Spaceborne Lasers to Revolutionize Global Change Research

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HU professor talks about spaceborne laser instruments ability to revolutionize understanding of global change

Long Beach, Calif. -- The first years of the new millennium promise to revolutionize our ability to see how the natural world is changing and to answer perplexing questions about mankind's impact on the planet. For the first time, scientists will be able to peer inside forests across the world, accurately measure changes in the amount of ice in the polar caps, and get a global look at how clouds and airborne dust particles affect global warming.

Many of these advances will be made when a new generation of laser-based sensors make their debut in space, says M. Pat McCormick, co-director of the Center for Atmospheric Sciences at Hampton University.

In 1999, McCormick was selected by the American Meteorological Society as the Remote Sensing Lecturer for this year's meeting in recognition of his outs tanding contributions to remote sensing of the atmosphere. His lecture, "Remote Sensing from Space Using Occultation and Lidar Techniques," will be presented on Jan. 12 at the meeting in Long Beach, Calif.

Three new NASA Earth-observing spacecraft will launch innovative "lidar" instruments into orbit beginning this fall. Lidars send pulses of light energy from a laser through the atmosphere and measure the speed and the amount of light that returns. The signal's roundtrip time is a direct measure of the distance to the object.

"Most instruments that scientists use to observe the Earth from space cannot see through even thin clouds or their view is distorted by clouds," says McCormick. "Many surface features and important phenomena in the lower atmosphere are completely hidden. Lidar can pierce many types of clouds and its very small beam can pass between clouds."

The first of these instruments will be launched this September. The Vegetation Canopy Lidar mission will create the first maps of the three-dimensional structure of vegetation in the world's forests. By measuring the height of trees and the amount of leaves and foliage in a forest, the mission will monitor forest health and conditions over most of the globe and produce a global estimate of how much carbon the forests hold.

The ICESat mission, scheduled for launch in July 2001, will carry the Geoscience Laser Altimeter System to map the surface of Earth's ice sheets in unprecedented detail. By comparing how the ice sheet surface changes over several years, scientists can calculate how much ice has been lost and how much that ice has contributed to sea level rise. The ICESat lidar also will detect polar clouds and haze. A similar instrument, the Mars Observer Laser Altimeter, recently mapped the surface and ice caps of Mars.

The Pathfinder Instruments for Cloud and Aerosol Spaceborne Observations (PICASSO-CENA) mission, scheduled for launch in April 2003, will provide key measurements of aerosol and cloud properties needed to improve climate prediction. The spacecraft will fly in formation with other NASA spacecraft. Hampton University is a partner with NASA on the PICASSO-CENA mission, and McCormick serves as a co-principal investigator.

Ground-based lidar systems were introduced in the early 1960s, andscientists used them to monitor ozone and small particles (aerosols) in the upper atmosphere. Airborne lidars were developed in the late 1970s to extend these local views to regional scales. The first spaceborne lidar flew aboard NASA's Space Shuttle in 1994. The Lidar In-space Technology Experiment (LITE) provided the first highly detailed global profiles of the multi-layered structure of clouds. It also was able to follow the movement of airborne dust from the Sahara Desert and urban air pollution particles from major industrial centers.

The new generation of space-based lidar is the result of technological advances in more power-efficient, long-lived lasers and lightweight telescopes to collect the returning laser signal.

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McCormick was one of the early pioneers in the use of lidars and built the first airborne system in 1978. He serves as the LITE project scientist. McCormick led the Aerosol Research Branch at NASA's Langley Research Center from 1975 to 1996.

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