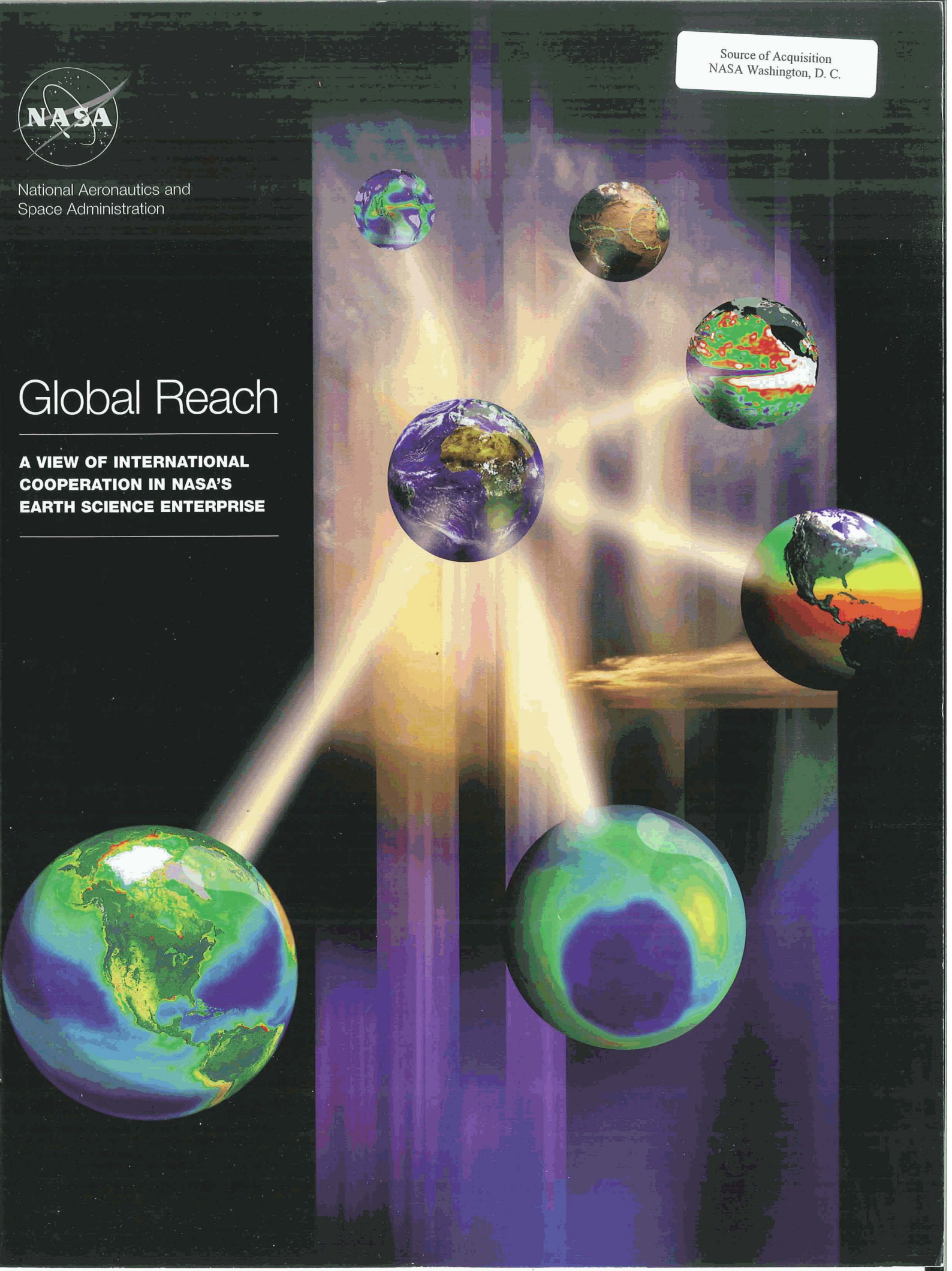
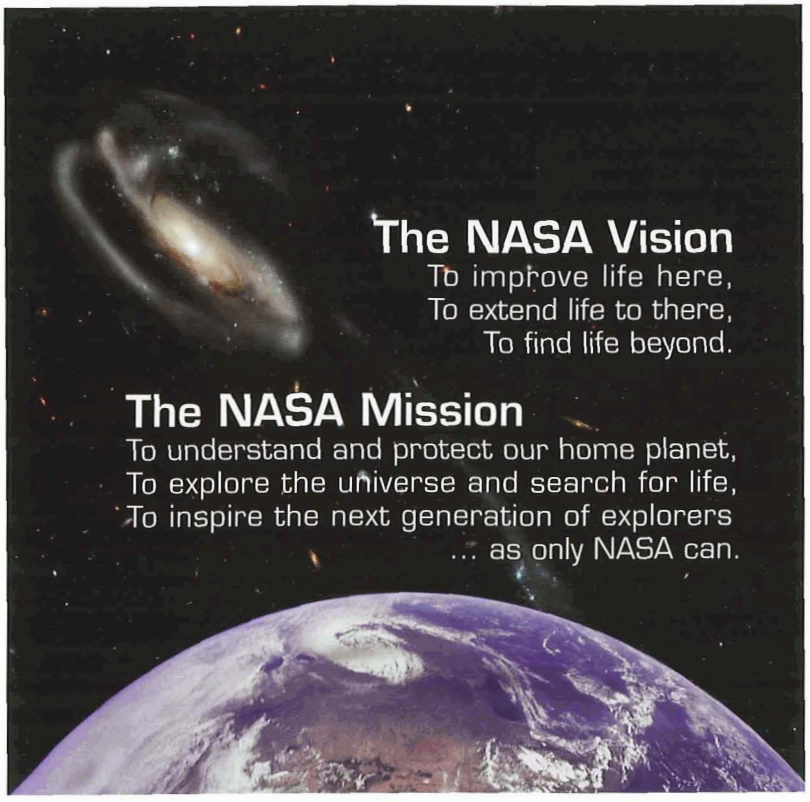
National Aeronautics and
Space Administration

Global Reach

A VIEW OF INTERNATIONAL COOPERATION IN NASA'S EARTH SCIENCE ENTERPRISE




The NASA Vision
To improve life here,
To extend life to there,
To find life beyond.
The NASA Mission
To understand and protect our home planet,
To explore the universe and search for life,
To inspire the next generation of explorers
... as only NASA can.

