GPS technology may enhance atmosphere monitoring

By Alan Bais

A new, cost-effective technology based on the venerable global positioning system (GPS) may soon revolutionize the way Earth’s atmosphere is monitored.

Scientists at JPL are excited by early analysis of data from their prototype instruments aboard two international scientific spacecraft in low Earth orbit. BlackJack GPS receivers aboard the German Challenging Mini-satellite Payload, or "Champ," and the Argentine Satelite de Aplicaciones Geofisicas-C (Scientific Applications Satellite), fitted with special antennas that focus on Earth’s horizon, are tracking the radio signals broadcast by each of the 28 high-orbiting global positioning system satellites as they rise and set on Earth’s horizon. The process is called GPS limb sounding (also known as GPS occultation).

By measuring—within a few milliseconds of a second—the subtle changes in the time it takes for the GPS signals to arrive at the spacecraft as they travel through Earth’s atmosphere, scientists can derive a surprising amount of data. These data include extremely precise profiles of atmospheric density, pressure, temperature and moisture content. Additional analysis can yield global pressure contour maps, critical climate variables and even the stratospheric wind fields that affect airline routes.

Preliminary evaluations indicate this technology will be applicable to fields as diverse as weather prediction and climate research. Sun-Earth interaction research, solid Earth dynamics and oceanography. It may also be used to create the first 3-D images of Earth’s ionosphere, a turbulent and mysterious shroud of charged particles that, when stimulated by solar flares, can disrupt communications around the world.

GPS occultation is a novel, cost-effective technology that augments current methods of Earth remote sensing from space," said Dr. Thomas Yunck, manager of JPL’s GPS Observatories Office. “It offers accuracies and resolutions that rival those of instruments aboard weather balloons, while filling in large global coverage gaps. Such precise measurements of the lower atmosphere have never before been accomplished from space. Our prototype instruments are serving as vital developmental test beds for GPS remote sensing. NASA looks forward to a blossoming of this remote sensing research as we continue to refine our knowledge of this new data source.”

”Tens of thousands of occultation soundings have already been made. Dozens of scientists worldwide are investigating how to best apply the data to Earth research.

GPS limb sounding offers numerous attractions. It can probe Earth’s atmosphere from the top of the stratosphere (50 kilometers, or 31 miles up) directly to the Earth’s surface. It can operate in all weather conditions. It can calibrate itself, resulting in stable measurements that can be compared between all occultation sensors over time. Its fully independent measurement of pressure and height permits atmospheric wind fields to be derived without external calibration or reference. In addition, it has numerous applications outside of atmospheric science.

The technology’s biggest advantage may well be its low cost. GPS receivers, comparable in size and complexity to a notebook computer, can be built for a fraction of the cost of traditional spaceborne sensors and placed unobtrusively on many low-orbiting spacecraft. Since most Earth satellites already carry such devices for timing and navigation, upgrading those instruments for science purposes might possibly ignite a revolution in Earth remote sensing.

Yunck says the potential from even a small array of such instruments is impressive. A single GPS receiver in low orbit could acquire more than 500 soundings a day, spread uniformly across the globe— comparable to the number of weather balloons launched worldwide every 12 hours. When combined with Russia’s 24-satellite GPS-like Global Navigation Satellite System and Europe’s planned 32-satellite GPS-like Galileo system, a single GPS sensor could conceivably collect more than 2,000 soundings a day.

GPS limb sounding data from the Argentine Scientific Applications Satellite and Champ are available through JPL’s GPS Environmental and Earth Science Information System at http://genesis.jpl.nasa.gov. The database is one of a new generation of data systems created under NASA’s Earth Science Information Partners program, which seeks to create government-industry partnerships to advance Earth science. Additional information on this program is available at http://www.esipfed.org.

JPLer resolves orbits for newly found Jupiter moons

By Guy Webster

The discovery of 11 small moons orbiting Jupiter leapfrogs the number of that planet’s moons to 39, more than the record of the previous champ, Saturn.

A team led by astronomers from the University of Hawaii made the discovery based on images taken in December 2001 and later follow-up observations. Orbits were determined by collaborators at JPL and the Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.

Researchers estimate the new-found natural satellites are each about two to four kilometers (one to two miles) in diameter, and were probably passing backs captured by Jupiter’s gravity long ago.

The discovery-team leaders, Scott Sheppard and Dr. David Jewitt of the University of Hawaii, also discovered 11 other small satellites of Jupiter in 2000.

The new moons were discovered by Sheppard, Jewitt and Jan Kruysa of Cambridge University, England. They used the Canada-France-Hawaii 3.6-meter [142-inch] telescope with one of the largest digital imaging cameras in the world to obtain sensitive images of a wide area around Jupiter.

