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Goddard News

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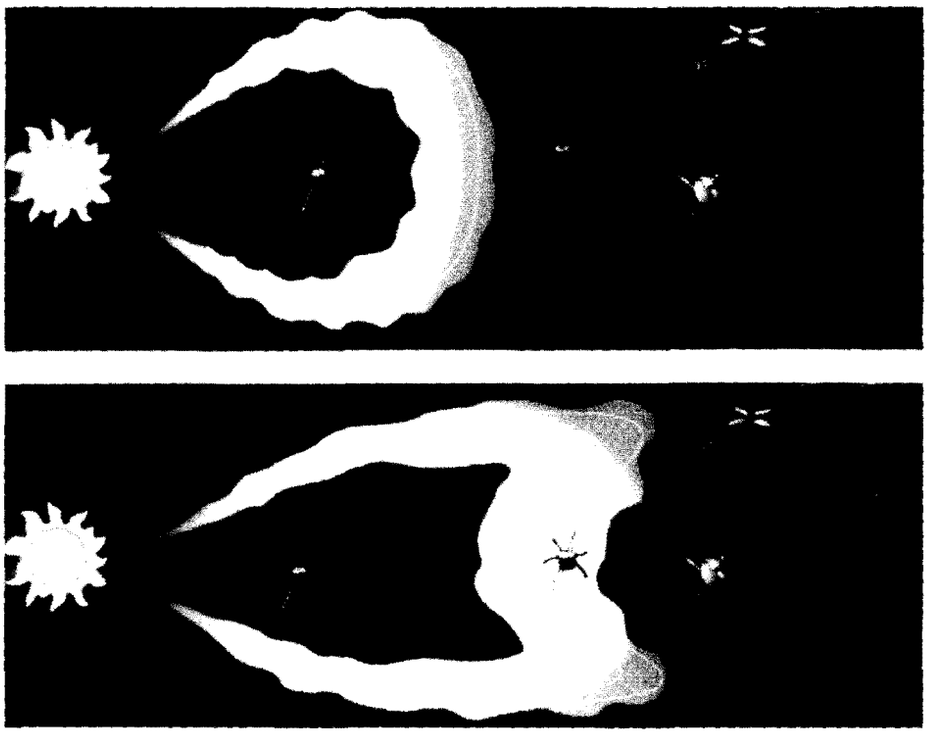
Space disturbance detected by NASA before it reached Earth

by Jim Sahli

A NASA spacecraft detected a huge interplanetary disturbance which struck the Earth's protective magnetic field on Oct. 18, producing a magnetic storm and auroral displays or "Northern Lights," that persisted for two days. The phenomenon was visible in the United States as far south as Denver, according to scientists at Goddard, who reported critical satellite data to other government agencies and scientists around the world.



NASA

These artist conceptions beginning with the top image show: A giant magnetic cloud containing hot gas from the solar corona being ejected from the Sun towards the Earth at 2.1 million miles per hour. It is detected by NASA's WIND spacecraft instruments half an hour before it encounters Earth. In both images the spacecraft to the left is the WIND spacecraft. The GEOTAIL spacecraft is the closest spacecraft to the Earth. The two spacecraft shown on the night side of the Earth are the Russian Interball Tail Probe and its nearby daughter probe. The second artist concept shows the cloud colliding and enveloping the Earth's magnetic field, compressing it on the day side, stretching it on the night side, and causing geomagnetic storms which can affect power grids and communication systems.

After receiving sensor measurements from NASA's Wind spacecraft on the Oct. 18 disturbance via radio telemetry, operators on Center processed it into special data sets called "key parameters," which are intended for wide use by space scientists and others.

The information was relayed electronically to the U.S. Air Force and to the National Oceanographic and Atmospheric Administration's Space Environment Laboratory, in Boulder, Colo., where evaluators issued an updated "space weather alert" to commercial satellite operators, electrical utilities, and other organizations worldwide.

"The rapid response to the WIND observations and the prompt issuance of the alert were made possible by advanced data systems, technology and networks," said Dr. Keith Ogilvie, Code 692, WIND Project Scientist. The central processing and distribution systems were developed and implemented by NASA and supported by the WIND science teams, NOAA, the USAF, and international partners.

The disturbance, called a "giant magnetic cloud, was 65 million miles (104 million kilometers) across and speeding toward the Earth at over 2.1 million miles per hour when it was detected at 3 p.m. (EDT) on Oct.

