NASA Fact Sheet

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Marshall Space Flight Center
Huntsville, Alabama 35812

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Optical Transient Detector

The Optical Transient Detector (OTD) is a small, highly sophisticated system which, from Earth orbit, will be able to detect and locate lightning over large regions of the globe. As such, it is one of the early elements of NASA's Earth Observing System within the Mission to Planet Earth program, which is aimed at gaining a better understanding of how the Earth functions as a system.

In recent years, scientists have become increasingly aware of the key role played by lightning in the dynamic interplay of forces occurring in the Earth's atmosphere. Research has indicated, for instance, that lightning may be a very good indicator of the strength of large-scale convective storm systems. Precipitation from these systems is not currently monitored on a global basis, since large areas of the Earth's surface are void of rain gauge measurements. Therefore, a rainfall indicator which can be monitored from space would provide a valuable addition to the types of data needed by atmospheric scientists and meteorologists.

The OTD project has also provided a concrete demonstration of how the development process for new technology systems can be greatly streamlined from the traditional model. Development of the OTD was formally launched at the Marshall Center in June 1993. The finished, tested and calibrated system was completed only nine months after that start date.

System Description

The OTD is a highly compact combination of optical and electronic elements. It was developed as an in-house project at NASA's Marshall Space Flight Center in Huntsville, Ala. The name, Optical Transient Detector, refers to its capability to detect the momentary changes in an optical scene which indicate the occurrence of lightning. The OTD instrument is a major advance over previous technology in that it can gather lightning data under daytime conditions as well as at night. In addition, it will provide much higher detection efficiency and spatial resolution than has been attained by earlier lightning sensors.

At the heart of the system is a solid-state optical sensor similar in some ways to a TV camera. However, in overall design and many specific features, OTD had to be uniquely designed for the job of observing and measuring lightning from space. Like a TV camera, the OTD has a lens system, a detector array (serving a function somewhat analogous to the retina in the human eye), and circuitry to convert the electronic output of the system's detector array into useful data.

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The sensor system (camera) is approximately eight inches in diameter and 18 inches high, while the supporting electronics package is about the size of a standard typewriter. Together, the two modules weigh approximately 18 kilograms (40lbs). The total weight of the satellite placed on orbit is 68 kilograms (150 pounds).

OTD Operations

Under an agreement between NASA and the Orbital Sciences Corporation, the Optical Transient Detector was carried as a secondary payload on a Pegasus, an Orbital Sciences Corporation air-launched rocket. The Pegasus launch on April 3, 1995, delivered the OTD into an Earth orbit of approximately 710 kilometers (446 miles) altitude, with an inclination of 70 degrees. With that orbit, and OTD's wide 100-degree field of view, it will be able to survey virtually all areas of the globe where lightning normally occurs.

OTD is expected to be in operation for two years, collecting data on the occurrence and worldwide distribution of lightning. The data will be transmitted on a daily basis from OTD to a ground station in Fairmont, W.Va., then to the Global Hydrology and Climate Center in Huntsville, for analysis.

Using a unique vantage point in space, the Optical Transient Detector promises to expand scientists' capabilities for surveying lightning and thunderstorm activity on a global scale. At the same time, it will help prepare the way for the future, when more systematic monitoring of a wide range of indicators will allow scientists to better track our Earth's vital signs.