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## Case Study: Airborne Observations of Stratospheric Intrusions Using Model 205 Ozone Monitor

Using a 2B Technologies Model 205 Ozone Monitor onboard a jet aircraft, a team of scientists at NASA's Ames Research Center discovered that an ozone standard exceedance at Thunder Basin, WY was caused by a stratospheric intrusion (SI) event where an air mass of stratospheric origin entered the troposphere.



Model 205 Ozone Monitor with custom enclosure mounted in pod of NASA's Dassault/Dornier Alpha Jet for AJAX measurements over California.



Once in the free troposphere, ozone-rich stratospheric air can be transported and mixed with tropospheric air masses, contributing to tropospheric and even ground-level O<sub>3</sub>. Because ozone is present in such higher mixing ratios in the stratosphere compared to the troposphere, it is frequently used as a tracer for stratosphere-to-troposphere events.

The elevated ozone readings from a June 6, 2012 stratosphere-to-troposphere event resulted in an 8 hour ozone standard exceedance of 88 ppb at Thunder Basin, Wyoming. The intrusion was detected by NASA's Alpha Jet Atmospheric eXperiment (AJAX), which measured ozone concentrations using 2B Tech's Model 205 Ozone Monitor as it traversed the tropospheric fold in Wyoming.

To read more about this work led by Emma Yates of NASA Ames Research Center, visit this [webpage](#) and see the recently published article: [Atmos. Chem. Phys. Discuss. 113, 10157-1012, 2013](#).

## Air Pollution News: Unmanned Aircraft in Antarctica

A lightweight, unmanned aircraft was recently successfully tested by the Center for Remote Sensing of Ice Sheets (CReSIS) to allow for radar measurements of rapidly melting glaciers in Antarctica.



Boldly going where no manned aircraft has gone before!

These glaciers hold a vast amount of the Earth's precious freshwater, and melt from this source could cause a global sea level rise of over 200 feet, causing problems unprecedented in severity. Researchers are seeking effective and inexpensive ways to measure and predict ice sheet activity, and this Unmanned Aircraft System (UAS) may close a key gap in

knowledge for climate modelers.

"We're excited by the performance we saw from our radar and UAS during the field campaign. The results of this effort are significant, in that the miniaturized radar integrated into a UAS promises to make this technology more broadly accessible to the research community," said Rick Hale, associate director of technology for CReSIS.

Though glacial monitoring has become increasingly important as areas of Greenland and Antarctic ice sheets are rapidly changing, this miniaturized aircraft has the potential to be routinely deployed in remote areas internationally, perhaps becoming the ideal tool for reaching the difficult (and most vulnerable) corners of the globe, where "cost associated with transporting and caching fuel is very high".

Researchers plan on testing the aircraft in Greenland in 2015, where fast-flowing glaciers make up much of the topography. You can read more about this exciting use of unmanned aircraft [here](#).

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### Monitoring Tip: DewLine for Eliminating Interference from Water Vapor in Ozone Monitors

During the course of developing the first 2B Tech ozone monitor (Model 202), it was discovered that all commercially available ozone monitors based on UV absorbance (including Thermo, Teledyne, Dasibi and 2B Tech) exhibit a water vapor interference. Although not widely recognized, most scientists who work with UV ozone instruments are aware that rapid changes in humidity, as may occur during a frontal passage, often cause a shift in the zero offset by a few ppb or more that lasts for up to several hours. This interference is especially troublesome in balloon and aircraft measurements where the instrument may rapidly pass through alternating dry and humid air parcels. The problem also arises when calibrating an ozone monitor using dry zero air.

The cause of the interference was identified as a refractive index difference within the detection cell during I (ozone present) and I<sub>0</sub> (ozone absent) light intensity measurement cycles ([Environ. Sci. Technol. 40, 6361-6367, 2006](#)). The solid phase ozone scrubber in UV ozone monitors acts as a "sponge" that either removes or adds water vapor to the sample air, with the result that the humidity is different during the sample (I) and reference (I<sub>0</sub>) measurements.

The 2B Tech DewLine® was developed to solve this problem. Nafion® tubes (usually 2 in parallel) when placed on the

entrance to the detection cell (after the flow paths through and around the scrubber recombine) are used to equilibrate humidity during I and Io measurement cycles and thereby completely eliminate this interference. DewLines are included in all 2B Tech instruments and may be installed in other ozone monitors as well.