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NASA Strategic Management

by Greg Williams, NASA Headquarters

To protect the global environment now and in future generations, we must build a long-term understanding of the Earth system. NASA's Mission to Planet Earth is working to comprehend this complex system, which includes the couplings and changes of the solid Earth, land surface, oceans, ice, atmosphere and biota.

The Mission to Planet Earth strategic enterprise conducts basic research on Earth system processes which are of immense scientific importance and considerable practical value to society. The unique vantage point of space allows scientists to study these interrelated systems and gather information that is obtainable in no other way.

The transport of energy and moisture between the oceans and atmosphere is a key subject of fundamental process studies. This research also is leading to the ability to forecast weather patterns that cause drought and flooding in agriculturally sensitive areas of the U.S. and other nations.

The Tropical Rainfall Measurement Mission, a joint program with Japan being readied for launch in 1997, will enhance the quality of this research. Mission to Planet Earth studies of land processes are enabling scientists to understand the rates and effects of deforestation in the Amazon. This research also may lead to a host of applications for farmers, foresters, urban planners and natural disaster response managers. The Landsat-7 and EOS-AM spacecraft will provide global coverage with resolutions fine enough for a wide variety of research and economic uses.

The Mission to Planet Earth program can be viewed in interrelated pieces. Its research and analysis program provides the intellectual foundation for Earth system science. It also employs aircraft and balloon campaigns and field observations to prepare for and augment space-based missions.

Early Earth observation missions, such as the Upper Atmosphere Research Satellite and the Shuttle-based Space Radar Laboratory, are returning data on critical Earth sciences questions, such as ozone loss and recovery.

The Earth Observing System (EOS) program, beginning with the EOS-AM1 launch in 1998, will kick off the true study of global climate change. For the first time, humankind will be able to form a globally integrated picture of land, sea and ocean interactions.

The Mission to Planet Earth's strategic enterprise plan has four major goals:

•Increase understanding of the Earth as an integrated environmental system and of its vulnerability to natural variations and human influences.

•Observe and characterize the entire Earth system and make the resulting research data widely available.

•Contribute to wise and timely national and international environmental policy.

•Foster the development of an informed and environmentally aware public.

The Goddard Center leads the Mission to Planet Earth program. Other important contributors are the Ames Research Center, Jet Propulsion Laboratory, Langley Research Center and Marshall Space Flight Center. NASA also collaborates with other agencies whose work involves Earth research, including the National Oceanic and Atmospheric Administration, the Department of Interior's U.S. Geological Survey, the Environmental Protection Agency, the National Science Foundation and others.

Because global change research is an inherently international endeavor, NASA has over 60 significant agreements with more than 20 other countries.

Today's program is laying the foundation for an ability to understand and predict global and regional Earth system processes.

For more information or a copy of the Mission to Planet Earth strategic enterprise, contact the Mission to Planet Earth Office, Code YM at NASA HQ, (202)-358-0241.

Space disturbance detected by NASA before it reached Earth

Continued from page 1

18 by NASA's WIND spacecraft, an unmanned spacecraft patrolling interplanetary space 662,000 miles (1.065 million kilometers) from Earth pointed in the direction toward the Sun. Invisible to normal telescopes and the human eye, the cloud was composed of magnetic fields and electrified subatomic particles ejected from the outer atmosphere or corona of the Sun.

"It was detected with instruments on WIND that sense the magnetic fields, particles and waves in interplanetary space," said Ogilvie. "This is a good example of what we had been expecting since WIND was launched on last Nov. 1st [1994]. This wonderful observation is a great first birthday present from WIND."

A complete analysis of the data on the Oct. 18 event from WIND and other spacecraft and instruments may take months or years, but is expected to tell scientists much about how interplanetary disturbances propagate through space and affect the Earth's environment. And, future disturbances are anticipated as the 11-year sunspot cycle is expected to peak shortly after the year 2000, according to NASA scientists.