To the Reader:

Improving life on Earth and understanding and protecting our home planet are foremost in the Vision and Mission of the National Aeronautics and Space Administration (NASA). NASA's Earth Science Enterprise endeavors to use the unique vantage point of space to study the Earth system and improve the prediction of Earth system change. NASA and its international partners study Earth's land, atmosphere, ice, oceans, and biota and seek to provide objective scientific knowledge to decisionmakers and scientists worldwide. This book describes NASA's extensive cooperation with its international partners.

The interconnectedness of life on Earth means that all countries are impacted by a variety of environmental issues. Global scientific questions require global cooperation to find answers. Effective Earth observation and research require participation and investigation from all regions of the globe. Thus, NASA's Earth Science Enterprise is inherently international in scope. The Enterprise participates actively in a number of Earth-science-related international and multilateral forums, including the Committee on Earth Observation Satellites, the United Nations Environment Programme, the United Nations World Meteorological Organization, and the International Geosphere-Biosphere Programme.

One of the most significant recent events in Earth science was the Earth Observation Summit held in Washington, DC, on July 31, 2003. The Summit was an unprecedented gathering of senior representatives from 34 countries and 21 international organizations. The Summit promoted a political commitment to the development of comprehensive, coordinated, and sustained Earth observation systems among governments and the international community in order to understand and address global environmental and economic challenges of the 21st century. Following the Summit, an ad hoc Group on Earth Observations was established to begin the process to develop a 10-year implementation plan for building these comprehensive, coordinated, and sustained Earth observation systems. With the broadest international participation, the United States is committed to the effort, and NASA's future Earth science programs will reflect the goals set out at the Summit.

NASA's Earth Science Enterprise is proud of its more than 300 international cooperative agreements signed since 1994. Earth science is science in the global interest, and the Earth Science Enterprise is honored to work closely with numerous international partners to better understand and protect our home planet.

We invite you to learn more about NASA's Earth Science Enterprise through our Web site at ***http://www.earth.nasa.gov***.

Dr. Ghassem R. Asrar
Associate Administrator for
Earth Science

Mr. Michael F. O'Brien
Assistant Administrator for
External Relations

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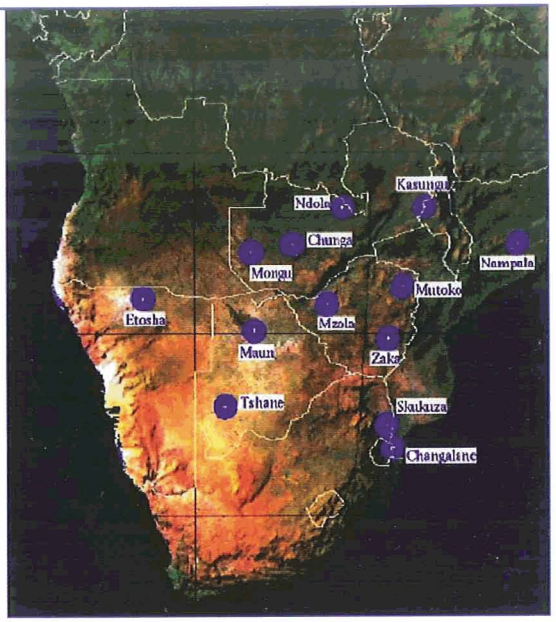
Future Missions

The SAFARI 2000 project was an international science initiative to study the linkages between land and atmosphere processes in the southern African region with a strong focus on the origin and fate of regional aerosol and trace gas emissions. SAFARI 2000 examined the relationship of biogenic, pyrogenic, and anthropogenic emissions and the consequences of their transport and deposition to the functioning of the biogeophysical and biogeochemical systems of southern Africa. This initiative, conducted between 1999 and 2001, was built around a number of activities funded by NASA, the international community, and national agencies in southern Africa.

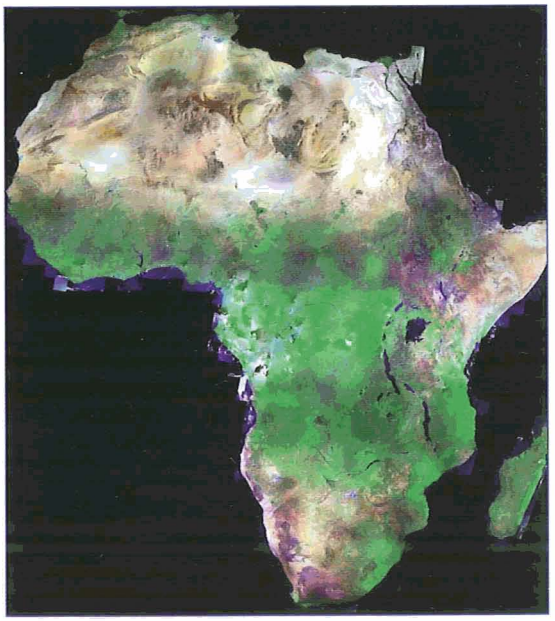
SAFARI 2000 was carried out using a wide range of intensive ground-based, airborne, and space-based remote sensing measurements. Results of SAFARI 2000 provide insights into the functioning of the southern African environment, with a strong emphasis on land-atmosphere interactions. Some of the findings of SAFARI 2000 with immediate relevance for policy on the environment in southern Africa include new estimates of terrestrial productivity, better satellite-derived fire products, and the documentation and determination of the degree to which transboundary atmospheric transport of aerosol and trace gas emissions impact southern Africa. SAFARI 2000 defined the extent of the transport of subcontinental biomass burning emissions from Africa and refined the quantitative estimates of the composition and magnitude of these emissions. Finally, SAFARI 2000 confirmed the transnational nature of physical connections by atmospheric circulations that influence weather and climate in southern Africa.

