



# Getting to know the inner solar system

—by Ilse Genovese

**T**here are places to go, things to see. We have the shuttle to take us there, or we can send satellites and space robots to be our eyes and ears. Our explorers' curiosity has taken us beyond low-Earth orbit into and beyond the solar system we are part of.

There are so many enigmas... was there ever life in Titan's valleys, lakes and rivers? Saturn's great moon is too cold for life as we know it, but the carbon-based molecules found by our scouts suggest a universe ready for life afflorescence. And what about the icebergs shifting above a deep subsurface ocean on Jupiter's moon Europa, or the part smooth, part ragged face of Saturn's Enceladus with its ice geysers conjuring images of a very cold Yellowstone.

Then of course there is Mars. Chilly, rusty, nearly airless, and blasted by radiation, the planet has just about as much land surface as Earth, water ice on the surface, and some mysterious liquid stuff underground. The Martian day lasts about 24 hours, but that's not

the only similarity with Earth: "on the warmest days, the air temperature on Mars is about the same as at a Green Bay Packers playoff game at Lambeau Field" (Achenbach 2008).

Our own Moon, unexciting though it may be to the space cognoscenti, apparently could yield raw materials necessary to fuel future fleets of spacecraft. With a powerful telescope stationed on the far side of the Moon that's protected from electromagnetic noise and our wireless chatter, it could also serve as an outpost for scanning deep into the universe.

This scientific wonderland, and the opportunities the outer space presents, would be unattainable were it not for NASA's large and growing fleet of manned and unmanned spacecraft—the shuttle, the orbiting observatories, satellites, and the robotic "surveyors" crawling the stellar surfaces and winging their way into the interstellar void.

Images: [www.nasa.gov](http://www.nasa.gov); <http://history.nasa.gov>



**The first LLRV in flight, 1967. Precursor of Apollo lunar landers.**

Blasting off into space to find water on, say, Europa when some on terra firma don't even have access to clean drinking water may seem frivolous. Except that becoming a space-faring civilization—which we have focused on since October 1, 1958, when the National Aeronautics and Space Administration was established by President Eisenhower—is not a frivolous undertaking. It's forward thinking, it's pushing the bar of knowledge and future options—it's being a superpower.

President John F. Kennedy understood that for America to thrive on Earth, it needed to race into space. And he hurled the Nation into a race the likes we had not seen before. His 1961 challenge to put a man on the Moon and return him safely to Earth by decade's end electrified the country. At NASA, it floored the engineers—after all, an orbital flight is not the same thing as an excursion to the Moon's surface—but they did deliver.

But first, they needed something to simulate, here on Earth, the descent to and landing on the Moon. "Among the challenges," remembers Christian Gelzer, NASA Dryden Flight Research Center's chief historian, "was simulating the Moon's gravity, which is only a sixth of Earth's. How, in the early 1960s, are you going to do this with a wingless aircraft? How will you negate five-sixths of the Earth's gravitational pull in flight? How will you compensate for the fuel you burn off while in flight? (Keep in mind the state of computing in 1962, and especially, of portable computers.) And how are you going to reproduce the Moon's lack of atmosphere right here on Earth? Flying in a vacuum is quite different from flying in an atmosphere, as the astronauts later attested."

Working with Bell Aircraft Corp. in Niagara Falls, N.Y., NASA engineers developed the "Flying Bedstead," a "fly-by-wire" aircraft — one of the very first — controlled by three analog computers."

Bell delivered the first LLRV (Lunar Landing Research Vehicle dubbed the "Flying Bedstead") to NASA in the spring of 1964. Ground tests began once it was uncrated and assembled, and in October of that year, Joe Walker, the center's chief pilot, took the LLRV up for its first flight. Flight tests convinced NASA that this was a viable training tool.

"Although the Apollo astronauts used other Lunar Lander simulators," Gelzer noted, "to a man they all said later that the LLTV was the most realistic trainer. Neil Armstrong went so far as to say on his return that the LLTV was so good at simulating the lunar landing that he



**Saturn v rocket engines that took NASA to the Moon.**

[Source: [www.bibleandscience.com](http://www.bibleandscience.com)]

was entirely comfortable with what he was doing when he made his actual descent to the moon that memorable day in July 1969.

