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Marshall Space Flight Center
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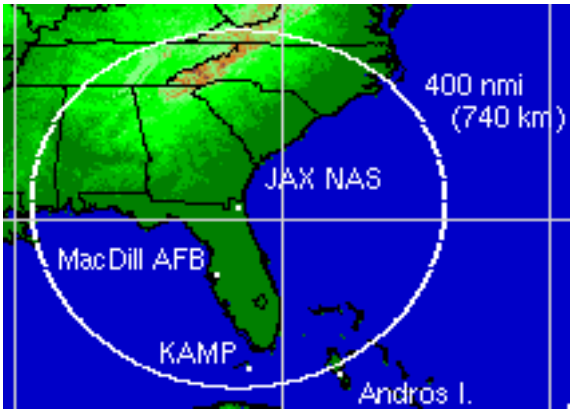
Seeking a Better Understanding of Hurricanes
NASA Marshall's Role in the CAMEX hurricane study

Three research teams from NASA's Marshall Space Flight Center in Huntsville, Ala., are playing key roles in the 2001 Convection And Moisture EXperiment (CAMEX) - the fourth in a series of field investigations to better understand hurricanes.

The Marshall's Center's Earth Science Department in the Global Hydrology and Climate Center located at the National Space Science and Technology Center in Huntsville, studies the influence of hurricanes on global weather change.



Based at the Naval Air Station in Jacksonville, Fla., CAMEX research aircraft will fly over, through and around selected hurricanes as they approach landfall in the Caribbean, Gulf of Mexico, and along the East Coast of the United States. Instruments aboard these aircraft will help scientists, including those from the Global Hydrology and Climate Center, learn more about these potentially deadly and destructive storms.

In yielding new data on hurricane structure, dynamics and motion, CAMEX will provide additional insight to researchers and forecasters who continually strive to improve hurricane predictions.

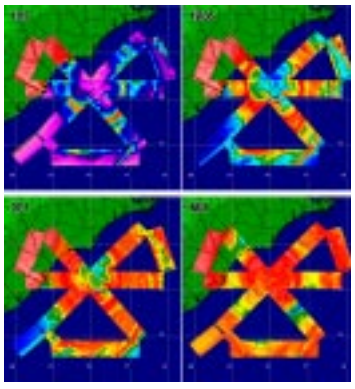
Joining researchers from four other NASA centers, 10 universities and the National Oceanic and Atmospheric Administration (NOAA), scientists from the Global Hydrology and Climate Center are focusing on several areas of hurricane study:

- measuring and predicting hurricane precipitation,
- studying hurricane-generated lightning and its storm electrification and
- implementing a mission-wide data system to help researchers share and analyze information collected through CAMEX.

Mapping of Hurricane Precipitation Before and After Landfall

When hurricanes move ashore, they bring with them high winds, tornadoes and a storm surge of ocean water along the coastline. Yet these aren't their most devastating effects. The highest number of hurricane-related deaths stem from inland flooding caused by torrential rains. Developing better tools and methods for predicting this rainfall is the primary objective of the Mapping of Tropical Cyclone Precipitation Before and After Landfall experiment.

This research uses passive microwave radiometers - instruments that detect precipitation and surface water by measuring natural microwave emissions from cloud water, cloud



A series of images depicts a section of hurricane Bonnie as seen by the Advanced Microwave Precipitation Radiometer carried by the ER-2 aircraft over Hurricane Bonnie Aug. 26, 1998 as part of the third CAMEX mission. This depicts rainfall and cloud ice distribution as seen in the microwave bands. (NASA)

ice, rainfall and surface water. To obtain the needed data from multiple altitudes, one passive microwave radiometer system will be flown aboard the NASA ER-2, a high-altitude research plane that will soar above the storm at 65,000 feet (19,800 meters), while another radiometer system will be flown 35,000 to 40,000 feet (10,700 to 12,200 meters) aboard the NASA DC-8 aircraft.

Data collected from this experiment, combined with data collected during the third CAMEX mission in 1998, will help scientists pursue multiple objectives, including:

- evaluating the latest approaches for mapping hurricane rainfall before and after landfall and
- evaluating and recommending the best rainfall estimation products, or blend of products, for use by researchers and forecasters when tropical cyclones - or hurricanes - move inland.

Advances in rainfall prediction are critically important to forecasters who must warn the public of potential flooding hazards caused by tropical cyclones that move ashore. Despite the high hopes offered by new sensors, significant work is still needed to improve techniques for estimating precipitation. This experiment seeks to move this process forward, helping forecasters and researchers evaluate new methods and technology that might lead to better predictions, and ultimately save lives.

More information on passive microwave radiometers is available at:

http://camex.msfc.nasa.gov/camex4/instrument_documentation/ampr.pdf

The Global Hydrology and Climate Center Investigators:

Principal Investigator: Robbie Hood, Marshall Earth Science Department

Co-Investigator(s):

- Frank LaFontaine, Raytheon Company,
- Anthony Guillory, Marshall Earth Science Department
- Daniel Cecil, University of Alabama in Huntsville

Total Lightning Measurements of Tropical Precipitating Systems

Lightning and electrical observations have been an integral component of CAMEX hurricane studies since the program began in the early 1990s. These measurements are critical in helping scientists study the relationships between lightning and other storm characteristics. Because lightning is often easier to measure than other parameters, this research may be a key to unlocking some of the mysteries associated with severe weather.