Background data for SAFARI 2000 are available on the SAFARI 2000 CD-ROM, Vol. 1. Satellite imagery, aerosol and fire products, meteorology, and atmospheric chemistry data are available on SAFARI 2000 CD-ROM, Vol. 2. Field data, fire products, Kalahari transect, and satellite products are available on the SAFARI 2000 CD-ROM, Vol. 3. SAFARI 2000 data can also be accessed via Mercury (***http://mercury.ornl.gov/safari2k/search.htm***) or via SAFARI Search and Order System ***(http://www.daac.ornl.gov/cgibin/DAAC/uncgi/csearch.sh?project=SAFARI+2000)***.

For more information regarding SAFARI 2000, please visit the following Web sites: ***http://safari.gecp.virginia.edu*** or ***http://eos.nasa.gov***; or see the *Journal of Geophysical Research*, Vol. 108, No. D13, 2003.



SAFARI 2000 test sites.



Africa continent mosaic based on 1,265 Landsat 5 scenes acquired and orthorectified using data from 1987 to 1993. This composite image uses Landsat Thematic Mapper bands 7, 4, and 2 for the red, green, and blue composites. *(Source: EarthSat)*

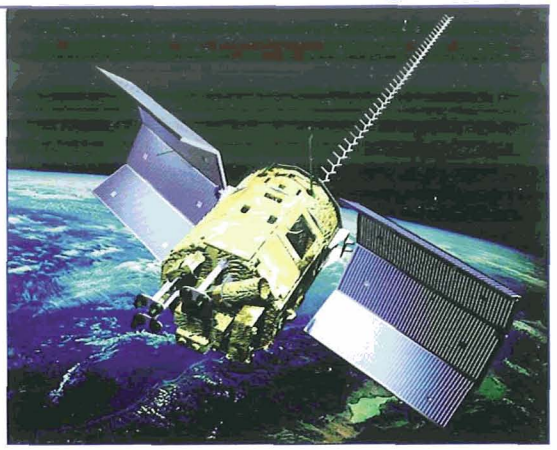
NASA and the United States (U.S.) Agency for International Development (USAID) signed an agreement in May 2001 to promote scientific and technical cooperation on the research, development, and application of remote sensing data, especially regarding environmental aspects of the carbon cycle and its influence on food and fiber production, as well as land use and land cover change that affect economic development.

Global climate change is a near-term focus of NASA Earth science research. The carbon cycle is a fundamental element in understanding global climate and global climate change. Human activity has a significant impact on the distribution of carbon on land, in the atmosphere, and in the oceans. Significant additions of carbon into the atmosphere, such as carbon dioxide, into the atmosphere from the burning of fossil fuels can be offset, in part, by removing carbon from the atmosphere and "storing" it in soils of selected areas of Africa, such as sub-Saharan Africa, that have been depleted of carbon after generations of agriculture and grazing. These soils offer a potential to mitigate the increase in atmospheric carbon while simultaneously enriching agricultural soils and providing an economic incentive to very poor farming communities.

NASA is working with USAID to determine how NASA-acquired data and information to assess land-cover and land-use changes and storage of carbon in soil and vegetation in Africa can be used to assess and monitor soil carbon sequestration in development projects in Africa. NASA funded two applications research projects in Mali and South Africa. NASA and USAID supported demonstration projects in Africa for the World Summit on Sustainable Development in Johannesburg in 2002. The primary sources were from NASA Earth Science Enterprise sensors, especially Moderate Resolution Imaging Spectroradiometer, Landsat 7, and the Shuttle Radar Topography Mission.

Sea-viewing Wide Field-of-view Sensor (SeaWiFS) image of Madagascar. *(Source: Orbview 2 satellite provided by SeaWiFS project, NASA Goddard Space Flight Center (GSFC), and Orbimage)*

NASA and Argentina's Comisión Nacional de Actividades Espaciales (CONAE) (Commission on Space Activities) are cooperating on the Science Applications Satellite C (SAC-C) Mission that was launched in November 2000. SAC-C conducts correlated observations of Earth—acquiring images to study terrestrial and marine environments. Argentina's multispectral medium-resolution scanner examines coastal marine areas and monitors forest inventory and agricultural production in Argentina. CONAE has also provided high-sensitivity and high-resolution technological cameras, as well as a data-collection system. NASA's contribution includes a scalar magnetometer, an advanced Global Positioning System (GPS), and the launch. SAC-C carries additional instruments provided by Argentina, Denmark, Italy, and France to study Earth's geomagnetic field and atmospheric structure.

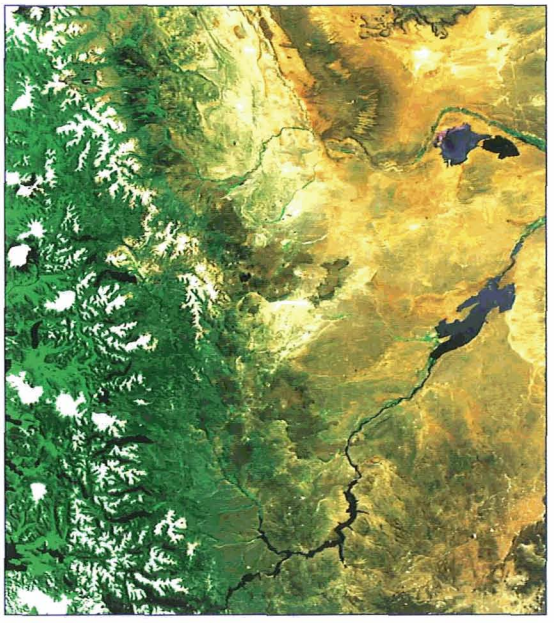


The SAC-C.

