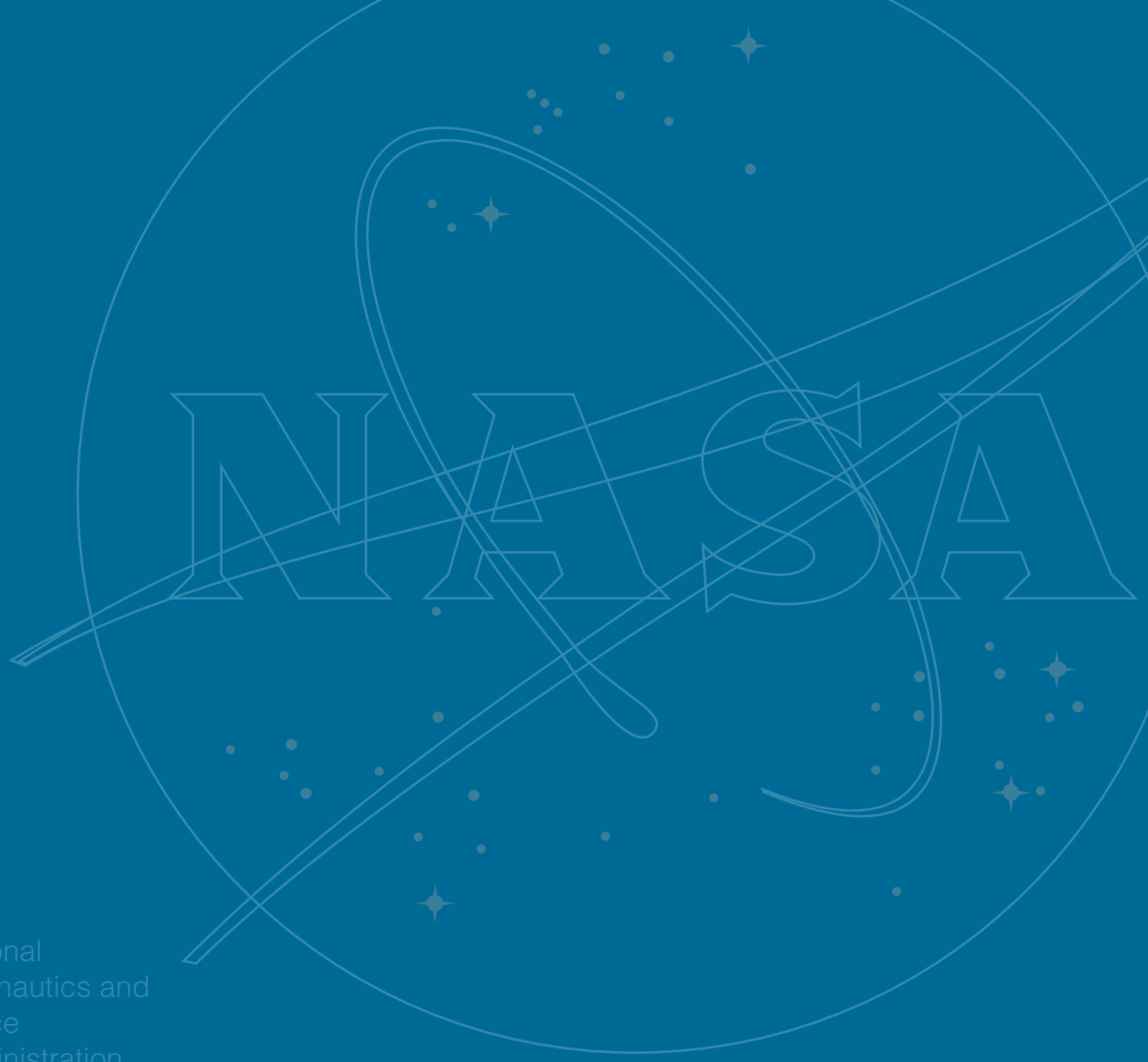


National
Aeronautics and
Space
Administration

Annual Report 2000

Goddard Space Flight Center

Table of Contents

Vision

We revolutionize knowledge of the Earth and the universe through scientific discovery from space to enhance life on Earth.

Mission

Goddard Space Flight Center enables discovery through leadership in Earth and space science.

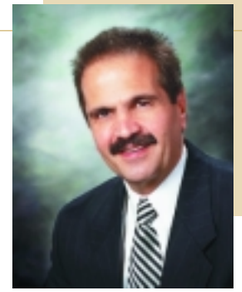
We serve the scientific community, inspire the Nation, foster education, and stimulate economic growth.

We partner with others to achieve NASA's goals.

We create technologies that support and advance these endeavors to take full advantage of doing research in space.

We accomplish this through innovation in all that we do.

Message from the Director



We, like thousands of corporations across the country, produce an annual report each year to give our constituents an idea of what we have accomplished over the past 12 months. The exercise gives us an opportunity to reflect on our successes and areas where we might improve in the future. I can honestly say that we made great strides in fiscal year 2000. We successfully delivered several high-profile spacecraft into orbit and we remained careful stewards of our financial resources.

In this report, you will learn the details of what we did. You will read about some rather remarkable scientific findings made by Goddard scientists, who worked closely with their university and industry colleagues to explore space and engage others in the excitement of discovery. You will learn how our employees made safety their number-one priority and how the Center itself set its sights on being the employer of choice. And you will learn how we worked with our neighbors to enrich our community and make the region a wonderful place in which to work and live.

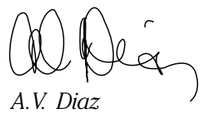
Indeed, our accomplishments are many. During the past fiscal year, Goddard employees delivered Terra, IMAGE, GOES-L, NOAA-L, HETE-2 and TDRS-H into safe orbits. They also extended the life of Goddard's astronomical workhorse, the Hubble Space Telescope. And they led the creation of the first Regional Finance Office, which consolidates the financial and business requirements of Goddard, Headquarters and the Jet Propulsion Laboratory. This is no small endeavor. Our financial community deserves recognition for its perseverance in making such a consolidation successful and a model for the rest of the Agency.

Even as 1999 drew to a close, the Center continued to shine. Our employees prepared for every potential emergency associated with the Y2K rollover, but nothing happened when the clock struck 12. I attribute that to one simple fact: We were prepared.

We looked critically at our work environment and took into consideration what is most important to our employees. We established a Diversity Council to help the Center maximize the full potential of every employee. We began looking at information technology, as today's needs, not tomorrow's goals. And to strengthen the operational needs of the Agency through independent testing and verification of software, we welcomed to our family a new facility in Fairmont, West Virginia.

This is our report card to you. Recognize that many, many people contributed to our success, and that we are forever changed by the positive actions of our employees. Every person is important to us.

I'm very proud to be a part of this organization, supported by dedicated and devoted people, who are critical to our mission success. After you read this document, you will see why I feel so fortunate.



A.V. Diaz

"Believe in your dreams..."

Harry Goett

The people of Goddard have been in our thoughts so often this past year. My husband, Harry, would have turned 90 this year. He passed away after a brief illness on January 6, 2000. Mr. Al Diaz graciously represented the Goddard community at my husband's funeral and our family was honored by his presence. Goddard meant so much to him.

Harry wrote to his grandchildren about space. He talked about the early days, satellites, synchronous orbits, tracking stations and the Big Bang. He said to his grandchildren, "On looking back, I hope you find a job that is as interesting and exciting as mine has been." Harry loved his work and valued each one of you.

You, the current employees of Goddard, are carrying on a legacy of excellence, achievement and boldness that began with the Center's first employees. Harry talked often about how impressed he was by the work you are doing. He would say, "Look, Barbara, look what Goddard has done now." He also would comment on the importance of the people who allowed the scientists and engineers to do their work, how each person was essential to the whole creative process.

The challenges may be different now, but the essence remains the same. Believe in your dreams and have the vision, courage and energy to see them through. Congratulations on your work.

Barbara Goett and Family

Note: *Harry Goett was Goddard Space Flight Center's first Center Director. He served from 1959 to 1965.*

Where We Are Today

We revolutionize knowledge of the Earth and the universe through scientific discovery from space to enhance life on Earth

Goddard Space Flight Center's Vision

Like many organizations of Goddard's size, age and mission, we have benefited from the diversity of our people and their innovations. Their contributions have allowed us to remain competitive and ready to face the challenges of a changing world.

Goddard's mission is to serve as NASA's Center of Excellence for Scientific Research. We are committed to the Agency's vision as outlined by NASA's Space Science and Earth Sciences Enterprises. Both state NASA's goals as advancing knowledge with new information, using revolutionary technologies and contributing to the educational goals of the Nation.

Maturity and Transition

With maturity, though, comes change. For Goddard, middle age brought about changes in personnel, as several Goddard leaders moved on to new leadership positions elsewhere in the Agency. Several members of the Executive Council completed their government service and retired for personal and other career goals. James Moore, Director of Flight Programs and Projects, and Dr. Stephen Holt, Director of Space Sciences, both retired from government service. Brian Keegan, Director of the Applied Engineering and Technology Directorate, moved to NASA Headquarters to serve as the Agency's Chief Engineer. Orlando Figueroa, Director of Goddard's Systems, Technology, and Advanced Concepts Directorate, joined Brian Keegan at NASA Headquarters as Deputy Chief Engineer for Systems Engineering. Sherry Foster, Director of the Management Operations Directorate, accepted a position as the Executive Director for the Centennial of Flight Commission.

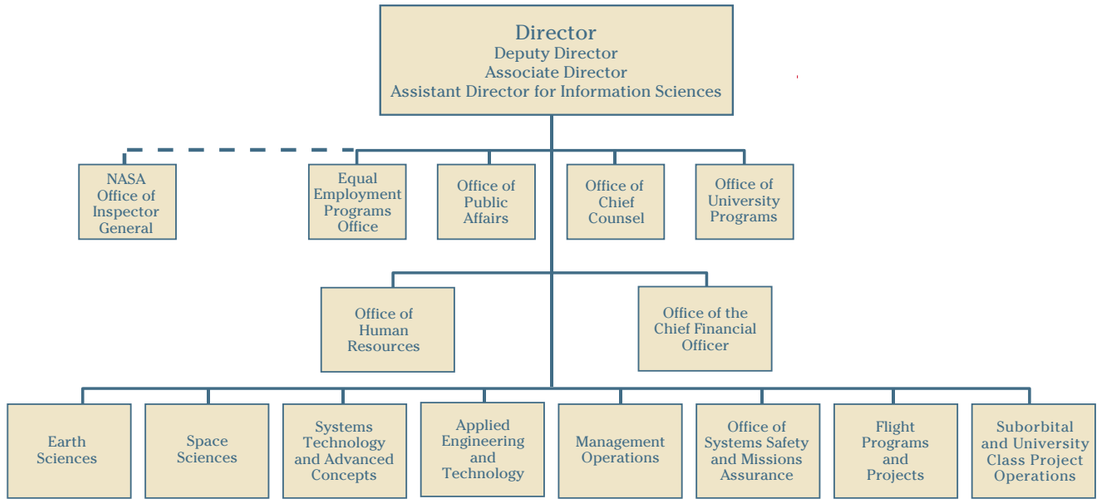
To ensure a smooth transition, the Center moved swiftly to fill the vacancies. John Campbell is the Director of Flight Programs and Projects and Jonathan Ormes serves as the Acting Director for the Space Sciences Directorate (at this writing). Rick Obenschain is the Director for the Applied Engineering and Technology organization. John Hrastar is the

Goddard Values

To achieve these goals, the Center has adopted a set of standards embraced by all employees. They include:

- Seeing safety as vital to the public, our astronauts and pilots and employees.
- Demonstrating excellence in quality and showing our customers that reliable results at an affordable cost can be expected time after time.
- Meeting our commitments and promises.
- Sustaining scientific and technological leadership in space and Earth science.
- Recognizing core competencies and processes that ensure the Center's competitiveness.

TOP: John Campbell
MIDDLE: Jonathan Ormes
BOTTOM: Rick Obenschain



Director for Systems, Technology, and Advanced Concepts. Alison McNally is the Director for the Management Operations Directorate. Each of these individuals is experienced and committed to excellence in service and product. These outstanding qualities reflect the overall high quality of Goddard's workforce, leadership and ability to continue our progress and advancements.

Goddard Organization

Employee Facts And Figures

Some of the world's preeminent scientists and engineers make up the Goddard workforce, which is predominantly technical and highly educated. The Center excels at instrumentation, modeling, detector development and the interpretation of data for space and Earth science research. A strong administrative base supports these and many other capabilities, particularly in the areas of financial management, contract management, procurement, grant administration, information technology and employee training.

TOP: John Hrastar
BOTTOM: Alison McNally

Civil Servant by Skill Group

	# of Work Force	% of Work Force
Clericals	248	7.6
Prof/Admins	831	25.6
Sci. & Engs.	1,886	58
Technicians	239	7.4
Wage Grades	46	1.4

Highest Degree Earned of Employees Currently on Board

	# of Work Force	% of Work Force
Ph.D.	474	14.6
Masters	605	18.6
Bachelors	1,265	38.9
Associate	117	3.6
No Degree	789	24.3

Economic Impact

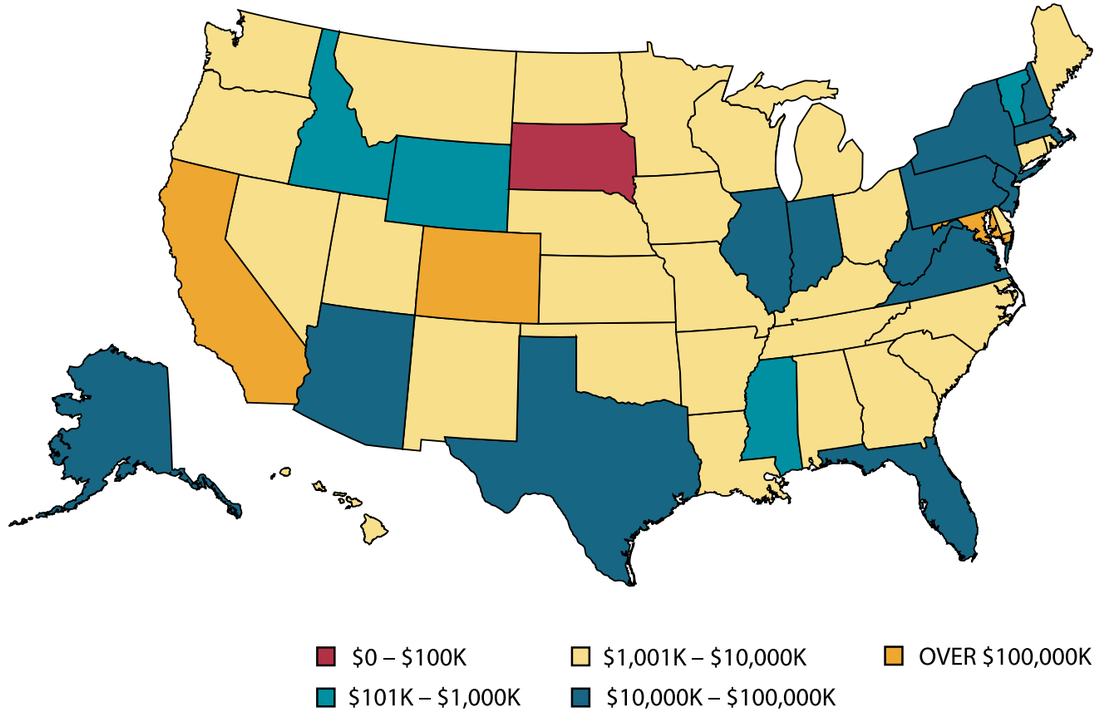
Goddard significantly affects the economy because we buy the goods and services to perform our mission. As a result, the local, state and national economies benefit because of business development, job creation and an increased tax base.

Contract Obligations

The largest portion of Goddard's budget is obligated through contracts with commercial firms, nonprofit institutions and other government agencies. These contracts allow the Center to acquire the goods and services necessary to accomplish our mission. Ultimately, these dollars are returned to the local, state and national economy in the form of gross output, sales, the purchase of intermediate goods and services and employee income.

During Fiscal 2000, Goddard processed more than 29 percent of the Agency's contractual actions and 19.9 percent of the contractual obligations. In total, the Center obligated more than $2.4 billion on new and existing contracts. These obligations and prime-contract awards are issued to contractors nationwide, as well as outside the U.S. Commercial firms received 59 percent, educational institutions 25 percent, nonprofit organizations 9 percent and other government agencies 6 percent. One percent was awarded geographically outside the U.S.