The digital images were processed and searched using computers. Candidate satellites were monitored in the succeeding months at the University of Hawaii’s 2.2-meter [88-inch] telescope to confirm their orbits and to reject asteroids masquerading as satellites.

JPL’s Dr. Robert Jacobson and Harvard-Smithsonian’s Dr. Brian Marsden determined the satellites’ irregular—highly elongated and tilted—orbits. All 11 objects orbit in the direction opposite to the rotation of the planet.

The orbits of the irregular satellites strongly suggest an origin by capture. Since no efficient contemporary capture mechanisms are known, it is likely that the irregular satellites were acquired when Jupiter was young, possibly still in the process of condensing down to its equilibrium size. As yet, nothing is known about their surface properties, compositions or densities, but they are presumed to be rocky objects like the asteroids.

The new discoveries bring the known total of Jovian satellites to 39, of which 31 are irregulars. The eight regular satellites include four large moons discovered by astronomers Galileo Galilei and four smaller moons on circular orbits closer to Jupiter. Jupiter’s nearest rival for having the largest number of known satellites is Saturn, with 30, of which 13 are irregular.

The satellites were formally announced by the International Astronomical Union on Circular No. 7890 (May 16, 2002). More information about them is available online from the University of Hawaii at http://wwwifa.hawaii.edu/~sheppard/satellites/jup.html. Other information about the Jupiter system is available from JPL at http://www.jpl.nasa.gov/solar_system/plantary/jupiter_index.html.

Free lunch for staff on June 6

All personnel contribute to the overall success of the Laboratory. In celebration of a job well done, a free lunch will be served to all JPL badge holders on the mall or on the Café 303 patio on Thursday, June 6, from 11:30 a.m. to 1 p.m.

Enjoy your choice of chicken, beef or vegetarian kabob, served with a seasonal fresh fruit salad, barbecue potato chips, cheese salad and assorted soft drinks or bottled water. Live music will be featured on the mall only. A JPL badge must be worn to participate.

In support of the thank-you celebration, JPL Café schedules for June 6 will be modified. 110 Crater Café will be open from 6:30 to 9 a.m. Grill service will not be available after 8 a.m., and 190 will be closed for lunch and after noon break. The 360 Orbit Café will be open 6:30 a.m. to 3:30 p.m., with no grill service after 9 a.m. The lunch menu is limited to hot entrees, pizza, salad bar and Grab n’ Go. The 167 Red Planet Café will open 6:30 a.m. to 3:30 p.m., with no grill service after 9:30 a.m. The lunch menu is limited to hot entrees, salad bar, and demo station.
CloudSat climbs to mesa for tests

JPL engineers earlier this month conducted successful tests on the CloudSat antenna at JPL’s Caltech campus. CloudSat is an experimental satellite that will use radar to map the vertical structure of clouds and cloud properties from space. Launch is planned for April 2003 from Vandenberg Air Force Base.

The preliminary tests, conducted on JPL’s mesa antenna range area, confirmed that the three-mirror antenna’s far-field range was working properly, according to engineering manager Suzanne Spit.

At every antenna’s input, a laser beam is converted to an electric signal. That signal is then sent to the “far-field” or distant portion of the antenna’s lens system, where it is converted back to an electric signal. A laser beam is then sent to each mirror, and that laser beam is reflected back to the “near-field” or close-to-the-antenna portion of the lens system. The signal from each mirror is combined and then sent to the receiver.

At that time, the quasi-optical transmission line—which carries the data from the laser beam to the receiver—will be integrated with the antenna.

CloudSat Deputy Principal Investigator Debora Sneed said integration of tests and all subsystems are scheduled for next year.

CloudSat will provide the first continuous global orbital survey of cloud structure and physical properties. The data gathered will improve the models used to describe clouds in global climate and weather prediction models.

Since clouds are a basic part of the link between energy and water cycles present in the Earth’s atmosphere, understanding their physical characteristics and associated seasonal and geographical variations is fundamental to meteorology.

CloudSat’s 94 GHz cloud-profiling radar is expected to be several orders of magnitude more sensitive than available weather radars and will yield detailed observations of the water droplets and ice crystals in clouds. Unlike the recent DCG Airborne Cloud Radar aircraft experi-

ment, CloudSat’s continuous data will allow the seasonal and geographical variations of clouds to be captured.

The absorption present when looking through precipitation from the ground severely limits the radar sensitivity, thus the ability to remotely sense the clouds from above.

CloudSat is a partnership between JPL, Colorado State University, the Canadian Space Agency, the U.S. Air Force, and the U.S. Department of Energy. Ball Aerospace is building the spacecraft. The antenna was built by Composite Optics of San Diego. For more information, log on to http://cloudsat.atmos.colostate.edu.

