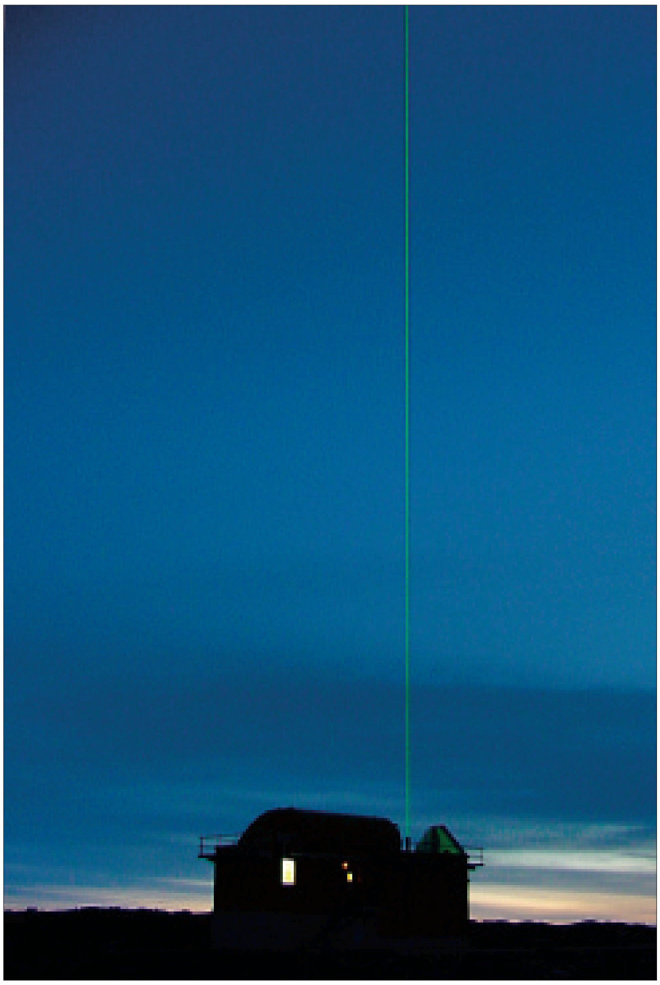
Davis LIDAR commences atmospheric observations



Mark Tell

A powerful green laser beam is now routinely probing the skies above Davis in the investigation of climate change at high altitudes. The laser light is being transmitted by a novel atmospheric Light Detection and Ranging (LIDAR) instrument developed by the AAD in collaboration with Adelaide University. During the 2000-01 summer, Atmospheric and Space Physics (ASP) Program and AAD trades personnel installed and commissioned the instrument at Davis, a culmination of five years of preparation by ASP, Science Technical Support and Engineering Branch staff.

The Davis LIDAR is a remote sensing instrument which profiles atmospheric density, temperature and wind velocity as a function of altitude. It operates in a manner akin to radar; pulses of laser light are transmitted into the sky, and the weak 'light echo' scattered back to the instrument from atmospheric gases and aerosols is collected and analysed.

The LIDAR is housed in a modular 'observatory' which consists of a temperature-controlled laboratory, an ambient-temperature enclosure with a retracting roof, and a general-purpose operations room. The observatory was progressively fitted out and tested at Kingston between early 1997 and mid-2000, and was shipped to Davis by RSV *Aurora Australis* on voyage one. Only three weeks were required to reassemble and commission the building.

The first LIDAR observations from Davis were undertaken in early February 2001. Initially, the instrument was operated in a 'biaxial' configuration, with the laser beam being transmitted independently of the receiving system. An advantage of the biaxial configuration is that it allows backscatter to be received from altitudes up to the mesopause (around 90 km) which is currently an area of intense interest in the atmospheric sciences community. There is evidence to suggest that the mesopause region may be cooling as a result of the current warming trend near the Earth's surface. Tenuous clouds of ice particles form near the mesopause in the summer at high latitudes. The visual manifestations of this phenomenon are called 'noctilucent clouds', and these have been observed by expeditioners at Davis, albeit rarely. One of the first tasks of the LIDAR is to examine the frequency of occurrence and structure of these clouds.

The Davis LIDAR is currently one of only three such instruments capable of retrieving temperatures in the mesosphere (the region between 50 km and about 95 km) from the southern hemisphere. Northern hemisphere measurements have suggested that a general cooling is taking place in the mesosphere and stratosphere (15 km to 50 km altitude), but little published data currently exists regarding trends at southern latitudes.

Biaxial operation will also allow further testing and refinement of the mechanical and optical system as the low temperatures of winter set in. Currently, a program of temperature comparisons between the LIDAR and Bureau of Meteorology balloon-borne radio-sondes is being undertaken up to altitudes of 40 km in order to test the LIDAR temperature retrieval techniques. It is hoped that the 'coaxial' operating mode of the instrument, in which the laser can be steered around the sky for horizontal wind measurements, will be tested before spring.

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Antarctica Online

Specific information on the instrument and its scientific program are outlined on the LIDAR web page at http://www.aad.gov.au/science/AntarcticResearch/AtmosphericSciences/lidar.asp.