Total Prime Contract Awards - FY00



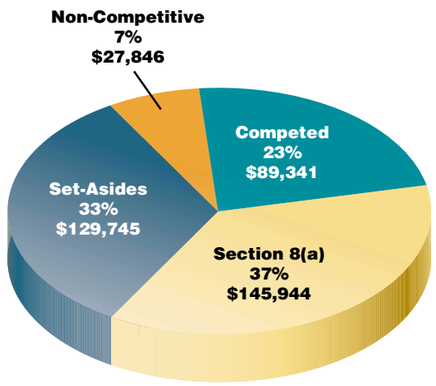
Geographical Distribution Summary - FY00

Obligations by State - Place of Performance

State	Total ($K)	State	Total ($K)
Alabama	$8,734	Montana	$4,543
Alaska	16,378	Nebraska	1,397
Arizona	29,669	Nevada	1,508
Arkansas	1,219	New Hampshire	11,702
California	373,368	New Jersey	63,999
Colorado	115,968	New Mexico	8,124
Connecticut	3,460	New York	29,536
Delaware	2,261	North Carolina	4,477
District of Columbia	205	North Dakota	2,348
Florida	13,342	Ohio	6,531
Georgia	5,818	Oklahoma	1,976
Hawaii	9,385	Oregon	7,073
Idaho	743	Pennsylvania	16,328
Illinois	11,644	Rhode Island	3,553
Indiana	47,043	South Carolina	3,393
Iowa	3,960	South Dakota	1,014
Kansas	1,582	Tennessee	3,613
Kentucky	3,714	Texas	45,806
Louisiana	2,086	Utah	3,245
Maine	1,435	Vermont	796
Maryland	1,006,768	Virginia	94,471
Massachusetts	50,182	Washington	9,971
Michigan	8,413	West Virginia	15,936
Minnesota	3,200	Wisconsin	7,389
Mississippi	952	Wyoming	544
Missouri	4,703		
		TOTAL	**$2,075,499**

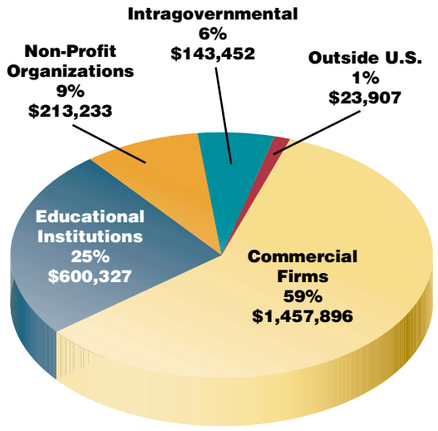
Distribution of Awards to Small and Disadvantaged Business - FY00 Obligations

(In Thousands)

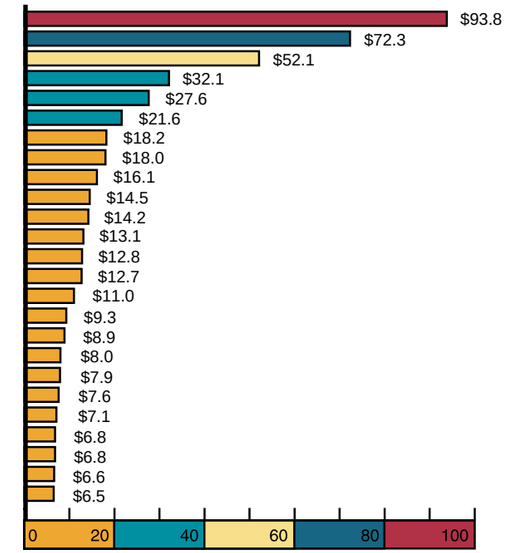


Distribution of Procurements - FY00 Obligations

(In Thousands)



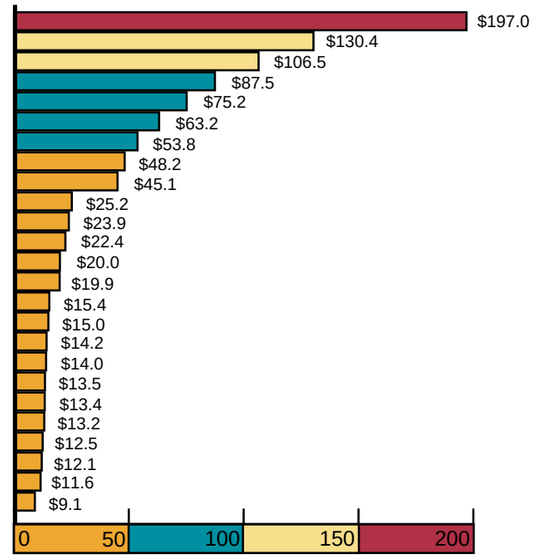
FY 00	FY 99	Institution	Number of Contracts	Millions of Dollars Obligated
1	1	Johns Hopkins University	98	$93.8
2	2	Assoc. of Universities for Res. in Astronomy	30	$72.3
3	3	University of Colorado – Boulder	169	$52.1
4	4	University of Maryland – College Park	141	$32.1
5	6	California Institute Technology	85	$27.6
6	5	University of California – Berkeley	91	$21.6
7	17	University of California – San Diego	71	$18.2
8	9	Universities Space Research	46	$18.0
9	16	University of Alaska – Fairbanks	27	$16.1
10	12	New Mexico State University – Las Cruces	19	$14.5
11	10	University of Arizona	140	$14.2
12	11	Smithsonian Institution	148	$13.1
13	13	Massachusetts Institute of Technology	114	$12.8
14	8	Southwest Research Institute	50	$12.7
15	14	Columbia University	67	$11.0
16	15	Wheeling Jesuit College	4	$9.3
17	34	Pennsylvania State University	68	$8.9
18	28	University of Maryland – Baltimore County	26	$8.0
19	17	University of New Hampshire	54	$7.9
20	20	University of Washington	71	$7.6
21	19	University of Texas – Austin	42	$7.1
22	22	University of Wisconsin – Madison	60	$6.8
23	21	University of California – Santa Barbara	46	$6.8
24	18	Stanford University	48	$6.6
25	23	University of Hawaii	72	$6.5



Top 25 Nonprofit Institutions FY00

FY 00	FY 99	Company	Number of Contracts	Millions of Dollars Obligated
1	1	Lockheed Martin Corp.	98	$197.0
2	6	Raytheon STX Corporation	30	$130.4
3	4	TRW, Inc.	169	$106.5
4	2	Hughes Aircraft Company	141	$87.5
*5	16	QSS Group, Inc.	85	$75.2
6	7	Swales & Associates, Inc.	91	$63.2
7	8	Ball Aerospace & Tech. Corporation	71	$53.8
8	6	Hughes STX Corporation	46	$48.2
9	9	ITT Corporation	27	$45.1
10	12	Computer Sciences Corporation	19	$25.2
11	13	NSI Technology Services Corporation	140	$23.9
12	18	PRC, Inc.	148	$22.4
13	11	Cortez III Service Corporation	114	$20.0
14	15	Science Systems Applications	50	$19.9
15	19	Space Systems Loral, Inc.	67	$15.4
16	5	Alliedsignal Technical Services	4	$15.0
17	23	General Sciences Corporation	68	$14.2
18	14	Aerojet General Corporation	26	$14.0
19	71	Orbital Sciences Corporation	54	$13.5
20	21	Unisys Corporation	71	$13.4
21	34	Silicon Graphics, Inc.	42	$13.2
22	22	CTA, Inc.	60	$12.5
23	9	ITT Industries, Inc.	46	$12.1
24	17	Fairchild Space & Defense Corp.	48	$11.6
*25	182	Spectrum Astro, Inc.	72	$9.1

*8(a) Minority



Top 25 Business Contractors - FY00

University Collaboration and Education

NASA has a strong interest in collaborating with the university community to complement and strengthen its in-house capabilities. In many cases, the expertise needed for a given mission or research effort exists only in the university world. As a science-oriented Center specializing in space-flight missions, Goddard's interest is to harness the best possible talent, wherever it exists. This way we can assure mission success and satisfy one of the Agency's main goals.

University-affiliated personnel already perform a very large segment of Goddard's work. We handle this in a variety of ways. We offer everything from major institutional grants, which fund large numbers of researchers to perform a specific task, such as the Space Telescope Institute at Johns Hopkins University, to simple grants to individual faculty and/or graduate students at universities across the nation. Goddard has a long history of partnering with the university world in this way.

The number of universities involved runs into the hundreds and the number of people supported is between 500-1,000 at any given time. These numbers vary throughout the year depending on the specific task being done at the time. The universities and people involved also vary, as needs change.

These efforts can be classified as follows:

Flight projects. As participants in our missions, universities might supply an instrument or part of an instrument, payloads on a sounding rocket or balloon, software, or they might offer solutions to special engineering problems.

Institutional grants. These are major contracts or grants awarded to universities with special capabilities that augment our missions or research. Awards may be for theoretical or modeling efforts, or perhaps for people who have developed a special capability that either strengthens or balances our research effort.

Science or engineering individual partners. Frequently, a specific individual or a few civil servants and their counterparts in the university community become co-investigators on experiments and other science-oriented efforts.

Grants. Goddard provides grants valued between $50,000 - $150,000, for specific peer-reviewed lines of research believed to merit NASA funding. NASA Headquarters also uses this funding vehicle to support its research and development efforts, including data reduction and analysis.

Faculty and students. Goddard offers opportunities for faculty members and students to work temporarily at Goddard's laboratories. We award assignments to Post-doctoral Fellows, Summer Faculty Fellows, Intergovernmental Personnel Act staff, graduate and undergraduate students and short-term visiting scientists from around the world.

Space Grant and Experimental Program to Stimulate Competitive Research. These are national programs supported by NASA Headquarters and assigned for technical guidance to each of the Centers.

Minority institutions. These are special funds that Goddard allocates to universities that historically serve underrepresented minorities, with the aim of strengthening these institutions.

Outreach. To increase scientific literacy, universities use Goddard funding to develop outreach programs. These university collaborations are accomplished throughout all of Goddard's technical organizations.

Education Programs

Goddard continues its commitment to develop programs and services that increase scientific literacy at the elementary, middle, high school and higher education levels. During the year, Goddard stepped up its curriculum efforts and the Center's service to teachers and students.

In Earth system science programs, for example, Goddard supported regional workshops in which teams of library media specialists and science teachers developed products that linked Earth system science definitions and concepts to Maryland learning outcomes and test results. Similar workshops and curriculum implementation efforts served as models nationwide for school districts seeking to improve Earth system science education.

Outside of Maryland, a Goddard-led partnership with the Connecticut/NASA Education Collaborative resulted in 24 workshops for Connecticut educators, reaching 1,520 classrooms. Connecticut is developing a

Maine teachers learning to inspire future rocketeers.

model to determine the impact of NASA's educational programs and resources on the improvement of instruction in science, mathematics and technology.

Maine drew upon the Center's resources for teacher training related to Earth and space science standards.

The NASA Sun-Earth Connection Education Forum, located at Goddard, is one of four national forums responsible for developing space science education programs and products. A major feature of the past year's forum was the web casting of a solar eclipse, which drew more than 225,000 individuals to the Goddard web site.

The Center increased support to underrepresented populations through partnerships with Morgan State University, the ASPIRA of New Jersey, Chicago and the Pennsylvania Organization for the Advancement of Hispanic Youth. Goddard hosted an urban initiative with the District of Columbia Public Schools through the SUNBEAMS program. Under this initiative,15 separate classes of sixth-grade students attended week-long classes at Goddard.

Education efforts also were prominent at the Goddard Institute for Space Science (GISS) in New York City and Wallops Flight Facility in Virginia.

Through its Institute on Climate and Planets, in collaboration with City University of New York, Columbia University and New York City public schools, GISS provides a range of research education experiences for pre-college and undergraduate students and faculty, focusing on the advancement of minority youth in science.

At the Wallops Flight Facility, students in kindergarten through college flew 23 experiments aboard the Space Shuttle via the Space Experiment Module.

Diversity at the Goddard Space Flight Center

The Goddard Space Flight Center created the Diversity Council in January 2000 to oversee diversity-related efforts at the Center. To that end, the Council will identify issues and actions, propose policies and develop strategies to make sure the Center attains a highly skilled and diversified workforce. The Council is made up of the Deputies of each Directorate, Directors of OHR and EEO, Chairs of the EO Advisory Groups and employee unions.

Since its creation, the Diversity Council has accomplished the following:

- Published a Business Case for Diversity that outlines how diversity adds value to the Center in a business context.
- Examined the results of the 1999 Culture Survey from a demographic perspective and developed a Plan of Action.
- Is in the process of developing a Quality of Work Life Program to promote a friendlier workplace that encourages employees to balance their lives.
- Is planning the Diversity Dialog Project, which involves small groups of employees who will facilitate a deeper understanding of diversity issues among Center employees. The project will emphasize the need to listen, introspect, find meaning and build acceptance of different perspectives.
- Other plans include the start of Directorate Diversity Focus Groups and Diversity Seminars as part of the Director's Colloquium and Diversity Training by outside experts for employees who want to learn more about diversity.

Deputy Center Director William Townsend (center) chairs a meeting of Goddard's Diversity Council.

Seeking Excellence in Scientific Research

Earth Science Accomplishments

The purpose of NASA's Earth Science Enterprise is to understand the total Earth system and the effects of natural and human-induced changes on the global environment. Goddard is leading a pioneering new interdisciplinary field of research called Earth system science. It recognizes that the Earth's land surface, oceans, atmosphere, ice sheets and biota are both dynamic and highly interactive. A highlight of the year was the launch of the first Earth Observing System satellite, Terra, the centerpiece of NASA's multi-disciplinary approach for studying Earth science and understanding global climate change. Almost immediately, the satellite began producing results, marking the start of this unprecedented research effort.

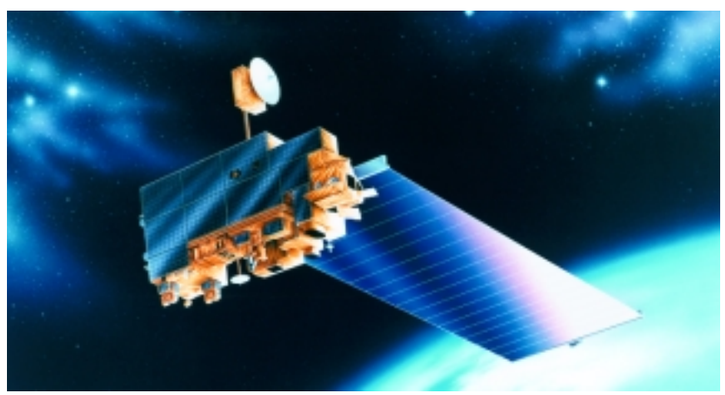
Terra Open For Business

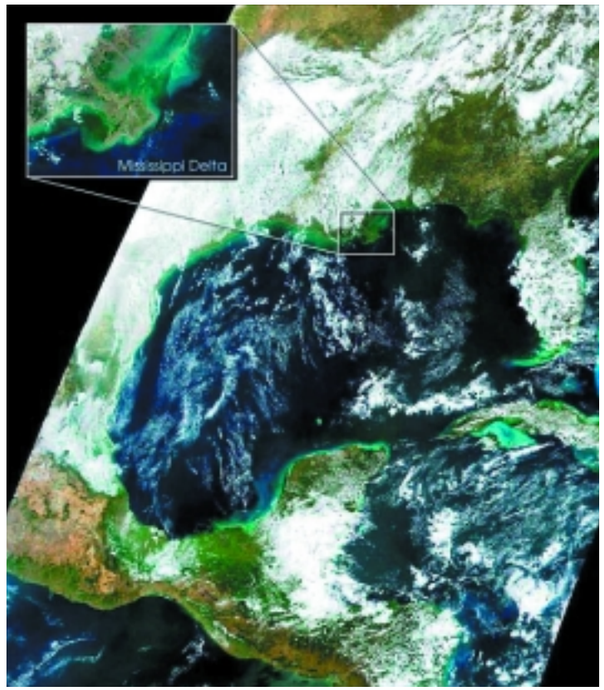
After a picture-perfect launch in December 1999, NASA's premier Earth Observing System satellite, Terra, completed its on-orbit checkout and verification and was declared "open for business" in 2000. Terra is the first satellite to monitor how the Earth's atmosphere, lands, oceans, solar radiation and life influence each other on a daily and global basis. Terra's wide array of measurements will give a comprehensive evaluation of the Earth as a system and will establish a new basis for long-term monitoring of the Earth's climate changes. Terra is measuring and documenting the Earth's vital signs, many of them for the first time. The data will help us understand our planet, aid in our distinguishing between natural and human-induced changes and show us how the Earth's climate affects the quality of our lives.

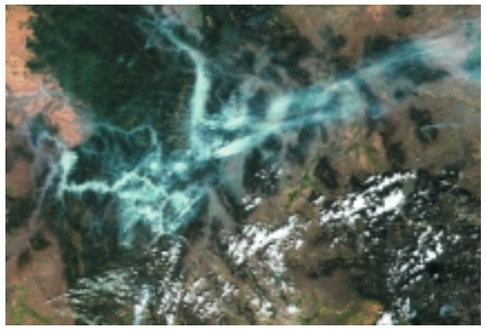
LEFT: A new era in the study of Earth as a system begins December 18, 1999 with the launch of the Earth Observing System flagship Terra spacecraft from Vandenberg Air Force Base, California.

BELOW: Depicted in this artist's concept, the Terra spacecraft is a part of NASA's Earth Observing System designed to study planet Earth. On February 24, 2000, Terra began collecting what will ultimately become a new, 15-year global data set on which to base scientific investigations about our home planet.

Among the first Terra images were those of the North American continent. These images, taken by individual sensors aboard the satellite, showed global surface temperatures and "spring greening." Others showed the Indian sub-continent and the relationship between population, vegetation and pollution, as well as concentrations of carbon monoxide in the lower atmosphere.







LEFT: This image of the Mississippi Delta was acquired on February 24, 2000 and is one of the first scenes taken by Terra's Moderate resolution Imaging Spectroradiometer (MODIS). It covers an area of 62 miles (100km) by 62 miles (100km) over New Orleans, Louisiana and the Gulf of Mexico. The scene was made by combining three of the visible bands of the MODIS Land Surface Reflectance product.

ABOVE RIGHT: This visible light/infrared composite image over Montana and Idaho was acquired by Terra's Moderate-resolution Imaging Spectroradiometer on Aug. 23, 2000. The image shows the locations of actively burning wildfires (red pixels) and the thick shroud of smoke they produced (grey-blue pixels). There were 57 wildfires burning across both states.

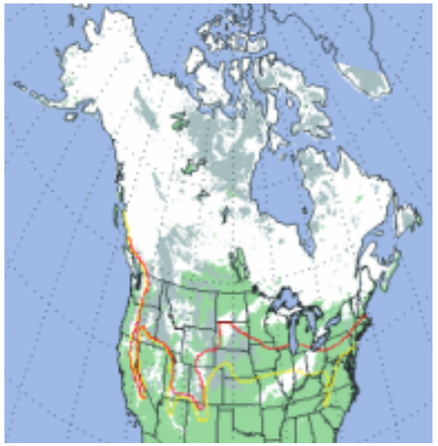
Terra data, along with other measurements from surface-based and aircraft-borne instruments, provide much-needed inputs for Earth science models. This ultimately will enable scientists to predict more accurately future climate change. Many scientists believe that to successfully build predictive computer models of complex Earth interactions, they must clearly understand global climatic processes and parameters. The Terra team estimates that the scientific community will complete the first Earth-system models making full use of Terra data by 2005.

Using Terra Data

Firefighters battling dozens of blazes that had consumed hundreds of thousands of acres across Montana and Idaho got some valuable assistance from Terra. Shortly after Labor Day, scientists from Goddard and NOAA began providing Forest Service officials with daily images acquired over those states by Terra's Moderate Resolution Imaging Spectroradiometer (MODIS) instrument. The MODIS sensor observed the fire region in 36 different wavelengths of the spectrum, ranging from visible to thermal infrared light. Consequently, MODIS data helped firefighters pinpoint the locations of still-burning fires, smoldering burn scars and spreading smoke.

Snow Cover as a Predictor

Early results from MODIS clearly observed below-normal snow cover in parts of the North American continent during the winter of 1999-2000, and the snow that did fall melted earlier than usual, too. Low snow cover can result in drier soil conditions, affect crop production and lead to wildfires. Using data from Terra's MODIS instrument and other satellites, scientists can



TOP: This Moderate Resolution Imaging Spectroradiometer (MODIS) 8-day composite map shows the maximum snow cover in North America during the period from March 5-12. When compared to the snow extent during average years, it is apparent that there was significantly less area covered by snow from November through April. The areas covered by snow are colored white, the non-snow covered land surface is colored green, those regions obstructed by clouds appear as gray and water is blue. The red line represents the "average" March snow line and the yellow line represents the "average" February snow line as determined from NOAA/NESDIS snow maps (1966-present).

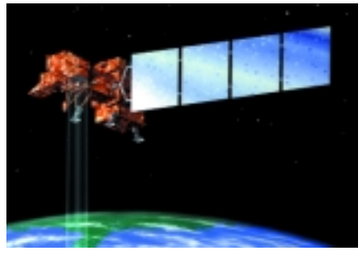
determine the extent of spring snow cover, which can be a harbinger of flood or drought conditions. The MODIS composite snow-cover map, derived from data taken over an 8-day period between March 5-12,depicts the snow line into Canada, in the provinces of Saskatchewan and Manitoba. Only scattered snow cover existed over parts of the northern U.S., though the mountains were still snow covered.

