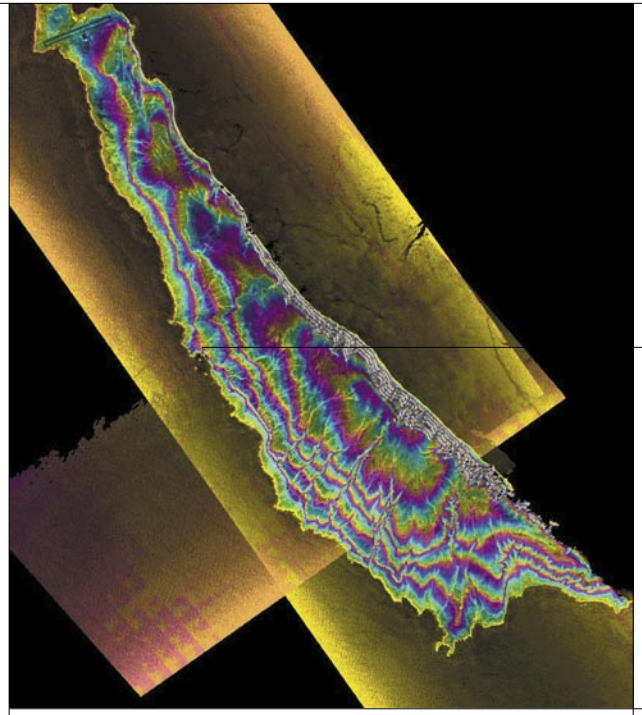
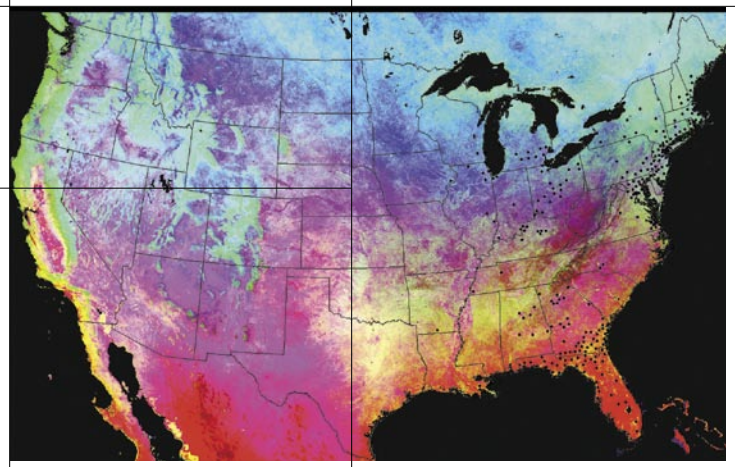
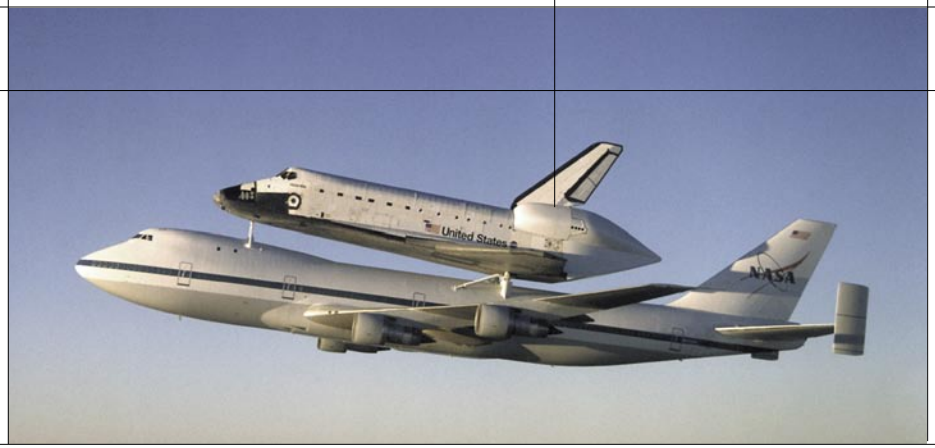




PARTNERSHIP SUCCESSES



As NASA plots new courses to fulfill its bold, new mission to explore the Moon, Mars, and beyond, the Agency continues to hold steadfast in its commitment to explore and improve our very own home planet. In doing so, NASA fervidly goes to great lengths to draw correlations between the "know-how" of its many scientists, engineers, and other technology facilitators, and the "know-how" of Federal agency counterparts, academic institutions, and private organizations. By sharing knowledge and resources, these entities come together to find the common ground necessary to preserve the past, present, and future of Earth—in the best interests of all of its inhabitants.

