NASAfacts

Mediterranean Israel Dust Experiment (MEIDEX)

The Meidex experiment was housed in a Get Away Special canister mounted on a support structure in the cargo bay of space shuttle Columbia. Although the canister was exposed to space, Ilan Ramon could operate the cameras and sensors from inside the shuttle to capture data. Data was transmitted to Earth during the mission. Photo credit: NASA

The Mediterranean Israel Dust Experiment, or Meidex, was a research instrument by the Israel Space Agency and NASA to find out the details about mineral dust transport through the air in the Mediterranean Sea and tropical Atlantic Ocean. The phenomena of aerosol transport around the planet, especially desert dust, is thought to play a critical role in climate change in many parts of the world.

Packaged inside a canister in space shuttle Columbia's cargo bay, the Meidex hardware — an array of cameras and sensors tuned to the wavelengths to best observe dust clouds moving through Earth's atmosphere — looked down on Earth as Columbia orbited the planet. NASA and the Israel Space Agency carried out the Meidex experiment jointly during STS-107, the final mission of Columbia. Astronaut Ilan Ramon operated the research platform.

The experiment's cameras and sensors were mounted inside a Get Away Special Canister mounted on a support structure that went across the cargo bay. There were six similar-sized experiments housed in the cargo bay during STS-107 under the name Freestar, for Fast Reaction Experiments Enabling Science Technology Application and Research.

Although the Meidex was housed in the cargo bay, Ramon could operate the equipment from inside the pressurized areas of Columbia.

Columbia broke up during re-entry over the United States on Feb. 1, 2003, and the seven astronauts aboard the spacecraft perished. Commander Rick Husband, pilot William McCool, mission specialists Dave Brown, Kalpana Chawla, Michael Anderson, Laurel Clark and Ramon, a payload specialist and Israel's first astronaut, were lost.

Along with crew remains, recovery teams also found elements of some of the experiments carried aboard Columbia for the science-dedicated mission. Among the items found was the Meidex experiment, although it was badly damaged.

Much of the data collected by Meidex sensors was radioed to Earth while Columbia was still in orbit, including images of the sky taken through specialized filters. Scientists used much of that data to complete the experiment.

Researchers evaluated the Meidex instruments thoroughly following the recovery in order to capture as much data and calibration elements as they could. Afterward, the Meidex experiment was moved to the Columbia Preservation Room inside the Vehicle Assembly Building at NASA's Kennedy Space Center in Florida. All the recovered remains of Columbia have been housed in that area in memoriam to the mission and so researchers

can consult the wreckage in the future as part of specialized aerospace research. As a partner in the Meidex experiment and home nation to astronaut Ramon, Israel requested the Meidex experiment be relocated to the nation.

While Meidex orbited overhead in the space shuttle, researchers observed the same portion of the sky from the ground simultaneously in some areas to get a complete impression of the atmosphere.

The official crew photo for STS-107 on space shuttle Columbia. From left are mission specialist David Brown, commander Rick Husband, mission specialist Laurel Clark, mission specialist Kalpana Chawla, mission specialist Michael Anderson, pilot William McCool, and Israeli payload specialist Ilan Ramon. Photo credit: NASA

Meidex measured smoke and other types of aerosols during the mission. Meidex observed a dust storm that originated in the Sahara Desert and carried dust over the Mediterranean Sea. Instruments aboard manned spacecraft such as the International Space Station form an important complement to orbiting satellites and ground-based measurements.

Once a satellite is launched into orbit, scientists are limited in their ability to measure exactly how the instrument is changing or degrading over time. Instruments flying aboard the shuttle were calibrated before and after launch, so their measurements could be more accurate than those from satellites.

Using the shuttle instruments to collect observations similar to those made by a long-term satellite mission permitted scientists to monitor an aging satellite's accuracy over time.

Station-mounted instruments are relatively inexpensive because they utilize the station's power, data, and communications equipment. Astronauts also are able to aim the sensors aboard, enabling them to capture unique and unpredictable events.

Aerosol particles reflect sunlight, which tends to cool surfaces locally. Some also absorb sunlight, warming and stabilizing the ambient atmosphere while still cooling the surface below, sometimes suppressing cloud formation, and even affecting large-scale atmospheric circulation.

Particle abundance and properties affect the brightness, thickness, and possibly lifetimes of clouds and ultimately, precipitation and the terrestrial water cycle. And in significant near-surface concentrations, they are pollutants, reducing visibility and raising health risks for those exposed.

The particles having the largest direct environmental impact are sub-visible, ranging in size from about a hundredth to a few tenths the diameter of a human hair (about 0.1 to 10 microns). As such, they can affect regions thousands of kilometers from their sources: Dust from the Sahara Desert, transported across the Atlantic Ocean, supplies iron to the underlying ocean surface waters, occasionally limits visibility in Florida and the Caribbean, and possibly fertilizes the Amazon basin. Pollution and dust from East Asia sometimes reach North America, and smoke from summertime fires in Siberia, northern Canada, and Alaska darken snow surfaces in the Arctic.

Lightning Phenomena and Sprites Discoveries

Although designed to detect dust storms, Meidex also recorded lightning phenomena known as sprites during the STS-107 mission. Sprites are bursts of light that appear over large thunderstorms and reach up toward the sky at the same time lightning flashes toward the ground.

Images and data recorded during the flight were transmitted from Columbia while the shuttle was in orbit, providing scientists with usable results from the instruments despite the loss of Columbia and its seven astronauts.

The Meidex experiment captured the first two sprites ever seen from space. Since then, cameras aboard the International Space Station have captured sprites in action.

The basic understanding of sprites is that they are related to lightning, in which a neutrally charged cloud discharges some of the electricity to the ground. Normally a negative charge is carried from the cloud to the ground, but about one out of every ten times the lightning is a positive charge — and that leaves the top of the cloud negatively charged. With this one in ten chance, the electric field above the cloud is just right to produce the sprite, an electrical discharge 50 miles above the thunderstorm.

Typically the weather experienced on the ground is considered to be a separate phenomenon from the weather that goes on higher up in the atmosphere, in the area known as the mesosphere. The sprites show, however, that some fundamental science connects these two regions, opening interesting physics questions about the interchange of energy between them.

International Cooperation

When NASA was created in 1958, its founding legislation — the National Aeronautics and Space Act — directed the new agency to pursue cooperation "with other nations and groups of nations." This principle of international cooperation has been a guiding philosophy for NASA, and it never has been more important than it is today. Such collaboration will be essential to addressing the inherently global and interrelated scientific challenges that will face us in the years ahead: expanding human exploration beyond the frontiers of low-Earth orbit; broadening human knowledge by answering profound questions about the Earth and the universe we live in; solving technical issues related to air traffic management, aviation safety, and the impact of aviation on climate and the environment; and leveraging technology investments to push the boundaries of innovation.

National Aeronautics and Space Administration

John F. Kennedy Space Center
Kennedy Space Center, FL 32899

www.nasa.gov