Landsat Exceeds Expectations

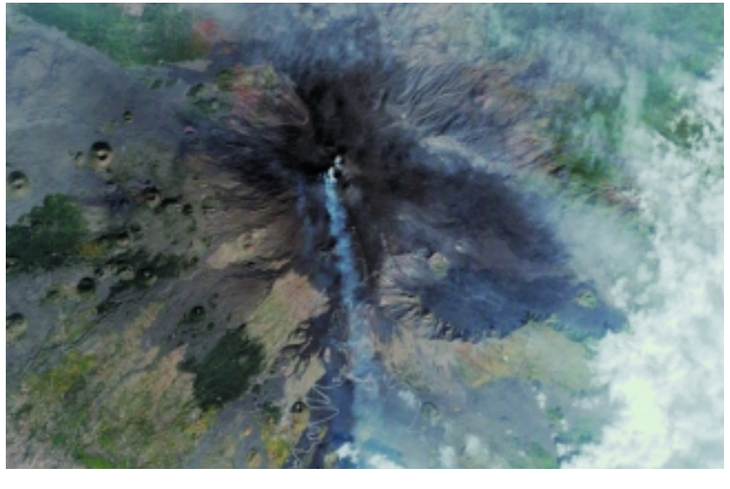
The new Landsat 7 spacecraft, launched April 15, 1999, continues to exceed scientists' expectations. With the satellite's state-of-the-art instrument and new computer ground systems, researchers closely monitored such events as erupting volcanoes in Hawaii, Italy and Latin America, the severe drought in the mid-Atlantic region and the devastating floods in North Carolina. In addition to its observations of natural disasters,

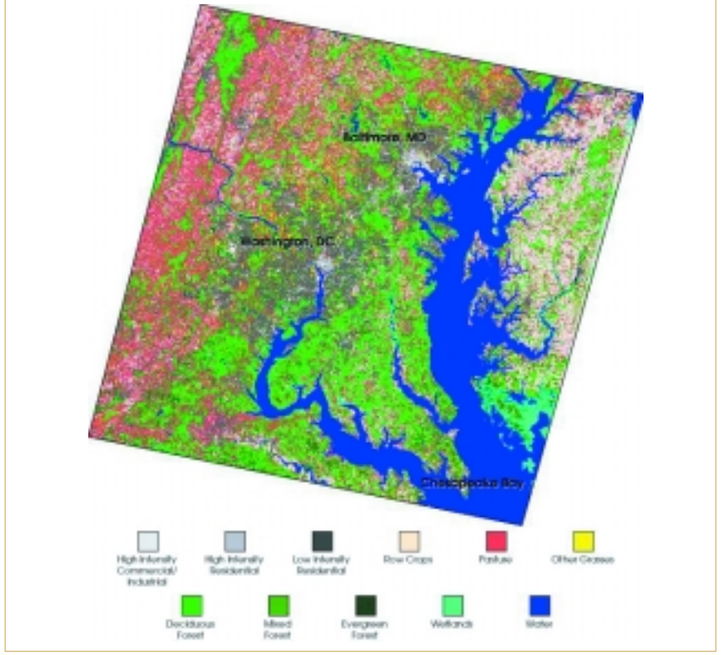
LEFT: Landsat 7, shown here under construction at the Lockheed Martin Missiles & Space facility in Valley Forge, Pennsylvania, will add to the global archive of sunlit, cloud-free images of the Earth by using an instrument called the Enhanced Thematic Mapper Plus.

BELOW: Landsat 7 captured this image of Mt. Etna, Sicily, Italy, on October 28, 1999. The satellite orbits the Earth at an altitude of approximately 438 miles (705 km) with a sun-synchronous 98-degree inclination and a descending equatorial crossing time of 10 a.m. The spacecraft's primary instrument, the ETM+, will produce approximately 3.8 gigabits of data for each scene, which is roughly equivalent to nearly 15 sets of encyclopedias at 29 volumes per set.



ABOVE: This artist concept shows Landsat 7 in orbit. Launched April 15 from Vandenberg Air Force Base, California, Landsat 7 will continue the Landsat program's 27-year legacy of gathering Earth surface images from space as part of NASA's Earth Observing System and Earth Science Enterprise.





LEFT: "Smarter" land-use planning and better estimates of polluted water runoff across the 64,000 square-mile (110,000-square-km) Chesapeake Bay watershed are on the horizon thanks to new land-cover maps being produced by the Mid-Atlantic Regional Earth Science Applications Center (RESAC) at the University of Maryland. These maps, generated by overlaying images from Landsat 7, will provide a more precise assessment of the presence and amount of different land-cover types, including residential development, wetlands, forests and crop lands.

Landsat is offering scientists a detailed look at unique weather and cloud-formation phenomena and glacial retreats and advances. Landsat 7 will acquire a nearly complete data set of the world's coral reefs to help researchers keep track of these important ocean ecosystems.

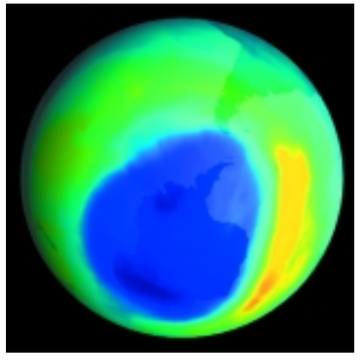
Regional Application Centers Focus on Earth Applications

"Smarter" land-use planning and better estimates of polluted water runoff across the 64,000-square-mile (110,000-square-km) Chesapeake Bay watershed are on the horizon thanks to new land-cover maps being produced by the Mid-Atlantic Regional Earth Science Applications Center at the University of Maryland. These maps, generated by overlaying images from NASA's Landsat 7, will provide a more precise assessment of the presence and amount of different land-cover types, including residential development, wetlands, forests and crop lands. This type of precise land-cover classification has not been done for such a large region. The new maps can distinguish low-density from high-density residential development and cropland from pastureland, as well as wetlands and different types of forest.

Record Ozone Depletion Recorded in 2000

Goddard scientists determined that the area of ozone depletion over the Antarctic — the well-known ozone "hole" — was a bit smaller in 1999 than it was in 1998. However, in 2000, scientists recorded an Antarctic ozone hole that was three times larger than the entire land mass of the U.S. — the largest such area ever observed. The hole expanded to a

BELOW: This year's Antarctic ozone 'hole' is the largest ever observed. Using data from NASA's Total Ozone Mapping Spectrometer (TOMS) instrument onboard the Earth Probe satellite, researchers can evaluate and compare current conditions over the South Pole to readings taken by other instruments in years past. Continued monitoring of polar ozone levels helps researchers gain a better understanding of how the planet's climate may be changing.



record size of about 11-million-square miles (28.3-million-square km) on September 3. The previous record was about 10.5-million-square miles (27.2-million-square km) on September 19, 1998. The lowest readings in the ozone hole are typically observed in late September or early October each year. These observations reinforced concerns about the frailty of Earth's ozone layer.

Although production of ozone-destroying gases has been curtailed under international agreements, concentrations of the gases in the stratosphere are now reaching their peak. Because of their longevity in the atmosphere, it will be many decades before the ozone hole is no longer an annual occurrence.

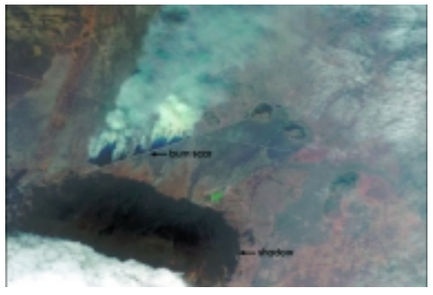
The lowest value of ozone ever seen in the Northern Hemisphere since spacecraft first began ozone measurements in 1978 also was observed in 2000. The measurement was obtained using the Total Ozone Mapping Spectrometer instrument aboard NASA's Earth Probe satellite. A combination of stratospheric and tropospheric weather systems can occasionally create these extreme low-ozone events. Scientists understand the dynamics that can cause them, but are unsure why this event set a new record low value.

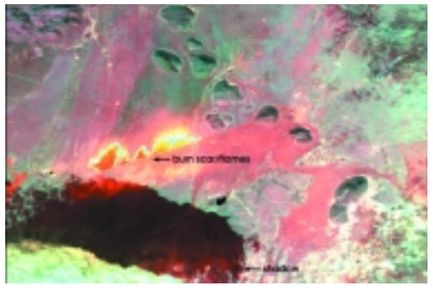
Africa and Amazon Sites for International Science Campaigns

Summer fires routinely scorch the Southern African landscape, blackening an area larger than Montana, Wyoming, Idaho, North Dakota and South Dakota combined. This year, SAFARI 2000, the Southern African Regional Science Initiative, brought together nearly 200 African, U.S. and international scientists in a multidisciplinary research effort aimed at understanding the sustainability of the region's sensitive and pressured ecosystems. An intensive 6-week field experiment combined observations from NASA's Terra and Landsat 7 spacecraft, NASA's ER-2 high-altitude research aircraft, and several other aircraft and ground stations. The base of operations is in Pietersburg, South Africa. SAFARI 2000 coincided with Southern Africa's dry season, the time of the most extensive biomass burning. The region is subject to some of the highest levels of biomass burning in the world.

Scientists who want to monitor the state of our global climate may have to look no farther than the coastal ice that surrounds the Earth's largest island. A scientist at NASA Goddard's Wallops Flight Facility reported that the frozen area around Greenland is thinning at a rate of more than 3 feet per year in some places. The ice mapping was completed by NASA, which has been surveying the Greenland ice sheet for nearly 7 years. In 1993 and 1994, NASA researchers surveyed the ice sheet using an airborne laser altimeter and precision global positioning satellite receivers. Those same areas were surveyed again in 1998 and 1999. Now, for the first time, portions of the entire ice sheet covering Greenland are mapped with sufficient accuracy to detect significant changes in elevation.

A small, prescribed grassland fire in Kruger National Park, South Africa, is set to coincide with the overpass of NASA's Terra spacecraft and research aircraft involved in the SAFARI 2000 field campaign. The Southern African Regional Science Initiative 2000 (SAFARI 2000) is an interdisciplinary science activity designed to increase our understanding of the southern African ecological and climate system as a whole, as well as its relationship to hemispheric and global climate.



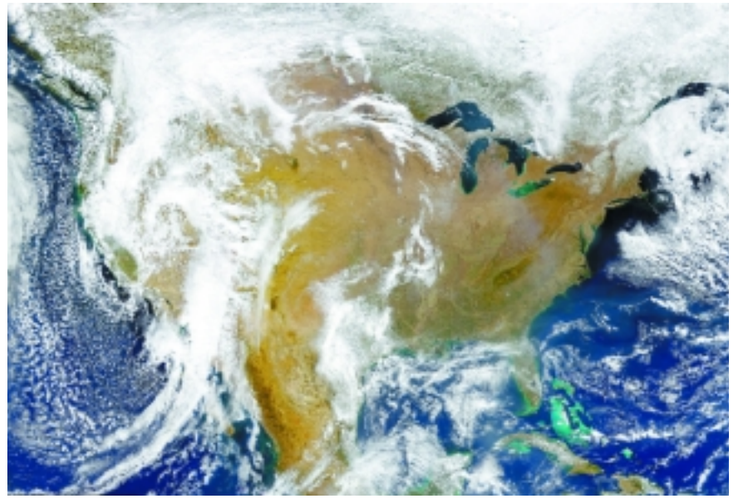


The MODIS Airborne Simulator (MODIS stands for Moderate Resolution Imaging Spectroradiometer, an instrument aboard the Terra satellite) took this image of a controlled burn in the Madikwe Game Reserve, South Africa, on August 20, 2000. The true color image (top) shows plumes of smoke blown in front of the advancing flames and a developing burn scar. The infrared composite image (bottom) sees through the smoke to reveal the hot flames (yellow) and the still-warm ground of the burn scar (orange). Scientists will use this and other data collected during the SAFARI 2000 field campaign, combined with data from the Terra satellite, to learn more about the ecosystems of Southern Africa,and the seasonal changes that occur there.

Any change is important because a smaller ice sheet could result in higher sea levels. A conservative estimate, based on the data, indicates a net loss of about 12.23 miles (51 cubic km) of ice per year from the entire ice sheet, sufficient to raise global sea level by 0.005 inches (12.7 mm) per year, or approximately 7 percent of the observed rise. This amount of sea-level rise does not threaten coastal regions, but these results provide evidence that the margins of the ice sheet are in a process of change. The thinning cannot be accounted for by increased melting alone. It appears that ice must be flowing more quickly into the sea through glaciers.

Latest News and Views on Climate Change

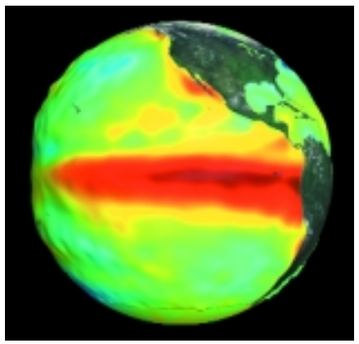
Because climate change affects everyone on Earth, scientists have been trying to pinpoint its causes. For many years, researchers agreed that climate change was triggered by what they called greenhouse gases, with carbon dioxide (CO^2) from the burning of fossil fuels (coal, oil and gas) playing the biggest role. However, new research suggests fossil-fuel burning may not be as important in the mechanics of climate change as previously thought. NASA-funded research by the New York-based Goddard Institute suggests that the real culprit is air pollution, and in particular non-CO2 greenhouse gases such as tropospheric ozone, methane, chlorofluorocarbons (CFCs) and black carbon (soot) particles. Since 1975, global-surface temperatures have increased by about 0.9 °F (-17°C), a trend that has taken global temperatures to their highest level in the past millennium. Estimates of global climate forcings, or factors that promote warming, indicate that the processes producing non-CO2 greenhouse gases are more significant in climate change. The good news is that the growth rate of non-CO2 greenhouse gases has declined in the past decade, and if sources of methane and tropospheric ozone were reduced in the future, further changes in climate because of these gases in the next 50 years could be near zero. If these reductions were coupled with a reduction in both particles of black carbon and CO2 gas emissions, such conditions could lead to a decline in the rate of climate change.



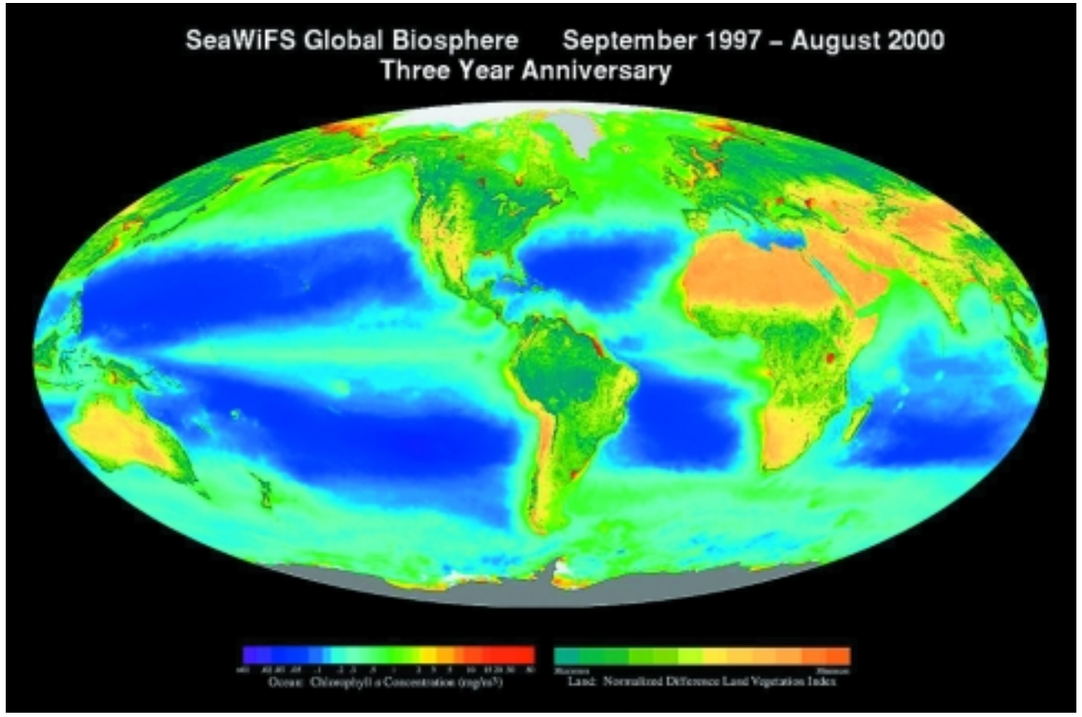
This view of the United States was produced from SeaWiFS data collected at four receiving stations on March 6, 2000.

Adios to La Niña

La Niña, the large area of cold water in the Pacific Ocean widely blamed for last summer's drought and often related to an increase in the number of hurricanes that make landfall, disappeared over the Pacific by the end of 2000. As expected, La Niña reached a maximum level of intensity during January 2000. Anomalous behavior, however, was not new



After 3 years of El Niño and La Niña and their often devastating climate consequences, the Pacific is finally calming down in the tropics. According to the latest spacecraft and ocean-buoy observations, La Niña disappeared entirely in the eastern Pacific Ocean followed by a rapid disappearance over the rest of the Pacific. As expected, La Niña reached maximum intensity during January 2000 and has been waning ever since.



This SeaWiFS image of the global biosphere shows where plant life exists on our planet, both on land and in oceans.

for the Pacific. Strange weather patterns have affected the region for the past 3 years. During the spring of 1997, for example, warm waters off the coast of South America associated with the strongest El Niño on record produced a multitude of storms that caused widespread flooding along the coast.

SeaWiFS

The SeaWiFS Project celebrated its third anniversary on September 18, 2000. The purpose of SeaWiFS is to provide quantitative data on global ocean bio-optical properties. Subtle changes in ocean color signify various types and quantities of marine phytoplankton (microscopic marine plants), knowledge that has both scientific and practical applications. The SeaWiFS Project developed and operates a data system that processes, calibrates, validates, archives and distributes data received from the Earth-orbiting ocean-color sensor.

The SeaWiFS image above of the global biosphere depicts the ocean's long-term average concentration of phytoplankton and chlorophyll between September 1997 and August 2000. The data are combined with the SeaWiFS-derived Normalized Difference Vegetation Index over land during July 2000.

The image shows where plant life exists on our planet. On land, the dark green areas signify an abundance of plant life, while the tan areas show relatively sparse plant cover. In the oceans, red, yellow and green pixels show dense phytoplankton blooms, while blues and purples indicate low concentrations of the microscopic marine plant.