The second LLRV still resides at the Flight Research Center, now known as the NASA Dryden Flight Research Center. It underwent a partial restoration in the late 1990s for use in filming of the television mini-series "From the Earth to the Moon" about the Apollo program, and it is now an historical highlight during tours of NASA Dryden.

Today, NASA faces a more complicated political, budgetary, and technological landscape, and its ambitions are not limited to human flight. Bigger space telescopes are coming, the search for extraterrestrial life and distant solar systems is in full swing, and robotic space probes regularly produce dramatic findings.

NASA is in the process of finishing the international space station, retiring the space shuttle and building a new architecture for putting humans in space, with the Constellation program. The agency is following a road map called the "Vision For Space Exploration," adopted



**The International Space Station.**

[Source: [www.shuttlepresskit.com](http://www.shuttlepresskit.com)]



Some of the most amazing discoveries about our universe have been made with the help of the Hubble space telescope. Cancelled after the Columbia disaster, the rescue of the ageing telescope is still a toss-up. [Source: [www.kieranoshea.com](http://www.kieranoshea.com)]

in 2005 with President Bush's imprimatur. That plan calls for a return of astronauts to the moon and the establishment of a permanent base there as a staging ground for missions that might someday include putting humans on Mars.

We have great reason to support this ambitious vision. Past government initiatives that included NASA spawned an era of technological innovation unequalled in history. Investment in NASA, the Advanced

Research Projects Agency (ARPA), and the NASA Innovative Partnerships Program—which has been a central link between the agency and the commercial sector—led to inventions that benefited all of us. NASA's *Spinoff*, an annual publication featuring successfully commercialized NASA technology, lists a number of technologies that have become "need-to-use" in the field of geospatial data collection, analysis, and application. Long-distance telecommunications is on the list, as is satellite radio, GPS receivers, radio telescopes, laser scanners, personal navigation devices, and much more.

Yet, despite the enormous gain from space research, the new visionary program for space exploration is not going anywhere fast. As a matter of fact, some people have voiced scepticism: Why do it at all? "Partly it's prestige," says Michael Griffin, NASA's Administrator. "It's definitely a strategic move. History tends to be written by countries that explore."

Griffin emphasizes that we won't know in advance how space will be useful, or whether it will be useful at all. What we have seen so far looks pretty empty—like the desert in the American West. Yet, had the U.S. Senate listened to Daniel Webster decrying wasteful spending on Western lands, America would not have been the country it is today.

When NASA began its space research half a century ago, the question was, Can we put a human being into orbit? We have mastered the principles of spaceflight; the next stage is to find whether the solar system is a place to live, a place to work.

"Fundamentally, it's about long-term human survival," said Griffin. "If we believe that human life is worth preserving, then we have to face the fact that the history of life on Earth is the history of extinction events. Diversification of our portfolio is a good thing in the long run."

#### Literature

In Search of the Next Frontier: After Half a Century of Exploration, There Is Still Much Left to Discover, by Joel Achenbach, *The Washington Post*, September 25, 2008.

NASA at 50: NASA Flight Research Center's LLRV Work led to Development of the Apollo Lunar Lunar Landers, by Christian Gelzer, NASA Dryden Flight Research Center's chief historian. [<http://www.nasa.gov>]

## Spinoff

### Extending Earth observation benefits to Africa

—by Steve Cole and Jennifer Morcone

NASA, the U.S. Agency for International Development (USAID), and their international partners launched a web-based information system in Nairobi, Kenya, on November 21<sup>st</sup>. SERVIR-Africa, which integrates the satellite resources of the United States and other countries, will make previously inaccessible information accessible to local scientists, government leaders, and communities concerned with addressing natural disasters, disease outbreaks, biodiversity, and climate change.

SERVIR—Spanish for "to serve"—has been in operation in Central America, the Caribbean, and in southern Mexico since 2005. Now, through the support of multiple government agencies and other organizations, NASA and USAID are expanding the system to Africa in partnership with the Regional Center for Mapping of Resources for Development in Nairobi. The center, an intergovernmental organization with 15 member states in eastern and southern Africa, is a leader in geospatial mapping in the region.