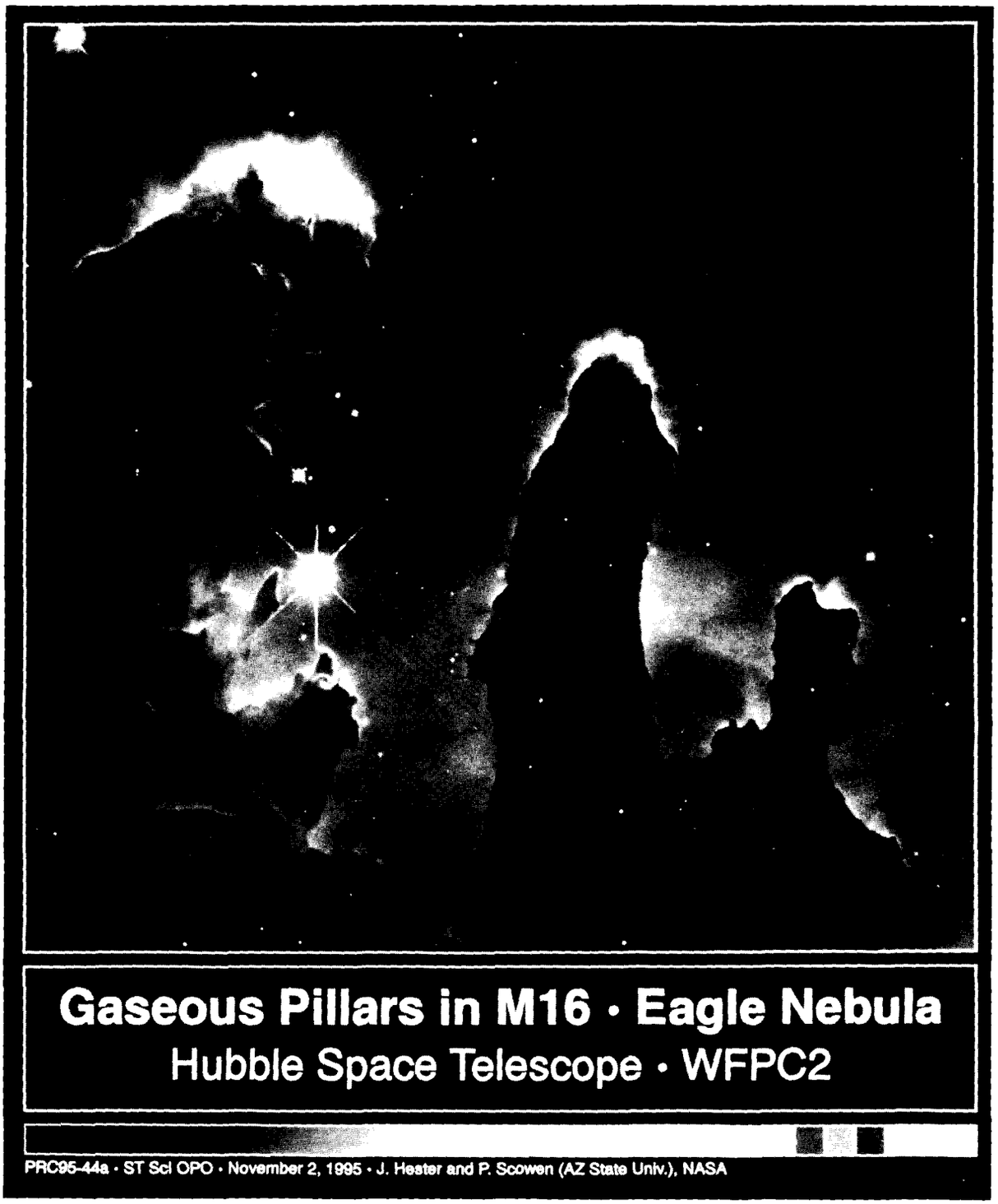
Magnetic storms set off by interplanetary disturbances sometimes disrupt communications and electrical power systems and the Alaska pipeline exhibited enhanced corrosion effects due to the electrical currents induced by the disturbances in the Earth's magnetic field. During the Oct. 18-19 interplanetary disturbance, an electrical utility in Wisconsin reported experiencing large "ground currents" (very low frequency electrical currents induced in power lines by the storm).

For Internet users: Detailed data and plots from WIND and GEOTAIL related to the events of Oct. 18-20 can be found at http://bolero.gsfc.nasa.gov/~solart/cloud/cloud.html

Dramatic Hubble images released

What some scientists are calling 'the most dramatic images yet taken by the Hubble Space Telescope were the focus of the Nov. 2 Space Astronomy Update, entitled "Star Birth in the Eagle Nebula."