The success that results from these partnerships is not always measured in the form of tangible spinoff products. Often, the outcomes yield benefits that are not physical in nature, and therefore cannot be seen or touched. Instead, these unique benefits are experienced, in a way that impacts all that exists on Earth. The following examples are just a few of the ways we experience NASA's impact as it reaches out to improve the quality of life on Earth.

COMMERCIAL AVIATION SAFETY

An aircraft normally used to transport the Space Shuttle has been pressed into service to test technology that could make airliners safer.

Researchers from Glenn Research Center arranged for a fuel-inerting system to be installed aboard a NASA Boeing 747. The system, designed to reduce the chance of an explosion inside an airplane tank, made its first flight tests in June as part of ongoing research being conducted by the Federal Aviation Administration (FAA) in partnership with NASA.

NASA's Boeing 747 Shuttle Carrier Aircraft, seen here delivering Space Shuttle Atlantis to Kennedy Space Center, was used to study a fuel-inerting system that is designed to reduce the chance of explosion inside an airplane tank.

The FAA had already tested the system using ground-based facilities, but the next critical step in the technology development was the program of actual flight tests aboard a large aircraft, such as NASA's 747. Glenn's Dr. Clarence Chang proposed that the FAA use the B747-100 Shuttle Carrier Aircraft.

The 747 flight tests, completed in 2 weeks at Johnson Space Center, produced data the FAA will use to help implement its recently announced policy to reduce fuel tank flammability. The FAA and NASA have been working on technology to prevent fuel tank fires since July 1996, when TWA Flight 800, a Boeing 747-131, suffered a catastrophic fuel tank explosion and crashed. To design a system that can be more readily installed on airliners, the FAA developed a relatively simple and unique technology-test system made up of inerting technology already available. NASA is conducting research that is closely coupled with the FAA's efforts. Engineers at Glenn are studying next-generation advanced gas-separation technologies that can make inert gas generation cheaper and fuels harder to ignite in the tank. This work, and research into advanced fire-detection gas sensors, is part of NASA's Aviation Safety and Security program.

ARCHAEOLOGY

Federal legislation mandates that all archaeological sites on Federal lands be located and evaluated by Federal managers, particularly if the sites could be damaged by construction or military maneuvers. Legislation also specifically protects Native American burial sites on Federal lands. However, less than 10 percent of the more than 700 million acres under Federal control have been surveyed, according to a recent National Park Service report.

In a conventional survey, archaeologists usually cover an area on foot. Sometimes they have to dig holes to see beneath the surface. It is a slow and expensive procedure. Last year, the U.S. Department of Defense's Strategic Environmental Research and Development program

turned to researchers Dr. Ronald Blom, a Jet Propulsion Laboratory (JPL) geologist, and Dr. Douglas Comer, an archaeologist, to see if a JPL instrument with an advanced type of radar could help speed up the process and make it more economical.

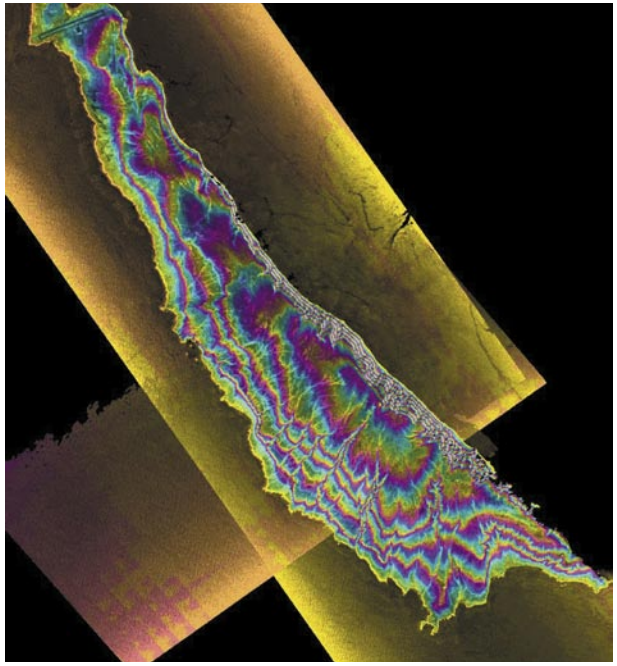
To test the idea, Blom, Comer, and their colleagues recently set out for San Clemente Island. Controlled by the U.S. Navy, San Clemente is the southernmost of the eight California Channel Islands, about 25 miles long and 31 miles offshore, northwest of San Diego. There are no ancient cities, temples, or monuments, but evidence remains of the Native Americans who camped and fished there for hundreds and thousands of years before the Spanish arrived in the 18th century.