TRMM

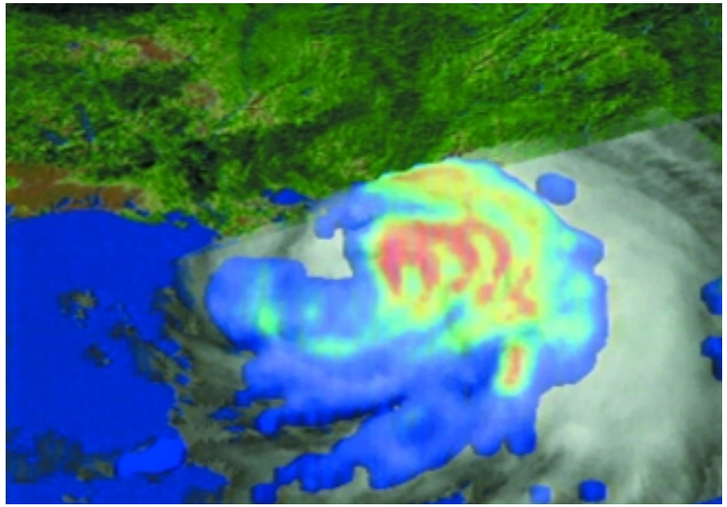
The Tropical Rainfall Measuring Mission (TRMM), the first satellite specifically designed to measure rainfall, also celebrated 3 years in orbit. Data collected by TRMM continued to contribute significantly to our knowledge of climatological rainfall over the tropics. Scientists are excited about these new data because they provide important steps in the effort to accurately measure rainfall from space. Before TRMM, scientists were uncertain about tropical rainfall amounts, which they must know to fully understand climate variations and related variations in floods and droughts. TRMM measurements are helping to improve that situation, although it will take further analysis to fully use the measurements.

SOLVE

During the winter of 1999-2000, NASA conducted its SAGE III Ozone Loss and Validation Experiment (SOLVE) with the Third European Stratospheric Experiment on Ozone (THESEO 2000), which scientists designed to investigate the processes that control polar and mid-latitude winter and spring ozone levels. With the joint experiment, they also wanted to validate measurements from SAGE itself, the Stratospheric Aerosol and Gas Experiment. All three experiments took advantage of other satellite assets and achieved a better understanding of polar ozone losses that winter. The insights gained by the experiment, especially the role of polar stratospheric clouds in producing ozone-destroying chlorine, will be used in diagnostic and assessment models to better predict changes in the stratospheric ozone.

The HPCC Earth and Space Sciences (ESS) Project

The High-Performance Computing and Communications (HPCC) Program conducted by Goddard's Earth and Space Sciences Project is designed to demonstrate the power of high-end computing to predict the effect of physical, chemical and biological processes on Earth, the solar-terrestrial environment and the universe. With this program, the project hopes to improve its ability to produce, analyze and understand mission data, while reducing the amount of time, money and human resources required to do so, especially important because currently available ground systems cannot process the volume of data expected from the next-generation spacecraft.



This hurricane visualization was developed using data from TRMM's precipitation radar. High rates of rainfall appear in red, with lesser amounts appearing in blue. TRMM gathered data for these images of hurricanes Mitch, Georges and Earl in 1998.

In fiscal year 2000, the project released the third solicitation for investigations through NASA's Cooperative Agreement Notice, titled "Increasing Interoperability and Performance of Grand Challenge Applications in the Earth, Space, Life and Microgravity Sciences." This round will have a broad impact on the scientific community. The program is seeking investigations whose code products will be used by other groups, including NASA scientific research programs and flight missions. A full peer review of the proposals will take place in early 2001, with award selection set for the spring of 2001. The program anticipates awarding eight to ten 3-year awards.

ESS develops systems software that helps scalable computer systems become integral high-end resources for Earth and space sciences. In these science communities, applications are increasingly complex and in a continual state of change, evolving as the scientific understanding of the problems evolve and using a series of computer systems because the lifetime of the software exceeds that of individual high-end computer platforms. ESS is focusing on four major thrusts while leveraging other research groups and vendors to provide complementary software tools.

Space Science Accomplishments

NASA's Space Science Enterprise seeks to answer fundamental questions about galaxies and the universe, the connection between the Earth and our Sun, the origin and evolution of planetary systems and the distribution of life in the universe. Goddard leads the space science community in space-based physics and astronomy. These highlights demonstrate Goddard's continued dedication to scientific excellence.

Hubble Space Telescope (HST)

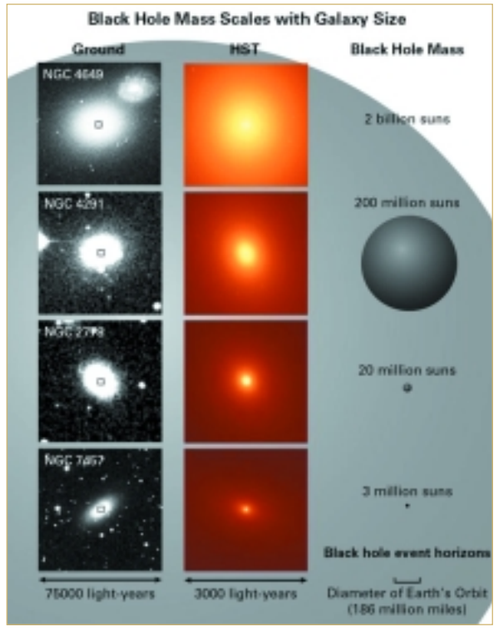
In its first 10 years, the 12.5-ton Earth-orbiting Hubble studied 13,670 celestial objects, made 271,000 individual observations and returned 3.5 terabytes of scientific data. The images, spectra and other measurement data have been archived for use by current and future generations of astronomers. The findings made with the telescope resulted in more than 2,650 scientific papers during Hubble's first decade.

On April 10, 2000, Goddard employees attended a special Hubble Space Telescope 10th Anniversary symposium featuring NASA Administrator Dan Goldin and Maryland elected officials. In addition, the U.S. Postal Service unveiled and provided a special cancellation of a new stamp commemorating the Hubble Space Telescope.

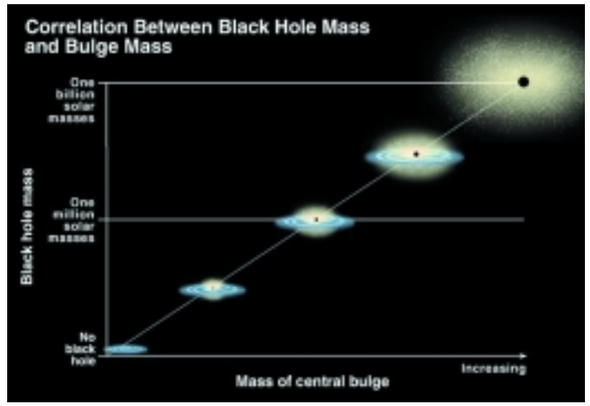
Hubble's scientific hall of fame includes the deepest view so far of the universe in visible light; images of the majestic birth of stars in spectacular stellar clouds; observations of extraordinary arcs, shells and ribbons of glowing gas sculpted by the deaths of stars much like our Sun; unique records of mega-megaton blasts produced by comet fragments falling into the cloud tops of Jupiter; a map of the surface of distant Pluto; and evidence that galaxies may have been built up from smaller objects early in the history of the universe.

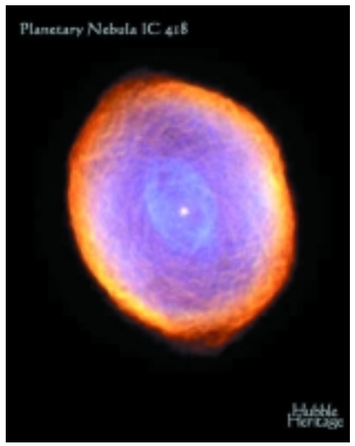
Because of widespread interest among scientists, amateur astronomers, the press and the public, the best images, known collectively as the Hubble Heritage, were released at regular intervals in fiscal year 2000.

One of Hubble's latest and potentially most significant breakthroughs came when researchers from two consortia independently discovered an unexpected and simple relationship between the masses of the black holes and the masses of the galaxy structures in which they are found. These structures, the central bulges of the galaxies, are huge round systems containing billions of stars. Black holes are regions of space where gravity is so powerful that nothing can escape, not even light. Giant or "supermassive" black holes range from about one million to several billion times the mass of the Sun.



These illustrations show the relationship between black hole mass and the stars that comprise an elliptical galaxy or the central bulge stars of a spiral galaxy. Galaxies with small bulges, like our Milky Way, have diminutive central black holes of a few million solar masses, while giant elliptical galaxies house billion-solar-mass black holes.





Three images from the Hubble Heritage Project, a collection of compelling HST images distilled from scientific data designed to pique curiosity about astrophysical understanding of the universe. Left: Glowing like a multi-faceted jewel, the planetary nebula IC 418 lies about 2,000 light-years from Earth in the direction of the constellation Lepus. Center: What appears as a bird's head, leaning over to snatch up a tasty meal is a striking example of a galaxy collision in NGC 6745. Right: This stellar swarm is M80 (NGC 6093), one of the densest of the 147 known globular star clusters in the Milky Way galaxy. Located about 28,000 light-years from Earth, M80 contains hundreds of thousands of stars, all held together by their mutual gravitational attraction.

The observations, conducted by the Goddard-built Space Telescope Imaging Spectrograph, showed that a giant black hole typically contains one-fifth of one percent of the mass of the galaxy bulge. Galaxies with big bulges contain more massive giant black holes, while galaxies with little or no bulge have black holes (if any) of much lower mass. The finding suggests a causal relationship between the presence of a black hole and the formation of the galaxy in which it is found.

X-Ray Astronomy

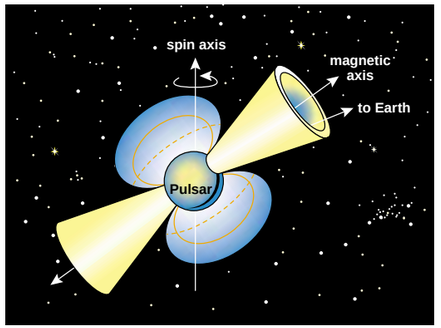
Hard X-Ray Background

Goddard and University of Hawaii scientists settled a decades-old mystery when they resolved a seemingly featureless celestial glow in many distinct objects. The glow, called the "hard X-ray background," had defied previous efforts to pinpoint its source. However, with the Advanced CCD Imaging Spectrometer on NASA's Chandra Observatory, the investigators traced the glow to numerous distinct and very distant objects, each a likely giant black hole at the center of a galaxy. The galaxies are so distant that the X-rays Chandra detected took billions of years to travel across time and space, and therefore we observe them as they were during the early stages of the universe. Many of the galaxies from which the X-rays come are quite strange, astronomers reported. They appear to lack the bright central regions or "galactic nuclei" that typically surround giant black holes.

The new findings on giant or supermassive black holes whetted researchers' appetites for definitive measurements of these strange objects. More powerful X-ray telescopes will be required to actually image the giant black holes.

Successful Tests of New X-Ray Instrument

A positive step in that direction came when scientists reported successful tests of a new instrument, which when fully developed and placed in space, could capture the first such images. The X-ray telescope, designed by scientists at the University of Colorado and Goddard, potentially can provide images 1,000 times sharper than current X-ray telescopes can. In orbit, it would be capable of discerning a spot the size of a dinner plate on the surface of the Sun. The technological approach employs interferometry, in which two or more telescopes are used simultaneously to detect fine details of a much larger instrument.



A diagram of a pulsar, showing its rotation axis and its magnetic axis.

Rossi X-Ray Timing Explorer

Goddard's Rossi X-ray Timing Explorer (RXTE) continued to advance X-ray astronomy and the study of objects of very high density, very strong gravity, and/or very high temperature. The behavior of matter under these forbidding conditions cannot be simulated or investigated in laboratories on Earth. One highlight was the identification of what may be the youngest-known pulsar. The object is located in an expanding nebula, called Kes 75, on the far side of the Milky Way about 60,000 light-years from Earth. Pulsars are very small and dense objects, the collapsed remainders of what once were stars larger, brighter and more massive than the Sun. Spinning rapidly, they flash like lighthouse beams into space. Some of these beams, like those from the recently discovered pulsar, are composed of X-rays, rather than radio waves or visible light. When the beams sweep past the Earth, telescopes and satellites detect brief flashes called pulses. The pulsar in Kes 75 is about 700 years old, according to Columbia University astronomers who worked with the RXTE to make the discovery.

Astronomers in The Netherlands used the RXTE to tune into unusual oscillations in matter spiraling down into three neutron stars. The oscillations may signal the distortion of space and time by the intense gravity of the stars. The researchers likened the signals to sidebands, which accompany transmissions from an AM radio station, perhaps the closest earthly analogy. Measurements of the oscillations can yield information about the masses and rotation rates of the stars and may provide significant tests of the General Theory of Relativity, first proposed by Albert Einstein.

The Sun and Space Weather

Goddard-operated space observatories made new discoveries about the Sun and also advanced our ability to predict the effects of solar storms on the Earth. Among the important contributors were SOHO, the European Space Agency/NASA Solar and Heliospheric Observatory, and Goddard's WIND and TRACE satellites.

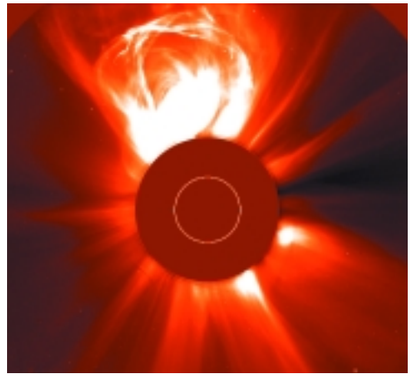
A new method for predicting the arrival time of certain huge solar disturbances on Earth should greatly improve warnings of these events, according to work by space physicists at the Catholic University of America and Goddard. These disturbances, called coronal mass ejections (CMEs), are clouds of electrified and magnetized gas that erupt from the Sun. A typical CME has a mass of about 1 billion tons and flies into space at about 1 million mph. The new technique can predict with an accuracy of about a half-day when the disturbance will begin affecting Earth. Previous methods were accurate to only 2 to 5 days. The travel time of a CME depends not only on the distance from the Earth to the Sun, but also on the disturbance's individual properties and the solar wind, the constantly changing outflow of solar gas that pervades interplanetary space. To make this advance, researchers combined information from SOHO with data on solar wind from WIND.

Besides improving the accuracy with which the arrival of solar disturbances can be predicted, research with SOHO resulted in a new procedure for long-range forecasting of bad "space weather." The sources of many solar events, which affect conditions in space and on Earth, are "active regions" that come and go on the Sun's surface. However, about one-half of these stormy regions arise on the far side of the Sun, out of Earth's view.

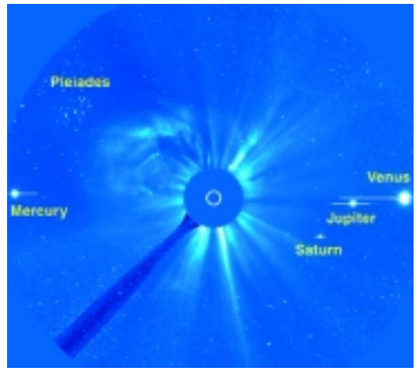
Researchers from Solar Physics Research Corp. and NorthWest Research Associates found that they can detect active regions on the far side by measuring and interpreting vibrations in the hot gas on the Sun's near side. Then scientists can estimate when the active regions will rotate to the near side, where they may discharge material and radiation toward the Earth.

Solar researchers pinned down the likely location of the heating process that makes the solar corona reach a temperature 300 times hotter than the Sun's visible surface. Scientists from Lockheed Martin and the Solar and Astrophysics Laboratory made the discovery while observing the Sun's immense, magnetized coils of hot, electrified gas, known as coronal loops. These structures were observed in unprecedented detail with TRACE, the Transition Region and Coronal Explorer. By taking the Sun's temperature at different positions along the lengths of the loops, the researchers concluded that the heating of the corona occurs in fountains of hot gas gushing upward at their foot points, the places where they emerge from the denser solar atmosphere below.

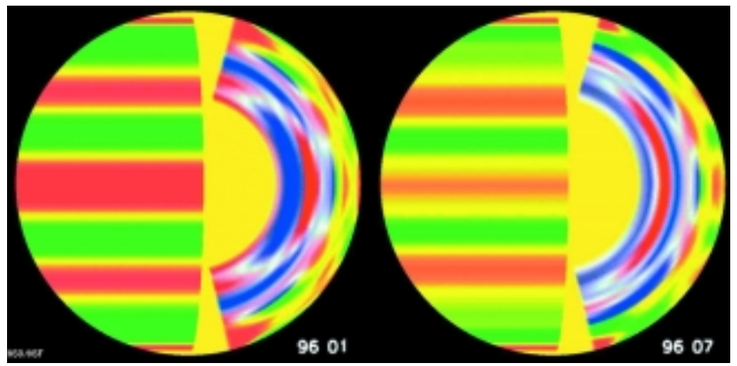
In related work, TRACE scientists detected a previously unknown solar phenomenon, which they dubbed "solar moss" because its spongy appearance reminded them of moss found in a garden. With this discovery, scientists are beginning to resolve the mysterious transition region, a thin region in the Sun's atmosphere



On February 26, 2000, a large filament eruption was seen in images from the Extreme ultraviolet Imaging Telescope (EIT) on the SOHO spacecraft. About an hour later, the filament eruption was seen as a huge coronal mass ejection (CME) in this image from the Large Angle and Spectrometric Coronagraph (LASCO). The shaded disk is a mask that blots out direct sunlight. The white circle added within the disk shows the size and position of the visible Sun.



Mercury, Venus, Jupiter, Saturn and the Sun all appear plainly in the same image sent to Earth on May 15, another scoop for the SOHO spacecraft. Also conspicuous in the picture is a famous star cluster, the Pleiades. Bright Venus entered the scene from the right, while Mercury exited on the left. Such congregations of planets are rare, and cannot be seen from the ground when so close to the Sun. But the LASCO instrument uses a mask to blot out direct sunlight, and its wide field of view (15 degrees) can take in all four planets.

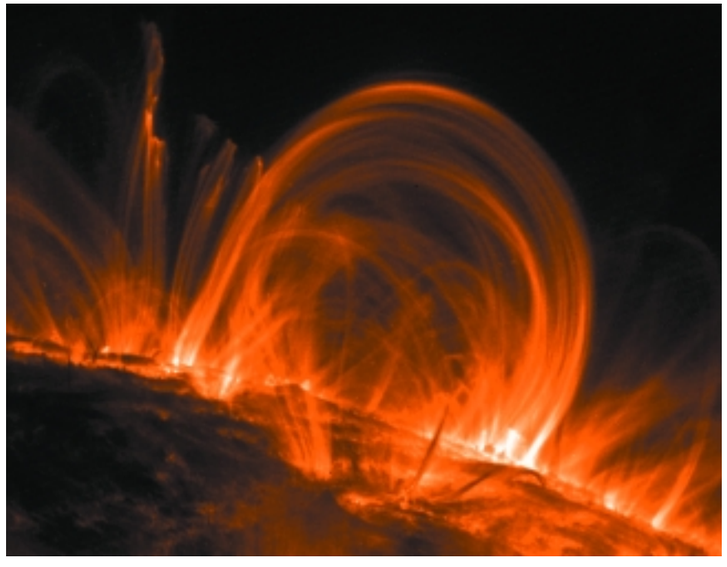


Currents of gas deep inside the Sun pulsate like the blood in human arteries, speeding and slackening every 16 months. Solar scientists were astonished by this discovery from an international team pooling observations from the MDI instrument on the ESA-NASA SOHO spacecraft and from a worldwide chain of ground stations called GONG. The need to understand the Sun's magnetic behavior, which produces space storms affecting the Earth, gives practical as well as theoretical importance to the discovery. To explain the cycle, in which dark sunspots and solar storminess peak at intervals of about 11 years, theorists visualize a dynamo inside the Sun. Relative motions between neighboring layers of electrified gas supposedly drive the dynamo. As the years pass, so the theory goes, the magnetic field becomes too strong for the gas to hold. It breaks out to the solar surface, causing sunspots and magnetic explosions. The changes now observed are at the right depth for a dynamo.

where the temperature soars from tens of thousands to millions of degrees Fahrenheit, getting hotter with altitude. The discovery may offer a new way to study the mass and energy flows in this region. It may also help to understand how the large loops located higher in the Sun's atmosphere, as mentioned just above, are formed from the underlying magnetic fields on the Sun's visible surface layer. The research was aided by images of the Sun in X-rays from Japan's YOHKOH satellite.

