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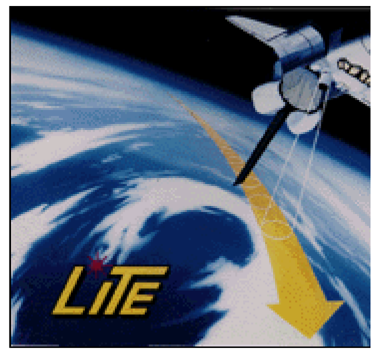
FACT SHEETS

Lidar In-space Technology Experiment (LITE) Aug

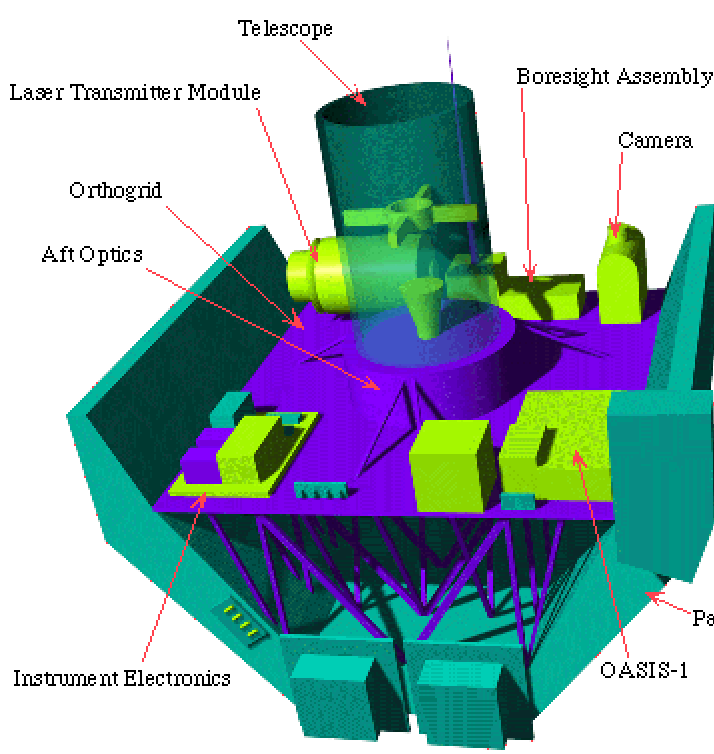
LITE: Measuring the Atmosphere With Laser Precision

This fall, for the first time, NASA plans to test a laser-based sensor in space that will help scientists better understand global climate and how it might be changing.



The instrument, called LITE (Lidar In-Space Technology Experiment), will orbit the Earth while positioned inside the payload bay of Space Shuttle Discovery. During this nine-day mission, LITE will measure the Earth's cloud cover and track various kind of particles in the atmosphere. Designed and built at the NASA Langley Research Center, LITE is the first use of a lidar (light detection and ranging) system for atmospheric studies from space.

Lidar is similar to the radar commonly used to track everything from airplanes in flight to thun storms. But instead of bouncing radio waves off its target, lidar uses short pulses of laser ligh of that light reflects off of tiny particles in the atmosphere and back to a telescope aligned wit laser. By precisely timing the lidar "echo," and by measuring how much laser light is received telescope, scientists can accurately determine the location, distribution and nature of the part The result is a revolutionary new tool for studying constituents in the atmosphere, from cloud to industrial pollutants, that are difficult to detect by other means.



Laser light, directed toward Earth, will bounce off of thin clouds, dust particles and the surfac Earth LITE's telescope receiver will "catch" that reflected light.)

Why lasers?

Virtually all remote sensing satellites, including the ones that produce our daily weather maps passive sensing. They simply measure the amount of solar radiation - visible light or other wavelengths - reflected, not emitted, back to the satellite from clouds, ocean or solid land. Lid active sensor. It carries its own source of laser illumination, which means that it can determin and when it will make measurements, both in the daytime and at night.

