ABSTRACT

The Surface Ozone Protocol Hands-on Workshop: Operation and Troubleshooting

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If there has ever been a concern about the quality of air we breathe, it's reflected most during hot summer days as "ozone alert days" or some other phrase to warn children and the elderly to restrict outside activity due to higher levels of surface ozone. Why? Because exposure to elevated levels of surface ozone over extended periods of time cause health problems and environmental damage. Some examples of health problems include damaging our immune system's defenses, aggravating asthma, and decreasing lung capacity over time. A few environmental problems include interfering with plants' abilities to produce and store food, resist disease, and reproduce thus decreasing crop yield.

We need to understand the transport patterns of local, regional and global levels of surface ozone, because surface ozone can be transported tens and hundreds of kilometers from its original source. A network of GLOBE ozone monitoring sites is an opportunity to provide extensive monitoring areas and a more complete inventory of surface ozone patterns. It will provide us with an abundance of data, and through the analysis of these data, help us to begin to understand how our behavior affects air quality, which eventually will guide the development of viable solutions to protect the quality or air. Making local surface ozone measurements is an opportunity to address questions about ozone levels in the local area, share data with other students and scientists, formulate questions, calibrate and use scientific instruments to gather data, and use our own data to answer questions about local surface ozone levels.

Why the air we breathe is being altered is of global concern. In urban areas like Los Angeles, atmospheric scientists have been investigating air quality since the 1950s. More recently, with the formation of the International Global Atmospheric Chemistry Project in 1988, the question of air quality on the global scale has become an important issue. The primary pollutants leading to the formation of surface ozone are the by-products of the fossil fuel combustion process used by power plants, industry, and automobiles. The by-products are given off as exhaust emissions and enter the atmosphere in the form of carbon monoxide (CO), very reactive partially burned hydrocarbons (called volatile organic compounds, or VOCs), and nitrogen oxides (NO_x). In the presence of sunlight these primary pollutants react to form a secondary pollutant called ozone. In general, surface ozone is the primary component of smog, or more commonly called photochemical smog since the energy from sunlight is a necessary perquisite for ozone-to be produced. The amount of surface ozone generated varies by season, time of day, topography, prevailing weather conditions, and the level of primary pollutants or precursors present in the air. Professional instruments have been placed throughout the world to make surface ozone measurements, but the equipment is expensive, so there are a limited number of surface ozone monitoring stations available.

Through Global Learning and Observations to Benefit the Environment (GLOBE), local ozone monitoring sites can be set up and managed by students, education and non-education teams, and community members interested in developing an awareness of surface ozone levels in their immediate area. Training in GLOBE's Surface Ozone Protocol prepares its participants to follow scientifically sound procedures for gathering data, and ensures proper calibration and use of the Zikua optical hand-held scanner used to measure concentrations of surface ozone. The surface ozone measurements gathered and submitted to the GLOBE Student Data server can contribute and extend an area's data base provided by professional instruments or fill a void where no professional instruments are available to measure surface ozone.

More local sites measuring surface ozone are critical to understanding surface ozone patterns. Higher concentrations of CO, VOCs, and NO are in areas with heavy travel and large industrial development.

However, the emissions generated in one area by human activity may be transported and dispersed by wind over a larger area, thus affecting the quality of air over larger regions. For example, the heavy early morning commute on the east coast of the United States produces high concentrations of CO, VOCs, and NO. If there is a southwesterly wind, it transports these pollutants up the East Coast. On sunny warm days, high levels of surface ozone are produced from the Carolinas, through urban and rural New England as far north a rural areas of Maine. Surface ozone is not only a local concern, but even an issue in pristine regions far removed from local pollution sources.

Interested in authentic science! Build on the curiosity of your students using the scientific processes and state-of-the-art equipment that scientists have worked on for the past five years to make accurate measurements.. The Surface Ozone Workshop will provide an overview of GLOBE's Surface Ozone Protocol with opportunities to operate and troubleshoot the Zikua optical scanner used to take surface ozone measurements. Learn how it utilizes simple technology to take a measurement, and the procedure to make an ozone measurement. It is rather straightforward. However, is it possible for the instrument settings to be inadvertently changed, resulting in incorrect readings. It doesn't hurt the optical scanner, but there are several checks that must be performed before making a measurement to ensure proper operation and accurate ozone readings. Receive training in the most critical element of the scientific procedure, calibrating the unexposed test card to set the instrument reading to zero for that specific unexposed test card. Subsequently, any additional color change to the test card after exposing it to ambient air for 60 minutes is the true ozone reading. Participants will explore the specific steps necessary to ensure proper operation of the optical scanner, learn more about its internal operation, work together to troubleshoot common problems associated with the use of the instrument, and follow the research procedure for making a surface ozone measurement.