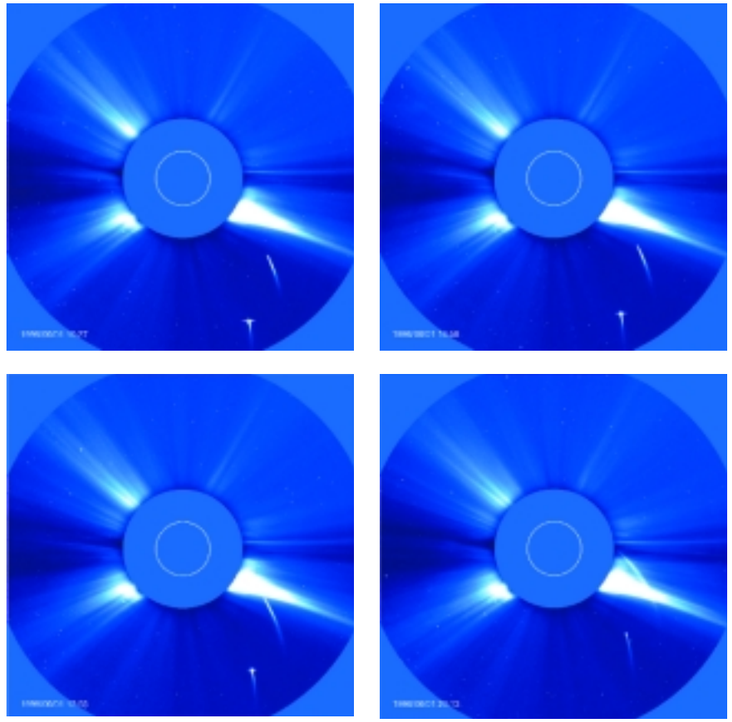
In studies reported in 2000, researchers with Goddard-operated NASA satellites described a remarkable event detected between May 10-12,1999. Amazingly, the solar wind that blows constantly off the Sun disappeared. According to satellite measurements by WIND and ACE, the episode was the most drastic and longest-lasting ever observed. The severe drop in the solar wind also changed the shape of Earth's magnetic field and produced an unusual type of auroral (Northern Lights) display at the North Pole. Dropping to just a percentage of its normal density and to half its normal speed, the wind died down enough to allow physicists working with the satellites to observe beams of electrons flowing directly from the Sun's corona to Earth. Normally, the great majority of the solar wind consists of particles that collide repeatedly with each other near the Sun, so that they do not proceed directly from their source locations to the place at which they are detected by satellites.

Space physicists from the U.S. and Japan made the first direct observations of the process that causes auroras and magnetic disturbances, or space weather, around the Earth. The scientists measured the transfer of energy from the solar wind into the Earth's protective "magnetic umbrella," the magnetosphere, and on down to the atmosphere. Such events can affect radio communications, spacecraft operations and the control of electric power systems on Earth. Relying on observations collected by NASA's Polar satellite and Japan's Geotail spacecraft, the investigators gathered clear evidence that this process, known as magnetic reconnection, occurs naturally in the Sun-Earth system. Previously, reconnection, which consists of the rearrangement and interconnection of so-called lines of magnetic force, had been observed only under artificial conditions in laboratories.



Fountains of multimillion-degree, electrified gas in the atmosphere of the Sun have revealed the location where the solar atmosphere is heated to temperatures 300 times greater than the Sun's visible surface. Scientists discovered this important clue for solving the long-standing mystery of the hot solar atmosphere while observing the gas fountains (known as coronal loops) in unprecedented detail with NASA's Transition Region and Coronal Explorer (TRACE) spacecraft.

Another Goddard satellite, the Fast Auroral Snapshot (FAST) spacecraft, discovered an "invisible aurora," which occurs along with the familiar visible aurora, also known as the aurora borealis (Northern Lights) in the Northern Hemisphere and the aurora australis (Southern Lights) in the Southern Hemisphere. Using FAST, University of California, Berkeley, researchers established the presence of the invisible aurora by consistently detecting upward flows of electrons interspersed with the downward flowing electrons that produce visible aurora. The discovery provides the first detailed picture of how the aurora and its inverted companion function together to complete a huge electric circuit in the magnetosphere, which is that region of space where electrically charged particles are controlled by the Earth's magnetic field.



Series of images from SOHO's LASCO C3 instrument showing two comets approaching the Sun. The time period covers about four hours.

Comets Strike the Sun

While observing the Sun's eruptions and vibrations, astronomers also used SOHO to discover more than 250 comets during its first 5 years of operation, making it by far the most successful comet-hunter in history. SOHO recorded more than 240 of these comets as they plunged to their doom in the Sun's outer atmosphere or corona. These objects, called Sun-grazing comets, are thought to be small fragments of a very large comet that broke apart in interplanetary space centuries ago. While many of the comets found in the SOHO images were discovered by SOHO scientists at Goddard, many others were discovered by amateur astronomers who studied SOHO data, which are available over the Internet.

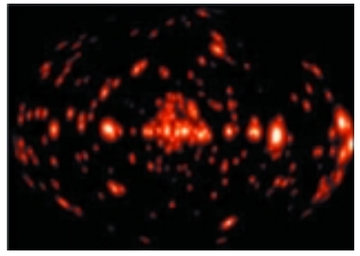
Gamma Ray Discoveries

Goddard astrophysicists using the Energetic Gamma Ray Telescope (EGRET) on the Compton Gamma Ray Observatory reported a new class of mysterious objects in Earth's home galaxy, the Milky Way. The nature of the objects is still uncertain. One theory is that the gamma rays are generated by the collisions of stellar winds from young stars, but further investigation with future space instruments is needed to account for them.

Set against the Earth's surface, the Compton Gamma Ray Observatory, with its solar array panels deployed, is grappled by the remote manipulator system during Space Shuttle mission STS-37.

This image is the map of objects detected in high-energy gamma rays by EGRET on Compton, including the objects of the new class just discovered.

Goddard researchers also reported finding a method to gauge the distances of the objects that produce gamma-ray bursts, considered perhaps the most powerful explosions in the universe. (These objects are located in faraway galaxies and are not related to the new class of objects in our Milky Way.) The investigators found that gamma rays of different energies within a single burst arrived at slightly different times, and that the brief interval between the arrival of the high-energy gamma rays and the subsequent arrival of the low-energy gamma rays depends on the true brightness of the burst. Consequently, the scientists were able to estimate the distances that the gamma rays had traveled. The new method may enable astronomers to identify the locations of objects beyond the reach of existing visible-light telescopes. As a result, scientists can explore how the geometry of the universe, the shape of space itself, has



changed since the Big Bang an estimated 14 billion years ago. Goddard researchers worked with data from the Compton Gamma Ray Observatory's Burst and Transient Source Experiment, an instrument developed by NASA's Marshall Space Flight Center, supplemented by observations from telescopes on the ground.

Universe from a Balloon

An international team of cosmologists released the most detailed map ever of a region of the universe as it looked in its infancy. The images reveal structures that existed when the universe was a tiny fraction of its current age and 1,000 times smaller and hotter than it is today. Detailed analysis of the data is helping to explore some of cosmology's outstanding mysteries, the nature of the matter and energy that dominate intergalactic space and whether space is "curved" or "flat." The project, dubbed BOOMERANG (Balloon Observations of Millimetric Extragalactic Radiation and Geophysics), obtained the images using an extremely sensitive telescope suspended from a balloon that circumnavigated the Antarctic continent in late 1998. The balloon carried the telescope at an altitude of almost 120,000 ft. (37 km) for 10-1/2 days. NASA's National Scientific Balloon Facility, managed by Goddard's Wallops Flight Facility, was instrumental in launching the large helium balloon that carried the instruments at high altitudes above the Earth. The Microwave Anistropy Probe (MAP), a satellite built at Goddard for launch in 2001, will follow this study with a definitive map of the entire sky at even higher sensitivity and precision.

With Mt. Erebus as a backdrop, NASA National Science Balloon Facility personnel inflate the 28 million-cubic-ft (1 million-meters-cubed) balloon which will carry the BOOMERANG telescope on its 10-day trip around the Antarctic continent. To make its exquisitely sensitive measurements, BOOMERANG is lifted above 99% of the atmosphere to an altitude of 120,000 ft(35 km). The continuous sunlight and stable air currents over Antarctica enable 10 to 20 day-long stratospheric balloon flights. This launch was preceded by two months of assembly at McMurdo research station, and half a decade of development and construction by an international team of researchers.

Space – How Sweet It Is

The scientific investigation of life-related chemicals and conditions in space was advanced by a Goddard scientist's discovery of the first known simple sugar molecule in space. The detection of the sugar molecule, glycolaldehyde, in a giant cloud of gas and dust near the center of the Milky Way was made with the National Science Foundation's 12-meter radio telescope on Kitt Peak in Arizona. The presence of this sugar molecule in an interstellar cloud from which new stars are forming increases the likelihood that the chemical precursors to life arise long before planets develop around the very same stars. It also indicates that similar events may have occurred when the Sun and Earth formed about 5 billion years ago.

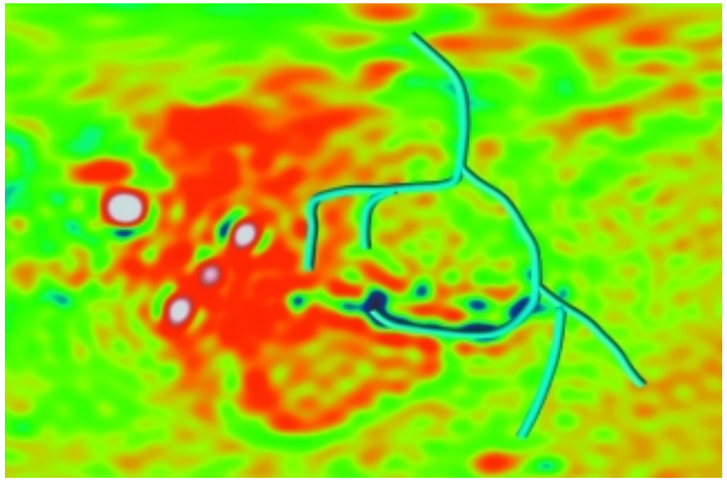
Exploring an Asteroid

As NASA's Near Earth Asteroid Rendezvous (NEAR) Shoemaker spacecraft circled the asteroid Eros, preliminary data from a Goddard instrument strongly implied that Eros is a very primitive object which may have been present while the Earth still was forming. The sensor detected X-rays from atoms in the minerals on the asteroid surface, which were generated when energetic radiation from explosions on the Sun stimulated the atoms and made them glow. Each brief flash of solar radiation caused the atoms to glow in unique "colors" of X-rays that are reliable indicators of the atoms' identities. The observations indicate that the chemical composition of Eros's surface is similar to that of a class of meteorites, the chondrites, which are agglomerations of dust grains from the birth nebula of the Sun and planets. The chemical readings indicated that Eros has never been exposed to substantial external or internal heat. As a result, it has not melted, and its heavy metals have not sunk toward the center, unlike Earth, for example, which has a molten nickel-iron core.

Hidden Secrets of Mars

Researchers with the Mars Global Surveyor (MGS), a Mars-orbiting spacecraft, discovered the presence of large underground channels that cannot be seen in photographs of the Martian surface. The channels, nearly 125 miles (200 km) wide and more

This image mosaic (below), showing Eros' saddle and a shadowed feature to its left, was taken on March 3, 2000 from a distance of 127 miles (204 km). Features as small as 65 ft (20 m) across are visible. The Sun illuminates a shadowed feature that consists of three large craters adjacent to each other. The two largest are each about 2-3 miles (4-5 km) across. Because the Sun is very low with respect to the craters, even small topographic features cast long shadows, making them easier to see, and several boulders on the crater walls can be distinguished, ranging from about 164-328 ft (50 to 100 meters) in diameter. The saddle (on the right) is relatively smooth with few impact craters, and has several grooves running across it. At the top of the saddle are several curved grooves that are brighter than the surrounding surface. Unusual brightness patterns are also visible in the crater at the top left of the mosaic. The walls of the crater appear to be more reflective and its floor less reflective than nearby parts of the asteroid.



Some of Mars' best kept secrets, long buried beneath the surface of the red planet, were recently revealed by instruments on NASA's Mars Global Surveyor spacecraft. New observations of Mars reveal that the planet's flat northern lowlands were an early zone of high heat flow that later may have been the site of rapid water accumulation. Elevation and gravity measurements, which have been used to probe beneath the surface of Mars, indicate a period of rapid cooling early in Martian history, and evidence for large buried channels that could have formed from the flow of enormous volumes of water.

than 1,025 miles (1650 km) long, might have poured water into a large basin, even an early ocean. The scientists used data from the Goddard-built MGS Mars Orbiter Laser Altimeter and the probe's Radio Science Experiment to investigate the gravity and topography of the planet's crust. Investigators from the Massachusetts Institute of Technology, Goddard and many other institutions worked together to unlock the record of heating, cooling and the effects of water on Mars' crust long ago. It appears that early in the planet's history, Mars' northern lowlands were the location of heat escape from the planet's interior. The buried channels may have been produced by the enormous water flows that are no longer present on the Martian surface. The MGS spacecraft is a project of NASA's Jet Propulsion Laboratory.

Exploring the Far-Ultraviolet Universe

An enormous halo of half-million-degree gas that surrounds the Milky Way was generated by thousands of exploding stars, or supernovae, as our galaxy evolved, according to observations by the Far Ultraviolet Spectroscopic Explorer (FUSE) spacecraft. The football-shaped halo of hot gas that surrounds our galaxy extends about 5,000-10,000 light-years above and below the mid-plane of the Milky Way and thins with distance. (One light-year is almost 6 trillion miles.) The FUSE observations reveal an extensive amount of oxygen VI (oxygen atoms that have had five of their eight surrounding electrons stripped away) in the halo. Some scientists thought that ultraviolet radiation from hot stars could produce the halo, which was discovered by Goddard's earlier International Ultraviolet Explorer satellite. However, the only way to produce the observed amount of oxygen VI is from the collision of blast waves produced by supernovae or exploding stars, the FUSE researchers said.

New Spacecraft Launched to Study Earth and Space

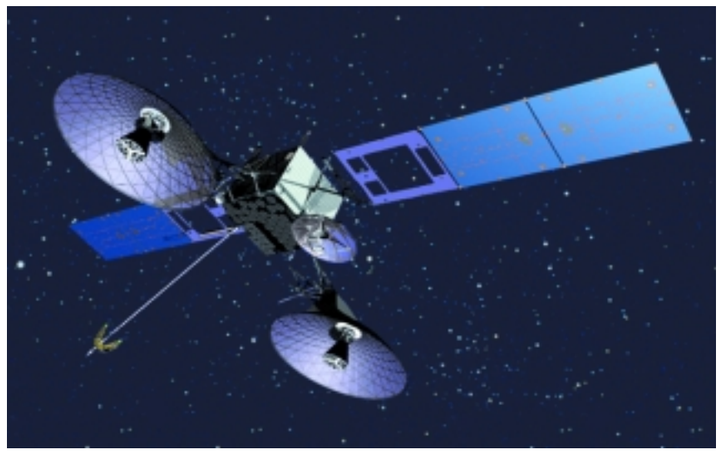
A hallmark of the Goddard Space Flight Center is its role managing the development and launch of scientific spacecraft for Earth and space science research, international projects, and weather satellites for the National Oceanic and Atmospheric Administration. During the year, Goddard supported the successful launch of eight spacecraft into orbit, a highly successful servicing mission to the Hubble Space Telescope and the test flight of a revolutionary concept for a long-duration science balloon.

NOAA-L
A new satellite that will improve weather forecasting and monitor environmental events around the world soared into space September 21, 2000 after a picture-perfect launch from Vandenberg Air Force Base, California. The National Oceanic and Atmospheric Administration (NOAA)-L spacecraft was launched by the Air Force on a Titan II rocket. Renamed NOAA-16, the spacecraft is the second in a series of five polar-orbiting satellites with improved imaging and sounding capabilities. The fleet of satellites will operate over the next 12 years. Like other NOAA satellites, NOAA-16 will collect meteorological data and transmit the information to users around the world to enhance weather forecasting. In the United States, NOAA's National Weather Service will use the data primarily for its long-range weather and climate forecasts.

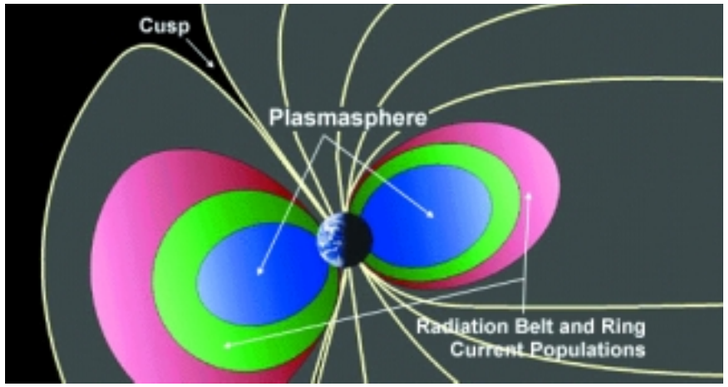
TDRS-H
NASA's newest Tracking and Data Relay Satellite-H (TDRS-H) lifted off June 30, 2000 from Cape Canaveral Air Force Station, Florida, aboard an Atlas IIA rocket. TDRS-H is the first of three new satellites that feature improved multiple access and S-band single-access performance, along with a new high frequency Ka-band service. Innovative design features also include a pair of 15-ft (4.5-m) diameter graphite mesh reflectors, which furl easily for launch and spring back to their original shape once on orbit.

Cluster
This project, an international collaboration led by the European Space Agency, investigates interactions between Earth's magnetic field and the solar wind. Four satellites, flying in formation, examine this complex relationship. The project began with the launch July 16, 2000 of two of the Cluster spacecraft aboard a Russian Soyuz rocket from Baikonur, Kazakhstan. The second pair was launched August 9, 2000. Cluster demonstrates the level of sophistication that NASA and ESA can achieve when they collaborate. During a 2-year mission, the quartet of satellites will travel around the Earth in a tetrahedral - or triangular pyramid - formation, collecting data on where the solar wind, which is a gas comprised primarily of electrons and protons, impacts Earth's magnetic field. The unprecedented detail provided by Cluster will allow scientists to assemble the first thorough three-dimensional maps of the environment that surrounds and protects our planet. Each spacecraft carries a complement of 11 identical instruments.

