

Vertical and Surface Ozone Variability Over Land and Water

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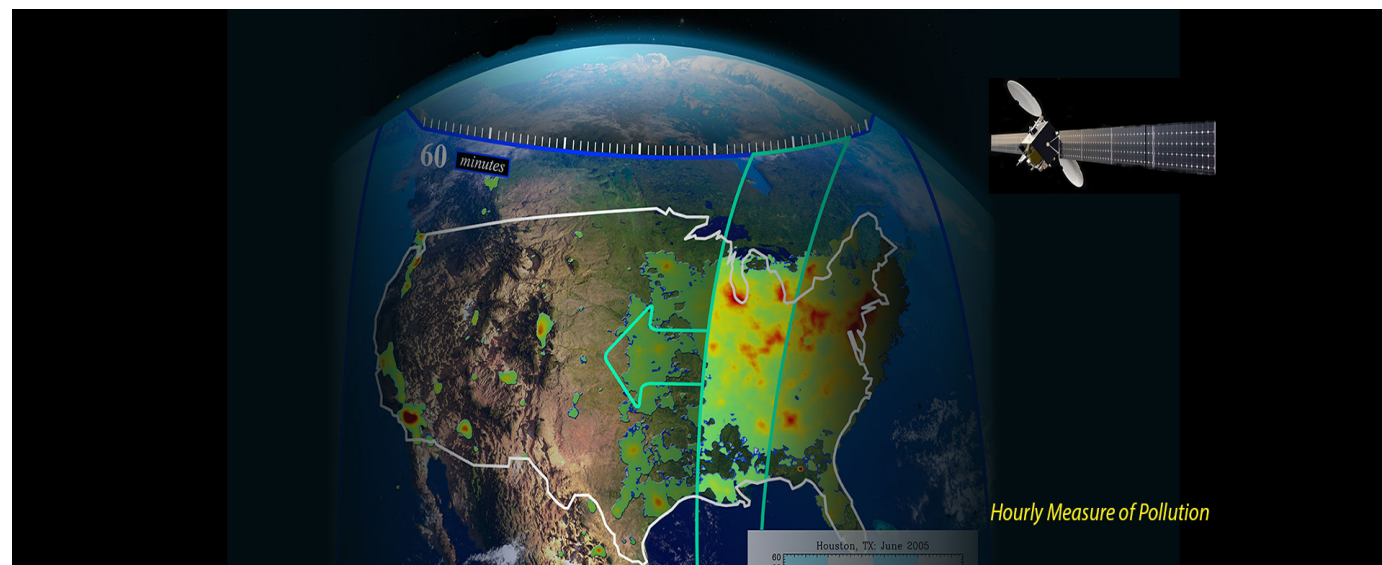


Introduction

The Summer 2017 Ozone Water Land Environmental Transition Study (OWLETS) mission set out to compare the differences in ozone concentrations between inland measurements of air quality, specifically at Langley Research Center (LaRC), and measurements taken over water, specifically on the Chesapeake Bay Bridge Tunnel (CBBT), as well as the vertical profiles above each location. Current weather models often predict a gradient in ozone concentration between land and ocean and this campaign attempted to capture this difference using hand-held Personal Ozone Monitors (POMs) in correspondence to ozonesondes and LIDAR measurements.

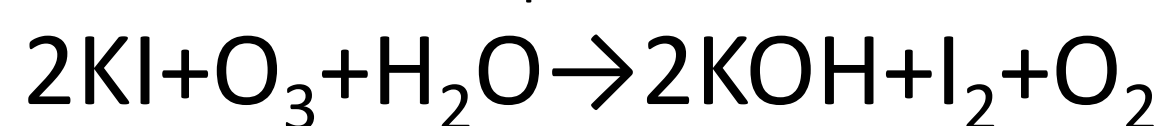
The Tropospheric Emissions: Monitoring of Pollution (TEMPO) is the first geostationary satellite that will take hourly measurements to monitor air pollutants across North America using solar backscatter. The small footprint allows for higher spatial resolution readings of many parameters including O_3 , NO_2 , and aerosol. TEMPO's higher resolution readings would benefit from validation techniques on the ground. Validation methods usually include comparison to air quality monitoring stations, but they could also incorporate other forms of validation such as comparison to small sensors. In cooperation with TEMPO, OWLETS aims to provide the user community high resolution temporal and spatial, both horizontal and vertical, variability of O_3 simultaneously over the land and water during various air quality events to improve forecast models and air quality satellite retrievals. Together, these missions will improve spatial resolution and capture temporal variability of air quality over North America.