Service awards

The following JPL 2002 Second Quarter Service Award Recipients celebrating 20 or more years of service were invited to attend a luncheon and ceremony in their honor on June 5.

45 years:
Hershall Flinchum

40 years:
Charles R. Bryan, Edger Davis, Richard Emmer-
son, Robert Hall, Alan Hoffman, Ronald Hogue, James Johnson Jr., Charles Ladd, Frank Legg, War-
ren L. Martin, Kenneth Perralta, Robert Polansky, Raymond Pringe-

niss, Thomas H. Snyder, Jamie Tomey, Alvin Willems

35 years: Stanley Bateman, George Bennett Jr., Joe Foster, Arthur Fransen, H. Kent Frewing, William Hurt, Patricia McLean, John Messinger

30 years: Richard Gardneau, James Fastman, Ingrid Hus, Susan Latanic, Robert Miller, Jose Miranda, Allison Owens, Ted Peng, George Rinker, Gary Tag

25 years: Frederick Skeers, Charles Avis, Julian Blouin, Barbara Ronca, Larry Bright, Robert Cearsam, Charles Cruzan, Kirk Gerhacht, Ronald Helling, Jose Landres, Linda Lee, Thomas Logan, Albert Magalhaes, Lee Melfinger, Donald Rockey, Yonne Samir, Chester Sasaki, Donald Sevilla, Barbara Sherr, Donald Spahr, Donald Stief, Harold Smith, John Smit, Jan Smith, Gary Sneed, Gerald Tipton, Thomas Stark, Curtis Tucker Jr., Joseph Wackley, Yonee Ziegler.

20 years: Donna Bonneris, Natesen-
dad Christie, David Chilis, Paul Chois, Derit Dearnor, Robin Dum, Randall Fordbar, Ivan Grot, Dwight Grett, Gail Linchen, Kathleen Lyon, Leon Malford Jr., Scott Marsh, Thomas Mermin, Samuel Mentoni, Barbara Mochrie, Steven Moniz, William Niederleiser, William Nijima, Christopher Paez, Paul Rapace, Audrey Ridley, Mary Rome-

jko, James Rooney, James Shmitka, Moniz, William Neiderheiser, William Menotti, Barbara Mochrie, Steven Markham, Thomas Meehan, Saundra Dumas, Randall Foehner, Ivan Gall, Butman, George Washington, Bennett of Section 341 will describe “Ju-

tional and Challenges” at noon in conference room 167. The talk is presented by JPL’s Asian American Affairs Unit. For more information, visit http://www.aas.

ased, said Cassini-Huygens Program Manager ROBERT MITCHELL.

camera lens is clearing up as anticipat-

y, warming treatments have correct-

ers and density of all frequently used Lab passwords is


http://cloudsat.atmos.colostate.edu/

study flux (left) and cloud loadings (right) over the CloudSat antenna on JPL’s mesa, where it underwent testing. Looking on are Greg Jones and Brooke Spots.

Special Events Calendar

Thursday, May 30
Asian Pacific American Heritage Month Talk—Dr. Min Zone, professor of sociology and chair of the Asian American Studies Inter-

departmental Degree Pro-

JPL’s Cassini spacecraft continues to fly in good health, spurring toward a July 1, 1 News Briefs 2002. — Participants and spouses are invited for this event that seeks to raise dollars to help fund a cure for hepato-

ic and other liver diseases. The 5K run and 5K walk will be held at Griffith Park in Los Angeles. Call Beth Leonard, ext. 4-5789 or (626) 355-1745. For more information, visit http://www.iidorc.com.

Tuesday, June 4
JPL Games Club—Meeting at noon in Building 306-302.

JPL Genealogy Club—Meeting at noon in building 301-271.

Wednesday, June 5
Associated Retirees of JPL—Caltech—Meeting at 10 am at the Caltech Credit Union, 528 Foothill Blvd, La Cañada.

JPL Gun Club—Meeting at noon in Building 183-228.

Saturday, June 8
Folk Music—Singer/Guitarist Katy Mollart will appear in Caltech’s Fadd-

ey Lounge at 8 pm. Tickets are $25 for adults and $4 for children under 12. Call (626) 395-4652 or visit http://www.cco.caltech.edu/~folkmusic.

Saturday, June 11
Spring fundraiser for college scholarships, working parents support group, and codependents anonymous—Meets the first Thursday of the month at 7 am in Building 167-11 (The Wellness Place). For more information, call the Employee Assistance Program at ext. 3-6030.

Working Parents Support Group—Meets the third Thursday of the month at noon in Building 167-11 (The Wellness Place). For more information, call the Employee Assistance Program at ext. 3-6030.

Special Events, Calendar

Ongoing Support Groups
 Alcoholics Anonymous—Meetings are available. Call the Employee Assistance Program at ext. 3-6030 for time and location.