The Argentine-built SAC-C, co-manifested with NASA's advanced land imager Earth Observing-1 (EO-1), was launched aboard a Delta II launch vehicle in November 2000. The SAC-C mission is further enhanced by NASA's creation of the AM Constellation, which consists of the formation flying of SAC-C, EO-1, Landsat 7, and Earth Observing System Terra satellites. This revolutionary approach to Earth remote sensing is preparing the way for future, more complex Earth observation systems. An AM Constellation Workshop commemorating the third anniversary of the SAC-C/EO-1 launch was held in Buenos Aires in December 2003. Argentine and U.S. investigators presented papers addressing initial research results based on multiplatform data, as well as plans for future activities.

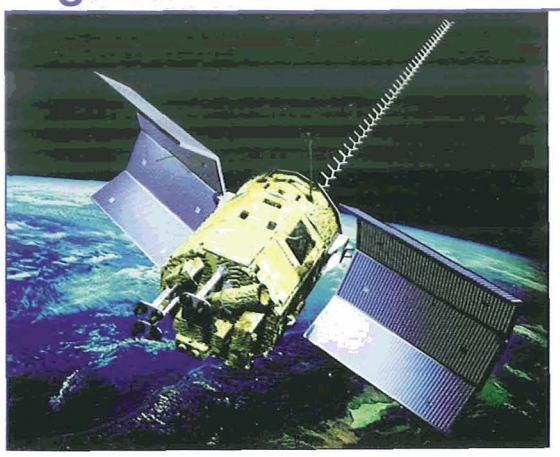
SAC-C continues to operate successfully, and Argentine and U.S. researchers continue to work together on the analysis of observations from this satellite. NASA and CONAE regularly conduct joint field campaigns to calibrate observations from SAC-C and EO-1 at several test sites in Argentina. Major applications areas include ecology, geology, coastal process research, hydrology, land-cover/land-use change, fire and natural hazards applications, forestry, and agriculture.

For more information regarding the EO-1 and SAC-C missions, please visit the following Web site: ***http://eo1.gsfc.nasa.gov***.

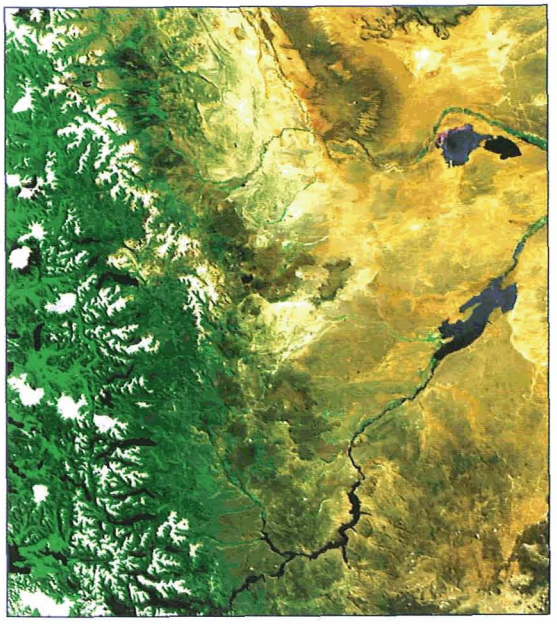


The first image taken by the Multispectral Medium Resolution Scanner (MMRS) instrument aboard the SAC-C satellite.

Argentina



El SAC-C.



La primera imagen captada por el escáner de espectro múltiple de mediana resolución (MMRS) a bordo del satélite SAC-C.

SAC-C
SATÉLITE DE APLICACIONES CIENTÍFICAS

La NASA y la Comisión Nacional de Actividades Espaciales (CONAE) de Argentina están cooperando en la misión del Satélite C de Aplicaciones Científicas (SAC-C), lanzado en noviembre del año 2000. El SAC-C lleva a cabo observaciones correlacionadas de la Tierra, a fin de obtener imágenes para estudiar el medio ambiente terrestre y marino. El escáner de espectro múltiple de mediana resolución (MMRS) de la Argentina, estudia las regiones marinas de la costa y monitorea el inventario forestal y agrícola en la Argentina. Por su lado, la CONAE también ha contribuido con cámaras tecnológicas de gran sensibilidad y alta resolución, y con un sistema de recolección de datos. La contribución de la NASA incluye un magnetómetro a escala, un Sistema de Posicionamiento Global (GPS) avanzado, y la capacidad para realizar lanzamientos. El SAC-C transporta además instrumentos adicionales proporcionados por Argentina, Dinamarca, Italia, y Francia para el estudio del campo geomagnético y de la estructura atmosférica de la Tierra.

El SAC-C de fabricación argentina, conjuntamente con el Captor de Imágenes Terrestres Observador Terrestre-1 (EO-1), fue lanzado del Vehículo de Lanzamiento Delta II en noviembre del año 2000. La Misión SAC-C se ha visto potenciada aún más por la creación por parte de la NASA de la Constelación AM, que consiste del vuelo en formación del SAC-C, EO-1, Landsat 7, y de los satélites Terra del sistema de observación terrestre. Este enfoque revolucionario de sondeo remoto de la Tierra está preparando el camino para los futuros y más complejos sistemas de observación de la Tierra. En diciembre de 2003, se llevó a cabo en Buenos Aires, un Taller de Trabajo de la Constelación AM en conmemoración del tercer aniversario del lanzamiento del SAC-C/EO-1. Investigadores de Argentina y Estados Unidos presentaron trabajos enfocando los resultados de investigación iniciales, basados en datos multiplataforma, así como proyectos para actividades futuras.

El SAC-C continua operando con éxito y los investigadores de Argentina y de los Estados Unidos continúan trabajando en forma conjunta para analizar las observaciones realizadas desde este satélite. La NASA y la CONAE llevan a cabo regularmente campañas conjuntas de campo para calibrar las observaciones de SAC-C y EO-1 en diferentes ubicaciones de prueba en Argentina. Las principales áreas de aplicación incluyen la ecología, geología, investigación de contaminación costera, cambios en la corteza terrestre y uso de la tierra, aplicaciones en caso de incendios y riesgos naturales, ingeniería forestal, y agricultura.

Para obtener información adicional relativa a las misiones EO-1 y SAC-C, sírvase visitar: ***http://eo1.gsfc.nasa.gov***.