TEMPO's projected track of flight over North America.

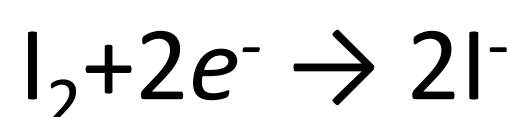


Objective: Ozonesonde Conditioning

This project's focus was the conditioning and launching of ozonesondes as well as the comparison of ground ozone measurements between stationary monitoring sites. One of the most direct ways to create a vertical ozone profile is with an ozonesonde launched at critical times during ozone events. Proper conditioning ensures reliable measurements once the sonde is launched. Air containing trace amounts of ozone is pumped through the cathode of the Electrochemical Concentration Cell (ECC) leading to a reaction with KI in an aqueous solution to form Iodine:



The change in iodine concentration leads to a change in electrochemical equilibrium between the anode and cathode and causes 2 electrons to flow in the cell's external circuit when the iodine is reconverted to iodide by the cell:



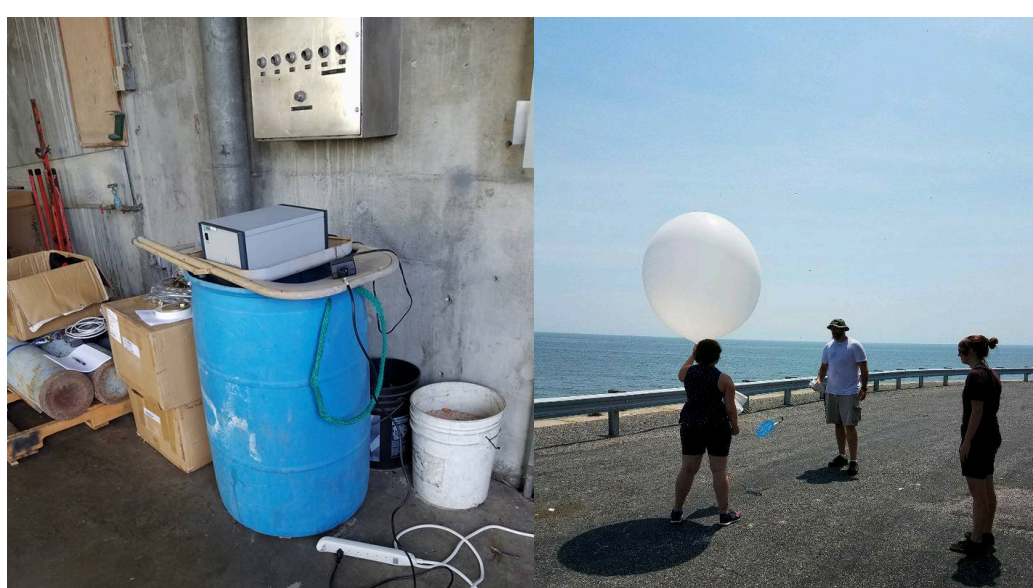
This flow of electrons through the cell's external circuit can be measured and is directly proportional to the partial pressure of ozone in the sampled air by the equation:

$$P_{O_3} = cTt_{100}(I - I_{BG})/\gamma$$

Where: P_{O_3} [mPa]; I [μA] measured cell current; I_{BG} [μA] background current from conditioning; T [K] air temperature; t_{100} [s] flow rate time; γ is the pressure dependent pump efficiency; c is the ratio of ideal gas constant R and Faraday constant F divided by the yield ratio $\chi=2$ electrons per ozone molecule.

In total, about 40 ozonesondes were conditioned for launch for both LaRC and CBBT. Ozonesondes were crucial to the vertical profiling above land and water for ozone comparison with LIDAR (Light Detection and Ranging) curtains and will be useful for analysis of the planetary boundary layer (PBL). Without this thorough conditioning and ozonesonde data analysis, it would be difficult to validate measurements from other instruments.

References: Vömel, H., & Diaz, K. (2010). Ozone sonde cell current measurements and implications for observations of near-zero ozone concentrations in the tropical upper troposphere. Atmospheric Measurement Techniques, 3(2), 495-505. doi:10.5194/amt-3-495-2010



Ozone Case Study: July 19-21