Researchers began surveying the island the old-fashioned way, by closely analyzing some of the sites on foot. They then collected radar data from above the island with the unique JPL instrument known as Airsar, short for airborne synthetic aperture radar. Airsar is not new to archaeology, however. In the 1990s, it revealed a previously unknown section of the ancient city of Angkor in Cambodia.

"Radar is particularly good at describing the physical environment and sensing changes, especially man-made changes," notes Blom. The idea in the San Clemente project was to collect Airsar data over a large area, process the data to bring out indications of past human presence, and then combine the results with other information, such as detailed topographical measurements, to target the most likely spots to search for archaeological sites.

So far, the results have been promising. "Yes, we can find archaeological sites," says Blom. "They show up as bright radar spots. Now we need to refine the system and find ways to screen out false positives."

The researchers are incorporating the radar results into a geographic information system, where they can be combined with detailed topographical measurements and information on soils, proximity of fresh water, drainage, and vegetation. "We're looking for patterns that link the archaeological sites with the island's geography," says Blom. "We know, for example, that most sites will be within 200 meters or so of a source of fresh water. So far, radar has not only shown us where many sites are, it has also told us so much about the environment that we know where the sites should be."



Radar reveals details of San Clemente Island's environment, history, and topography.

The final result, they hope, will be a model that can predict which bright spot on the radar image will indeed be a potential archaeological site—or in other words, they hope the radar will allow them to look at the haystack and predict where the needle will be.

"Of course, our ultimate goal," adds Blom, "is to identify and protect our cultural heritage so that we can both learn from those who came before and honor them."

WEATHER FORECASTING

NASA is providing new technology and satellite data to help forecasters at the National Oceanic and Atmospheric Administration (NOAA) create the best possible forecasts of severe weather situations.

NASA data gathered from satellites, a lightning ground-tracking network, and unmanned vehicles that fly into storms are some of the many tools used by NOAA, the Federal agency charged with issuing weather forecasts. These tools will help make the severe weather season safer for everyone. "It's an evolutionary process and partnership between NOAA and NASA," claims Bill Patzert, a JPL oceanographer. "NOAA is the ultimate operational meteorological agency in the world, and NASA is developing state-of-the-art operational and fundamental research to make it better than ever. Together we're looking to the future to provide better and better service to the American public."

NOAA's National Weather Service is responsible for monitoring and forecasting severe weather events. The service issues watches and warnings for tornadoes, flash floods, severe thunderstorms, and non-precipitation events (such as high-wind warnings), as well as daily weather forecasts. It reaches the public with these watches and warnings mainly through NOAA weather radio and the Internet.

At NASA, scientists pull data from Earth-observing satellites and models to characterize and understand the way atmosphere, oceans, and land interact. "Adding NASA satellite data and model output to NOAA forecasts could lead to more confident 7-day severe local storm forecasts, better prediction of thunderstorm occurrence by 3 hours, and an increase in tornado warning lead times by 18 minutes," says Dr. Marshall Shepherd, research meteorologist at Goddard Space Flight Center. NASA satellite data that enhances NOAA's weather model forecasts include surface wind data from QuikScat and rainfall data from the Tropical Rainfall Measuring Mission satellite. NASA's new Aura satellite will additionally provide

A lightning ground-tracking network from NASA is one of the many tools the National Oceanic and Atmospheric Administration is using to create the best possible forecasts of severe weather situations.

temperature and moisture information to give a clearer atmospheric picture, and improve forecast model prediction capabilities.

