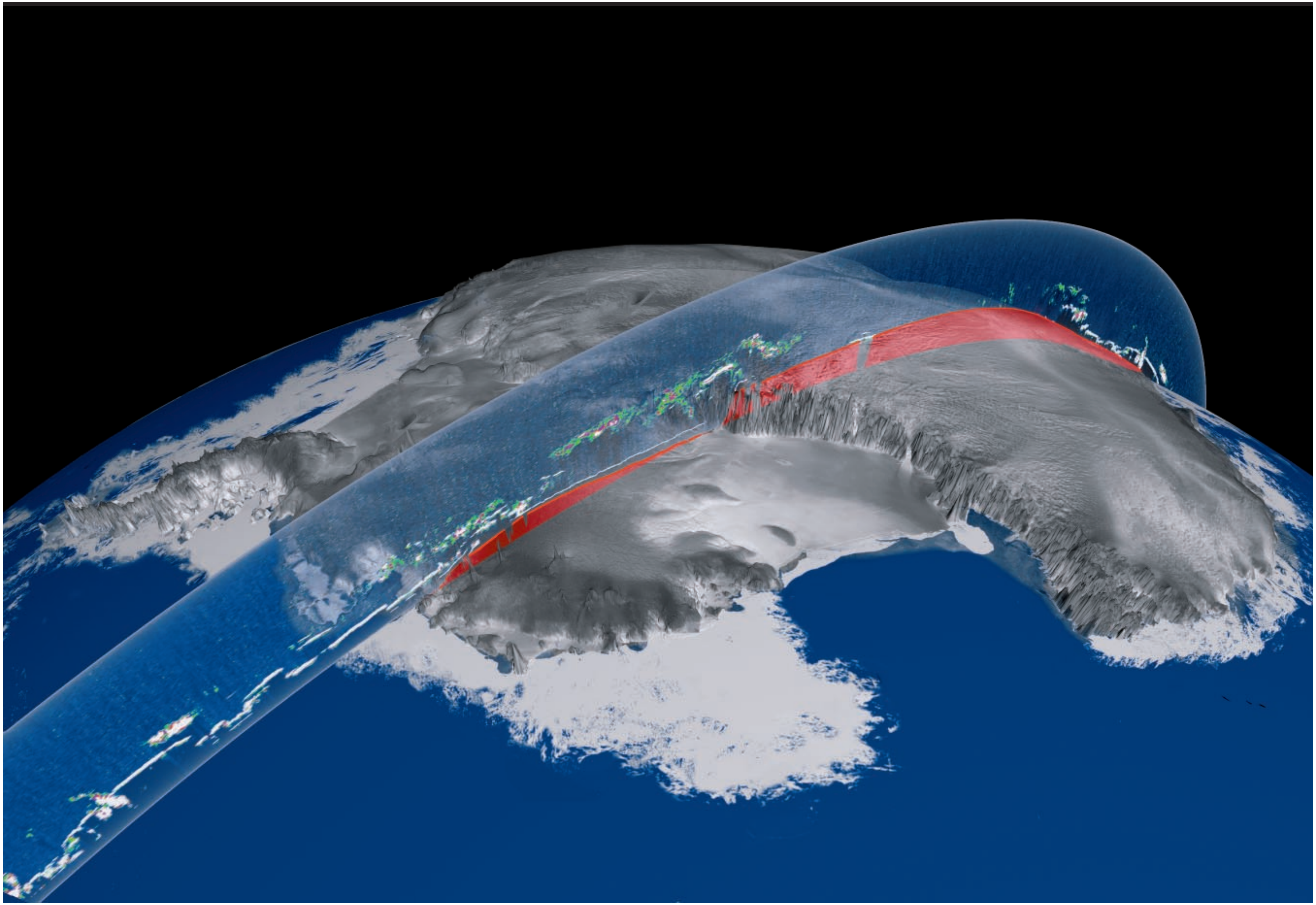
National Aeronautics and
Space Administration
Goddard Space Flight Center

Ice, Cloud, and land Elevation Satellite (ICESat)



Ice, Cloud, and land Elevation Satellite (ICESat)

Are the ice sheets that still blanket the Earth's poles growing or shrinking? Will global sea level rise or fall? NASA's Earth Science Enterprise (ESE) has developed ICESat to provide answers to these and other questions, to help fulfill NASA's mission to understand and protect our home planet. Launched on January 12, 2003, ICESat is part of NASA's Earth Observing System (EOS). ICESat's primary goals are to quantify ice sheet mass balance and to understand how changes in the Earth's atmosphere and climate affect polar ice masses and global sea level. ICESat will also determine the heights of clouds and aerosols in the atmosphere, as well as the elevation of land topography, sea ice, and vegetation cover characteristics.

