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Case Study: O-Buoy - Network of Arctic Ocean Chemical Sensors

The focus of this project is to increase our understanding of the behavior of ozone (O_3), carbon dioxide (CO_2) and bromine oxide (BrO) in the Arctic Ocean region. These three species are poorly understood as of yet primarily due to a lack of capability. In the O-Buoy project, observations of these species are made on autonomous buoys, which use a customized 2B Tech instrument for ozone measurements, with the intention of improving the understanding of sources, transformations and sinks of reactive bromine species in the troposphere as well as their impact on tropospheric chemistry and the Artic ecosystem.

O-Buoy recovery

Ozone chemistry in the Artic is of interest due to its ability to act as an oxidizing agent and because it undergoes near complete depletion events in the early spring. It has been hypothesized that these ozone depletion events are a product of a catalytic bromine cycle that only takes place under a special set of circumstances that include low temperature, presence of sunlight, large bromine sources, and an ice/aerosol surface upon which to regenerate the chain precursors. A significant aspect of this project is to measure the ozone mixing ratios in the Artic as a function of time of year, then compare the data with other relevant species, such as BrO. 2B Tech designed and built a customized Model 205 Ozone Monitor, which met O-Buoy's requirements of low power consumption and stability over a wide range of temperatures. The instrument includes an

auto zero function and photolytic ozone source to zero the instrument and check its span on a frequent basis. This instrument (see below) has allowed for a deeper understanding of the role ozone plays in the Arctic Region.

Customized buoy instrument

To read about this project in more detail, please click here.

Monitoring Tip: Startup Time Required for Operation of Ozone Monitors at Low Temperatures

2B Tech Ozone Monitors are often employed in low temperature environments, such as on ocean buoys in the Arctic Ocean where seawater temperature is near 0°C. In a situation like this, the instruments are turned on intermittently for short periods of time to conserve power. We have carried out experiments to determine just how long it takes for ozone measurements to stabilize following a cold start at near freezing conditions. To create the proper surroundings, a Model 202 was placed in an ice chest with Teflon-lined sample tubing extending outside of the ice chest for an hour or more, allowing the entire instrument to fall to 1-3°C. The Ozone Monitor was then powered on and sampling begun of either ozone-scrubbed air or air containing approximately 50 ppb of ozone. Data were obtained for 30 minutes. Duplicate runs were carried out for ozone-scrubbed air and for air containing 50ppb ozone.

The measurements were erratic for up to the first 10 minutes as the lamp warmed up. Following 10 minutes, standard deviations of the detrended data were in the range 1.2-1.5ppb; i.e., the precisions were within the normal specifications of the Model 202 Ozone Monitor (1.5 ppbv). After 30 minutes of warm-up, both the zero and the 50 ppbv ozone measurements were within 2 ppb of the true values. These experiments demonstrate that the Model 202 Ozone Monitor will turn on at 1-3°C and make measurements within the instrument specifications for precision and accuracy after 30 minutes of warm-up. Measurements possibly could be made as soon as 10 minutes after powering

up the instrument if small corrections are made to the data.

This study represents an extreme case. Under moderate temperature conditions of 10-40°C, the required warm-up time for accurate measurements with good precision is 20 minutes or less.

To obtain specific details relating to this experiment, please see Tech Note 004.

Air Pollution News: Over 2 million People are Dying Annually

CNN reported that an estimated 2.1 million deaths are caused by anthropogenic increases of fine particulate matter, such as dust, soot, smoke, etc. smaller than 2.5 micrometers while a further 470,000 are killed annually as a result of human-caused increases in ozone pollution. East Asia is the worst affected area with researchers estimating more than a million people dying prematurely every year and 203,000 from the effects of ground-level ozone. India follows with 397,000 from fine particulates and on average 118,000 from ozone.

Air pollution in New Delhi

Particulates such as those described above have been known to lodge deep in the lungs, increasing the chance for cancer and other respiratory diseases. Jason West, the co-author of this study which was published in the *Journal of Environmental Research Letters* states "Outdoor air pollution is an important problem and among the most important environmental risk factors for health." West, and assistant professor in the Department of Environmental Sciences and Engineering at the University of North Carolina in Chapel Hill says, "going forward into the future, climate change will get more severe and that could have greater effects on air pollution."

On the plus side, "...what we are getting to now is systems that let us manage the distribution of air quality with knowledge of

where people are and what people are doing." This statement was made by Roland Leigh, and Air Quality Scientist from the UK's University of Lancaster." Improved data in monitoring air pollution, such as particulates and ozone, can help manage the exposure to sensitized individuals. Although this is the case, the road to improved air quality might be a long one.

To read the entire article, please click here.

Featured Product: Model 205 Ozone Monitor™ EPA Federal Equivalent Method (FEM)

The Model 205 Ozone Monitor makes use of two detection cells to improve precision, baseline stability and response time. In the Dual Beam instrument, UV light intensity measurements Io (ozone-scrubbed air) and I (unscrubbed air) are made simultaneously. Combined with other improvements, this made it possible to reduce the time between ozone measurements to 2 seconds, making our instrument the fastest UV-based ozone monitor on the market, while still retaining the small size, weight and power requirements of our popular Model 202 Ozone Monitor. Fast measurements are especially desirable for aircraft and balloon measurements where high spatial resolution is desired. Alternatively, one can choose to average more points internally to obtain even better precision. The Model 205 Ozone Monitor has been approved by the EPA as a Federal Equivalent Method (FEM) based on a modification of the Model 202.

The Model 205 has all of the features of the Model 202, including choice of averaging time (2 s, 10 s, 1 min, 5 min, 1 hr), analog output (0-2.5 V), real time serial output, internal data logger with 3 analog inputs for simultaneous logging of other measurements (e.g., T, P and RH), real time clock, and optional flash memory.

Features

- Backup sampling pump and flow meter (now standard); if the flow rate drops below a critical value, the backup pump is activated and an indication displayed on the LCD
- Internal data logger (EEPROM), logs 14,336 lines of data
- Real time clock
- Both serial and user-scaleable analog voltage outputs (5-20 mA current output optional)
- Three 0-2.5 VDC analog inputs for logging other measurements, such as external temperature, pressure and humidity
- Convenient user interface to microprocessor, including calibration parameters (gain and zero)
- Selectable data averaging times of 10 s, 1 min, 5 min and 1 hr (custom averaging times available)
- DewLine™ for elimination of any water vapor interference, a unique feature of 2B Tech instruments

To learn more about this product, click here.

GO3 Announces the CO_2 Experiment!

In the CO_2 Experiment, students at schools around the world measure the greenhouse gas carbon dioxide outside their schools and upload their data to the GO3 Database. Student-measured CO_2 data may be plotted online and visualized on Google Earth by anyone having internet access. Carbon dioxide, which is produced in combustion of fossil fuels and through deforestation, is the most important greenhouse gas. Continued emissions of CO_2 and other greenhouse gases are expected to cause an additional warming of 1.5-4.5 ^{o}C by the end of this century.

If you are interested in learning more about the project, purchasing a package or donating to the cause, please click

here.