In situ measurement of stratospheric ozone above Utah's Uintah Basin

Weber State University

HARBOR

Rosana Baldraco, Nathaniel Klemm, Michael Shaw, Erika Muller, Ian Hardy, John E. Sohl
Department of Physics, Weber State University, Ogden, Utah 84408

Ozone Measurement Types

Scientists have been measuring ozone since the 1920s, and since then the instruments have evolved. There are several methods of measuring it nowadays, from ground based spectrometers to balloons, aircraft, rockets, and satellites.

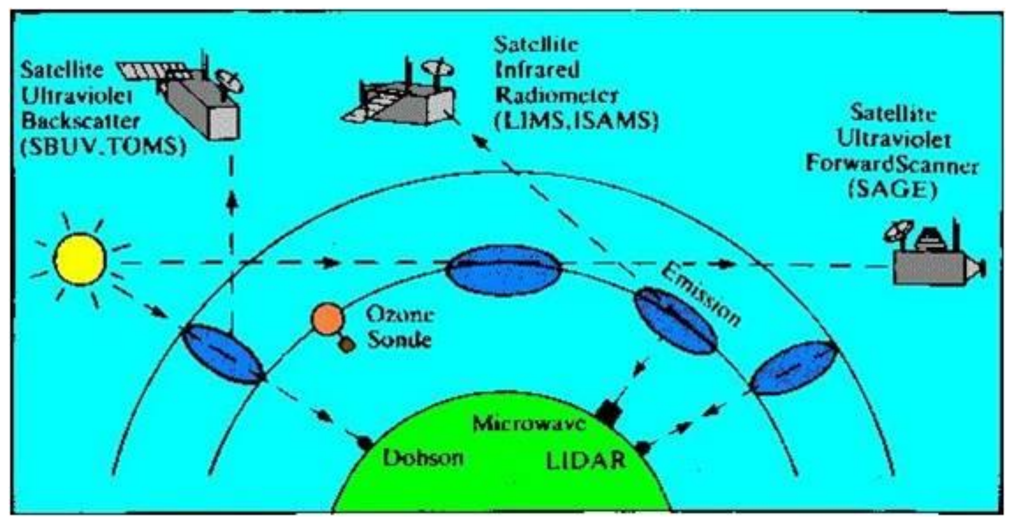

Figure 1. *The primary methods used for ozone measurement (http://www.albany.edu)*

Ozone depletion and reconstitution process

A single CFC molecule can destroy 100,000 ozone molecules.

$CFCl_3$ + UV Light ==> $CFCl_2$ + Cl

Cl + O_3 ==> ClO + O_2

ClO + O ==> Cl + O_2

The atomic Cl is again free to destroy another ozone molecule.

