NASA Facts

National Aeronautics and
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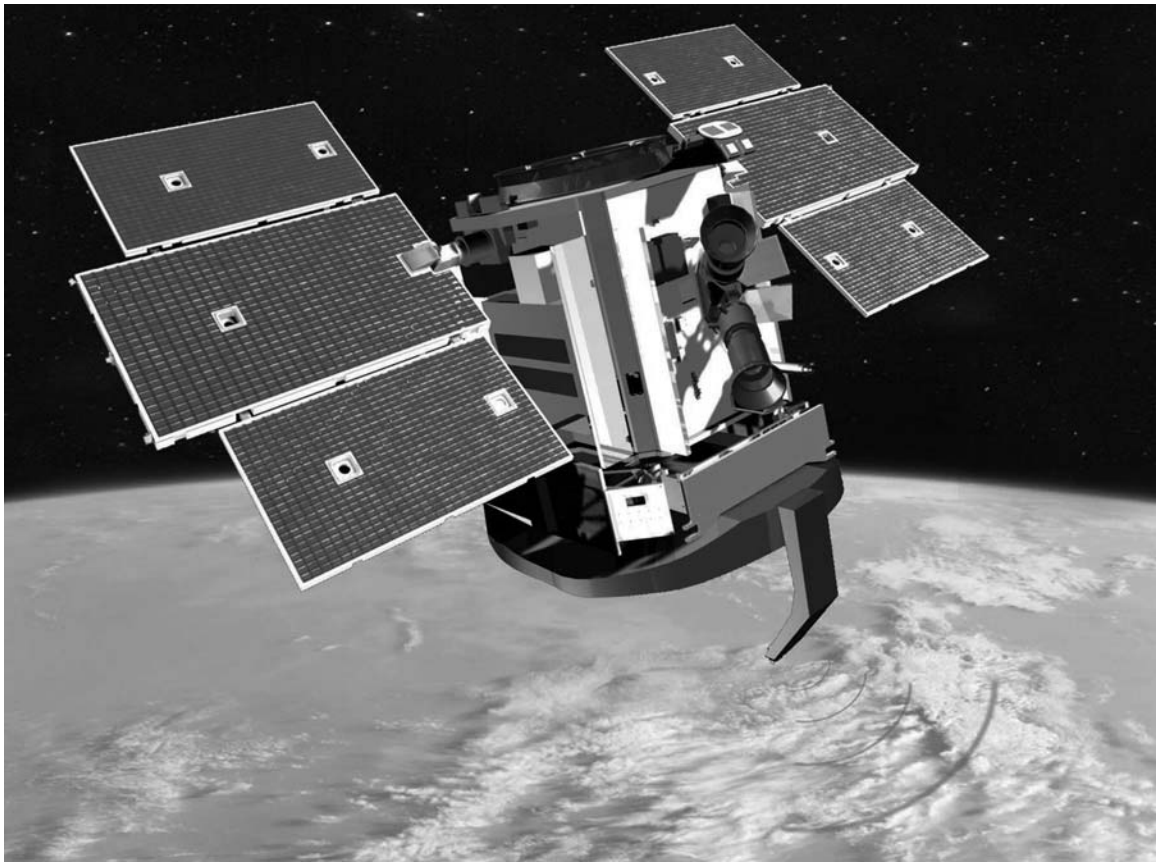
CloudSat

Clouds exert an enormous influence on our weather and climate. Clouds are everywhere around us, yet despite the fact that scientists have studied clouds for a long time, much about clouds remains a mystery. Until now, our information about clouds has come from satellites in Earth orbit that see mostly the tops of clouds, from limited surface observations that see mostly the bottoms of clouds, and from sparse research aircraft observations.

Clouds transport and redistribute one of Earth's most precious resources - freshwater. If our world had no clouds, there would be no way to replenish our reservoirs of freshwater. Improved knowledge of cloud and precipitation processes will help us better predict future freshwater supplies for societal use.

Clouds also dominate the energy balance of Earth, warming and cooling



our planet. Even small changes in their abundance or distribution could alter the climate more than anticipated changes in greenhouse gases, human-produced aerosols, or other factors associated with global change. Scientists believe that the main uncertainties in climate model simulations are due to the difficulties in adequately representing clouds and their influence on the energy balance of the planet.

NASA's CloudSat mission will give us a never-before-seen 3-D perspective of Earth's clouds that will answer questions about how they form, evolve and affect our weather, climate and freshwater supply. CloudSat observations will fuel discoveries that will improve our weather and climate forecasts, while helping public policy makers and business leaders make more-informed, long-term environmental decisions about public health and the economy.