"A satellite birds-eye view can provide an overall picture of a natural disaster, such as a flood, and its consequences," said Tesfaye Korme, director of remote sensing and geographic information systems at the center. "Using the





**SERVIR-AFRICA**  
Visualization and Monitoring System

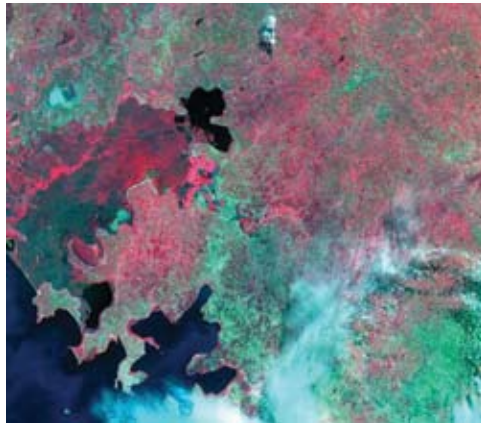
Enabling the use of observations and predictive models for timely decision making to benefit society

Models   Online Mapping   Visualization  
Support   Training   Partnerships

servir@rcmrd.org

SERVIR-Africa platform, we will be able to develop near-real time maps of flood-affected areas to estimate the number of displaced people and locate potential transportation disruptions.”

SERVIR-Africa will use Earth science satellite data from many of NASA’s missions and other information to better predict areas at risk for severe flooding



The Nzoia River basin lies entirely within the Lake Victoria basin in Kenya. The SERVIR-Africa team captured multispectral imagery of the Nzoia River basin from the NASA’s EO-1 satellite on August 23, 2008 to provide baseline imagery of this frequently flooded area for future analysis. [Credit: NASA/EO-1]

and map regions hit by floods. It also will develop an early-warning tool to predict the distribution of vector-borne diseases such as Rift Valley Fever. By mapping the location of climate change projections, the system will allow people to see impacts on such things as Africa’s diverse ecosystems.

The system will use the Internet to acquire and distribute satellite and ground-based Earth observations, map data, and geospatial analyses that target issues such as urbanization, biodiversity threats, and management of natural resources. It will also benefit “from valuable NASA Earth science satellite and model analyses,” said Dan Irwin, SERVIR project director at NASA’s Marshall Space Flight Center in Huntsville, Ala. “Science and technology are key, but ultimately it is the combination of local knowledge along with space-based observations that makes real-time monitoring of Africa’s environment effective.”

The strength of the SERVIR system is in its diverse international team of scientists, developers, and researchers. SERVIR-Africa builds on existing capacity at the mapping center in Nairobi. The center is collaborating with SERVIR’s

lead partner in Central America, the Water Center for the Humid Tropics of Latin America and the Caribbean, in developing an integrated system. The two regional organizations are standardizing database management and evaluating common methods for predicting severe weather events, analyzing impacts from climate change and working to understand health and ecosystem interactions.

SERVIR also has been building relationships with industry. “Public-private partnerships are critical to the success of the SERVIR system,” said Jacqueline E. Schafer of USAID. “Bringing together the expertise and resources of geospatial information systems software and cell phone companies, university researchers, conservation organizations, and governments, SERVIR puts science and technology into the hands of local decision-makers.”

The SERVIR system was developed with USAID by researchers at a global coordination office and rapid prototyping facility at Marshall. Three other NASA centers—NASA’s Goddard Space Flight Center in Greenbelt, Md., NASA’s Ames Research Center at Moffett Field, Calif., and NASA’s Jet Propulsion Laboratory in Pasadena, Calif.—partnered with Marshall on the system. Also participating in the implementation of SERVIR-Africa is the Institute for the Application of Geospatial Technology in Auburn, N.Y.

For information about SERVIR, visit: <http://www.nasa.gov/servir>, or contact Steve Cole <[stephen.e.cole@nasa.gov](mailto:stephen.e.cole@nasa.gov)> or Jennifer Morcone at <[jennifer.j.morcone@nasa.gov](mailto:jennifer.j.morcone@nasa.gov)>.

## Full motion video assets

—by Walter Pincus

“ISR” has become the new silver bullet in counterinsurgency. It stands for intelligence, surveillance and reconnaissance, but it really means a series of new sensors and other electronic collection and analytic gadgets. It also includes the manned and unmanned airborne platforms from which they primarily operate.