HEALTH AND MEDICINE

Using an infrared video camera developed by NASA scientists at JPL, surgeons are testing thermal imaging and image processing to see if they can create useful maps of brain tumors. The camera, which detects infrared, or heat, emissions, might help neurosurgeons better visualize tumors before they operate and find tiny clusters of cancerous cells that might remain after surgery. Physicians have used infrared technology for mapping the roots of skin cancer, but it has never been used for brain tumors until now.

Doctors at the Keck School of Medicine of the University of Southern California in Los Angeles are using the JPL-developed camera and infrared imaging in a clinical trial. Since tumor cells emit more heat than healthy ones, the doctors are trying to learn if they can sketch tumor margins by detecting temperature changes during surgery. Currently, neurosurgeons delve carefully into the brain and remove as much of the tumor as they can see under magnification. However, they may take healthy tissue along with the cancerous cells or leave residual cells that can grow back along the tumor's margins.

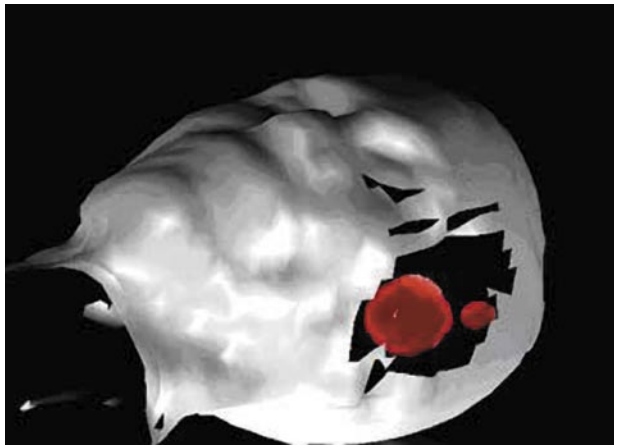
"Brain tumor tissue looks the same as healthy tissue on the edges," explains Babak Kateb of the Keck School of Medicine, a research fellow and lead scientist of the project. "Tumor cells use different biochemical pathways from normal cells, and when researchers use the infrared camera, they can pick up hotspots or areas of tissue warmer than normal tissue," he adds.

After doctors receive infrared images of the brain, imaging-processing software marks the boundaries between tumor regions and surrounding healthy tissue. "An advantage of thermal imaging is that it's noninvasive," says Dr. Peter Gruen, a neurological surgeon at the Keck School of Medicine. "It measures heat energy emerging from patients without exposing them to X-rays or intravenous solutions, and is performed without incisions or contact to the brain tissue."

The continued study of infrared technology is also bringing value back to NASA, as JPL refines software similar to what the medical group is using for analyzing rocks on Mars and other planets.

EARTH SCIENCE

Last year, more than a million people died of malaria, mostly in sub-Saharan Africa. Outbreaks of Dengue Fever, West Nile Virus, Rift Valley Fever, and even Plague still



This three-dimensional, computer-generated image shows two red spots that represent brain tumors.

