Novel LIDAR instruments

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Introduction:

Lidar (light detection and ranging) is a technique whereby laser light is transmitted into the atmosphere, and the back-scattered light detected with a telescope. Our group uses lidars to investigate a number of atmospheric properties - pollution and mixing in the atmospheric boundary layer, measurements of atmospheric gases such as water vapour and ozone, temperature profiles and atmospheric aerosol. We develop our own lidars, use mobile lidars on field campaigns and use lidar data in conjunction with other techniques, particularly radar wind profilers. Through the National Centre for Atmospheric Science, we also collaborate widely with other lidar groups throughout the UK.

This project is suitable for a student who wants to learn about lidar technology and develop their own experiments. Atmospheric lidars are becoming increasingly common beyond purely research applications – e.g. for monitoring pollution, volcanic ash, greenhouse gases and wind energy. At Manchester we work with Raman lidars – lidars which measure light shifted in wavelength from the incident laser. This project will look to further developing the Raman technique.

Project Summary:

Two possible avenues for experimental development are offered:

a) Developing new humidity measurements using Raman lidar. The group already has a Raman water vapour lidar at Capel Dewi near Aberystwyth. This project will develop a mobile capability, based on an existing trailer-mounted lidar system designed for ozone measurements. Aerosol optical depth and backscatter measurements will also be made with this lidar. These measurements will form the basis of experiments to study the development of clouds in the lower pat of the atmosphere.

b) Improved temperature lidar. We have built a Raman lidar to measure boundary-layer temperature over Manchester, based on a diode-pumped solid state laser. As the figure shows, this lidar has shown some promising results. However, it has also revealed a number of problems with the present design which require us to re-examine the optical system from first principles. The student would take the lead in designing a new lidar, then building and evaluating it. Once complete, the lidar will be used to study the evolution of night-time temperature over Manchester, to study in particular clear still nights in winter when pollution build-up can present a health hazard in the city.

Allied to these measurements will be modelling work using a range of meteorological models available under the aegis of the National Centre for Atmospheric Sciences.

Image 1- Lidar humidity measurements on 5-6 October 2016 showing dry and wet layers

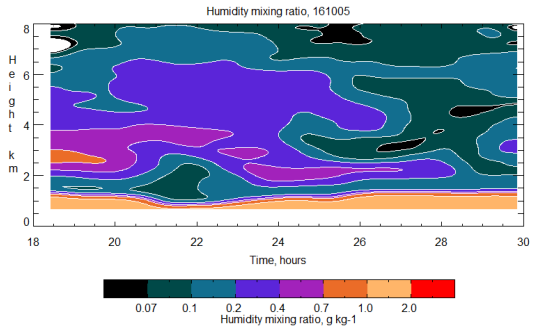
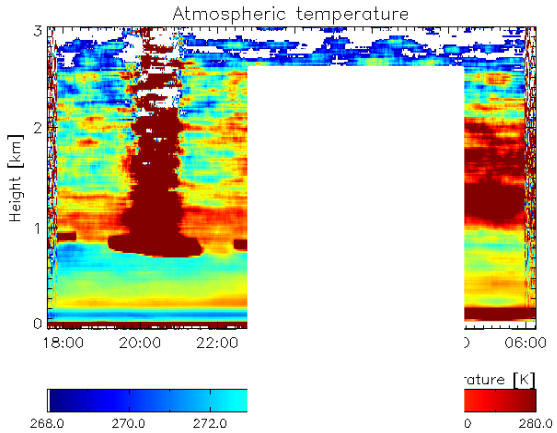


Image 2 Caption - Temperature measured by lidar over Manchester on 24/25 November 2016. Cloudy areas are blanked out.



References

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