12. LASER RADAR STUDIES IN AUSTRALIA

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Despite its small size and relatively small number of groups working with lidar,several varied and interresting lidar projects are being carried out in Australia.Work being carried out in three separate groups will be described, together with a brief description of future plans.

Up to the present,all groups have been using ruby lidar systems and the work has concentrated on applications of this lidar rather than development of new types of lidar.However all three groups are planning to introduce tunable lidars for varied spectroscopic applications in the near future.

(i) FOOTSCRAY INSTITUTE OF TECHNOLOGY,VICTORIA

Here the interest has been in studies of the lower tropospheric region and particularly in the detailed structure of thermal inversions.In the summer months in Melbourne,the water vapour concentration gradients across thermal inversions frequently give rise to gradients of the microwave refractive index which exceed the critical value for anomalous propagation or ducting of the microwaves in the surface layer.The F.I.T. lidar system has been used simultaneously with the University of Melbourne high-power acoustic sounder(8.1kW) to observe the detailed structure of the inversions.A variety of atmospheric structures have been simultaneously observed with the two sensors and inversions have been detected by both systems at altitudes up to about 9 km.Correlation between the structures as seen by the two sensors and also with radiosonde data has been extremely good.

In future it is planned to use the differential absorption technique to make direct measurements of water vapour concentrations in the region of the inversions.

(ii) C.S.I.R.O. DIVISION OF ATMOSPHERIC PHYSICS,ASPENDALE,VICTORIA

The C.S.I.R.O. lidar system is principally committed to the study of clouds and aerosols and their influence on the radiation budget of the atmosphere.This

lidar has been in operation for approximately one year and prior to that time the C.S.I.R.O. conducted extensive cloud studies in cooperation with the University of Adelaide lidar group.So far the new system has been used mainly to study the optical properties of cirrostratus clouds in conjunction with a passive IR radiometer(10-12 μm).These clouds are particularly amenable to lidar studies as they are semi-transparent and have a large climatic effect.Multiple scattering effects play an important part in scattering from clouds and these are also being studied experimentally and theoretically(Monte Carlo)

The lidar has also been used to study the composition of middle-level(alto-stratus)clouds using profiles of integrated lidar backscatter coefficient and depolarisation.Values of depolarisation ratio indicate layering with ice layers existing below water ones and mixed regions where water and ice drops exist simultaneously.

Aerosol studies have been made using comparisons between nephelometer profiles from aircraft,temperature and humidity soundings(radiosonde) and lidar scans at various angles.An attempt is being made to categorise the tropospheric aerosols by their backscatter to extinction ratios.

(iii) THE UNIVERSITY OF ADELAIDE,ADELAIDE,SOUTH AUSTRALIA

The University of Adelaide has been operating its ruby lidar system for more than seven years and since that time the major area of interest has been in studying stratospheric aerosols.The aim has been to monitor and study variations in aerosols occuring between 9km and 60 km altitude and to determine seasonal and long term variations.Continuous observations have been made since 1969.Results show regular seasonal variations of aerosol scattering at some altitudes.Over the period 1969-1973 there was a general decrease in aerosol scattering at 20 km and a gradual increase at higher levels.Continuous monitoring is being carried out in order to produce reference profiles of aerosol content,so that the introduction of natural and man-made aerosols can be detected and measured in the future.

Recent work also includes comparison of extinction measurements using lidar and airborne nephelometer and the commencement of construction of a high-power tunable dye laser system for use in studying spatial and temporal variations in the free sodium layer near 90 km.