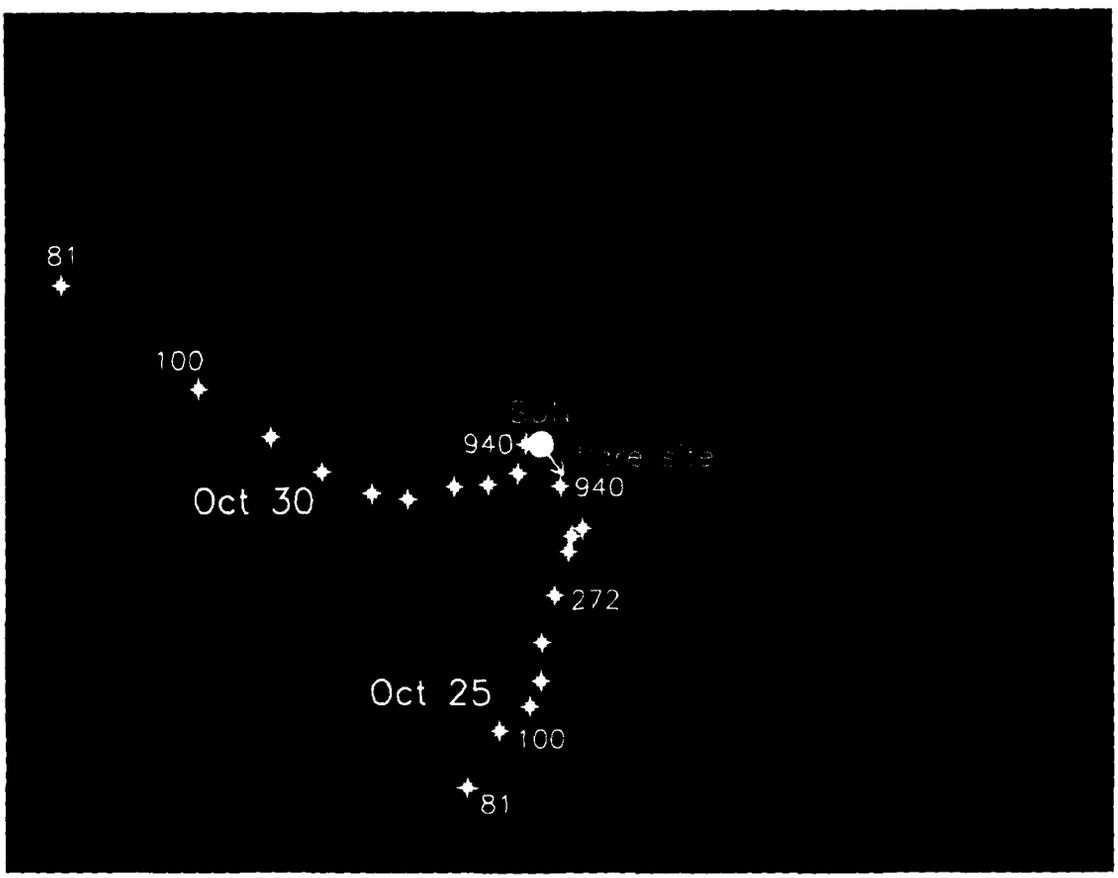
The images reveal dark pillar-like structures in the Eagle Nebula (also called M16) which are columns of cool interstellar hydrogen gas and dust. The pillars, protruding from the interior wall of a dark cloud like stalagmites from the floor of a cavern, are slowly being eroded away by radiation from nearby stars. This process exposes small globules of even denser gas which had been buried deep inside the clouds. These are incubators for new stars and are called, appropriately enough, "EGGs" (Evaporating Gaseous Globules).



Panelists on the program were Dr. Jeff Hester, an Astronomer in the Department of Physics and Astronomy at Arizona State University, Tempe; Dr. Anne Kinney, Project Scientist for Education, Space Telescope Science Institute, Baltimore; and Dr. Bruce Margon, Chairman of the Astronomy Dept., University of Washington, Seattle. Dr. Steve Maran, Senior Staff Scientist, Code 680 served as the moderator.

First "snapshot" taken of our solar system's magnetic field

by Jim Sahli



View from the North Ecliptic Pole – Ulysses Radio Observations

NASA physicists using an instrument aboard the European Space Agency's (ESA) Ulysses spacecraft have obtained the first instantaneous view, or "snapshot," of the spiral structure of our solar system's magnetic field.

These lines of magnetic force originate in the Sun and extend outward into the solar system. The "snapshot," assembled from observations of radio waves by a U.S.-French radio receiver on Ulysses, shows the spiral magnetic field extending from the Sun past the orbit of the planet Venus toward the orbit of Earth. Scientists used the unique vantage point of Ulysses above the pole of the Sun and the plane of the planets to obtain this image.