Mission Overview

CloudSat will provide the first global survey of cloud properties that are critical for understanding their effects on both weather and climate. The key observations are vertical profiles of cloud liquid water and ice water. These cloud properties are not obtainable from current satellite measurement systems.

The mission's primary science goal is to furnish data needed to evaluate and improve the way clouds are characterized in global models. These data will contribute to improved predictions of weather, climate, and the poorly understood interaction between clouds and other variables of the climate system. This interaction is complex: clouds absorb and reflect solar energy and affect the distribution of thermal radiation in the atmosphere. The distribution of radiation in the atmosphere, in turn, affects atmospheric circulation and determines where new clouds will form.

CloudSat Firsts

CloudSat will achieve a number of important firsts:

❑ First statistics on the vertical structure of clouds (for the first time, we will see clouds from top to bottom).

❑ First global estimates of the percentage of clouds that produce rain.

❑ First vertically resolved estimates of how much water and ice are in clouds.

❑ First ability to detect snowfall from space.

❑ First estimates of how efficiently the atmosphere produces rain from condensates.

❑ First observationally-based estimate of how much clouds contribute to the vertical distribution of atmospheric heating.

Launch

CloudSat will be launched on a Delta II launch vehicle together with the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) satellite.

Mission Duration and Orbit

The CloudSat mission was designed to operate for two years to enable more than one seasonal cycle to be observed, although the radar is expected to operate for three years or longer. It will orbit at an altitude of 705 kilometers (438 miles).

Science Objectives

❑ Quantitatively evaluate the representation of clouds and cloud processes in global atmospheric circulation models (weather prediction and climate models).

❑ Quantitatively evaluate the relationship between the vertical profiles of cloud liquid water and ice content and the radiative heating of the atmosphere and surface by the various cloud systems.

❑ Evaluate cloud properties retrieved from other satellite systems, in particular those of Aqua and CALIPSO.

❑ Improve our understanding of the indirect effect of aerosols on clouds by investigating (in cooperation with other satellite platforms) the effect of aerosols on cloud formation and cloud processes.

Payload Overview

CloudSat carries a first-of-its-kind Cloud Profiling Radar that is more than 1,000 times more sensitive than existing weather radar. It will "see" inside clouds to determine, from space, how much water and/or ice is inside. CloudSat flies a 94-Gigahertz, millimeter-wavelength radar that looks straight

down at Earth to measure the vertical structure of clouds and rain from space. Unlike the centimeter wavelength used in ground-based radars to detect raindrop-size particles, the CloudSat radar will allow us to study the interior structure of clouds. This increased sensitivity allows us to see inside the large cloud masses that make our weather. We will be able to see the processes that convert the tiny cloud particles to precipitation.

CloudSat's Cloud Profiling Radar will work much like a physician's CT scan examines the human body, providing a vertical, cross-sectional view of clouds and furnishing new meteorological data types including cloud-layer thickness, cloud top and base altitudes, and cloud water and ice content.

"A-Train" Constellation

CloudSat will fly as part of a constellation of satellites called the "A-Train," providing a unique, multi-satellite observing system particularly well suited for studying the atmospheric processes of the hydrological cycle. CloudSat will fly in tight formation with the CALIPSO satellite, which carries a two-wavelength, polarization-sensitive backscattering lidar that provides high-resolution vertical profiles of aerosols and clouds. These two satellites will follow behind NASA's Aqua satellite in a somewhat looser formation. The combination of data from the CloudSat radar with coincident measurements from CALIPSO and Aqua provides a rich source of information that can be used to assess the role of clouds in both weather and climate.

Partners

CloudSat is managed by NASA's Jet Propulsion Laboratory, Pasadena, Calif. The radar instrument was developed at JPL, with hardware contributions from the Canadian Space Agency. Colorado State University, Fort Collins, Colo., provides scientific leadership and science data processing and distribution.

Other contributions include resources from the U.S. Air Force and the U.S. Department of Energy. Ball Aerospace and Technologies Corp., Boulder, Colo., designed and built the spacecraft. A host of U.S. and international universities and research centers provides support to the science team. Some of these activities are contributed as partnerships with the project.

CloudSat is a project from the NASA Earth System Science Pathfinder Program. NASA’s Goddard Space Flight Center, Greenbelt, Md., provides program management, system engineering support and overall program management for the Earth System Science Pathfinder Project Office.