NASA's newest Tracking and Data Relay Satellite-H (TDRS-H), depicted in this computer-generated image, lifted off June 30, 2000 from Cape Canaveral Air Force Station, Florida., aboard an Atlas IIA rocket. TDRS-H is the first of three new satellites that features improved multiple access and S-band single access performance, along with a new high frequency Ka-band service. NASA's new TDRS system will serve the Space Shuttle, International Space Station, Hubble Space Telescope and other Earth-orbiting satellites with improved communications and data relay services well into the 21st century.



A Delta II rocket carrying NASA's newest Sun-Earth Connection spacecraft, the Imager for Magnetopause-to-Aurora Global Exploration, lifts off from the Western Range at Vandenberg AFB, California.

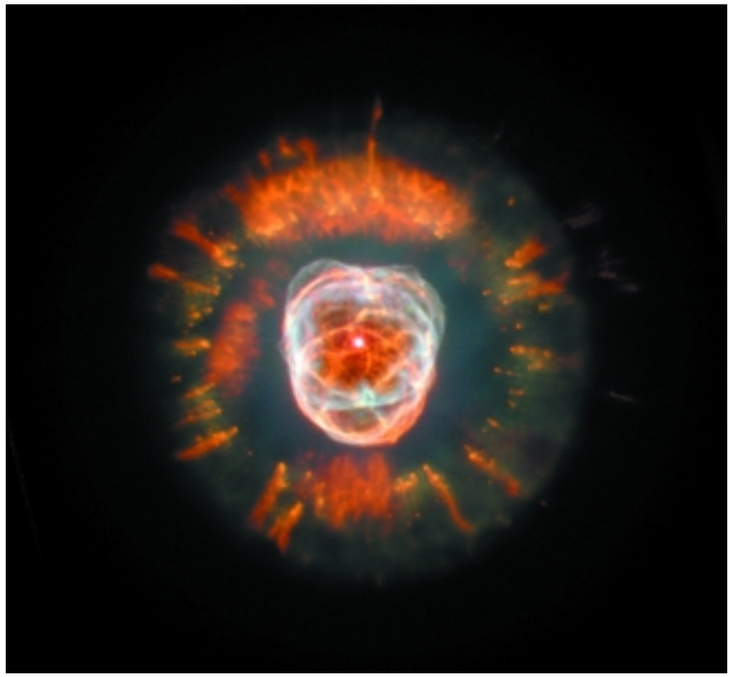


The IMAGE spacecraft carries an extreme ultraviolet (EUV) imager to detect solar EUV photons that are resonantly scattered by singly ionized helium in the plasmasphere, the torus of cold dense plasma surrounding the Earth in the inner magnetosphere. Unlike the plasma of the central plasma sheet, which in general "convects" (i. e., flows) sunward toward the dayside magnetopause, the cold, dense plasma of the plasmasphere is trapped on magnetic field lines that rotate with the Earth and thus "co-rotates" with them. It is the competitive interplay between these two flow regimes – one convecting sunward, the other co-rotating – that, together with the outflow of plasma from the ionosphere, determines the size, shape, and dynamics of the plasmasphere, which vary strongly according to the level of magnetospheric activity.

IMAGE
NASA's newest Sun-Earth Connection spacecraft lifted off March 25, 2000 from the Western Range at Vandenberg AFB, California. Called IMAGE (Imager for Magnetopause-to-Aurora Global Exploration), the spacecraft separated from the Delta II third stage about 56 minutes after launch. IMAGE's initial pictures revealed that the global ebb and flow of hot, electrified gas around the Earth is a reaction to the solar wind. Severe disturbances in this region, which is controlled by the Earth's magnetic field, are capable of disrupting satellites, telephone and radio communications and power systems. IMAGE is the first weather satellite for space storms. This revolutionary spacecraft makes these invisible storms visible.

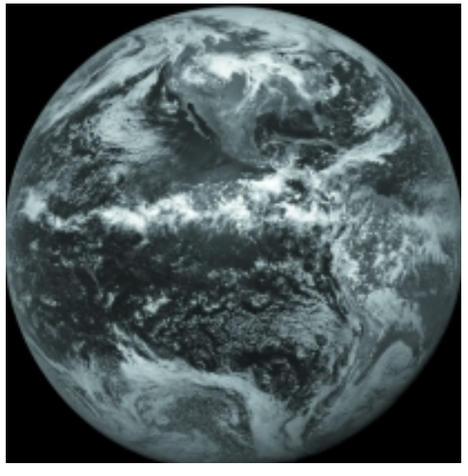
GOES-L
The fourth in a series of five sophisticated weather spacecraft soared into space May 3, 2000 from Cape Canaveral Air Force Station, Florida. The Geostationary Operational Environmental Satellite (GOES)-L spacecraft, considered the most sophisticated ever built, was carried in space aboard a Lockheed Martin Atlas IIA rocket. The Nation's newest weather satellite, renamed GOES-11, sent back its first image from space shortly after launch. GOES-11 takes images of clouds and reads the amount of moisture in the atmosphere. Shortly after launch, the satellite sent back a clear, crisp image from its vantage point 22,300 miles (35,887 km) in space. GOES-11 is being stored in orbit and will replace either GOES-8 or GOES-10 as needed.

GOES-L (now called GOES-11), the fourth in a series of five of the most sophisticated weather spacecraft ever built, soars into space May 3, 2000. The spacecraft has the dual capability of providing pictures while performing atmospheric sounding at the same time. The successful launch of GOES-11 launch assures continuity in services from NOAA's two-spacecraft constellation.



NASA's Hubble Space Telescope was back in business, as made dramatically evident in this stunning new celestial picture of a colorful dying star released in January 2000. Designated NGC 2392, it is dubbed the "Eskimo Nebula" because, as seen through ground-based telescopes, it resembles a face inside a furry parka. In Hubble's sharp view, the "furry" features resemble giant comets all pointing away from the central star, like the spokes of a wheel. The clumps that form the comet heads all seem to be located at a similar distance from the star.

Hubble Servicing Mission 3A
NASA's Hubble Space Telescope was back in business just weeks after a successful servicing mission, as made dramatically evident in stunning new celestial images of remote galaxies and a colorful dying star. The pictures, taken January 10-13, 2000 as part of NASA's activities to re-commission the telescope, culminated the successful Space Shuttle servicing mission (STS-103) in December 1999. During the servicing, astronauts restored NASA's premier optical space observatory to full capability by beefing up its electronics and installing critically needed replacement gyroscopes.



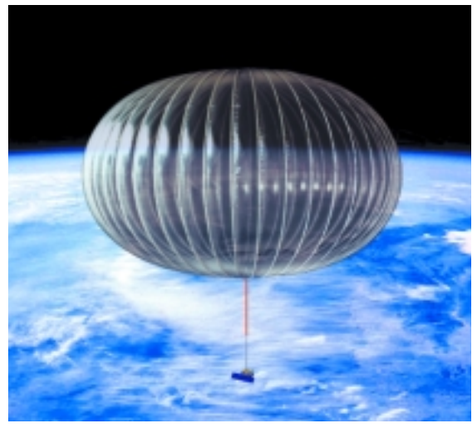
On May 18, 2000, GOES-11 sent back its first image from space. GOES-11 is being stored in orbit and will replace either GOES-8 or GOES-10 as needed. GOES satellites are operated by NOAA's National Environmental Satellite, Data, and Information Service in Suitland, Maryland,

Terra
A new generation of Earth science, one that studies the Earth's land, oceans, air, ice and life as a total global system, began with a flawless launch of the Terra spacecraft from Vandenberg Air Force Base, California. Formerly known as EOS AM-1, the Terra spacecraft lifted off on an Atlas IIAS rocket. Terra is the "flagship" of NASA's precedent-setting Earth Observing System program, which will study the complex interactions of Earth's land, water and air.

XMM
American scientists anxiously awaited the launch of the European Space Agency's (ESA) X-Ray Multi Mirror (XMM) spacecraft, which lifted off December 10, 2000 from French Guyana on an Ariane 5 launch vehicle. NASA contributed to the development of XMM with critical components for two of the spacecraft's three science instruments and is participating in the science-observing program. XMM will provide high-quality spectra of X-ray sources, including black holes and very hot objects created when the universe was very young.

ULDB
NASA successfully launched and demonstrated a prototype of its experimental balloon, the Ultra Long-Duration Balloon (ULDB). ULDB has the potential to revolutionize scientific balloon research because it can carry telescopes and other experiments weighing several tons to the edge of space for 100 days or more. In addition to be being less expensive than a rocket, the balloon allows the payload to be retrieved and launched again. The flight from Ft. Sumner, New Mexico, lasted more than 30 hours and tested the durability and functionality of the scientific balloon's unique pumpkin-shaped design and its novel material, a lightweight polyethylene film.

Goddard Mission Selected for Next MIDEX
Goddard is currently developing a satellite capable of capturing brief flashes of highly energetic light that momentarily outshine the rest of the universe and appear without warning once or twice a day above the Earth. NASA selected Swift, the fast moving gamma-ray burst detection satellite, as its next MIDEX-class mission. Gamma-ray bursts, which scientists believe may originate from the farthest reaches of space, perhaps when the universe was still very young, are among the most mysterious objects in space. MIDEX is the right venue for studying these objects. The program's aim is to incorporate the latest technology onto smaller satellites, which engineers and scientists can build and launch quickly and less expensively. Swift will be launched in 2003 and operate for 3 years at a cost of about $163 million.



An artist's concept of NASA's Ultra Long Duration Balloon (ULDB), a revolutionary new balloon system capable of supporting scientific observations above 99 percent of the Earth's atmosphere for durations approaching 100 days. Balloons offer a low-cost, quick-response method for doing scientific investigations.

2001 Launches

HESSI - High Energy Solar Spectroscopic Imager	March
QUIKTOMS - Total Ozone Mapping Spectrometer	May
TIMED/Jason - Thermosphere, Ionosphere, Mesosphere, Energetics and Dynamics	June
MAP - Microwave Anisotropy Probe	June
GOES-M - Geostationary Operational Environmental Satellite-M	July
AQUA-formerly Earth Observing Spacecraft PM-1	July
NOAA-M (POES) Polar-Orbiting Operational Environmental Satellite	August
TDRS-I - Tracking and Data Relay Satellite	October
GRACE - Gravity Recovery and Climate Experiment	November
HST SM 3B - Hubble Space Telescope Servicing Mission 3B	November
ICESAT/CATSAT - Ice, Cloud and Land Elevation Satellite, Cooperative Astrophysics and Technology Satellite	December

Innovations in Information and Engineering Technology

Goddard's aim is to build cutting-edge spacecraft and incorporate the information technology needed to speed up and reduce the cost of delivering data to researchers worldwide. In addition to state-of-the-art information technology, evolving technologies at Goddard include thermal control, spacecraft navigation, microelectronics, intelligent systems and super-conducting detectors. The following are a few examples of the technologies Goddard pursued in fiscal year 2000.

The Earth Observing Data and Information System (EODIS)
The Earth Observing Data and Information System (EODIS) is a complex data system that operates several satellites and instruments, captures data, generates data products and makes products available to users around the globe. In the past year, EODIS began supporting 1.1 terabytes per day of scientific data from the Terra spacecraft alone.

Intelligent Software
In the space sciences, advances in information technology resulted in the development of an experimental intelligent software interface, which guides a scientist through an observation's specifications in scientific terms rather than in mission parameters. This tool enables a scientist to specify his or her goals. Prototypes such as these will serve as the next generation of planning tools for spacecraft like the Hubble Space Telescope.

Goddard engineer Douglas B. Leviton holds his invention, an ultra-high resolution, optical position encoder, that won the NASA "Government Invention of the Year" award.

Satellite Situation Center Web
A major challenge in space exploration is access to data on the global interactions, structure and dynamics of space, information generated by multiple spacecraft. Two information technology services are available to help scientists. The Satellite Situation Center Web reveals the geophysical location of each orbiting satellite. With that information, scientists can learn how activities in Earth's magnetosphere, including solar wind and other events, affect satellite technology and a spacecraft's ability to gather data.

Coordinated Data Analysis Workshop Web
Another service is the Coordinated Data Analysis Workshop Web. Operational since 1996, this service has grown dramatically in recent years as a tool for researchers to gain access to multiple mission data sets provided by agencies worldwide. Armed with this data, scientists can determine the engineering aspects of instrument operations and analysis.

Position Encoder
A new, ultra-high resolution, optical position-encoding technology, invented by Douglas B. Leviton of Goddard's Optics Branch, won NASA's "Government Invention of the Year." Position encoders are devices that measure linear or rotary positions of moving parts in machines such as robots, machine tools, inspection systems and telescope mounts. NASA already has used the patented encoder in several mission-critical measurement operations and calibrations.

NASA used the instrument, for example, to develop the first far-ultraviolet prism refractometer, which calibrated the spectral dispersion of flight prisms for the Hubble Space Telescope's Advanced Camera for Surveys (ACS). The Agency also used it to precisely measure the motions of a large, three-axis positioning platform that accurately positions a 350-lb. (160-kg) optical stimulus in front of the ACS for ground calibrations. NASA then used it to qualify the accuracy of the flight encoders in the ultra-high resolution, gimbaled scan mirror assembly for the High Resolution Dynamics Limb Sounder instrument for the Earth Observing Systems-Chemistry mission. No other encoder was capable of performing this task.

Encoders now are being built for seven mechanisms in the optical calibration stimulus for Hubble's Wide Field Camera 3 where the mechanism's encoding requirements are beyond the conventional. These encoders also are being used in the Wide-field Imaging Interferometry Testbed (WIIT), which will demonstrate the feasibility of science observations for the Sub-millimeter Probe for the Evolution of Cosmic Structure mission.

As part of its technology-transfer efforts, Goddard's Technology Commercialization Office is aggressively marketing the new encoder technology to the private sector.

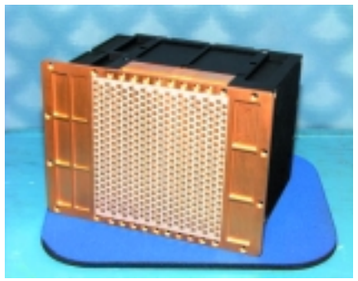
High Rate User Ka-Band Phased-Array Antenna
Although new NASA missions are getting smaller, they are not generating less data. To advance communication technology, Goddard is developing an engineering model of the High Rate User Ka-Band Phased-Array Antenna (HRUPAA). With the antenna, low-Earth orbiting spacecraft will be able to establish high data-rate communications in the 25.25-27.5 GHz band with ground stations or the Tracking and Data Relay Satellite System. The antenna is small enough to be carried by small satellites and has no moving parts, which eliminate undesired mechanical disturbances that may affect instruments. The antenna will provide future satellite projects with the compact antenna system to take advantage of the new Ka-band allocation.

Technicians complete the integration of the Infrared Array Camera instrument to the Space Infrared Telescope Facility's Multiple Instrument Chamber baseplate.

Infrared Array Camera
Goddard built and integrated the Infrared Array Camera (IRAC) onto the Space Infrared Telescope Facility (SIRTF), the fourth and last of NASA's Great Observatories. SIRTF will explore the cosmos in the infrared portion of the electromagnetic spectrum, particularly young galaxies and stars, dust disks around stars where planets may be forming, objects hidden by dust and some of the most distant objects in the universe. IRAC, one of three instruments to be installed and flown on SIRTF, will be used for a wide variety of astronomical investigations during SIRTF's mission, including the study of the early universe, searching for brown dwarfs and protoplanets and the study of galaxies.

Three-Dimensional Stacked Microelectronics
Goddard is developing advanced forms of microelectronic packaging which are critical to the development of smaller satellites and instruments. In particular, Goddard is developing a concept for three-dimensional (3-D) stacked microelectronics. With stacking, engineers can more efficiently use printed circuit boards.

Chemical Vapor Deposition (CVD) diamond meets these requirements. CVD diamond is used as a substrate for Vertical Cavity Surface Emitting Lasers, Power



Scale engineering model of the High Rate User Ka Band phased array antenna which is being developed so that low-Earth orbiting spacecraft can communicate with ground stations or TDRS satellites in the Ka-band frequency.

Monolithic Microwave Integrated Circuits and 3-D stacked multi-chip modules (MCM).

Goddard's advanced 3-D stacked multi-chip modules combine a number of important features for next-generation, high-density electronics, such as laser repairable substrates for non-contact rework of high-density circuits. Another important feature is high input/output (I/O) density. It is anticipated that many applications will require high I/O Field Programmable Gate Arrays and Application Specific Integrated Circuits in a single stack.

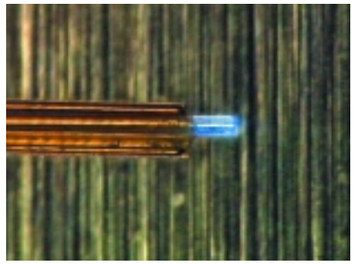
Sol-Gel and Fiber Optic Waveguides

Goddard researchers have developed an innovative process for incorporating sol-gel into hollow-core fiber optic waveguides. A number of commercial companies have expressed interest in licensing the patent rights because of their potential in the communications, chemical, public safety, environmental and food safety industries.

Earth Science Technology at Goddard

In fiscal year2000, Goddard assumed the role of lead Center in the management of the Earth Science Technology Office for the Earth Science Enterprise. This office is responsible for integrating technology-development programs, which include advanced information systems, instruments, sensors, detectors and sensor web technologies, into a single comprehensive program for the Enterprise.

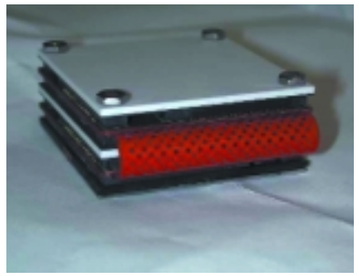
Specifically, the office is involved in developing:



TOP LEFT: Goddard's Paul Haney and Claef Hakun hold the Infrared Array Camera's cryogenic assembly in the Building 7 optics lab clean room.

BOTTOM LEFT: Integrating sol-gel sensors into optical fibers, as shown here, may provide both scientific and spacecraft housekeeping data needs in the same fiber.

BELOW: Electronic components of the future could include advanced 3-D stacked multi-chip modules like the one pictured here.



Smaller, smart detector arrays and passive sensing systems that reduce subsystem mass and power to simplify calibration, integration and operation.

Instrument architectures, such as active sensors for space-based laser, lidar and radar applications, with improved lifetime, efficiency and performance and with reduced mass, volume and cost.

Platform architectures that provide significant reductions in life-cycle costs by decreasing mass, volume, power and operations complexity and increasing the autonomy of onboard operations

Advanced miniaturization that will enable smaller, more capable sub-orbital and surface based platforms.