“Employment of ISR can be credited for the initial success of the surge in Iraq,” stated the commander of Multi-National Forces-Iraq, Lt. Gen. Raymond T. Odierno. “Threats come not just from insurgents but also from “militias who at any time might be working with or against each other, but most are consistently working against coalition forces.”

New success in meeting these challenges is attributed to the recent increase of IRS “full motion video assets” which keep, in military speak, the “unblinking eye” on targets.

# Spinoff



Civilian applications of IRS technology include nonproliferation, detection of nuclear explosions, lightning science, climatology, broad-area mapping of land use, and environmental monitoring. The MTI sensor shown here enables accurate quantitative analysis of thermal processes on the Earth's surface.

Four years ago, there was no such video capability and limited top secret communications channels. Couriers were often used to synchronize intelligence databases at unit command posts.

Now, brigade combat team commanders have a platoon with unmanned aerial vehicles that can provide 18 hours of full motion video coverage and signal intelligence teams that can collect and analyze intelligence, as well as tap into classified national data resources.

The result? "On any given day," wrote Odierno and colleagues in a recent issue of *Joint Force Quarterly*, a brigade combat team commander "might be simultaneously focused on targeting a cell leader in an IED [improvised explosive device] network, providing security for a very important person's convoy, monitoring a potentially violent demonstration, or responding to troops in contact—to name only a few potential operations." That commander needs to have not only his own ISR assets but also the ability to call in, for instance, the higher-command Predators.

To demonstrate how IRS works, consider a combat operation mounted to destroy an insurgent mortar team. The

location of the mortar firing point was determined by a counter-fire radar which sent the data to an unmanned aerial vehicle. The UAV maintained contact through full motion video with the mortar site while information was sent to alert close support aircraft.

The brigade tactical operations center brought in another UAV which "provided clear evidence of mortar tubes being transferred to a second truck." The close air support plane destroyed the mortar team, and a UAV immediately verified its destruction. Success was attributed, they wrote, to the brigade commander being able "to orchestrate FMV [full motion video] assets based on rapid feedback from intelligence analysts supporting the commander and tipping and cueing from multidiscipline intelligence sensors."

*A new report entitled "The Global Airborne ISR Market 2008-2018" can be accessed at <http://www.asdreports.com>. Walter Pincus can be contacted at [fineprint@washpost.com](mailto:fineprint@washpost.com).*

## Mapping borders

—by Leslie Coppola

The Fairfax, VA-based 3001, Inc., working with a team of aerial data collection companies, was tapped by the National Geospatial-Intelligence Agency (NGA) to collect aerial imagery over the U.S.–Canada and Mexico borders. The mapping is being undertaken in support of the Department of Homeland Security (DHS) office of Customs and Border Protection (CPB).

For digital aerial data collection over the vast project area, the 3001 team will use a combined fleet of fifteen airborne sensors, including the Leica Airborne Digital Sensor and the Zeiss/Intergraph Digital Mapping Camera (DMC).

"Not only is this the largest aerial data collection team in the history of the geospatial industry, many of these firms are our long-time partners and leaders in their particular field," said Bart Bailey, 3001 CEO.

3001 will supplement its large fleet of aircraft, sensors, and processing capacity with support from BAE Systems, Bohannon-Huston Inc., Continental Mapping Consultants (CMC), Fugro-Earthdata, MJ Harden, A GeoEye Company, Intergraph Services Corporation (ISC), Photo Science, and Woolpert, Inc.

3001 has experience bringing strong teams of geospatial firms together for large state and federal contracts. In addition to this new contract, 3001 is also one of six prime contractors providing geospatial services for the NGA's Global Geospatial Intelligence (GGI) program.



## nüvi 500 for rugged navigation

—by Garmin

Garmin, the global leader in satellite navigation, today announced its first multi-use nüvi portable navigation device (PND) dedicated to walking, cycling, scootering, driving and boating in one rugged easy-to-use unit. The nüvi 500 series comes equipped with the latest technology from Garmin together with NavTeq sophisticated mapping data and the ability to accept different types of mapping such as TOPO for outdoor navigation and Blue Chart cartography for marine usage.