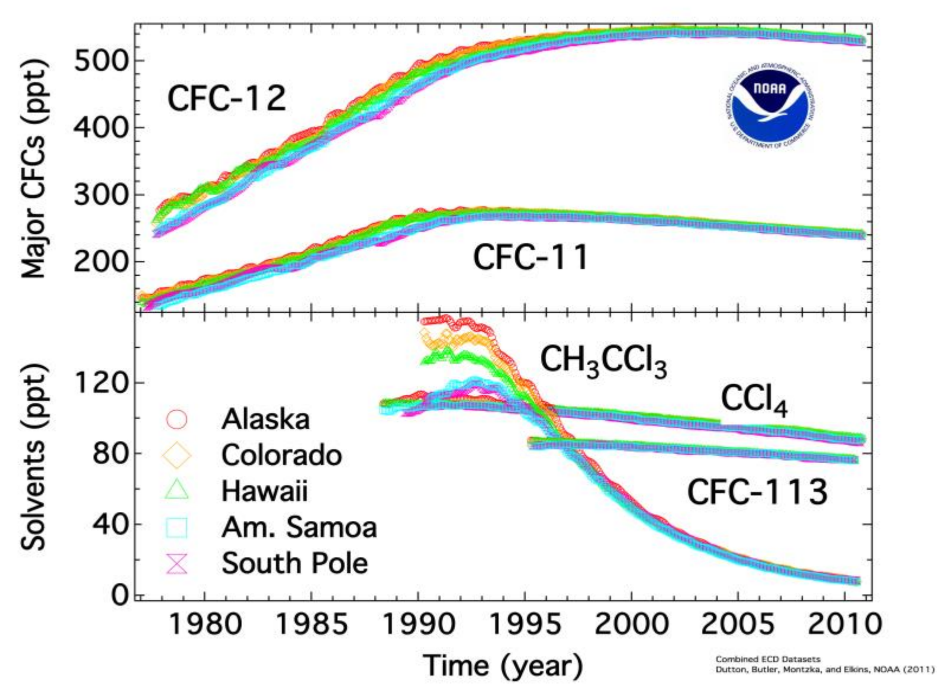

Figure 2. *Atmospheric concentration of CFCs (NOAA).*

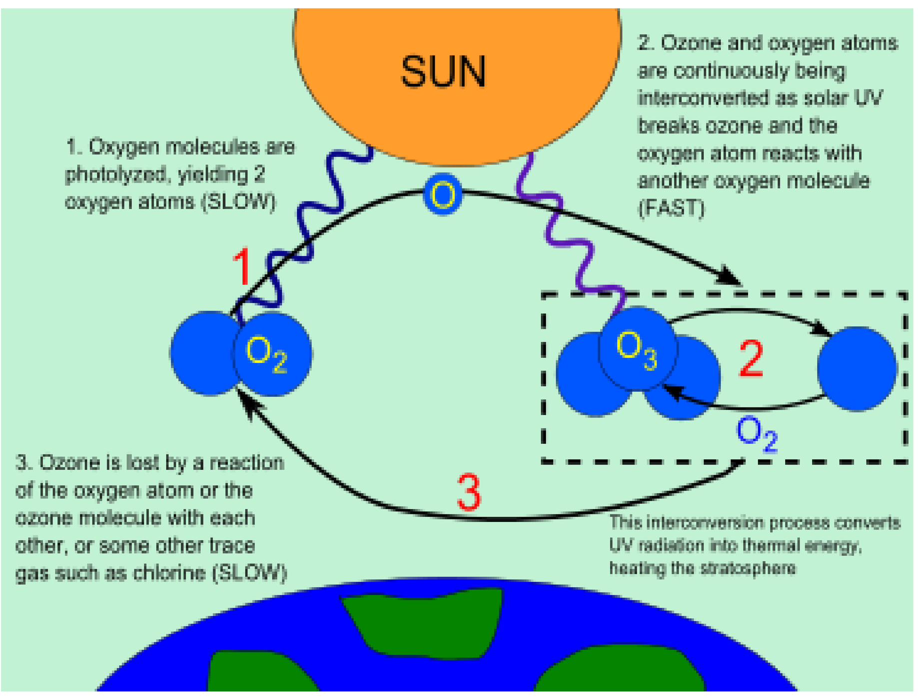

Figure 3. *The formation of ozone from oxygen by sunlight (Wikimedia Commons).*

Abstract

Although well publicized, measurements of Earth's ozone layer are actually very limited. We have assembled a system to fly an ozonesonde along with other instrumentation into the stratosphere with the goal of measuring ozone to approximately 35km above sea level. We currently have a live telemetry system that relies on the sound card of the computer being used, which varies in efficiency from one computer to another. We are working on replacing that method by using a modem. The radiosonde SNR is being tested by assessing possible changes in the geometry and length of its current antenna for better transmission. Our last season's flights data is comparable to the one provided to us by NASA HASP in October 2012. Results, current methodology being used and status of systems and antenna testing will be presented in details.

Our method for measuring ozone concentration

We fly a modified ECC Ozonesonde, which is designed to detect ozone molecules by utilizing a chemical cell that reacts with a dilute solution of potassium iodide to produce a weak electrical current proportional to the ozone concentration of the sampled air. We have preflight tested the system in a vacuum chamber and do system performance tests before every flight. Calibration methods are being developed.