Effective approaches for linking multiple data sets and extracting and visualizing Earth system data and information.

Goddard is developing advanced information systems technology, such as a Cloud Contamination Detection with Atmospheric Correction process. The foundation of this research could lead to onboard decisions whether to downlink cloud contaminated imagery or not. In this image, the Atlantic Ocean is blue and cloud cover is flagged in red.

Tools to expand access to Earth science information by commercial and local users in forms suitable for their own applications.

Independent Verification and Validation Facility

In Fiscal 2000, the Goddard Space Flight Center welcomed to the family NASA's Independent Verification and Validation (IV&V) Facility in Fairmont, West Virginia. Located in the heart of the state's emerging technology sector, the facility was established in 1993 as part of an Agency-wide strategy to provide the highest levels of safety and cost effectiveness for mission-critical software.

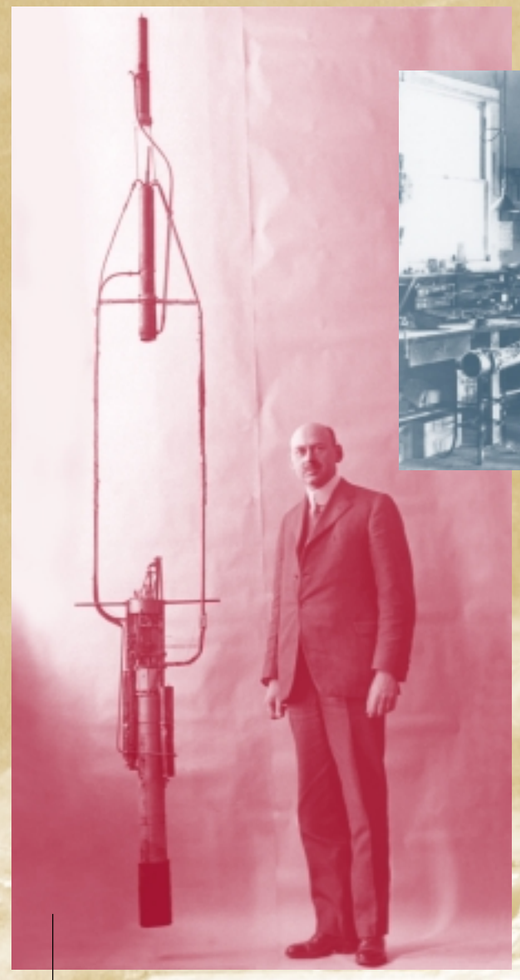
Since its founding, the IV&V facility has experienced continuous growth in personnel, projects, capabilities and accomplishments and has contributed significantly to NASA's improved safety record. Now staffed with 140 full-time employees, the facility leverages the expertise of more than 20 in-house partners and contractors.

Their expertise is especially necessary today. As NASA becomes increasingly dependent on complex, critical software to achieve its mission objectives, the Agency is turning to IV&V to identify and mitigate possible software risks. During the summer of 2000, for example, the Agency evaluated its missions for the potential application of IV&V.

In addition, the IV&V Facility has a research division that develops new methodologies and tools to enhance the efficiency and effectiveness of its NASA work. The facility collaborates with the NASA Office of Safety and Mission Assurance, other NASA Centers, the NASA Software Working Group, West Virginia University and other academic institutions.

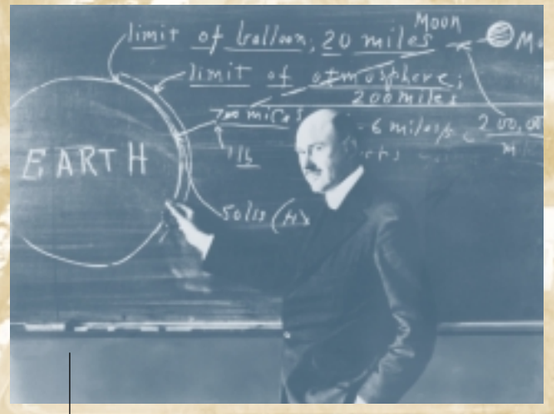
Workers place a large NASA logo on the NASA Independent Verification and Validation Facility located in Fairmont, West Virginia..

Goddard Heritage



Dr. Robert Goddard first developed and launched a liquid-fuel rocket March 16, 1926.

Dr. Goddard checks the fuel pumps on one of his rockets as his assistants look on. A combustion chamber is on the left and the oxygen and gasoline tank are on the right.



Dr. Robert H. Goddard at the chalk board at Clark University in 1924, explaining the method by which a rocket might reach the moon.

Building 2 at GSFC as it looked under construction.

Dedication ceremonies take place at Goddard Space Flight Center on March 16, 1961.

This aerial photo of GSFC shows a few completed buildings.

Goddard Services

Located on nearly 1,100 acres, the Goddard Space Flight Center is committed to being NASA's Center of Excellence for Scientific Research, particularly in the fields of space and Earth sciences and technology. Our success hinges almost exclusively on whether we can attract and retain the Nation's top scientific and engineering talent. That is why Goddard focuses so much effort on its special services. They bolster Goddard's reputation as one of the region's "employers of choice," which then assures our goal of attracting top scientific and engineering talent.

Goddard employees attend the Learning Center to refresh or learn new skills.

Office of Human Resources

The Office of Human Resources (OHR) partners with the Goddard community to create and sustain a diverse, vital and effective workforce. The organization's goal is to "get the right people, with the right skills, in the right place at the right time." In addition to recruiting employees, the office offers an array of programs to promote job satisfaction, including the annual awards and recognition program.

The Office of Human Resources offers employees professional development and academic courses in such areas as computer graphics and web development.

Goddard Homer E. Newell Library

The goal of Goddard's Homer E. Newell Library, which includes the Technical Library at the Wallops Flight Facility, is facilitating research in Earth science, space science and the enabling technologies. To support this mission, the Library maintains and provides access to more than 150,000 books and bound journals, 1,100 current journals and more than 150 electronic journals. The collection concentrates on aerospace, astronomy, physics, Earth sciences, engineering, robotics and computers/communication. It also maintains special profiles in subject areas of interest to the Center. The Library is open to all Goddard employees and contractors, temporary employees, research associates and civil service retirees with approved library cards.

Technical Information Services Branch

The Technical Information Services Branch (TISB) provides a wide range of services, including audio-visual service, conference support, duplicating, editing, graphics, printing, photo, video production, video teleconferencing, copy management and auditorium scheduling.

Goddard Employee Welfare Association

The Goddard Employees Welfare Association (GEWA) encourages and supports group activities and functions at the Center and is dedicated to the social, athletic, educational and cultural welfare of its members. To that end, GEWA supports more than 50 clubs and sponsors several special events and activities for employees and their families.

Recreation Center
Goddard employees and their families, on-site contractors and their families and official clubs recognized by GEWA use the GEWA-built Goddard Recreation Center. The facility is located on about 17 acres of land and includes a playground, softball field and a basketball and volleyball court.

Goddard Child Development Center
Established in 1972, the Goddard Child Development Center, Inc. (GCDC) provides quality childcare for 122 children, aged 24 months through kindergarten. The GCDC is licensed by the Maryland Department of Human Resources, certified as a preschool and kindergarten by the Maryland State Department of Education and accredited by the National Association for the Education of Young Children. Membership is open to all Goddard employees and on-site contractors.

Post Office
GEWA owns and operates the on-site Post Office for the convenience of Goddard employees. A GEWA employee, trained by the U.S. Postal Service, operates the Post Office 4 days a week, providing the full range of postal services.

Cafeteria
Goddard employees have a choice of two on-campus cafeterias, operated by GEWA-contract employees. Both facilities offer full lunch menus with an occasional guest chef. The cafeterias serve more than 420,000 people annually.

Fruit Truck
GEWA coordinates with local produce growers to provide fresh fruits and vegetables for Goddard employees. The "fruit truck" visits Goddard once a week to sell seasonal fruits, vegetables, homemade bread and pies, jams and jellies.

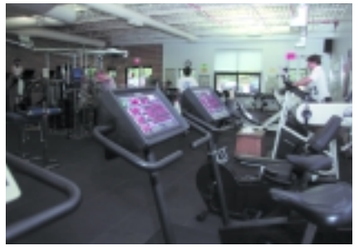
The Goddard Child Development Center provides educational and developmental childcare for employees' children during the year.

The Goddard Employee Welfare Association sponsors a weekly "fresh-from-the-farm" service. A vendor sells local fresh fruits, vegetables and homemade breads and jams.

Director's Colloquia
The Center Director's Colloquia Series began in 1997 to educate the workforce about the Center's Strategic Implementation Plan and other NASA initiatives. In fiscal year 2000, the Colloquia Series featured 12 distinguished speakers, who discussed a variety of business and leadership topics.

Two cafeterias within walking distance of most Goddard building, provide full breakfast and lunch menus.

The Director's Colloquium series focuses on Goddard's seven organizational values. Speakers address a wide range of topics. Shown above is Dr. Robert Ballard, founder of the JASON Project and the Institute for Exploration, discussing his explorations in oceanography.



Safety and good health practices are for employees. The Goddard Health Unit pictured above, offers a fitness facility, medical services and health and education programs

The NASA Federal Credit Union, also shown above, offers services to over 60,000 members across the country. Featured here is the Greenbelt, on-site branch. Other nearby locations provides easy access for employees.

Health Unit
NASA's Occupational Health Program provides medical services to all civil servant employees and is staffed by employees of Occu-Health, Inc. Vibrant and vital to the health and welfare of Goddard's 3,000 government employees, the health unit offers, among other things, health education and wellness programs, hypertension screening, a fitness facility, an annual health fair and regularly scheduled health-related seminars.

Credit Union
NASA Federal Credit Union, founded in 1949 by employees of the National Advisory Committee for Aeronautics, provides employees with responsive, reasonably priced access to financial services. Today, the credit union proudly serves about 60,000 members across the country and throughout the world.Members of NASA FCU also are owners. Members elect the officers who set the policies and direction of the credit union. As a "not-for-profit" institution, the credit union returns its profits to its members in the form of lower loan rates, higher savings rates and other free or affordably priced services.

Goddard Visitor Center

Goddard employees take great pride in their accomplishments and scientific achievements and are eager to share their work with the public. The Goddard Visitor Center is a place where our scientists and engineers can do just that. The facility offers permanent and temporary exhibits as well as the "Discover Goddard" program, featuring special presentations by Goddard scientists.

The Visitor Center offers a location for Goddard's engineers and scientists to share their work with the public, teachers and students.

Beyond our Gates

Goddard interacts with its neighbors on a regular basis and collaborated with them on a variety of events, including the 10th Anniversary of the Hubble Space Telescope, Earth Awareness 2000, Engineering Week and Goddard Community Day, just to name a few. The Center shares its expertise, resources and, most importantly, its people with others.

The Patuxent Wildlife Research Center, an international leader in wildlife research and management since its founding in 1936, is one of America's first wildlife experiment stations and research refuges. Its scientists are responsible for some of the most significant advances in wildlife conservation and management, especially in such areas as waterfowl harvest management, wildlife habitat improvement, effects of environmental contaminants, conservation of endangered species, migratory bird management and wildlife population analysis. Located in Laurel, Maryland, the Patuxent Wildlife Research Center is part of the U.S. Geological Survey and one of Goddard's neighbors to the north.

The Maryland Science Center is located in Baltimore's Inner Harbor and contains three floors of interactive exhibits as well as an IMAX Theater, Davis Planetarium, Lightspeed Laser Theater, Kids Room and Demonstration Stage. The new exhibit, Outer Space Place, is home to the Hubble Space Telescope National Visitor Center, where visitors can explore Hubble's images and technology.

ABOVE: SpaceLink is the Maryland Science Center's new high-tech, high-touch update center that treats its visitors to the latest in space exploration, space science and astronomy. Four large video screens are connected to 18 inputs, including satellite feeds, NASA TV and live video from the Science Center's rooftop Observatory. Interactive SpaceLink exhibits and Internet-connected computers invite visitors to investigate Mars exploration, the International Space Station and other NASA missions with Maryland connections, including SOHO, the Hubble Space Telescope and NEAR Shoemaker.

Andrews Air Force Base (AAFB) is in Camp Springs, Maryland, about 15 miles from Goddard. The 4,300- acre main base includes runways, aircraft-support facilities and administrative, housing and recreational facilities. The facility, established in 1942 as the Camp Springs Army Airfield and later renamed Andrews Air Force Base, supports the operations of several aircraft, including fighters, bombers, cargo and passenger aircraft. The facility continues to serve as the home of the presidential air fleet, including Air Force One.

The Howard B. Owens Science Center, part of the Prince George's Public School System, emphasizes hands-on instruction for students and educators. The facility includes a Challenger Learning Center, a planetarium and a nature trail. Hands-on activities provide students with experiences in physics, chemistry, physiology, biology, space science education, paleontology, meteorology, optics, nutrition, computer science and astronomy.

The City of Greenbelt is a suburb of Washington, D.C., located within Prince George's County, one of the largest and fastest-growing counties in the country. A number of major employment centers, including the Goddard Space Flight Center, the Department of Agriculture Research Center and the University of Maryland, are located just outside the city limits. City facilities include two recreational centers, a community center, indoor and outdoor swimming pools, a fitness center, extensive ball fields, 23 playgrounds, 190 acres of parkland (including scenic Greenbelt Lake) and an 1,100-acre national park. Downtown Greenbelt is only 2 miles from Goddard.

As part of the National Park Service, Greenbelt Park is a retreat from the pressures of life and a refuge for native plants and animals located just 2.5 miles from Goddard. Greenbelt Park has a campground, nature trails and picnic area. Goddard employees and their families enjoy nearby Greenbelt Park in their leisure.

On the first anniversary of Hurricane Floyd, which brought flooding rains, high winds and rough seas along a good portion of the Atlantic seaboard in mid-September 1999, NOAA opened at Goddard its new backup station for satellite command and data acquisition. The backup station will ensure that data from NOAA's geostationary satellite, which watches over the Atlantic Ocean, continues to flow if a hurricane disables the primary site at its station in Wallops, Virginia. The Wallops station acquires and distributes a continuous flow of data from NOAA's Geostationary Operational Environmental Satellites to users around the country. NOAA's environmental satellite system is made up of two types of satellites: geostationary operational environmental satellites for national, regional and short-range warning as well as "now-casting" and polar-orbiting environmental satellites for global, long-term forecasting. Both kinds of satellites are necessary for providing a complete global weather monitoring system.

RIGHT: The Henry A. Wallace Beltsville Agricultural Research Center (BARC) complex in Beltsville, Maryland, comprises 47 laboratories and more than 400 other buildings located on 7,000 acres. It includes eight weather stations, 10 million-dollar greenhouses and the 14-story Abraham Lincoln Library, which houses the world's largest collection of agricultural-related materials. Part of the U.S. Department of Agriculture, BARC has been a Goddard neighbor for more than four decades.

College Park Airport is the "world's oldest continuously operated airport." It was established in 1909 when Orville and Wilbur Wright brought their newly accepted government aircraft to the field, where they taught the first two Army officers how to fly. The Maryland-National Capital Park and Planning Commission owns the College Park Airport and maintains it as both an operating airport and an historic site.

RIGHT: Marietta House, located in Glen Dale, approximately 4 miles from Goddard, was the plantation home of Gabriel Duvall. He undertook the building of this modest Federal-style brick house about the same time he was appointed an Associate Justice on the U. S. Supreme Court in 1811. Marietta is owned by the Maryland National Capital Park and Planning Commission and operated by the Natural and Historical Resources Division of the Prince George's County Department of Parks and Recreation.

Resources

The United States Naval Academy is located in Annapolis, Maryland. Its mission is "to develop midshipmen morally, mentally and physically and to imbue them with the highest ideals of duty, honor and loyalty in order to provide graduates who are dedicated to a career of naval service and have potential for future in mind and character to assume the highest responsibilities of command, citizenship and government." This is a tall order, but one that the Academy has successfully fulfilled for more than150 years. Over the years, several retired Goddard scientists and engineers have served on the Academy's faculty.

Founded in 1983, the Goddard Retirees & Alumni Association is open to all retired Goddard civil-service employees, alumni and spouses. Several members, who are well versed on the history of the U.S. space program, serve as volunteers for the Goddard Office of Public Affairs, staffing posts at the Goddard Visitor Center, giving talks and demonstrations at schools and sharing their knowledge and experiences with younger people.

Firefighters from Wallops and members of volunteer companies from the surrounding area took part in a training session with the Mobile Aircraft Rescue Fire Fighting Trainer from the Commonwealth of Virginia in March 2000. Wallops will again host a training session in March 2001.

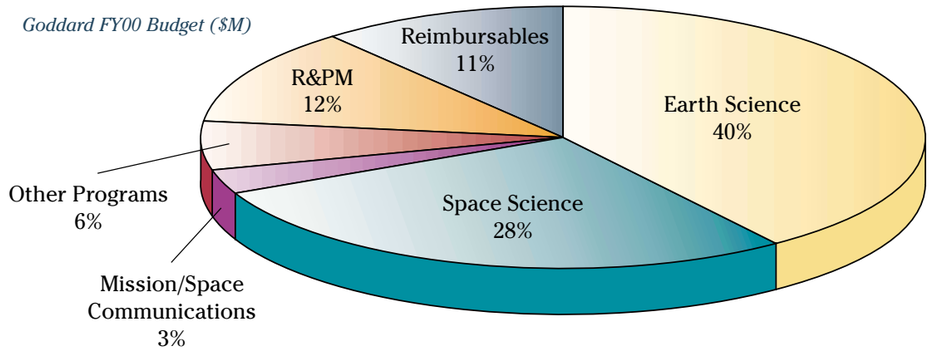
Goddard FY00 Budget ($M)

Earth Science	1,185.6
Space Science	832.2
Mission/Space Communications	88.9
Other Programs	167.1
R&PM	352.8
Subtotal Direct Appropriations	2,626.6
Reimbursables	309.4
Total	**2,936.0**

Goddard Workforce (FTEs)
Civil Service/Contractor Support FTEs

	FY00
Earth Science	2,106
Space Science	1,944
Mission/Space Communications	1,095
Other Direct Programs	1,005
Indirects	1,951
Total	**8,101**

Goddard FY00 Budget ($M)



Financial Statements

Overview of the Goddard Space Flight Center's Financial Statements

The Fiscal Year (FY) 2000 Financial Statements have been formulated to present the financial position and results of operations of NASA, Goddard Space Flight Center (GSFC), pursuant to the requirements of the Chief Financial Officers Act of 1990 and the Government Reform Act of 1994. These statements include the Statement of Financial Position and the Statement of Operations and Changes in Net Position. The statements have been prepared from the official accounting and budgetary records of GSFC (Basic Accounting System and Fiscal System) in accordance with the form and content prescribed by the Office of Management and Budget (OMB) Bulletin 94-01.

The statements should be read with the realization that they reflect the component of a sovereign entity; that liabilities not covered by budgetary resources cannot be liquidated without the enactment of an appropriation; and that payment of all liabilities, other than contracts, can be abrogated by the sovereign entity.