To gather lightning data for CAMEX-4, a Lightning Instrument Package (LIP) will be flown aboard NASA aircraft, including the ER-2, a high-altitude research plane that will soar above the storm at 65,000 feet. These measurements are critical in helping scientists study the relationships between lightning and other storm characteristics. (NASA Dryden)

To gather lightning data for this year's CAMEX mission, a Lightning Instrument Package (LIP) will be flown aboard the NASA DC-8 and ER-2 aircraft. Each instrument package consists of electric field mills, and the ER-2 package includes a conductivity probe.

Electric field mills are sophisticated instruments that measure the electric field over a wide range that extends from small fair weather levels to large thunderstorm fields. The conductivity probe measures the air conductivity, which when combined with the electric field observations, yields the flow of electric current through the atmosphere. These instruments are compact sensors, each weighing less than 10 pounds (4.5 kilograms).

Data obtained by these instruments will help scientists explore:

- what lightning can tell us about atmospheric processes associated with convection - the vertical transport of heat and moisture by updrafts and downdrafts -- and
- how lightning observations can contribute to improved forecasts.

Previous research suggests lightning is related to precipitation amounts, distribution and structure, as

well as to the release and transport of heat into the atmosphere. Yet much work remains. More information, such as that acquired during CAMEX, is needed to quantify lightning relationships, particularly those associated with hurricanes and tropical oceanic convection.

Technical specifications on the Lightning Instrument Package can be found at:

http://camex.msfc.nasa.gov/camex4/instrument_documentation/lip.pdf

The Global Hydrology and Climate Center Investigators:

Principal Investigator: Richard Blakeslee, Marshall Earth Science Department

Co-Investigators:

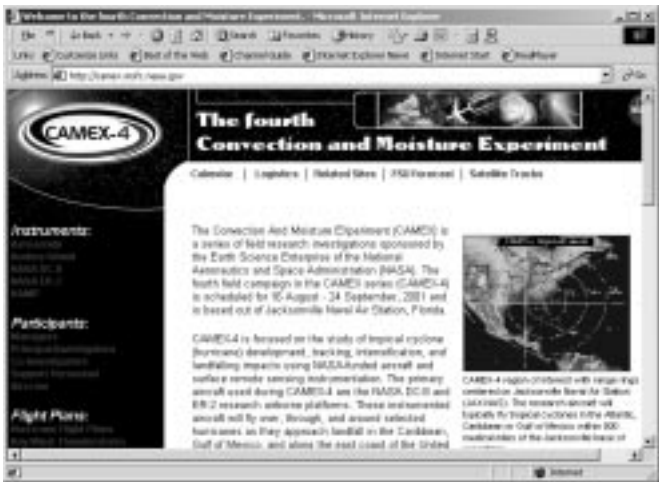
- Monte Bateman, University Space Research Association
- Douglas Mach, the University of Alabama in Huntsville

The CAMEX-4 Data and Information System

CAMEX field experiments will generate a tremendous and varied amount of data over the six-week experiment lifetime. Designed and developed at the Global Hydrology and Climate Center, the CAMEX-4 Data and Information System will support field experiment operations while they're being conducted, as well as fulfill data-analyses and information requests long after experiments are completed.

The sophisticated CAMEX-4 data system builds on the existing CAMEX-3 system, hosted at the Global Hydrology and Climate Center. Expanding on Web-based applications first used in CAMEX-3, the CAMEX-4 system:

- supports planning and information exchange among researchers in the pre-experiment stage,
- provides information about the instruments, investigators, aircraft flight scenarios, weather forecasts for flight planning and field logistics,
- provides an avenue for posting timely "quick-look" post-flight data and instrument reports during the field experiment stage to support in-field decision-making,
- archives and distributes investigator-approved CAMEX-4 data for use by the scientific community and the general public after the field research is completed.



The CAMEX-4 data and information system can be accessed on the Web at: http://camex.msfc.nasa.gov/

The Investigators:

Principal Investigator: Michael Goodman of NASA Marshall is working at the Global Hydrology and Climate Center, based at the National Space Science and Technology Center.

Co-Investigators:

- Sara Graves, University of Alabama in Huntsville
- Danny Hardin, University of Alabama in Huntsville
- Dan Hollands, University of Alabama in Huntsville
- Phil Parker, University of Alabama in Huntsville
- Marilyn Drewry, University of Alabama in Huntsville

About the Global Hydrology and Climate Center at the NSSTC

The Global Hydrology and Climate Center conducts research and education in the global hydrology and climate science disciplines. Its primary objective is to understand the Earth's global water cycle, the distribution and variability of atmospheric water, and the impact of human activity as it relates to global and regional climate.

The Global Hydrology and Climate Center is one of seven science research centers at the National Space Science and Technology Center (NSSTC). The NSSTC is a partnership with the Marshall Center, Alabama universities, industry and federal agencies. It enables scientists, engineers and educators to share research and facilities, focusing on space science, materials science, biotechnology, Earth sciences, propulsion, information technology and optics.