Figure 4. *HARBOR'S ECC Ozonesonde*

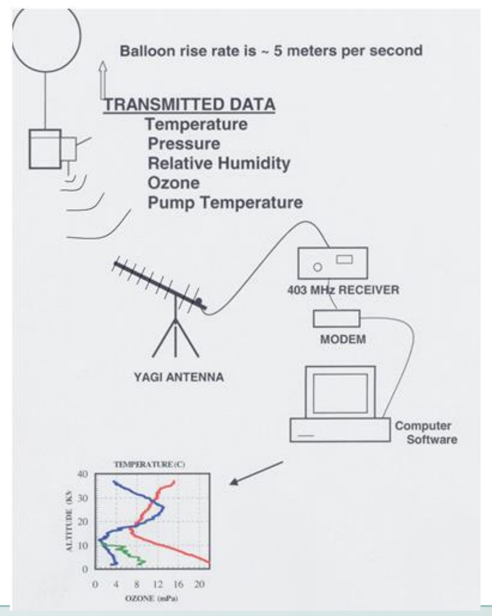

Figure 5. *Data acquisition and analysis process (diagram by Dr. H.Volmer).*

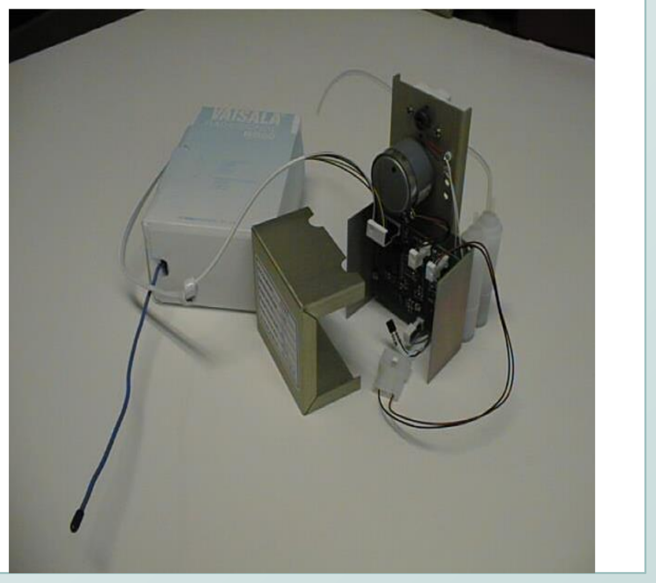

Figure 6. *ECC Ozonesonde (picture by Dr. H.Volmer).*

Results from 2012 season flight and tests performed in lab

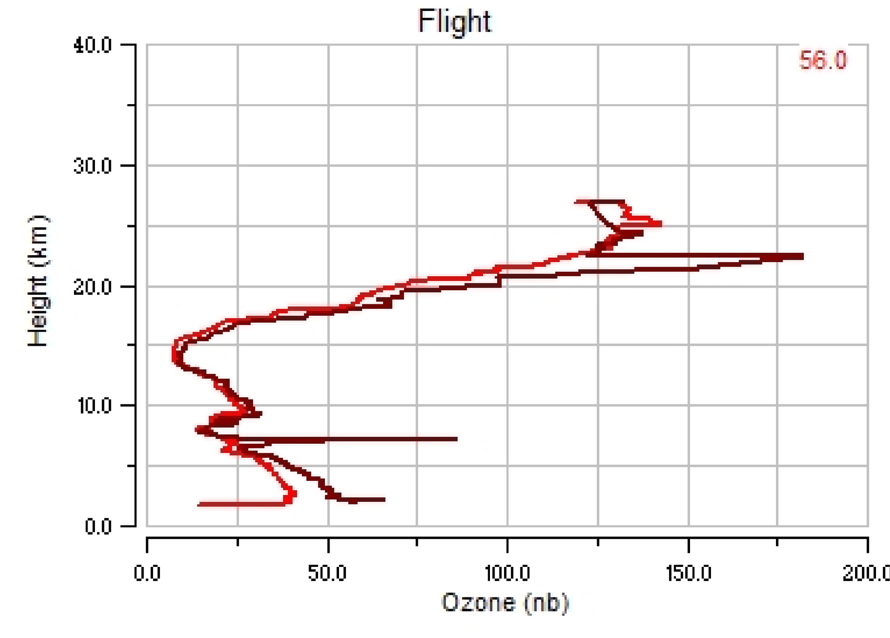

Figure 7. August 2012 data collected with *our instrumentation. Red line = flight up, Brown line = return to Earth.*