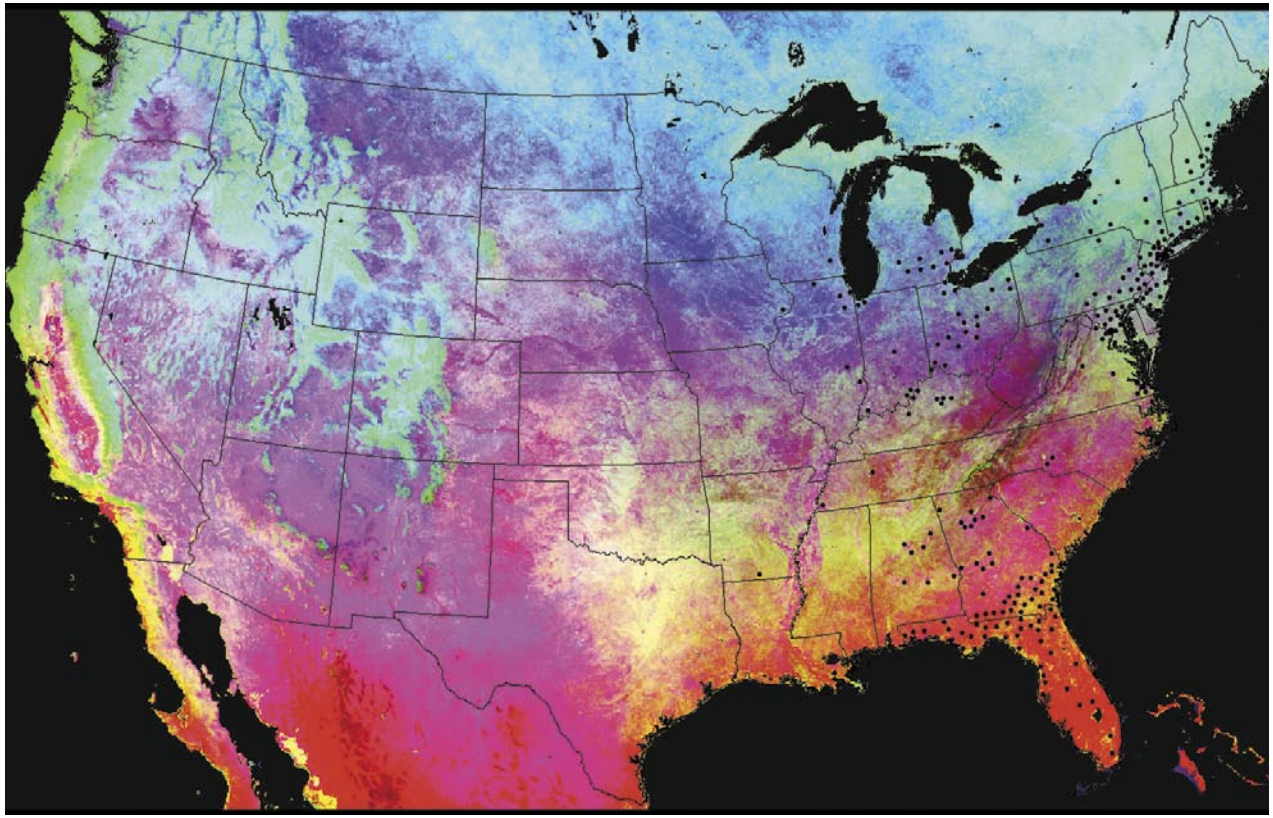
strike villages, towns, and whole regions. When outbreaks occur, they usually are tied to environmental conditions such as temperatures and rainfall that attract disease-carrying pests like mosquitoes and ticks.

Ronald Welch of NASA's Global Hydrology and Climate Center in Huntsville, Alabama, is working to develop an early warning system for disease outbreaks that combines data from environmental satellites with field work. Scientists seek out and visit places with disease outbreaks, then scrutinize satellite images to learn how disease-friendly conditions look from space. The satellites can then watch for those conditions over an entire region, country, or continent.

Field data such as soil type, lingering water puddles, humidity levels, pest behavior, and locations of human and animal dwellings are plugged into a computerized mapping system known as a geographical information systems database. Then, region-wide variables such as rainfall, temperature, vegetation types, and soil moisture are derived from medium-resolution satellite data, such as from the Landsat 7 or NASA Terra satellites. All of the information is fed into a computer simulation that runs on top of a digital map of the landscape. Mathematical algorithms produce an estimate of outbreak risk.

Welch expects the system will be able to give warnings of high disease risk for a given area up to a month in advance. Once they receive the warning, health officials will be able to focus their vaccination programs, mosquito spraying, and other disease-fighting efforts in the areas that need them the most. With proper preparation, it may be possible to prevent an imminent outbreak altogether.

With the same determination to make known what is currently unknown about our surrounding universe, NASA continues to uncover the secrets of the Earth with each new partnership it forms. In "doing business" with NASA, the partnering organizations are doing their part in making the world a better place to live.



NASA is working to develop an early warning system for disease outbreaks that combines data from environmental satellites with field work. This composite of land surface temperatures recorded between 1997 and 2000 was used to help monitor and predict the spread of West Nile Virus in the United States.