NASA is cooperating with the Australia Antarctic Division (AAD) Amery Ice Shelf Ocean Research (AMISOR) program through the involvement of NASA scientists and the loan of NASA's Ice Borehole Probe instrument to the AAD. In 2003, the AAD, which is part of the Australian Government's Department of the Environment and Heritage, and NASA's Polar Science Program created a joint program of glaciological science research in Antarctica to support AMISOR. AMISOR conducts ongoing glaciological research in Antarctica addressing a variety of factors, including ice dynamics and structure.

Under this collaboration, NASA will provide its Ice Borehole Probe instrument and related NASA expertise to the AAD during the 2003–2004 Field Season (October to February) and will conduct follow-on data analysis and joint research for a 2.5-year period after the 2003–2004 Field Season. NASA is supporting the deployment of the hot-water ice borehole probe with visible light cameras at one specific location in the East Antarctic sheet, the Davis Station, which is in East Antarctica, situated at latitude 68°35' south, longitude 77°58' east, on the Ingrid Christensen Coast in Princess Elizabeth Land. The AAD's contribution involves the scientific expertise and logistical support necessary to perform the planned 2003–2004 AMISOR field work. Through this joint project, NASA and AAD plan to develop in situ optical data sets that, when combined with satellite-based ice sheet observational data, may form a more complete picture of glacial mass balance and change over the past few glacial cycles.

The Antarctic ice sheet, equal in size to the United States and Mexico combined, holds a potential treasure trove of information related to the geological history of this frozen continent and the mechanisms by which ice flows from this area to the oceans. Studies show that significant changes in glacier melting and flow rates could have a considerable impact on global sea levels. The project complements a similar project that NASA's Jet Propulsion Laboratory (JPL) conducted from 2000 to 2001 and fits into the bigger picture of planetary studies as it provides scientists with some understanding of how to observe what goes on deep in ice caps such as Earth's, Mars's, and Europa's (Jupiter's ice-covered moon).

For more information regarding this mission, please visit the following Web site: ***http://robotics.jpl.nasa.gov/~behar/JPLAntIceProbe.html***.

NASA Jet Propulsion Laboratory's team retrieving pressure and temperature sensors measuring the ice stream of the West Antarctic ice sheet.

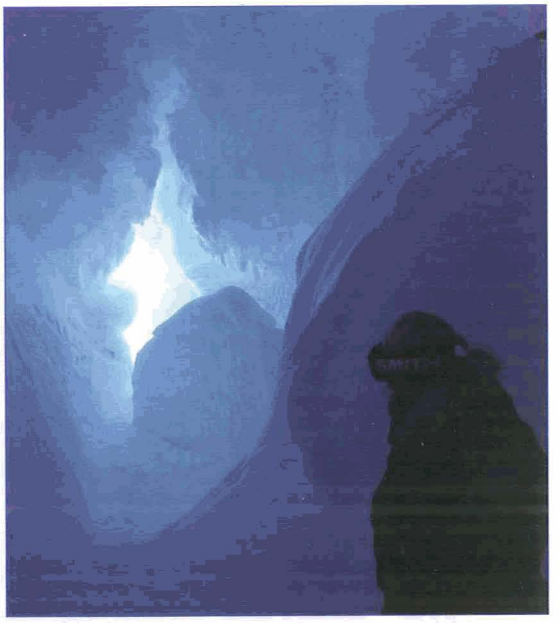


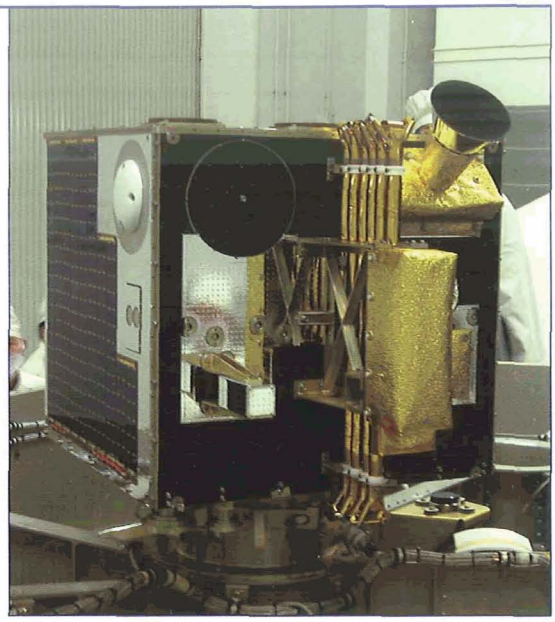
Photo of Antarctic ice sheet.

NASA and Australia's Cooperative Research Centre for Satellite Systems (CRCSS) cooperated on the Federation Satellite (FedSat). Launched in December 2002 and operational since February 2003, Australia's first microsatellite in three decades was constructed by the Cooperative Research Centre for Satellite Systems, an organization comprising universities, private industry, and the Commonwealth Scientific and Industrial Research Organization. FedSat is an ambitious mission carrying four payloads, ultra high fidelity (UHF)/Ka communications, a space science magnetometer, an advanced computer demonstrator, and a navigation payload.

As part of this mission, NASA provided a dual-frequency GPS receiver to provide satellite timing and position determination, to test new algorithms, and to support other scientific studies such as atmospheric sounding. NASA also supported the provision of a U.S.-Australian cooperatively designed High Performance Computing Experiment, known as the Adaptive Instrument Module (AIM), for demonstrating remote reconfiguration and inorbit self-healing.

Originally intended to commemorate the 100th anniversary of the federation of Australia, FedSat is Australia's first step in developing low-cost microsatellites for communications, space physics, and Earth observation. Launched on the Japanese Aerospace Exploration Agency H-IIA rocket, the FedSat satellite was recently honored on the 1-year anniversary of its launch and received an Australian National Award for Engineering Excellence. The FedSat satellite, operated by the CRCSS, is currently in the second year of its 3-year mission and continues to provide valuable data to researchers.

For more information regarding FedSat, please visit the following Web site: ***http://www.crcss.csiro.au/***.



