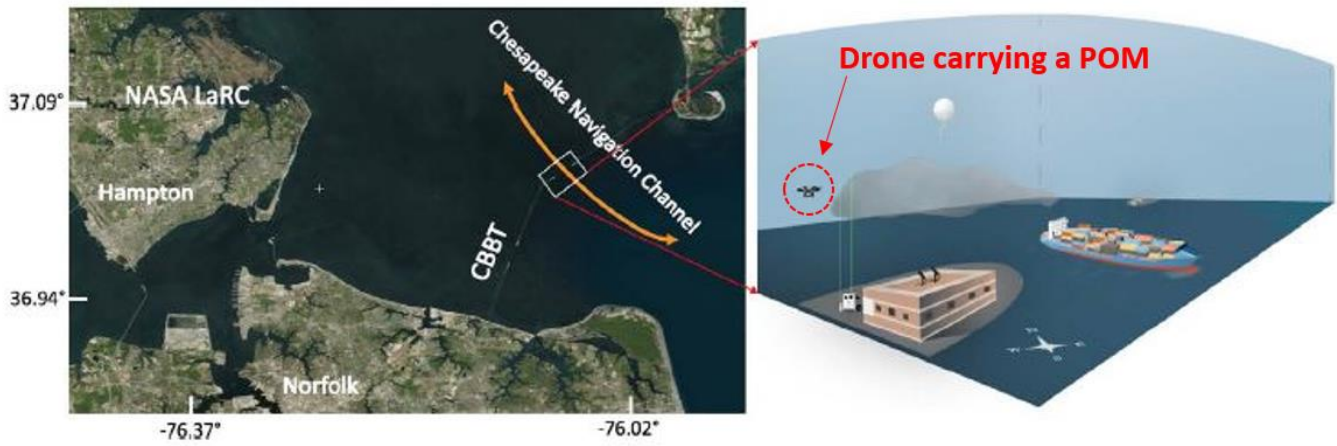
What Happens to Ozone Inside a Ship Plume?

Researchers from the NASA Langley Research Center Measure Ozone in The Plume of a Large Freighter in Chesapeake Bay During the Ozone Water Land Environmental Transition Study (OWLETS)

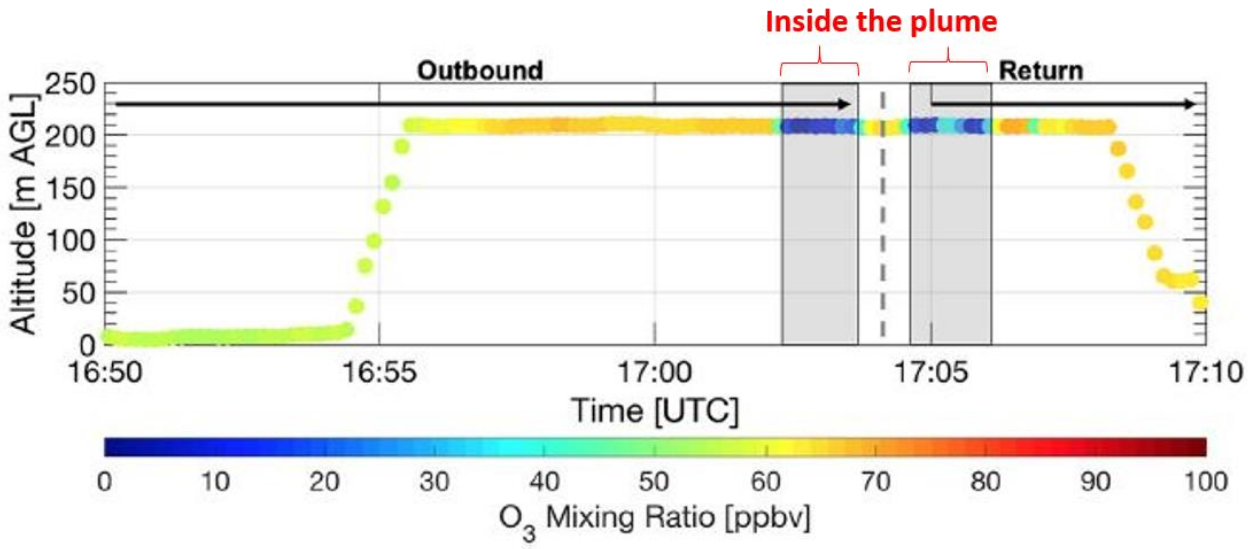
The Problem: Coastal regions near estuaries, such as Chesapeake Bay, have seen large increases in population in recent years. It is now estimated that more than 40% of the U.S. population lives within 100 miles of the coast. Offshore maritime shipping has quadrupled in the last 50 years and the ships themselves have become larger, resulting in an increase in emissions of oxides of nitrogen (NO_X) and sulfur oxides (SO_X). It is now estimated that 15% of all anthropogenic NO_X emissions are emitted by ships at Sea. Nitrogen dioxide (NO_2), a component of the NO_X emissions, is a criteria pollutant that can cause respiratory healthy issues such as inflammation of the airways and reduced lung function.