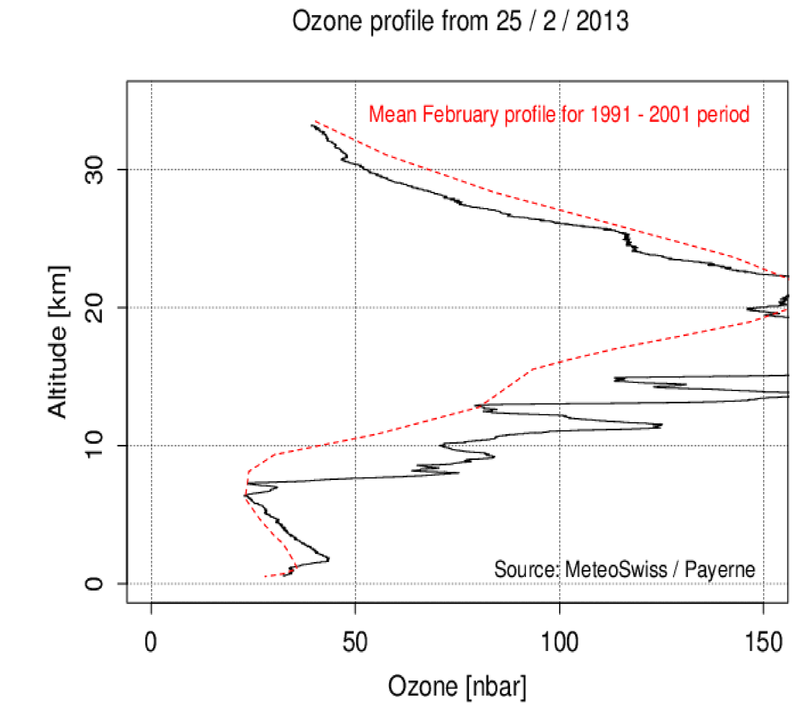

Figure 8. *Typical data from other researchers. (http://www.meteoschweiz.admin.ch)*

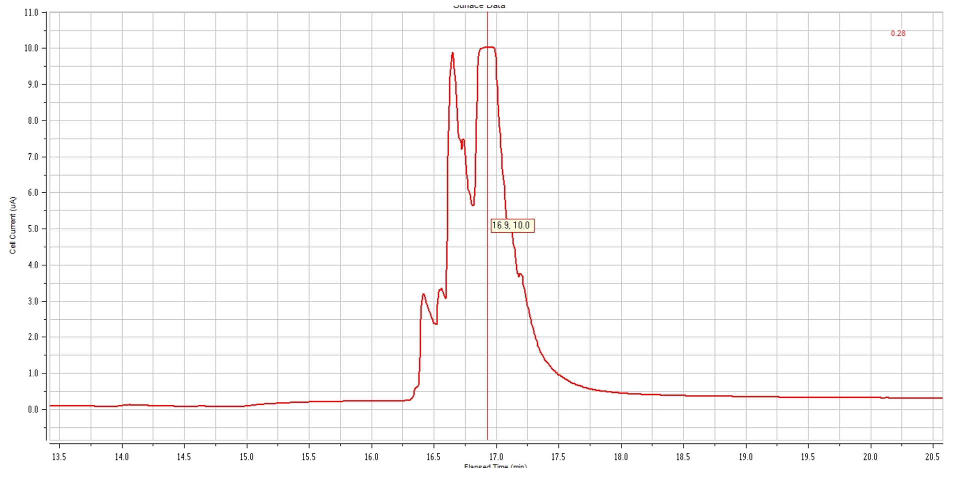

Figure 9. *Preflight performance test performed in the vacuum chamber.*

Radiosonde antenna assessment

In order to improve the live transmission from the radiosonde, our team has been working with Dr. J. Ward from the Electronics Engineering Department who has specialized knowledge in the field. The idea is to find the best geometric configuration for the radiosonde antenna that strengthens the transmitted signal while keeping the original impedance and resonance of the original monopole antenna. The testing is done by utilizing an impedance analyzer on a mock antenna that is a reproduction of the original. The possible modifications are still under investigation and have not been implemented yet. In a previous flight, we have used an improvised dipole antenna that was able to transmit signal throughout the entire flight.