The method to obtain the image involved tracking the path of the bright spot of radio waves excited by moving electrons ejected from the Sun at speeds over 62,100 miles per second. This spot was caused by solar flares or other explosive events on the Sun. "As the electrons speed out into the solar system, they are constrained to follow the large scale magnetic field lines similar to the way cars are constrained to follow roads," said Dr. Joseph Fainberg, Code 692.

"The radio emissions, caused by the fast electrons moving through with the slower solar wind, allow us to trace out the magnetic lines of force much like you might deduce the course of a road at night from an airplane by tracking the headlights of individual cars," said Dr. Michael Reiner, chief scientist at Hughs STX Co., Greenbelt, Md. "A chart of the received radio emissions shows that they follow the expected spiral shape, even including the kinks due to variations in solar wind speed. At these high speeds, the whole path takes about 20 minutes to Earth's orbit."

Previous radio observations made by space probes orbiting in or near the plane of the Earth's orbit did not provide a good vantage point for observing the spiral shape of the magnetic field. Observations in space are required because the radio frequencies of the solar wind do not get through the Earth's ionosphere.

"It was like trying to determine the shape of our Milky Way galaxy from our location inside," explains Dr. Robert Stone, a senior scientist in the Laboratory for Extraterrestrial Physics Code 690. "We could get fine photos of individual stars and star clusters, but no perspective on the whole system. What we needed was the equivalent of an aerial photo of our Milky Way galaxy."

"The aerial photo of the interplanetary magnetic field became possible with the flight of Ulysses over the south pole of the Sun in 1994," said Reiner. "Now we could look down on the solar system, and these radio observations made by Ulysses gave us the first direct observation of the spiral structure in space between the Sun and the Earth."

The radio receiver on board Ulysses used to make the new "snapshot" was developed in a cooperative effort with experts at the Paris Observatory in France, the University of Minnesota in Minneapolis and Goddard. Stone led the project.

Ulysses was launched in October 1990. The spacecraft's course led it to the planet Jupiter, where in February 1992, it received a gravitational assist from the huge planet that sent it out of the plane of the Earth's orbit and eventually over the poles of the Sun. After passing over the south pole in October 1994, Ulysses continued on a trajectory that recently took it over the Sun's north pole.

The Ulysses mission is managed jointly by ESA and NASA to study the regions over the Sun's poles. NASA's Jet Propulsion Laboratory, Pasadena, Calif., oversees the U.S. portion of the mission for NASA's Office of Space Science, Washington, D.C.

Goddard's POLAR spacecraft scheduled to launch in January

NASA's POLAR spacecraft now at its launch site in California is undergoing final preparations for an anticipated launch the second week of January from Vandenberg Air Force Base, Lompoc. The spacecraft was shipped Oct. 16 from it's manufacturer, Lockheed-Martin, in East Windsor, N.J. to the west coast by an Air Force C-5A aircraft from McGuire Air Force Base (AFB), NJ.

"It is great to see the spacecraft shipped to the West Coast after several years of pulling the platform together," said Joseph A. Dezio, manager of the Global Geospace Science (GGS) Project in Goddard's Flight Projects Directorate, Code 406. "With a successful launch in January, we will then have a second GGS spacecraft in orbit to gather important information for NASA's space physics research programs," said Dezio. The first spacecraft is the WIND satellite which was launched from Cape Canaveral Air Station (CCAS) Nov. 1, 1994.

"The POLAR spacecraft is the second mission of NASA's Global Geospace Science program. It will perform simultaneous, coordinated measurements of the key regions of Earth's geospace, or space environment, with the WIND spacecraft measuring the solar wind properties. Also, a large array of ground-based scientific observatories and mission related theoretical investigations will also be involved," said Dr. Robert A. Hoffman, Code 696; POLAR Deputy Project Scientist, in the Space Sciences Directorate.

"There is a new area of interest to space scientists called space weather. The objective is to make observations of the sun and the solar wind, the insert the data into models and hopefully predict where various types of activities will occur in the system. Data from POLAR will be used to assess the accuracy of the developing models," said Hoffman.

"The practical application of this work will come from the ability to predict the times and locations of severe disturbances in geospace that can disrupt and even damage various high technology systems developed for modern civilization, such as long power transmission and communication systems, satellites and other signal transmission systems," added Hoffman.

The POLAR spacecraft is scheduled to launch on a Delta II rocket from the Western Space and Missile Center, Lompoc, Calif. Its orbit around the Earth will be inclined 86 degrees from the equator. The furthest point from the Earth on the orbit–the apogee–will be eight Earth radii altitude (32,000 miles or 51,000 kilometers), and the closest point–the perigee–will be 0.8 Earth radius (3,200 miles or 5,100 kilometers).