FedSat satellite under construction: FedSat is an Australian microsatellite measuring approximately 50 cubic centimeters, with a mass of 58 kilograms.

The launch of FedSat in December 2002.

PACRIM II
SECOND PACIFIC RIM CAMPAIGN

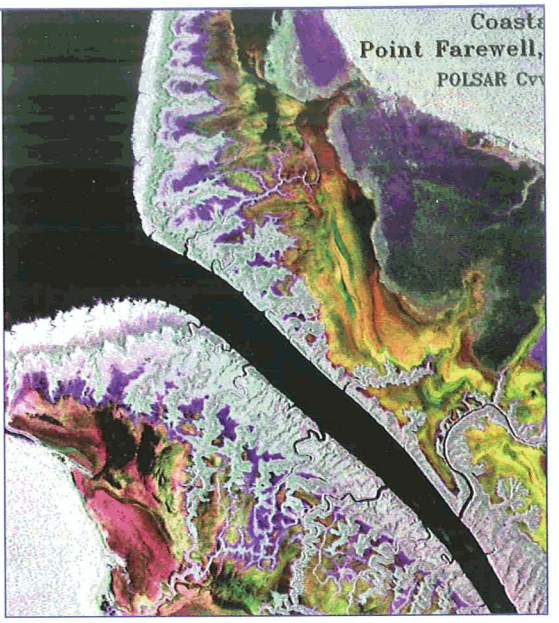
The PacRim II airborne campaign, conducted from July to October 2000, was a followup to the first PacRim Campaign of 1996. The second campaign included a deployment of the NASA DC-8 aircraft carrying two primary instruments on board—the Airborne Synthetic Aperture Radar (AirSAR) and the MODIS/ASTER Airborne Simulator (MASTER) instrument. MASTER is an airborne simulator of the Moderate Resolution Imaging Spectroradiometer (MODIS) and the Advanced Spaceborne Thermal Emission Reflectance Radiometer (ASTER), instruments on NASA's Terra satellite, launched December 18, 1999.

The PacRim II campaign collected data over 18 countries/regions, including the United States, Australia, Cambodia, Fiji, French Polynesia, Guam, Indonesia, Japan, Malaysia, the Federated States of Micronesia, New Zealand, the Northern Mariana Islands, Palau, Papua New Guinea, the Philippines, South Korea, and Taiwan. Scientists in each of the participating countries, in cooperation with American and Australian scientists, continue to interpret data collected from the PacRim I and II campaigns to advance Earth science research and applications.

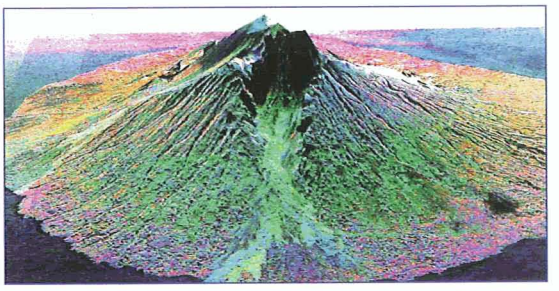
The research and applications areas that benefit from the PacRim missions include agriculture, coastal processes, geology and tectonics, disaster management, forestry, urban and regional development, and continued cooperation in synthetic aperture radar (SAR) research. AirSAR data for landforms in the participating countries have been used for topographic analysis, ecological research of forest and coastal mangroves, volcano and tectonic research, geological research, and archeology; MASTER data are being used for volcanological research and mapping of topography, geothermal anomalies, sulfur dioxide plumes, and geology.

Archeologists and PacRim scientists collaborated to understand how the ancient civilization of Angkor Wat in Cambodia managed the use of water to sustain itself. Using a technique known as radar interferometry, which combines two images to create a three-dimensional topographic map, scientists constructed a map of the area surrounding Angkor and gained a new perspective on natural and humanmade water-management features. The findings revealed a more densely populated ancient Angkor Wat than was previously believed by the archeological community to have existed, and the findings revealed more detailed outlines of ancient waterways, providing archeologists with new and more accurate data to develop new theories of the growth and ultimate demise of the ancient civilization.

For further information regarding PacRim II, please visit the following Web site: ***http://airsar.jpl.nasa.gov/***.



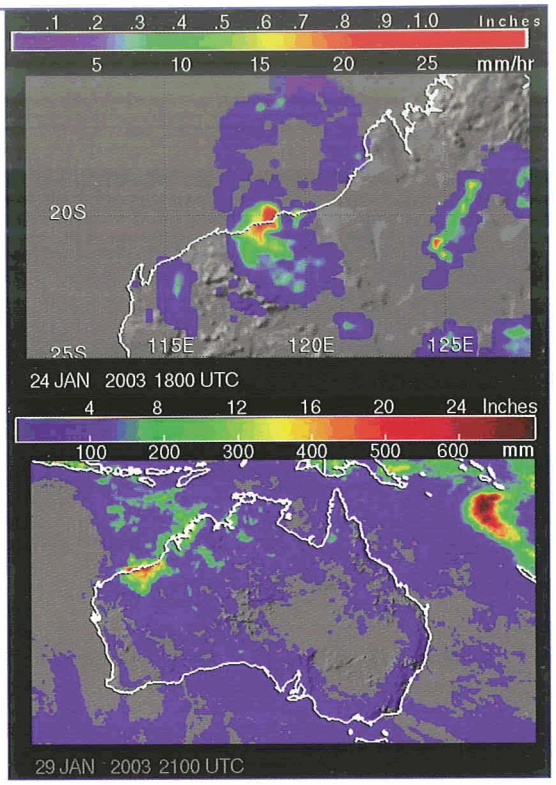
AirSAR image of the Alligator Rivers region in Arnhem Land, Northern Territory, taken during the PacRim mission, helps scientists monitor the health of coastal systems in inaccessible areas.



The PacRim mission in Australia has revealed details of the landscape, producing images like this one of a volcano on Manam Island, Papua New Guinea. The ability of the AIRSAR radar to see through clouds of volcanic ash allowed the volcano to be mapped during an eruption (note the lava flow). Scientists will use this information to study potentially dangerous volcanoes in the Pacific Rim.

