Discovery shines LITE on clouds

At 6.25 pm on Friday, 9 September 1994, the massive roar of space shuttle Discovery's engines shattered the evening calm at Florida's Kennedy Space Center. Vast plumes of grey smoke filled the air as the shuttle began its spectacular ascent into an orbit 260 kilometres above the earth's surface. On board was a two-tonne atmospheric monitoring device known as a lidar.

Less than three hours after lift-off, the shuttle's crew began firing powerful laser beams from the lidar down into the earth's atmosphere, making measurements that had never been made before.

After the launch, Dr Martin Platt from CSIRO's Division of Atmospheric Research joined his colleagues from the LITE Science Team at Johnson Space Centre to obtain data and celebrate the culmination of 10 years' work.

LITE stands for the Lidar In-space Technology Experiment which is led by the National Aeronautics and Space Administration (NASA). The experiment marks the first use of a lidar (light detection and ranging) for atmospheric studies from space.

For more than 30 years, instruments on board satellites have monitored weather patterns, tracked pollution and detected algal growth in the oceans. Most of these instruments are passive, simply recording the changing picture in their field of view in much the same way as a camera preserves a scene on film.

But a lidar is an 'active' instrument. It operates in a similar way to a radar. Instead of bouncing radio waves off its target, lidar uses powerful pulses of laser light. When the laser beam strikes a cloud it bounces back into the lidar's telescope. The time taken for the pulse to be reflected gives the height and thickness of the cloud and the strength of the signal indicates the amount of material present.

For nine days Discovery's six-member crew probed the atmosphere and the earth's surface with the lidar, sending masses of data to investigators on the ground.

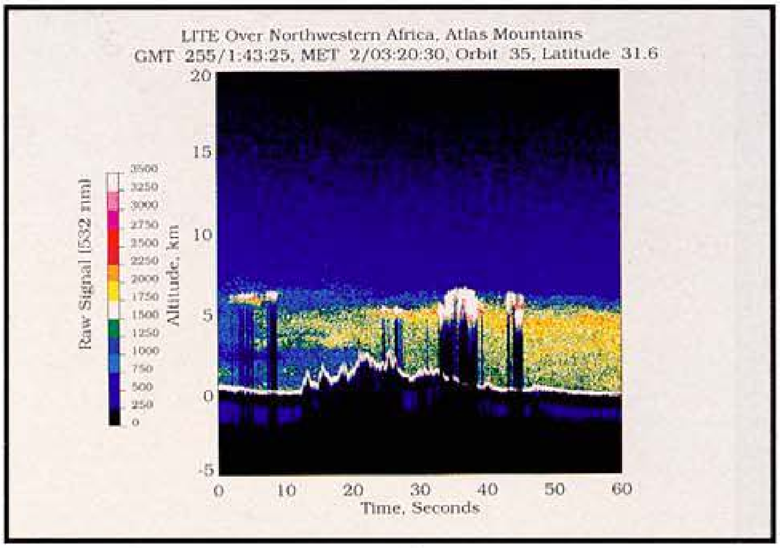
Platt was thrilled with the results. A highlight for him was the set of three-dimensional cloud pictures collected by the astronauts. 'Clouds are so crucial to our climate,' he says. 'Some clouds trap heat released by the ground, warming the planet. Others reflect sunlight back into space. The important question is which type of cloud will dominate in future. This experiment will help provide the answer.'

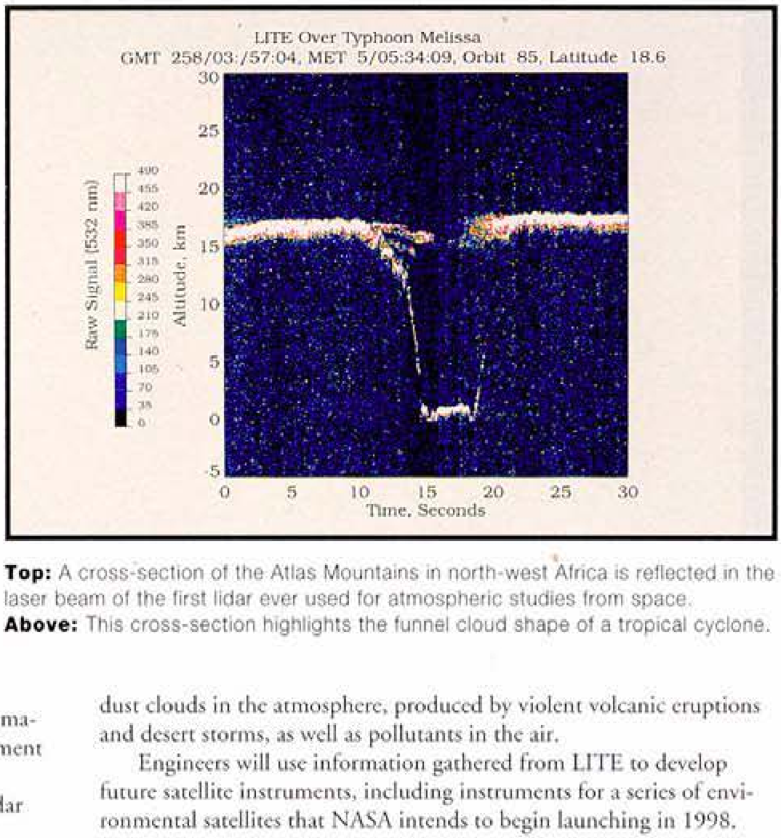
Platt is particularly interested in the lidar's ability to look inside dense clouds that are impenetrable to detectors on satellites. Droplets inside these opaque clouds act like tiny mirrors, reflecting the light pulse backwards and forwards through the clouds' interior in a process known as multiple scattering. The information obtained will let Platt establish the height of clouds, a measurement of vital interest to climate studies.

Meanwhile, back in Australia, Platt's CSIRO colleagues took lidar measurements from the ground as the Discovery passed over Melbourne. Dr Stuart Young says the ground measurements had two functions. One was to test the measurements made by the lidar on board the satellite. The second was to build up a composite picture of the atmosphere over Melbourne by combining the view from above with that from below.

Young's team was one of 50 at ground sites in 20 countries making supporting measurements during the LITE mission. In addition, five scientific aircraft flew over regions including Europe and the United States making further measurements.

Results from LITE will help scientists better understand global climate and how it might be changing. The experiment will also monitor dust clouds in the atmosphere, produced by violent volcanic eruptions and desert storms, as well as pollutants in the air.





Top: A cross-section of the Atlas Mountains in north-west Africa is reflected in the laser beam of the first lidar ever used for atmospheric studies from space.
Above: This cross-section highlights the funnel cloud shape of a tropical cyclone.

Engineers will use information gathered from LITE to develop future satellite instruments, including instruments for a series of environmental satellites that NASA intends to begin launching in 1998.

Platt says LITE marks the beginning of a new era in atmospheric measurements. He would like to see a lidar mounted on a permanently orbiting satellite, providing continuous, accurate global data. He says one day we may even have customised lidars in space, some probing clouds, while others track urban smog or monitor the gases in the atmosphere.

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