There are 11 instruments on the spacecraft and they can be divided into three categories: Three instruments to observe electromagnetic and electrostatic fields in the vicinity of the Polar spacecraft; five instruments to characterize the particle populations found in the high-latitude magnetosphere; and three instruments to image the auroral emissions in ultraviolet light, visible light and X-rays. These imaging instruments are located on a despun platform which can be pointed to continuously view the Earth.

NASA is collaborating with the European Space Agency (ESA) and the Japanese Institute of Space and Astronautical Science (ISAS) in three additional solar-terrestrial missions, Geotail, SOHO and Cluster. Geotail was launched in July 1992 to explore the tail of the magnetosphere, which is the region around the planet dominated by the Earth's magnetic field. These missions, together with GGS, make up the International Solar-Terrestrial Physics (ISTP) science initiative.

"The aim of ISTP is to understand the physical effects of solar activity on interplanetary space and the Earth's space environment. This will lead to the capability of predicting the responses of each part of the Sun-Earth connected system to solar activity," said Dr. Mario Acuna, Code 695; ISTP Project Scientist, Space Sciences Directorate.

SPACECRAFT AND MISSION OPERATIONS

POLAR is a spin-stabilized cylinder-shaped spacecraft 7.9 feet (2.4 meters) in diameter and 6.9 feet (2.1 meters) high with many appendages for instrument sensors. The dry weight of the space-craft is about 2,200 pounds (997 kilograms) with an additional 660 pounds (300 kilograms) of hydrazine propellant for orbit and attitude control. The design life of POLAR is three years.

Several NASA facilities and Goddard will play key roles in the collection and dissemination of POLAR science data. The NASA Deep Space Network will be used to command the spacecraft and to collect POLAR science data via radio link. At Goddard raw data will be processed, organized and stored. The Project's Central Data Handling Facility will produce "key parameter data" for surveying the much larger volume of raw data. Detailed analysis of the data will be performed by investigators at their own sites and the data will be shared through the NASA Science Internet connections throughout the United States, Japan and Europe.

The POLAR mission is being managed by Goddard for the Office of Space Science at NASA Headquarters.

Ecosystem data could lead to better weather forcasting

by Ernie J. Shannon

After only six months of data analysis, NASA scientists believe that their understanding of the large Boreal forest ecosystem could improve weather forecasting around the world.

"We think that the observations from the Boreas field experiment have changed our picture of how the land system and the atmosphere interact up there," said Dr. Piers Sellers of Code 900.

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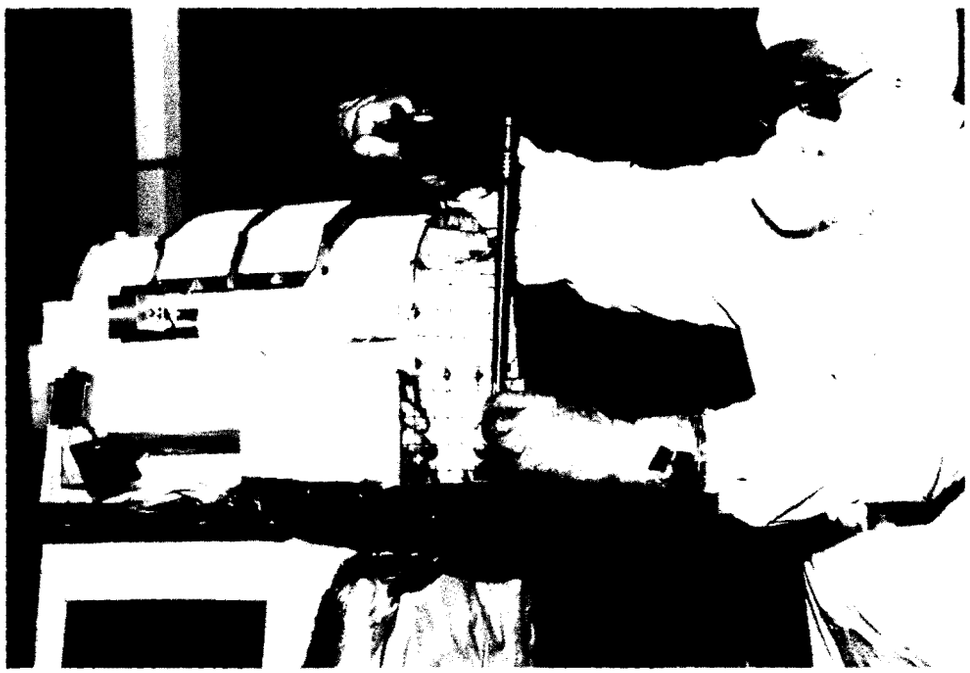
Tropical Rainfall Measuring Mission receives instruments

by Ernie J. Shannon

NASA

Goddard engineers in Building 10 are preparing the TMI (top) and CERES (bottom) instruments for integration aboard the TRMM spacecraft.