Counselors Anonymous—Meets every Wednesday. Call Occupational Health Services at ext. 4-2219.

Gay, Lesbian and Bisexual Groups—Meets the first and third Fridays of the month at noon in Building 111-17 (The Wellness Place). For more information, call the Employee Assistance Program at ext. 3-6030 or Randy Herrera at ext. 3-0664.

Caregivers Support Group—Meets the Thursday of the month at noon in Building 167-11 (The Wellness Place).

For more information, call the Employee Assistance Program at ext. 3-6030.

JPL Golf Club—Meeting at noon in Building 306-302.

“California Liver Run/Walk 2002”—Participants and spouses are invited for this event that seeks to raise dollars to help fund a cure for hepato-

ic and other liver diseases. The 5K run and 5K walk will be held at Griffith Park in Los Angeles. Call Beth Leonard, ext. 4-5789 or (626) 355-1745. For more information, visit http://www.iidorc.com.

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A 60-day period of warming the JPL’s Cassini spacecraft continues to fly in good health, spurring toward a July 1, 2002, appointment to begin orbiting Saturn. Test images of a star taken in early May provided a tuning requirement that a haze problem noticed on a Cassini camera frame is being cleared up as anticipated, said Cassini Chief Engineer GEORGE WASHINGTON, Manager ROBERT MITCHELL.

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DC Honors JPL's 40th

JPL's celebration of the 40th anniversary of the first U.S. planetary mission, Mariner 2, and the 25th anniversaries of Voyagers 1 and 2, made its way to Washington, D.C. on May 7 with “Journey to the Planets and Beyond,” an event held at the Smithsonian Institution’s National Air and Space Museum. In attendance were Lab Director Dr. Charles Elachi and all surviving former directors, as well as other JPL and NASA officials, members of Congress and special guests.

The celebration included a new video produced by the Office of Communications and Education on JPL’s history and current missions. A videotape of the Smithsonian event is being prepared for archiving on the Daily Planet, JPL's online news source (http://dailyplanet).

Clockwise from top: Viewing a 2003 Mars Exploration Rover model are Shaun Parkin (left), aide to Utah Senator Bob Bennett, and Kevin Burke, an engineer from JPL’s Mars Exploration Rover Project. From left: former JPL Directors Dr. William Pickering (director from 1954-76), Dr. Edward Stone (1991-2001), Dr. Lew Allen (1982-90), Dr. Bruce Murray (1976-82) and Elachi.

David M. Seidel (left), manager of Pre-College Programs, Education and Public Outreach Office, and Randii Wessen, Manager, Origins and Astrophysics Programs, Mission and Systems Architecture Section, set up a display. Elachi, at center, introduces participants in a panel discussion; from left are Tom Young, mission director of the 1976 Viking landings on Mars and former director of NASA’s Goddard Space Flight Center; Pickering; Murray; and Stone. Dr. Ed Weiler, NASA’s associate administrator for space science, greets U.S. Rep Adam Schiff (D-Pasadena). From left: NASA Administrator Sean O’Keefe, U.S. Rep. David Drier (R-San Dimas), and Caltech President Dr. David Baltimore. Karen Yuen (left), Earth outreach theme lead, and Dr. Andrea Donnellan, deputy manager, Earth and Space Sciences Division, chat with O’Keefe.
Just as JPL in celebrating the 40th anniversary of planetary exploration this year; another 40th anniversary is also being celebrated at JPL this year. Four years ago after moving to Los Angeles from Brooklyn, NY, the Dodgers opened their new home, still considered one of the best ballparks in the major leagues. Today, the Dodgers are offering JPL and Caltech staff a special deal. Tickets are still available at the JPL Store and the Caltech Credit Union in La Cañada. Beginning today, Dodger Nation specials the June 1 match up against the San Francisco Giants will be available. These Dodger Nation deals end after the first two home games.

Over 100 classified ads will be available in our Classifieds this Friday by the employees, contractors and others who came to us for support during the time of mourning. These classifieds are available for one person. For more information, log on to the JPL Store website at http://www.jplstore.caltech.edu/dodgers.html.

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**Classifieds**

**For Sale**

**For Rent**

**Vacation Rentals**

**Vehicles/Accessories**

**Letter**

**Passings**

**Letter from the Editor**

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**Editor's Note:**

Advertiser is available to JPL employees, contractors and retirees and their families. No more than two ads of 60 words each will be published for each advertiser. All ads are combined within one submission. Ad must be submitted on ad cards available at the EAC and the Universe Office, 10th-16th, or via e-mail to universe@jpl.nasa.gov. Ads are due at 2 p.m. on the Monday after publication for the following issue. All housing and vehicle ads require that the qualifying person(s) placing the ad be listed as an owner on the ownership documents.