THE DESIGN AND OPERATION OF A TROPOSPHERIC REMOTE SENSING SYSTEM

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ABSTRACT

A remote sensing system consisting of multiwavelength lidar, a 24 GHz radar, and an infrared radiometer coaxially mounted on a 70 cm Newtonian telescope has been placed in operation. The system was designed for atmospheric science investigations, for flexibility in development of new lidar techniques, and for investigation of the feasibility of using lidar techniques in automated unmanned weather stations to observe current weather conditions and analyze obstructions to vision. The discussion will principally concern the design of the system, but some preliminary observations on mountain lee waves, cloud parameters such as ice-water ratios, and aerosol distribution under inversions will be presented. The telescope, radar and radiometer are mounted on a converted radar mount with azimuth and elevation scan and slew drives. The mount may be positioned within one milliradian and is stable to one-tenth milliradian. The stability of the mount is of crucial importance because of the use of a Coudé path to launch the lidar signal. Although the Coudé path has some disadvantages noted below, location of the laser transmitters in a temperature controlled trailer was considered necessary to allow their use in ambient temperatures from -40 to 44 C. This mounting also allows rapid switching from one laser to another by a detented mirror. The receiving telescope is equipped with several detectors which may be selected by turning the secondary mirror. Detectors with dichroic mirrors and dual detectors for polarization measurement are available for studying cloud depolarization ratios. Optical-filters

are angle tunable. The requirement to know the output polarization is complicated by the effects of five prisms in the Coudé path. Quarter wave and half wave plates are used to restore polarization for search procedures The output polarization without restoration is a known function of azimuth and elevation and is accounted for in data processing. The data processing presently uses a transient recorder and interfaces to a digital tape to which 48 housekeeping functions may be added (e.g., power monitor, azimuth, elevation). At present, data analysis is done in a large computer. Incorporation of a mini-computer for on-line processing is underway. The radar is used for safety and for determining the depth of thick, large drop-size clouds. The radiometer is used for measuring cloud temperature.