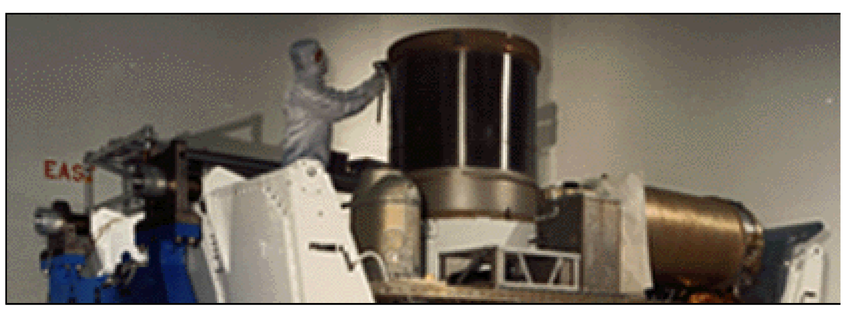
Lasers also produce a tight, coherent beam that does not disperse as it travels away from its as ordinary light does. From an orbital altitude of about 140 nautical miles (260 km), LITE's pe wide laser beam would spread to approximately 300 meters wide at the surface - about the si three football fields. This allows the LITE instrument to measure a very small, narrowly define column of the atmosphere with each pulse. A space-based lidar offers another great advanta ability to penetrate thin or broken clouds to "see" through to the troposphere (i.e., the lower pa atmosphere where weather systems develop). From its vantage point above the atmosphere, lidar instrument - the most powerful civilian laser ever flown in space will flash extremely sho pulses of laser light directly downward, ten times every second. These pulses, lasting less tha billionths of a second each, will be in three different wavelengths corresponding to ultraviolet, and visible green light. Because the wavelengths are very precisely known, and because LITI telescope is designed to filter out other types of radiation, the signals returning to the Space S after reflecting off of small airborne dust particles, water droplets and other aerosols (suspenc particles) are easy to identify. Timing the returned signal pinpoints the particle altitude to wit accuracy of 15 meters.

Lidar's ability to locate water droplets and ice particles in the atmosphere gives scientists a po new tool for studying clouds. Some high, thin cirrus clouds are invisible to conventional remot sensing satellites. LITE will be able to determine their heights with great precision. It also will the vertical structure of complex, multi-layered clouds that contain different sizes and types of particles at different altitudes. The interiors of these clouds would be hidden from ordinary, pa sensors.

Scientists also will be able to gain an estimate of density and temperature variations within th stratosphere (the region where most of our ozone resides, located about 6 to 30 miles above Earth) by studying the returning lidar signals at LITE's ultraviolet wavelength. In the stratosph will be able to map with unprecedented accuracy the particles produced by violent volcanic er These particles help to explain global circulation and are important to understanding climate. addition, LITE will return valuable data on the planetary boundary layer close to the Earth's su where the atmosphere interacts with the ocean and solid land, and where much of the dust an pollutants in the atmosphere reside. Finally, LITE will determine reflection characteristics of th Earth's surface. This data will be used both to determine LITE's ability to measure vegetative and to distinguish various types of surfaces.

Why space?

Ground-based lidar instruments can profile the atmosphere over a single viewing site, while li onboard aircraft can gather upward- or downward-looking data over a wider area. But each of methods is limited to sampling a comparatively small region. A space-based lidar offers a trul view. Space Shuttle Discovery, orbiting at an inclination of 57 degrees to the equator, will pas about 10,000 miles of the planet's surface every 90 minutes. The LITE instrument can therefo collect data for a wide range of geographic and atmospheric settings, including remote areas open ocean, in a very short period of time.



A NASA Langley scientist prepares LITE for the September 1994 mission.

The LITE mission

The LITE instrument will be mounted to a pallet inside the open payload bay of Discovery, wh orbit upside-down - positioning LITE toward the Earth. Discovery will fly at a relatively low altit (about 140 nautical miles or 260 km), so that each downward-pointing lidar pulse is dispersec as possible on its way down through the atmosphere. Over the course of its nine-day mission will collect atmospheric data during ten separate periods lasting 4.5 hours each. During those the returning lidar signals collected by LITE's telescope will be converted to digital data, which stored on tape and simultaneously transmitted to investigators on the ground.

In addition, the LITE instrument will take a number of 15-minute "snapshots" over target areas selected either for scientific interest or to support validation observations. These validation observations will involve instruments at ground stations, on balloons, and on aircraft, all of wh gather data to help calibrate the LITE results. A lidar at the Langley Research Center, for exa will take upward-looking data at the exact time the Space Shuttle is passing overhead. Among other "snapshot" targets are sites in Europe, Australia, and the Sahara desert (to observe des dust).