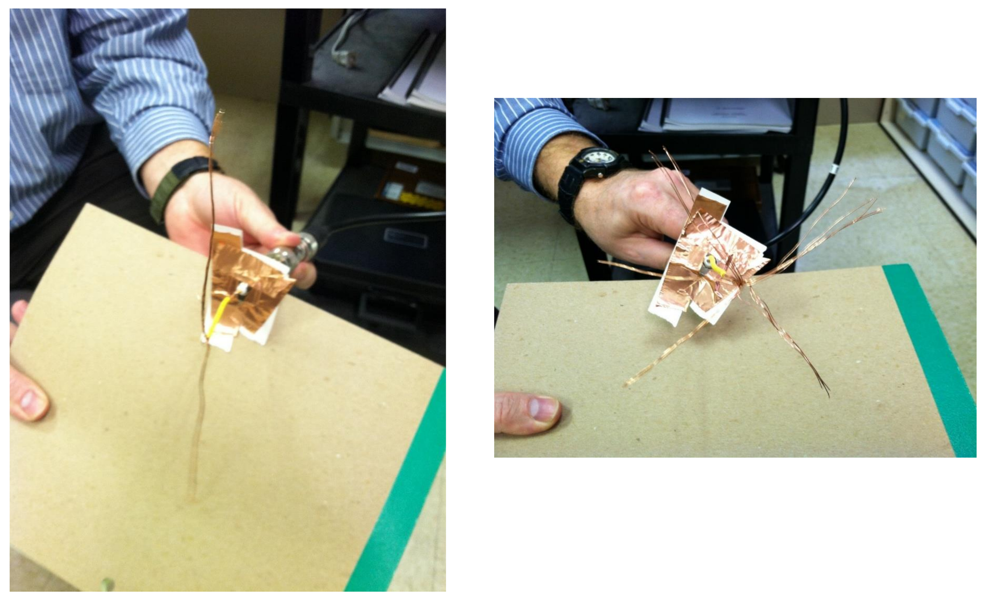

Figure 10. *Investigation of possible geometric configurations for the radiosonde antenna for better transmission. Two possible antenna configurations are shown here. Left: Dipole configuration. Right: Quintopole configuration.*

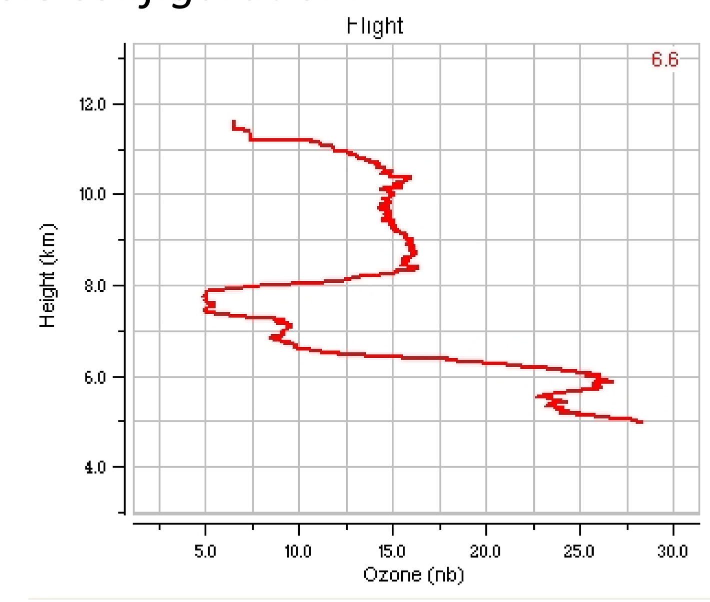

Figure 11. *Flight when we lost communication with the radiosonde because of transmission issues.*

Acknowledgements

Funding for this research was provided by:

Val A. Browning Foundation

Weber State U. Office of Undergraduate Research

NASA EPSCoR, Utah Space Grant Consortium