Australia

Australia is a key participant in the international effort to calibrate and validate Tropical Rainfall Measuring Mission (TRMM) data, and it is providing essential ground-based rainfall data over Australia and the surrounding region. In cooperation with the TRMM Science Team, Australia's Bureau of Meteorology Research Centre (BMRC) conducts scientific analyses and investigations using TRMM data at the BMRC Darwin Climate Monitoring and Research Station; obtains ground-based precipitation data in Australia, particularly in the area near Darwin; and analyzes TRMM validation data collected during the South China Sea Monsoon Experiment and other field experiments. The Australian validation data, as well as measurements made by Japan and the U.S. validation sites, flow into a major data archive at NASA's Goddard Space Flight Center for use in the accurate determination of global tropical rainfall. BMRC researchers are also using TRMM-based multisatellite analyses to study precipitation variations over and surrounding Australia and are key participants in international programs for intercomparison of satellite algorithms, including those associated with the TRMM mission.



Rain map illustrating flooding in Western Australia in January 2003.

The Tropical Rainfall Measuring Mission is a joint NASA/Japan Aerospace Exploration Agency (JAXA) mission launched on November 27, 1997, aboard a Japanese H-II rocket. TRMM is a research satellite designed to study tropical rainfall and the associated release of energy that helps power the global atmospheric circulation shaping both weather and climate around the globe. TRMM has established an improved tropical rainfall climatology, demonstrated improved forecasting using assimilation of rainfall information into numerical models, defined interesting new impacts of aerosols and pollution on rainfall, and established new relationships between hurricane/typhoon intensity variations and convection variations within those systems. Real-time TRMM data are used in tropical cyclone monitoring by weather agencies around the world, and TRMM real-time rainfall products are used as input into operational numerical weather-prediction models and for global flood monitoring.

For further information regarding TRMM, please visit the following Web site: ***http://trmm.gsfc.nasa.gov***.

TRMM data illustrate global rainfall.

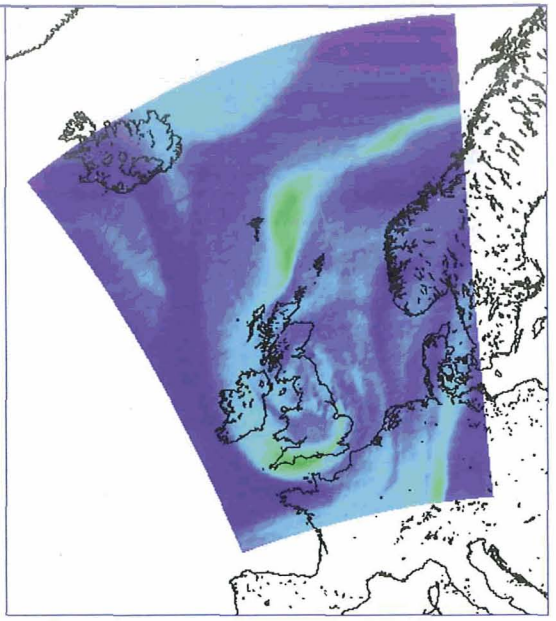
The Brazilian Space Agency, via the Brazilian Space Research Institute, provided a humidity sounding instrument aboard NASA's Aqua Earth-observing satellite, which was launched in May 2002.

The Humidity Sounder for Brazil (HSB) is a 4-channel radiometer on the Aqua satellite. In combination with the Atmospheric Infrared Sounder and Advanced Microwave Sounding Unit, HSB was able to obtain humidity measurements under cloudy and hazy conditions. HSB obtained atmospheric water vapor (humidity) profiles near Earth's surface by receiving and measuring radiation from the atmosphere. As a part of this sounding system, the HSB contributed to climate monitoring, the improvement of modeling efforts, and numerical weather prediction.

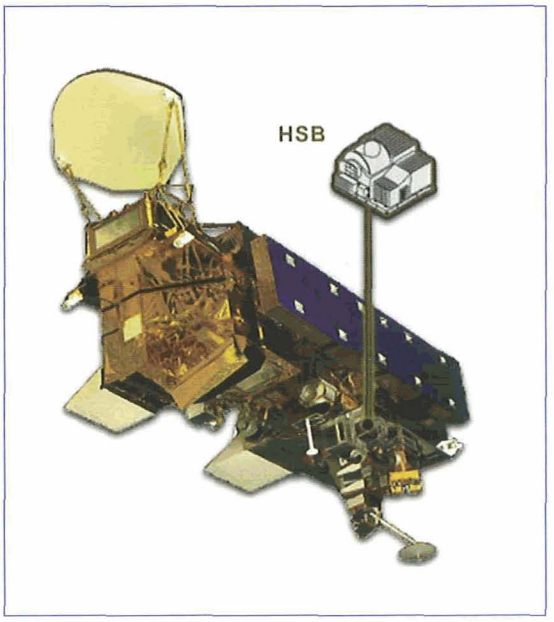
NASA's Aqua mission was launched on May 4, 2002. Orbiting Earth 16 times a day, the Aqua satellite collects climate-related data by measuring clouds, atmospheric temperature, moisture content, precipitation, snow, sea ice, and sea surface temperature. The HSB instrument experienced an anomaly in February 2003 and has been turned off since that time.

For more information regarding HSB, please visit the following Web sites: ***http://aqua.nasa.gov/HSB2.html*** and ***http://www.dss.inpe.br/programas/hsb/ingl/index.html.***

For information regarding the Aqua mission, please visit the following Web site: ***http://eos-pm.gsfc.nasa.gov***.