NASA



The Tropical Rainfall Measuring Mission (TRMM) received a big boost recently with the delivery of two of its five instruments. The TRMM Microwave Imager arrived from Hughes in California about a month ago and the Clouds and the Earth's Radiant Energy System (CERES) was shipped from TRW also in California late last month.

The TRMM mission is the first dedicated to measuring tropical and subtropical rainfall through microwave and visible infrared sensors and includes the first space-borne rain radar. Tropical rainfall comprised more than two-thirds of global rainfall and it is the primary distributor of heat through the circulation of the atmosphere. It provides heat to the atmosphere by means of the "latent" heat which is released when water vapor condenses to liquid water droplets and falls out as rain.

The Microwave Imager is a multi-channel radiometer with a combination of signals that accurately measure rainfall over oceans and somewhat less accurately over land. It is the "workhorse" instrument of the TRMM rain package, since earlier-version passive microwave radiometers have had good success in estimating the rain rate over oceans.

The TMI is improved over previous instruments by having a channel at a lower frequency (10 GHz) which has a more linear response to the rain rate than do the higher frequencies. It will also have finer resolution than preceding instruments, which further adds to its accuracy.

The CERES, which is provided by the EOS, will measure reflected solar radiation and emitted thermal radiation over the Earth's surface to determine the influence of clouds on the Earth's temperature. Small changes in the amount of solar radiation absorbed or reflected can cause significant temperature changes. With the ability to measure rain and its energy release together with the radiation forcing on the same satellite, the first opportunity is provided to estimate from space major, previously unknown, components of the heat budget of the tropical atmosphere, which is vital to know for large-scale weather and climate prediction.

Both instruments have completed the receiving and inspection phase including testing at Goddard and soon will be integrated onto the TRMM observatory located in Building 7.

Klein picked Jump Award Winner

by Jim Sahli

NASA

Timothy A. Klein

Goddard's Timothy A. Klein has been chosen the 1995 co-winner of the prestigious William A. Jump Award for his outstanding public service to the U.S. government. Klein received the award from the Secretary of Agriculture in Washington in late September.

The Goddard awardee also was the 1995 NASA nominee for this government-wide award. Klein, who serves as the Deputy Project Manager for Resources in the Global Geospace Science Project (GGS) Code 406, also received a certificate of recognition for the 1994 Jump Award.

"We at the GGS project are proud of the honor Tim received as co-winner of the William A. Jump Award. This is just another example of the outstanding young government employees we have at Goddard striving to make our country's space program even better," said Joseph A. Dezio, Code 406 GGS Project Manager. "He contributed a lot to the success of the Wind mission which launched last year and is a vital member of the GGS team which will soon launch the POLAR laboratory."

Sponsored by the William A. Jump Memorial Foundation, this award is given in recognition of outstanding service in administration and notable contributions to the efficiency and quality of the public service. The award was established in 1950 in honor of the late William A. Jump for his leadership and distinguished contributions to effective public administration. Nominees must be career employees of the Federal government who have not reached their 37th birthday as of Dec. 31 of the preceding year in which nominated.

"It is a great honor to be a Jump Award winner and to represent Goddard. I know there must be plenty of outstanding civil service employees also qualifying for this significant award," said Klein. "It is also great being the first Goddard employee to win the award."

Klein joined the Goddard Center as a Presidential Management Intern in the Management Operations Directorate in 1986. He also has served on the Upper Atmosphere Research Satellite and Mission to Planet Earth projects.

He received a bachelor of arts degree in Public Affairs from The George Washington University in 1984 and a Master of Public Administration degree from that same university in 1986.

The Pennsylvania native is the father of three and is married to the former Michelle Renee Moore. They live in New Carrollton, Md.

Ecosystem data could lead to better weather forcasting

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The Boreal ecosystem consists primarily of aspen and coniferous forests. It girdles the earth at 48 degrees north latitude and covers about 17 percent of the earth's land surface. Drs. Sellers and Forrest Hall have coordinated a large interdisciplinary science team working in central Canada. The team of 300 scientists and 12 aircraft sponsored by several Canadian and American government agencies, is studying the Boreal forest area from land and air.