There are eight direct appropriations included in GSFC's Financial Statements. The current appropriations are Human Space Flight (HSF), Science, Aeronautics and Technology (SAT), Mission Support (MS), Office of the Inspector General (OIG), and the Science, Space and Technology Education Trust Fund. Actual expenses for all appropriations including government and non-government reimbursable activities are reflected in the Financial Statements for FY 2000.

Statement of Financial Position
As of September 30, 2000

	2000	1999
Assets		
Intragovernmental Assets:	(In Thousands)	(In Thousands)
Fund Balance with Treasury (Note 2)	$ 1,401,140	$ 1,429,862
Accounts Receivable, Net (Note 3) – Federal Claims	41,220	45,892
Advances and Prepayments (Note 4)	5,151	2,749
Governmental Assets:		
Accounts Receivable, Net (Note 3) – Non-federal Claims	739	2,211
Operating Materials & Supplies, Net (Note 5)	254,050	241,320
Property, Plant and Equipment, Net (Note 6)	2,067,630	2,216,432
Total Assets	**$ 3,769,930**	**$ 3,938,466**
Liabilities		
Liabilities Covered by Budgetary Resources:		
Intragovernmental Liabilities:		
Accounts Payable	$ 42,117	$ 50,411
Other Liabilities (Note 7)	32,144	20,005
Governmental Liabilities:		
Accounts Payable	610,435	628,934
Lease Liabilities (Note 8)	141	190
Other Liabilities (Note 7)	17,831	16,827
Total Liabilities Covered by Budgetary Resources	**$ 702,668**	**$ 716,367**
Liabilities Not Covered by Budgetary Resources:		
Intragovernmental Liabilities:		
Other Liabilities (Note 7)	$ 2,106	$ 2,092
Governmental Liabilities:		
Lease Liabilities (Note 8)	—	121
Other Liabilities (Note 7)	34,115	31,609
Total Liabilities Not Covered by Budgetary Resources	**36,221**	**33,822**
Total Liabilities	**$ 738,889**	**$ 750,189**
Net Position (Note 9):		
Balances:		
Unexpended Appropriation	$ 745,469	$ 764,517
Trust Fund Balance	225	
Invested Capital (Note 10)	2,321,539	2,457,440
Cumulative Results of Operations	29	21
Future Funding Requirements	(36,221)	(33,701)
Total Net Position	**$ 3,031,041**	**$ 3,188,277**
Total Liabilities and Net Position	**$ 3,769,930**	**$ 3,938,466**

The accompanying notes are an integral part of these statements.

Statement of Operations and Changes in Net Position
For the Year Ended September 30, 2000

	2000	1999
Revenues and Financing Resources:	(In Thousands)	(In Thousands)
Appropriated Capital Used	$ 2,546,252	$ 2,588,377
Revenues from Sales of Goods & Services		
To the Public	2,812	16,048
Intragovernmental	295,432	342,375
Other Revenues and Financing Resources	(9,563)	4,490
Less: Receipts Transferred to Treasury	9,563	(4,490)
Total Revenues and Financing Resources:	**$ 2,844,496**	**$ 2,946,800**
Expenses:		
Program or Operating Expenses:		
Current Appropriations:		
Science Aeronautics and Technology	$ 2,086,404	$ 2,128,938
Human Space Flight	14,272	23,073
Mission Support	444,686	458,051
Office of Inspector General	—	8
Science, Space and Technology Education Trust Fund	190	(169)
Noncurrent Appropriations:		
Space Flight Control and Data Communications	(1,102)	(434)
Research and Development	(1,529)	(21,570)
Research and Program Management	—	(5)
Construction of Facilities	1,524	464
Financing Resources Transferred Out Without Reimbursement	1,810	—
Special Fund Receipts, CY Expenses	(11)	—
Reimbursable Expenses	298,244	358,423
Total Expenses:	**$ 2,844,488**	**$ 2,946,779**
Excess, (Shortage) of Revenues & Financing Sources Over Total Expenses	**$ 8**	**$ 21**

Changes in Net Position

Nonoperating Changes:		
Unexpended Appropriations	$ (19,048)	$ (394)
Trust Fund Balance	225	—
Invested Capital	(135,901)	(511,106)
Future Funding Requirements	(2,520)	(1,733)
Total Nonoperating Changes	**$ (157,244)**	**$ (513,233)**
Excess, (Shortage) of Revenues & Financing Sources Over Total Expenses	**$ 8**	**$ 21**
Net Position, Beginning Balance	**$ 3,188,277**	**$ 3,701,489**
Net Position, Ending Balance	**$ 3,031,041**	**$ 3,188,277**

The accompanying notes are an integral part of these statements.

Notes to the Financial Statements
For the Year Ended September 30, 2000

Summary of Accounting Policies and Operations – Note 1

Basis of Presentation

In accordance with NASA's Chief Financial Officer (CFO) directive that installations begin the process of fulfilling the requirements legislated by the Chief Financial Officers Act of 1990, regarding the preparation of subject to audit financial statements (beginning FY 1996), these statements were formulated from the books and records of GSFC in conformity with form and content procedures specified in OMB Bulletin 94-01.

Reporting Entity

GSFC is one of nine NASA field centers established to assist NASA in its mission to provide for aeronautical and space activities. The financial management of NASA's operations is the responsibility of Center officials at all organizational levels. Ultimately, the Regional Finance Office, Code 151, within the Office of the Center's Chief Financial Officer is responsible for synthesizing, aggregating, and reporting accounting events to NASA Headquarters Code B and the Department of Treasury (for cash transactions), in accordance with Agencywide financial management regulations. These statements refer only to the Goddard business.

The GSFC overall accounting system consists of numerous feeder systems. When combined, they provide the basic information necessary to meet internal and external financial reporting requirements in terms of funds control and accountability. Albeit, it is recognized that the current systems do not meet OMB Circular A-127 requirements for a single integrated financial system. NASA is moving to implementing a fully-integrated financial system. NASA has selected SAP Public Sector and Education, Inc. to deliver a commercial off-the-shelf accounting system as part of the intergrated financial program that will replace 10 different systems now used by NASA field centers. Currently, Goddard is scheduled for deployment in FY 2002.

The following eight direct appropriations require individual treatment and are distinctly classified in GSFC combined accounting and control systems:

(1) **Human Space Flight (HSF) —** supports human space flight research and development activities for space flight, spacecraft control, and communications actions. This includes research, development, operations, services, maintenance, and construction of facilities, which encompass the repair, rehabilitation, and modification of real and personal property.

(2) **Space, Aeronautics and Technology (SAT) —** provides for the conduct and support of science, aeronautics, and technology programs. Research, development, operations, services, maintenance, and construction of facilities (repair, rehabilitation, and modification of real and personal property) also serve as by-products of this appropriation.

(3) **Mission Support (MS) —** funds safety, reliability and quality assurance activities in support of Agency programs and space communication services for NASA programs. The appropriation also provides budgetary resources for salaries, fringe benefits and related expenses, while supporting research and construction of facilities.

(4) **Space Flight Control and Data Communication (SFCDC) —** provides for space flight, expendable launch vehicles, spacecraft control, and communication activities, including operations, production services, related institutional activities, minor construction, maintenance, repair, rehabilitation and modifications. This appropriation was restructured and replaced in the FY 1995 NASA budget.

(5) **Research & Development (R&D) —** includes research and development contracts, as well as materials, supplies, and contractual services applied directly to the in-house performance of specific projects, programs, or tasks. R&D also provides for the institutional activities related to research and development. This appropriation was restructured and replaced in the FY 1995 NASA budget.

(6) **Construction of Facilities (C of F) —** provides budgetary resources for construction, repair, rehabilitation and modification of facilities, minor construction of new facilities and additions to existing structures, and facility planning and design. This appropriation was restructured and replaced in the FY 1995 NASA budget.

(7) **Office of the Inspector General (OIG) —** funds necessary OIG salary, travel and related expenses required to conduct audits and investigations of Center activities.

(8) **Science, Space and Technology Education Trust Fund —** expenses of all property and services procured for the trust fund. The trust fund was new funding in the FY 1998 NASA budget.

In addition to the direct appropriations, we receive funds from various federal and non — federal customers to perform aeronautical and space activities.

Basis of Accounting

GSFC accounts are maintained on an accrual basis (i.e., expenses are recorded when incurred and revenue when earned). Expenses are classified in the accounts by appropriation in accordance with the Agencywide coding structure, which sets forth a uniform classification of financial activity that is used for planning, budgeting, accounting, and reporting. The expenses are further categorized in the General Ledger as operating or capitalized expenditures.

Advances

GSFC distributes the majority of its funding used for the University Contracts and Grants Program by the method of Letter of Credit through the Health and Human Services (HHS) Payment Management System (PMS). The HHS serves as an agent for the U.S. Treasury in processing the drawdown of funds (disbursements) from a pre-established balance set up by GSFC based on contract/grant awards. The established balance for each University constitutes advance payments. A smaller number of university contract/grant recipients receive advance payments on a quarterly basis via check payments through the U.S. Treasury system. In accordance with OMB Circular A-110, Quarterly financial reporting of transactions is provided by recipients on Federal Cash Transactions Reports (SF 272's). Detailed monitoring, funds control (against outstanding obligations), and accountability records are maintained. In addition, audits by the Defense Contract Audit Agency and NASA's OIG support this monitoring.

Property, Plant, and Equipment (PP&E)

GSFC-owned Property, Plant, and Equipment (PP&E) may be held by the Center or its contractors. Under the provisions of the Federal Acquisition Regulation (FAR), contractors are responsible for control over and accountability for such property in their possession. The GSFC General Ledger is capable of separately classifying Government-held PP&E from Contractor-held PP&E.

Government regulation does not make a provision for depreciating PP&E under appropriated funding authority. However, in accordance with the User Charge Act and OMB Circular A-25, NASA is permitted to assess depreciation charges for the use of facilities and equipment, under the "full cost" concept, to non-government reimbursable customers. In addition, automated data processing software is treated as operating cost rather than capitalized in accordance with GAO Title II guidelines.

Equipment with a unit cost of $100,000 or more and a useful life of two years or more and will not be consumed in an experiment is capitalized. Capitalized cost includes unit cost, transportation, installation, and handling and storage cost. Real property, such as land, buildings, and other structures and facilities, is capitalized when the asset value is $100,000 or more. Effective in FY 1998, NASA raised the capitalization threshold for Property, Plant, and Equipment (PP&E) from $5,000 to $100,000.

Land values are recorded at original acquisition cost and do not reflect current market value or include cost of improvements. Buildings are also valued at acquisition cost, including the cost of capital improvements and fixed equipment required for functional use of the facility.

Government-owned/Contractor-held property includes GSFC real property, such as land, buildings, and structures, materials, plant equipment, space hardware, special tooling, and special test equipment. Contractors are directed to report annually (on NASA Form 1018) plant equipment costing $100,000 or more and having a useful life of two years and will not be consumed in an experiment. In addition, this reporting includes capturing the other property categories mentioned above, regardless of the value (although most exceed $100,000), and is included in the Statement of Financial Position. This reporting is certified by the contractor's representative and reviewed by a government property administrator. Space hardware work-in-process represents the largest amount of assets owned by GSFC.

Revenues and Other Financing Sources

GSFC receives the majority of its funding through multiyear appropriations. These include three-year appropriations for construction activities, two-year appropriations for operational and space flight activities, and a single year appropriation for civil service payroll and travel. In addition to appropriated funds, the Center performs services for federal and non-federal customers upon receipt of customers funding authority.

Notes to the Statement of Financial Position
For the Year Ended September 30, 2000

NOTE 2 – FUND BALANCES WITH TREASURY *(In Thousands):*

	Obligated Available	Unobligated Available	Unobligated Restricted	Total
Appropriated Funds	$ 1,241,372	$ 116,964	$ 12,493	$ 1,370,829
Trust Fund	—	225	—	225
Reimbursable Advances	30,086	—	—	30,086
Total Funds Balance with Treasury	**$ 1,271,458**	**$ 117,189**	**$ 12,493**	**$ 1,401,140**

GSFC cash receipts and disbursements are processed by the U.S. Treasury. The funds with the U.S. Treasury include appropriated funds, trust funds, and deposited funds for advances received for reimbursable services.

NOTE 3 – ACCOUNTS RECEIVABLE NET *(In Thousands):*

	Entity Accounts Receivable	Allowances for Losses on A/R & Interest	Net Amount Due
Intragovernmental	$ 41,220	$ —	$ 41,220
Governmental	755	(16)	739
Total Accounts Receivable	**$ 41,975**	**$ (16)**	**$ 41,959**

Accounts Receivable consist of amounts owed to GSFC by other Federal Agencies and amounts owed by the public. NASA establishes an allowance amount for reporting purposes based on an analysis of outstanding receivable balances. Most receivables are due from other Federal Agencies for reimbursement of services. Non-federal customers provide advance payments which are placed on deposit with the U.S. Treasury until services are performed.

NOTE 4 – ADVANCES AND PREPAYMENTS *(In Thousands):*

	2000	1999	CHANGE
Intragovernmental	$ 5,151	$ 2,749	$ 2,402

The increase in intragovermental advances represents a governmentwide partner reconciliation requirement issued by The Office of Management and Budget.

NOTE 5 – OPERATING MATERIALS AND SUPPLIES *(In Thousands):*

	2000	1999	CHANGE
Contractor-held Materials	$ 247,674	$ 234,917	$ 12,757
Stores Stock	6,376	6,349	27
Standby Stock	—	54	54
Total Operating Materials and Supplies	**$ 254,050**	**$ 241,320**	**$ 12,730**

NOTE 6 – PROPERTY, PLANT, AND EQUIPMENT *(In Thousands):*

Government-owned/Government-held	**2000**	**1999**	**Change**
Land	$ 5,473	$ 5,473	$ —
Structures, Facilities & Leasehold Improvements	492,426	494,008	(1,582)
Equipment	255,528	284,768	(29,240)
Assets Under Capital Lease	877	877	—
Work-in-Process	43,854	43,944	(90)
Total	**$ 798,158**	**$ 829,070**	**$ (30,912)**

Government-owned/Contractor-held	**2000**	**1999**	**Change**
Structures, Facilities & Leasehold Improvements	$ 7,866	$ 7,461	$ 405
Equipment	30,106	45,489	(15,383)
Special Tooling	8,187	5,555	2,632
Special Test Equipment	78,056	63,120	14,936
Space Hardware	180,580	106,639	73,941
Work-In-Process	964,677	1,159,098	(194,421)
Total	**$ 1,269,472**	**$ 1,387,362**	**$ (117,890)**
Grand Total	**$ 2,067,630**	**$ 2,216,432**	**$ (148,802)**

See Note 1 for dissussion on Property, Plant, and Equipment .

NOTE 7 – OTHER LIABILITIES *(In Thousands):*

Liabilities Covered by Budgetary Resources:	**Current**	**Non-Current**	**Total**
Intragovernmental Liabilities:			
Liabilities for Deposit and Suspense Funds	$ 2,058	$ —	$ 2,058
Liabilities for Reimbursable Advances	30,086	—	30,086
Total	**$ 32,144**	**—**	**$ 32,144**
Governmental Liabilities:			
Liabilities for Deposit and Suspense Funds	$ 280	—	$ 280
Liabilities for Statistical Reimbursable Cost	—	—	—
Accrued Funded Payroll	17,551	—	17,551
Total	**$ 17,831**	**—**	**$ 17,831**
Total Liabilities Covered by Budgetary Resources	**$ 49,975**	**—**	**$ 49,975**

Liabilities Not Covered by Budgetary Resources:	**Current**	**Non-Current**	**Total**
Intragovernmental Liabilities:			
Accounts Payable for Closed Appropriations	$ —	$ 2,106	$ 2,106
Liabilities for Receipts Accounts	—	—	—
Total	**$ —**	**$ 2,106**	**$ 2,106**
Governmental Liabilities:			
Accounts Payable for Closed Appropriation	$ —	$ 9,538	$ 9,538
Liabilities for Receipt Accounts	—	2	2
Unfunded Annual Leave	24,575	—	24,575
Total	**$ 24,575**	**$ 9,540**	**$ 34,115**
Total Liabilities Not Covered by Budgetary Resources	**$ 24,575**	**$ 11,646**	**$ 36,221**
Grand Total	**$ 74,550**	**$ 11,646**	**$ 86,196**

Accounts payable include amounts recorded for receipt of goods or services furnished to the Center but not disbursed. "Additionally, throughout GSFC, cost is recognized and accrued based on information provided monthly by contractors" on cost and performance reports (NASA Form 533, Contractor Financial Management Report). The Defense Contract Audit Agency (DCAA) performs independent audits on reported cost to ensure reliability of estimates. Also further assurance is provided by GSFC resource analysts as a result of examining cost accruals generated from the NF 533s.

NOTE 8 – LEASE LIABILITIES *(In Thousands):*

Assets under Capital Lease:		
Equipment		$ 877
Accumulated Amortization		$ 736

NASA capital leases consist of assorted ADP and copier equipment with non-cancelable terms longer than one year, a fair market value of $100,000 or more, a useful life of 2 years or more, and agreement terms equivalent to an installment purchase.

Future Lease Payments:	Fiscal Year 2001	$ 150
	Future Lease Payments	$ 150
	Less: Imputed Interest	(9)
	Capital Lease Liability	$ 141

NOTE 9 – NET POSITION *(In Thousands):*

Appropriated Funds

Unexpended Appropriations		
Undelivered	$	616,012
Unobligated:		
Available		116,964
Unavailable		12,493
Trust Fund Balance		225
Invested Capital (Note 11)		2,321,539
Cumulative Results of Operations		29
Future Funding Requirements		(36,221)
Total Net Position	**$**	**3,031,041**

NOTE 10 – INVESTED CAPITAL *(In Thousands):*

Property, Plant and Equipment	$	2,067,630
Operating Materials and Supplies		254,050
Less: Liability for Capitalized Leases		(141)
Invested Capital	**$**	**2,321,539**

Goddard's Values

Safety

The personal security of all those associated with or potentially affected by Goddard's programs and activities is the foundation upon which we build success. We will also be active stewards in the use and protection of all the resources and assets that NASA and this Nation have entrusted to us.

Agility

Anticipating the future, leading change, and adapting quickly are crucial to thriving in a dynamic environment.

Balance

An employee's work life and personal life, including health, family, community involvement, and other interests, contribute to the vitality both of the individual and of the Center.

Creativity

Freedom to explore new ideas stimulates discovery, fosters innovation and leads to more effective ways of doing work.

Dedication

Successful results require a commitment to excellence and to individual and team responsibilities.

Integrity

Trust, fairness, honesty and accountability for our actions are the cornerstones of personal and organizational integrity.

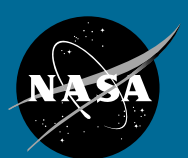
Respect

Diversity among people and their ideas is an inherent strength as we work toward fulfilling Goddard's mission.

Teamwork

Accomplishments result from successful teams, both internal and external to the Center, that capitalize on the strengths and contributions of every team member.

NP-2001-2-183-GSFC



National Aeronautics and
Space Administration

Goddard Space Flight Center