LIDAR STUDIES OF THE MIDDLE ATMOSPHERE.

By

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Contents

Abstract

The work described in this thesis includes the design, construction, operation and data analysis for a stratospheric Rayleigh lidar (LIght Detection And Ranging) system.

This thesis first reviews the areas of atmospheric physics and light propagation in the earth's atmosphere. A review of the history and present state of lidar techniques is also given.

The present Lidar system was designed to operate as a Doppler lidar, however as the first stage of this project it has been set up to operate in a similar manner to a more conventional stratospheric Rayleigh lidar.

This lidar system has a number of unique design features. These include the use of a single 1 m diameter telescope for transmission of the laser pulse and reception of the backscattered light. Associated with this is a high speed rotating shutter system that switches the optical system from transmit to receive mode. A detailed description of the equipment is given. This includes details of the production of the telescope and of the operation of the lidar's electronic control system.

A problem encountered with fluorescence from optical components that are common to both the transmit and receive optical paths is discussed, along with a solution.

The methods used for the analysis of Rayleigh lidar data are discussed. Scattering ratio and temperature profiles are calculated for data collected during the period 10 March 1992 to 11 May 1993.

The scattering ratio profiles clearly show the reduction in the scattering from the stratospheric aerosol layer. This is due to the removal of the aerosol injected by the eruption of Mt. Pinatubo. The measured relative density profiles show very good agreement with the CIRA model densities. Agreement with the model of Fleming et al is not as good.

Calculated temperature profiles generally agree well with the model temperatures.