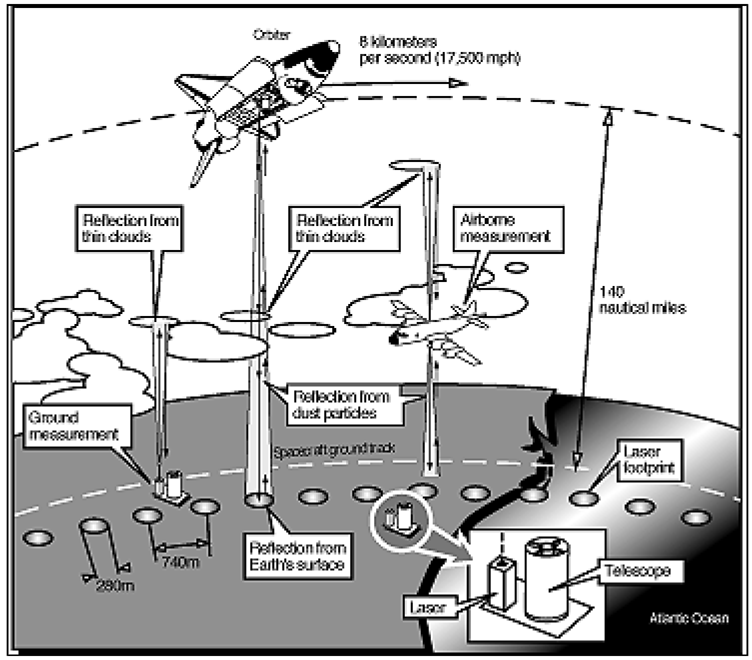
Another experiment requires that the Shuttle execute roll and pitch maneuvers to change the which the lidar reflects off of its targets below. These tests will be useful to engineers designin lidar instruments that can scan from side to side or front to back instead of holding to a fixed, downward-looking point of view.

What will scientists learn from the LITE experiment?

Because this type of lidar has never flown in space, the LITE mission is primarily a technology Scientists and engineers want to verify that the entire system works as planned in orbit, for ex that the laser and telescope remain aligned, that the built-in cooling system can handle the he produced by a powerful lidar instrument and that the signals and noises are measured as exp The Space Shuttle is an ideal "platform" for conducting this kind of technology test. It provides opportunity to fly a heavy, multi-purpose instrument at comparatively low cost without building dedicated satellite. Then, once the practical utility of lidar in space is demonstrated, the lesso learned during the LITE mission can be applied to designing future, operational systems that lighter in weight, use less spacecraft power and are more capable.

Eventually, lidar instruments could be flown on permanently orbiting satellites to provide conti global data. While LITE will collect data on a wide range of particles, from aerosols in the stra to cloud droplets and pollutants, future lidar instruments could be tailored to specific purposes one instrument studied clouds, another could track urban smog or desert dust storms.

Perhaps the greatest value of early space-based lidar is the unprecedented accuracy with wh measure clouds on a global scale. Information on clouds is critical to improving computer moc global climate. Current remote sensing satellites leave large gaps in our understanding of hov reflect and absorb solar energy, and how heat and moisture are exchanged between the air, and land. Only by gathering more accurate information can scientists improve their models to point where they can confidently predict the behavior of the real atmosphere, and tell how the environment is being affected by human activity. LITE - and its successors - will make a uniqu valuable addition to that store of information.



Laser light from the shuttle contacts thin clouds, dust particles and the Earth's surface, a
reflection is bounced back to LITE's telescope.

LITE Facts and Figures

Date: September 1994
Mission: STS-64
Duration: 9 days
Space Shuttle Orbiter: Discovery
Orbit altitude: 240 to 260 kilometers
LITE Payload Weight: 2 metric tons
LITE Payload Length: 3 meters
Telescope diameter: 1 meter
Laser wavelengths:
1064 nanometers (near infrared)
532 nm (visible green)
355 nm (ultraviolet)

Laser Safety

The laser NASA will use on this mission poses no hazard to the general public. There is no h when viewing with the naked eye, binoculars or small telescopes. In the interest of safety, the International Science community has been asked not to attempt to view the Shuttle directly th any telescope larger than 6 inches in diameter during the STS-64 mission.

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For more information, check out the LITE Homepage.

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