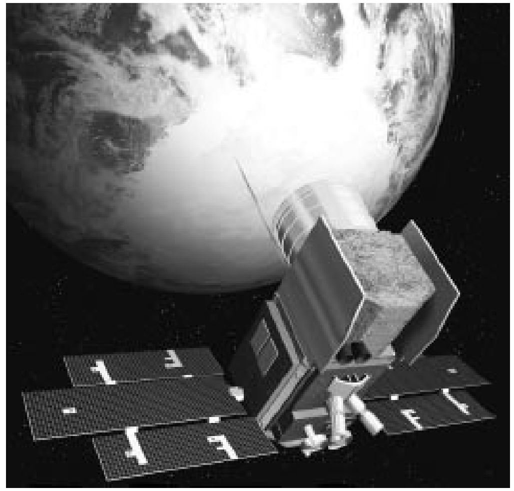
The Geoscience Laser Altimeter System (GLAS) on ICESat is providing global information (between 86°N and S latitude) on ice sheet elevations, changes in elevation through time, height profiles of clouds and aerosols, land elevations and vegetation cover, and sea ice thickness. Future missions similar to ICESat will extend and improve assessments from this mission, as well as monitor any ongoing changes. By combining GLAS data with other aspects of NASA's ESE, such as current and planned EOS satellites, scientists will be able to study the Earth's climate system. Ultimately they will be able to use this information to predict how ice sheets, sea-level, clouds and aerosols may respond to future climate change.

What is the Geoscience Laser Altimeter System and How Does it Work?

GLAS is the first polar-orbiting space lidar and is the primary scientific instrument on ICESat. It combines a high precision surface lidar with a sensitive dual wavelength cloud and aerosol lidar. GLAS has three lasers that emit infrared and visible laser pulses at 1064 and 532 nm wavelengths. These lasers operate at eye-safe signal levels and only one operates at any given time.

On orbit, GLAS operates continuously and emits laser pulses at a rate of 40 per second from the Earth-facing (nadir) side of ICESat. GLAS precisely measures the time it takes for photons in a laser pulse to pass through the atmosphere to the Earth, reflect, and travel back to GLAS. By halving this total travel time, and applying corrections for the speed of light through the atmosphere and motion of the satellite, the distance from ICESat to the laser footprint on Earth can be calculated. ICESat accurately calculates its position in space by using on-board GPS (Global Positioning System) receivers, augmented by a network of ground GPS receivers and satellite laser ranging stations. The angle of the laser beam relative to stars is measured precisely by GLAS with star-tracking cameras on the zenith side of ICESat. The data on the distance to the laser footprint on the surface, the position of the satellite in space, and the pointing of the laser beam are all combined to calculate the elevation and position of each point measurement on the Earth's surface.

ICESat Mission Summary



The GLAS instrument was developed at NASA Goddard Space Flight Center in partnership with a science team from universities, government, and industry. Ball Aerospace built the spacecraft and ICESat was launched on a Boeing Delta II rocket. On-orbit, ICESat is operated by the University of Colorado, Laboratory for Atmospheric and Space Physics. The GLAS and ICESat data are initially processed at the ICESat Science Investigator-led Processing System with support from the University of Texas, Center for Space Research. The mission data are being distributed and archived by the National Snow and Ice Data Center's Distributed Active Archive Center. ICESat is designed to operate over the next several years and will be followed by other missions to measure ice sheet elevations and other Earth phenomena over the next 15 years.

FRONT: This figure illustrates ice sheet elevation and cloud data from ICESat's Geoscience Laser Altimeter System (GLAS) on its first day of operation, February 20, 2003. On that day, the instrument collected a1064 nm wavelength profile across Antarctica: the lower West Antarctic Ice Sheet in the foreground is separated from the higher East Antarctic Ice Sheet in the background by the steep TransAntarctic Mountains. The elevation profile (in red) is depicted relative to the Earth's standard ellipsoid, with 50x vertical exaggeration. Data collected across floating sea ice and open water of the adjacent Southern Ocean cannot be shown at this scale. Clouds of various thicknesses are indicated by colors changing progressively from light blue (thin clouds) to white (opaque layers). Note that the laser cannot penetrate the thickest clouds causing gaps in the elevation profile below. RADARSAT data is used to render the surface of the Antarctic continent.

For additional information on this NASA ESE mission, go to the ICESat web site at http://icesat.gsfc.nasa.gov

LG-2003-11-073-GSFC