GSFC Code 916
Atmospheric Chemistry and Dynamics Branch

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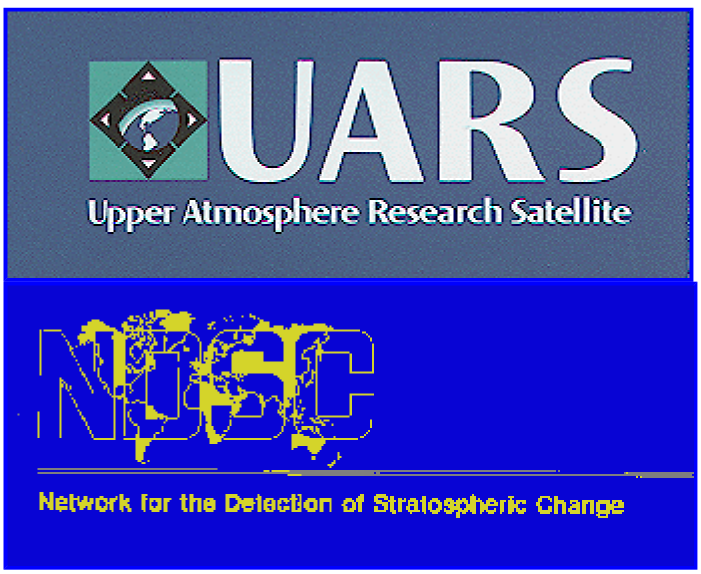
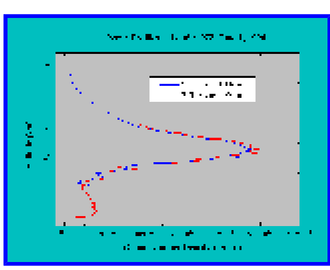
Stratospheric Ozone Lidar Trailer Experiment (STROZ-LITE)

The STROZ-LITE system has been actively acquiring data since 1988. It is a mobile lidar instrument housed in a forty-five foot trailer. This system is capable of making vertical profile measurements of ozone, atmospheric temperature, and aerosols. Several Lidar techniques are used to make these measurements. This instrument is a primary instrument within the International Network for the Detection of Stratospheric Change, and is part of the UARS Correlative Measurements Program. As part of these two programs, the Stratospheric Ozone Lidar has been deployed at various sites within the United States, France and New Zealand.



Ozone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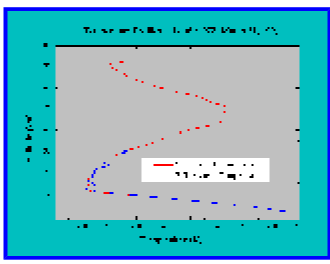
Ozone is measured using a technique called Differential Absorption Lidar or DIAL. In this technique, two different laser beams are transmitted vertically into the atmosphere. One has a wavelength which is absorbed by ozone (308 nm), and another which is not absorbed by ozone (351 nm). These two beams are scattered elastically by molecules and particles, and the light which is backscattered is collected using a 30" telescope. The 308 nm signal falls off much more quickly than the 351 nm signal because of ozone absorption. Ozone concentration as a function of altitude can be extracted from a ratio of the two backscattered signals.

This technique fails, however, when there is a heavy concentration of aerosols in the atmosphere, such as occurred after the eruption of Mt. Pinatubo in 1991. Under such heavy aerosol loadings, a technique known as Raman DIAL is used to measure ozone in the presence of the aerosols. In this technique, the two laser beams are scattered inelastically by atmospheric nitrogen, which is a purely molecular scattering process. The Raman backscattered wavelength from the 308 laser still retains the ozone absorption signature, and the Raman backscattered wavelength from the 351 nm laser is essentially a purely molecular signal. Ozone extracted from these signals is much more reliable when aerosols are present. The figure shows a typical ozone profile recorded during a deployment of the instrument to New Zealand during 1994. Also shown is an ozone profile from a locally flown balloon sonde.

The altitude range for an ozone measurement is typically from 10 km to 50 km.

Temperature



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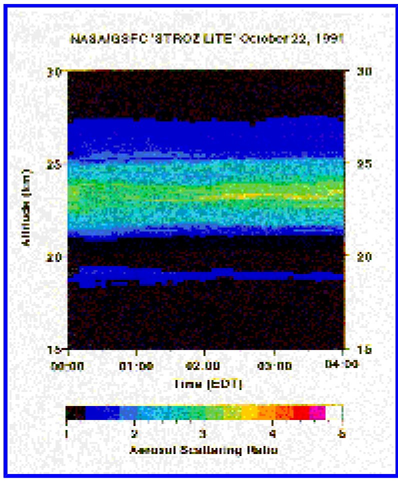
Temperature can be extracted using the lidar return from the 351 nm laser. There is virtually no absorption due to ozone at this wavelength, and so the signal can be directly related to the atmospheric density. If it is assumed that there is little vertical motion during the measurement, the ideal gas law can be used to relate the density to the temperature. This method relies on assuming a reference pressure or temperature at a high altitude, but, within 15-20 km of the assumed reference pressure or temperature, the extracted temperature converges to a value which is independent of the assumed reference value.

In this manner temperature can be retrieved from the elastically scattered return in regions where there are no aerosols (if aerosols are present then the elastic return no longer is directly proportional to the atmospheric density). When a moderate aerosol loading exists, a Raman scattered return can be used to extract temperature, but when heavy loadings are present (such as after a major volcanic eruption) the Raman signals collected by this Lidar system are not sufficient to permit a temperature measurement. Temperature can still be measured at altitudes above the aerosol layer.

The figure shows a Lidar measured temperature profile recorded in New Zealand in 1994. Along with the Lidar profile, the NMC data, and the data from a locally flown sonde are also presented.

Aerosols



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The Stratospheric Ozone Lidar instrument records both elastically and inelastically scattered radiation. Elastically scattered radiation is a function of both molecular and particulate species. Inelastic scattering, however, is only a function of molecular scattering. Taking the ratio of both signals yields a parameter called the Aerosol Scattering Ratio, which is a rough measure of the concentration of aerosols. Extinction and backscattering coefficients can also be obtain from the available data. The figure illustrate the data available from these measurements. The data was recorded in the Provence region of France during the Summer of 1992.

To obtain data

The STROZ-LITE data are available through a number of avenues. All data collected at NDSC sites can be acquired by NDSC members through the NDSC data computer facility. Data obtained since June 1991, the launch date of UARS, can be obtained through the UARS Central Data Handling Facility (CDHF). During 1994, the STROZ-LITE instrument participated in the ASHOE/MAESA aircraft field experiment. All data collected during that time is part of the ASHOE/MAESA database. The files in each of these three data collection facilities is in the AMES file format. Data can also be obtained by contacting the group directly.

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