26B7 NATIONAL CENTRAL UNIVERSITY LIDAR FOR THE LOWER AND UPPER ATMOSPHERIC STUDIES

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SYSTEM DESCRIPTION:

A Rayleigh/Mie scattering lidar has been installed at the National Central University since the summer of 1993. The system uses a YAG laser at 532 nm as a transmitter (SP Model GCR4-30) with a pulse repetition rate of 30 hertz and an average operating power of about 5 watt. The receiver of the lidar system consists of a Newtonian type telescope of diameter 18". A cooled photomultiplier tube (Hamamatsu R4430) operated in the photon counting mode was used to collect the signals. A narrow band interference filter centered at 532 nm with FWHM of 3 nm was employed to select the backscattered laser signals. The PMT signals are amplified and sent into a fast multichannel analyzer (Stanford Research System model SR430). The instrumental bin width is normally set at 160 ns corresponding to an altitude resolution of 24 meters. The data acquisition is controlled by a 386 PC computer. We normally accumulated data for 5-10 minutes corresponding to 9000-18000 laser shots for each measured profile. The data in the MCA is then transferred to the microcomputer for storage.

The NCU lidar system has been used so far to study the particles and temperatures of the atmosphere. In the first year operation, we gathered data about high altitude clouds, stratospheric aerosols, and stratospheric temperatures, covering an altitude range of about 15-60 km.

CLOUDS AND AEROSOLS:

The heterogeneous compositions of the atmosphere which include aerosols and clouds are part of our major efforts. The Mie scattering lidar is the best way of observing the particles in the lower atmosphere. Since its operation, NCU lidar has detected the cirrus clouds in the 8-15 km region. The high altitude cirrus clouds appear more frequently and locate higher in altitudes during the summer but less frequently in the fall. At present we have collected data about height, thickness and durations of observation for these high clouds. In a rare chance we observed clouds higher than 15 km.

The aerosol layers in the stratosphere of altitude 15-30 km were also detected. They originated from the 1991 Pinatubo eruptions. The calculated backscattering ratios have an averaged value of about 1.5 and were derived based on the method of Fernald [1]. The boundary condition is set at 40 km where no aerosol particles are existing.

The aerosol layers appeared to have layer structures and are quite stable during one night's observations. But variations were found on the daily basis. Optical thickness calculated shown a decrease trend. The consistent layered structures in the aerosol distributions are not understood at this time. It may be related to the horizontal dynamics in the lower stratosphere.

STRATOSPHERIC TEMPERATURES:

The non-resonant Rayleigh scattering by air above 35 km may be utilized to derive the temperature of the stratosphere. The derivation is based on the assumption of ideal gas law and hydrostatic conditions [2]. The calculation started with a known value of temperature at 55 km from the model standard atmosphere. The measured temperatures are generally consistent with standard atmospheric temperature, however there are variations found in some temperature profiles. The largest variations with wavelike activities were usually at the 40 km regions. These should be related to the gravity waves propagating into the upper atmosphere [3].

As previous studies indicated that gravity waves are strongly correlated with the wind and have an orographic origins. The seasonal and long term trend will be the main efforts of our lidar research in the future.

CONCLUSIONS:

Lidar observations of the lower and upper stratosphere in the first six months at NCU have revealed very interesting results about clouds, aerosols, and temperatures of the atmosphere. There are similarities and differences between our results as compared with other lidar observations around the world. These may be attributed to latitudinal and geological origins. We are looking forward to collecting more data in the future in order to elucidate these problems.

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