DewLine

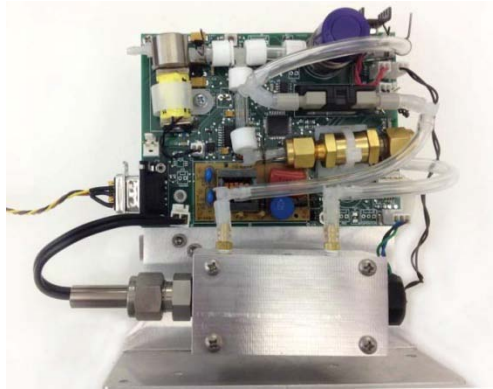
Also, it is highly recommended that DewLines be used on the inlets of ozone, NO<sub>x</sub> and other air pollution monitoring instruments when using dry calibration gases. The Nafion tubes selectively allow transport of water vapor through the capillary wall and thereby bring a dry calibration gas to ambient humidity prior to entering the instrument to be calibrated. As a result, the instrument is calibrated at ambient humidity.

There is a common misconception that the Dewline is a drier. Nafion tubes are used in gas driers, which also contain a desiccant. The Dewline, however, is not a drier. It simply equilibrates humidity of air flowing through it with ambient air.

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### Featured Product: GPT Scrubberless Module

The GPT Scrubberless Module™ allows you to convert conventional ozone monitors to the new gas phase titration (GPT) technology ([US Patent # 8,395,776 B2](#)) used in our Model 211 Scrubberless Ozone Monitor. This module removes interferences from mercury, aromatic VOCs and other UV-absorbing compounds by replacing the solid-phase scrubber with gas-phase titration of ozone using NO generated in the photolysis of N<sub>2</sub>O. On high ozone days in highly polluted cities, such interferences can contribute up to a few ppb of false ozone reading, sometimes causing a region to be out of compliance.



### Features:

- Converts your conventional ozone monitor to new scrubberless technology
- Removes interferences from Hg and UV-absorbing compounds such as aromatic VOCs
- A more accurate ozone measurement could bring your region into compliance
- Includes DewLine™ for elimination of any water vapor interference, a unique feature of 2B Tech instruments
- Especially useful for indoor air measurements where UV-absorbing interferences are more abundant
- FEM designation coming soon (and candidate for the new FRM)
- No change in your ozone monitor operational characteristics
- Our custom installation includes fresh calibration to a NIST-traceable standard

Currently, this conversion kit is available only for the Teledyne API Model 400 series, but we plan to develop one for the Thermo 49 series as well. For more detailed information on the GPT Scrubberless Module, including example data and specifications, see [Model GPT](#).

### Model 211 Promotion



In anticipation of our [Model 211 Scrubberless Ozone Monitor](#) soon being designated as a Federal Equivalent Method (FEM), we are offering a 25% discount on purchases of this model through June 30. Please mention the promo code "Accurate Ozone" when you contact us.

### The GO3 Project in Peru

This year the GO3 Project, 2B Technologies' non profit outreach program that promotes STEM projects around the world, has teamed up with [The Visionaria Network](#) (TVN). TVN provides training for the next generation of sustainable development leaders by empowering young, indigenous Peruvian women in their pursuit of self-envisioned social and environmental improvements within their communities. One of the focuses includes the implementation of clean burning cookstoves. The United Nations estimates that more than half of the world's population uses cookstoves on a daily basis. These cookstoves, which burn biofuels such as wood and dung, are now considered to be the largest anthropogenic source of black carbon (commonly known as 'soot').



36% of the population of Peru use cookstoves on a daily basis.  
Photo By: Christopher Carruth

Partly due to high black carbon emissions around the world, especially in developing countries where cleaner technologies have not been introduced, we are experiencing air pollution, atmospheric warming, deglaciation, and other climate effects. Not only is black carbon damaging to the environment (it has a warming effect on the climate due to its low albedo), it's also detrimental to human health. The small, submicron



particles are respirable, penetrating the lungs and causing significant health effects ranging from asthma, to lung cancer, to premature death. Women in developing countries, who spend the majority of the time around cookstoves, are being disproportionately exposed to this dangerous pollutant.



A Peruvian woman stands beside her cookstove.

Photo By: Christopher Carruth

In Peru, the GO3 students have identified this as a major issue in their communities and are actively working to remedy the problem. Currently they are targeting specific communities in need, and will be going into those villages to help build cleaner burning cookstoves, which have the capability of reducing smoke emissions by up to 80%! By using the GO3 Project's Black Carbon curriculum and equipment, students are able to monitor the concentration of black carbon in the local air and educate community members about this dangerous pollutant. Not only will they be helping to reduce emissions and therefore help slow down global warming, their efforts will improve the health of Peruvian women and their families.



G03 Students at The Visionary Leadership Institute