While their work reaffirmed that the Boreal ecosystem consists of wetlands, numerous lakes and water-logged peat beds on which much of the forests grows, it also revealed that the atmosphere above the forest is often very dry. In addition, they discovered that humidity and deep boundary layer convection often mimic conditions found only over arid zones.

Physiological measurements of the trees show that this lack of moisture in the atmosphere is a result of the forest's biological control limiting surface evaporation. The data indicates that this tight control is linked to the low soil temperatures and a lack of soil nutrients which reduce rates of photosynthesis.

In an earlier similar study of the grassland prairies of the United States, scientists showed that more correctly accounting for the stored soil moisture and evaporative heat release in weather forecast models, permitted much more accurate predictions of the 1993 floods that inundated portions of the central plains.

According to Sellers and Hall, current weather models do not realistically represent the boreal ecosystem, thus it is anticipated that the Boreas results, when incorporated into operational forecast models, will greatly improve weather forecasts.

Technology Utilization Update

by Donna Drelick

The annual New Technology Reporting Luncheon of the Goddard Office of Commercial Programs, Code 702 was held on Oct. 25 at the Greenbelt Marriott Hotel. The event honored contributions made by Goddard scientists and engineers who have contributed to the Technology Commercialization Program.

"In today's increasingly competitive global economic climate, we must insure that Goddard's technological resources are fully utilized. Our technology transfer and commercialization actions serve as a powerful tool to build the Nation's economic strength and spur it's growth. All NASA employees must do their part to help in this effort," said George Alcorn, Chief of Goddard's Office of Commercial Programs.

John Vranish, Code 723.4, was awarded the James Kerley Award for his partnered Capaciflector Technology, which is expected to yield 10 patent licenses. The Kerley Award is named in honor of the brilliant scientist who made outstanding contributions to commercial technology for more than forty years.

Tom McGraw of the Scientific and Commercial Systems Corp., provided the keynote address for the luncheon event. McGraw has commercialized "Earth Alert", a hand held device that provides warnings of pending weather disasters in remote areas. The device has recently received accolades for its ability to warn the Pacific Islands of weather disasters. The Scientific and Commercial Systems Corp. was named the Goddard Commercial Technology Business of the Year.

Greg Reck, Deputy Associate Administrator for NASA Headquarters Code X, Space Access and Technology, also addressed the crowd of 125, stressing the importance of commercialization within NASA's "Agenda for Change".

Goddard scientists and engineers who are interested in the commercialization of technology are urged to contact the Technology Transfer Office at x6-5810.

GODDARD-SBIR PARTNER BRINGS HOME TOP AWARD

Thermacore, Inc. of Lancaster, Pa., received one of the five "1995 Small Business Innovation Research (SBIR) Technology of the Year" awards at the Technology 2005 Conference Awards Dinner held Oct. 25 in Chicago, Ill. The award was presented to Thermacore for their continuing work in heat pipe technology and innovative commercialization of this technology. Thermacore has extensive experience with various SBIRs, and has been associated with Goddard since 1989.

"We are extremely pleased that Technology 2005 has show-cased Goddard's technology transfer capabilities, and are proud of our association with Thermacore. The goals of the SBIR program are to stimulate technological innovations for use by NASA and also to commercialize the results of the federally sponsored research. This creates a win-win scenario, said Nona Minnifield, Commercial Research Manager of Goddard's Office of Commercial Programs.

"Thermacore is viewed as a model SBIR partner because they have advanced commercial uses of federally sponsored research in such innovative ways." Thermacore's loop heat pump, developed under the SBIR program, is a completely passive device created for the dissipation of heat. The loop heat pump can transport heat in remote or tightly confined locations where there is no source of cooling to prevent the electronics from operating at extreme temperatures. This technology has led to other applications, most notably miniature heat pipes for Pentium Processor notebook computers. Further application of the technology include uses in cellular telephones, camcorders, and various hand-held electronics.

FEDERAL LAB CONSORTIUM MEETING

In an effort to provide awareness of NASA partnering opportunities, the Goddard Office of Commercial Programs conducted a Federal Laboratory Consortium Technology Transfer meeting at GSFC on Oct. 18. Representatives from nine states, including congressional office representation, attended the outreach workshop. The consortium received in-depth information on NASA technology commercialization practices, as well as an over-view of Goddard Programs and success stories.

Goddard News

National Aeronautics and Space Administration — Goddard Space Flight Center

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