Drone Carrying a POM During the OWLETS Study in Chesapeake Bay

The Solution: As part of the Ozone Water Land Environmental Transition Study (OWLETS) researchers from the NASA Langley Research Center decided to measure ozone in a ship plume. Ozone is depleted by NO_X emissions via the titration reaction of $NO + O_3 \leftrightarrows NO_2 + O_2$. This means that ozone depletion can be used to determine the extent of NO_X emissions from a ship.

The researchers measured ozone in the plume of a large freighter passing through Chesapeake Bay, and simultaneously measured ozone at ground level a few hundred meters away. 2B Tech's Personal Ozone Monitors (POMs) and Model 202 Ozone Monitor, along with a Pandora Spectrometer, were used to conduct the ground-based ozone measurements at the observation base. Ozonesondes and a drone carrying a POM made the measurements of ozone in the ship plume, while an ozone Lidar located at NASA Langley rounded out the ozone instrumentation used in the study.



Ozone Data from the POM Onboard the Drone While Passing Through The Ship Plume

Results: The ship plume caused a distinct change in air composition, with ozone being severely depleted in the plume due to increased NO_X emissions. This was captured most vividly by the POM onboard the drone that was flown through the plume. The other instruments in the OWLETS study confirmed this event by observing ozone loss and a subsequent increase in NO_2 concentration. There was also no decrease in ozone measurements at ground level, confirming the observation that the loss of ozone in the plume was due to the NO_X emissions from the ship.

Click here to access the full research paper:
https://www.sciencedirect.com/science/article/abs/pii/S1352231019300846

The 2B Tech Instrument's Role:

During OWLETS the POM was used to measure ozone both at ground level and onboard a drone passing through the ship plume. The combination of high portability and FEM-quality measurements allowed the POM to be deployed in a variety of ways throughout the study. The incredible versatility of the POM was on full display during the OWLETS program.

The 2B Technologies Personal Ozone Monitor (POM)

The Bottom Line: The POM is the ultimate combination of portability and high-quality performance in an ozone monitor. The POM is the smallest FEM approved ozone monitor on the market and offers 1.5-ppb precision and accuracy. The low power consumption makes it possible for the POM to be powered using a 7.4-volt lithium-ion battery. The POM's built-in GPS provides GPS location along with ozone measurements during field campaigns. With a size of just 5.0" x 3.0" x 1.5" and a weight of just 1.0 lb., the POM has hitched rides on vehicles such as UAVs and quadcopters, and it can be easily carried for personal exposure monitoring indoors. If you require highly accurate ozone measurements in a small package, please contact 2B Technologies to discuss using the POM for your application.

sales@twobtech.com | www.twobtech.com | (303) 273-0559