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LIDAR MEASUREMENTS OF THERMAL STRUCTURE

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Rayleigh backscatter observations at 532 nm and 355 nm of relative atmospheric density above Aberystwyth (52° 25' N, 4° 04' W) on a total of 93 nights between December 1982 and February 1985 have been used to derive the height variation of temperature in the upper stratosphere and mesosphere. Preliminary results for heights up to about 25 km have also been obtained from observations of Raman backscattering from nitrogen molecules. Comparisons have been carried out for stratospheric heights with satellite-borne measurements; good agreement has been found between equivalent black-body temperatures derived from the lidar observations and those obtained from nadir measurements in three channels of the stratosphere sounder units on NOAA satellites; the lidar-based atmospheric temperatures have shown general agreement with but a greater degree of structure than the limb-sounding measurements obtained using the SAMS experiment on the NOAA-7 satellite.

In summer, stratospheric and mesospheric temperatures showed a smooth height variation similar to that of the CIRA model atmosphere. In contrast, the winter data showed a great variability with height, and marked temperature changes both from night to night and within a given night. A notable feature of the winter data was the frequent occurrence of large amplitude wave-like structures in the height variation of temperature above about 60 km. Night-to-night changes in the appearance of these structures were apparent but vertical-phase phase progression of the structure was observed on only one winter night. Data for three winters showed the lidar technique is capable of resolving large enhancements of stratopause temperature and marked height gradients of temperature during stratospheric warmings.