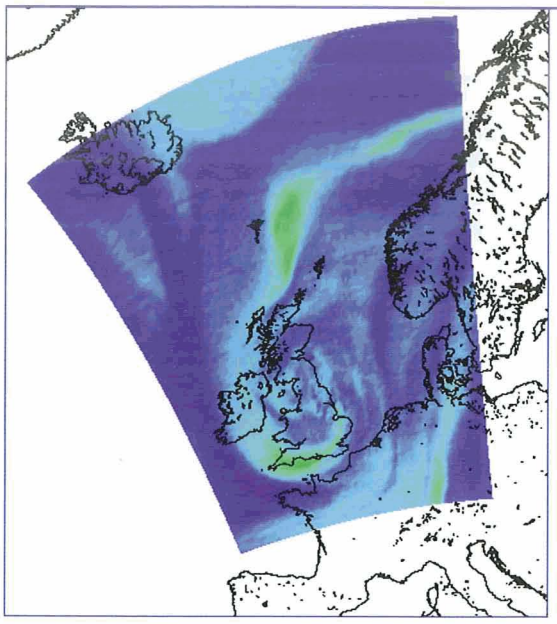


This image is from a microwave channel from the Humidity Sounder for Brazil; the instrument is very sensitive to humidity and does not see the surface at all, but instead reveals the structure of moisture streams in the troposphere.

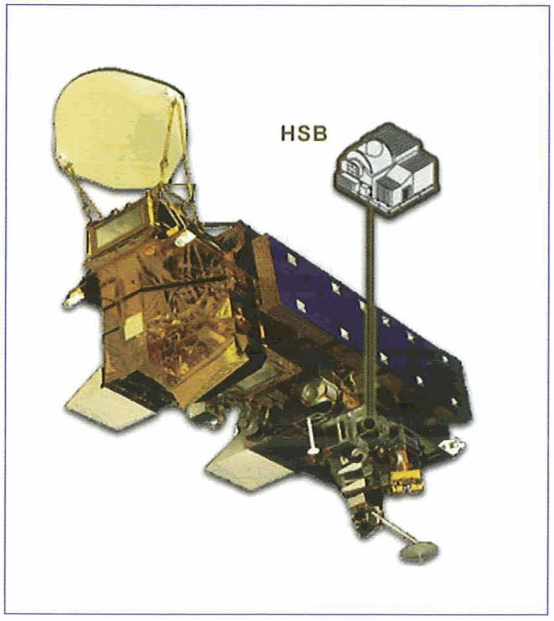


The HSB, provided by Brazil, was developed by Matra-marconi Space (Bristol, United Kingdom) with participation from the Brazilian company Equatorial Sistemas.

Brasil



Esta imagem é de um canal de microonda do Sondador de Umidade do Brasil; o instrumento é muito sensível à umidade e não vê a superfície de maneira alguma, mas, em vez disso, revela a estrutura dos fluxos de umidade na troposfera.



O SUB, provido pelo Brasil, foi desenvolvido por Matra-marconi Space (Bristol, Reino Unido) com a participação da empresa brasileira Sistemas Equatoriais.

SUB
SONDADOR DE UMIDADE DO BRASIL

A Agência Espacial Brasileira, por meio do Instituto Brasileiro de Pesquisas Espaciais, proveu um instrumento sondador de umidade a bordo do satélite de observação terrestre Aqua da NASA, lançado em maio de 2002.

O Sondador de Umidade do Brasil (SUB) é um radiômetro de quatro canais no satélite Aqua. Juntamente com o Sondador Atmosférico Infravermelho e a Unidade Avançada de Sondagem de Microonda, o SUB conseguiu obter medidas de umidade em condições nubladas e encobertas. O SUB obteve perfis de vapor d'água atmosférico (umidade) próximos da superfície da Terra recebendo e medindo a radiação da atmosfera. Como parte deste sistema sondador, o SUB contribuiu para o monitoramento do clima, a melhoria dos esforços de padrão, e a previsão meteorológica numérica.

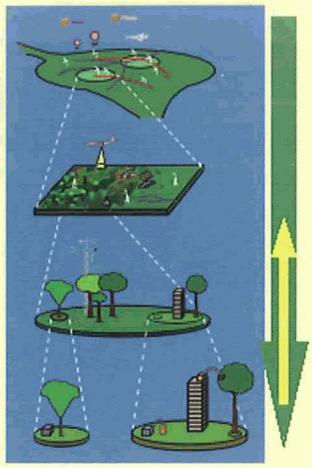
A missão Aqua da NASA foi lançada em 4 de maio de 2002. Girando em volta da Terra 16 vezes por dia, o satélite Aqua coleta dados relacionados ao clima medindo as nuvens, a temperatura atmosférica, o conteúdo da umidade, precipitação, neve, gelo no mar e a temperatura da superfície marinha. O instrumento SUB experimentou uma anomalia em fevereiro de 2003 e, desde então, seu uso foi interrompido.

Para obter mais informações a respeito do SUB, visite os seguintes websites: ***http://aqua.nasa.gov/HSB2.html*** e ***http://www.dss.inpe.br/programas/hsb/ingl/index.html.***

Para obter mais informações a respeito da missão Aqua, visite o seguinte website: ***http://eos-pm.gsfc.nasa.gov.***

The Large-Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) is a multidisciplinary, multiyear (1998–2005), international research initiative led by Brazil. The goal of the experiment is to gain an increased understanding of the climatological, ecological, biogeochemical, and hydrological functioning of Amazonia; its interaction with the Earth system; and its response to land-use change. This project is the largest cooperative international scientific project ever to study the interaction between the tropical forests of the Amazon and the regional and global atmospheres. The Brazilian Ministry of Science and Technology is responsible for the policy management of LBA, and the National Institute for Amazonian Research is responsible for LBA's scientific coordination and implementation in Brazil. Many Brazilian, European, and U.S. institutions contribute scientific research investigations to LBA. NASA is leading the U.S. scientific participation that is currently focused on improving our understanding of the effects of tropical forest conversion on ecosystem function (carbon, nutrients, trace gases) and the sustainability of land use. From 1998 to 1999, a NASA-led field validation campaign for the Tropical Rainfall Measuring Mission was conducted.

LBA will analyze across scales, examining fluxes at the basin scale and validating measurements from the TRMM satellite.



LBA combines newly developed analytical tools (satellite and airborne remote sensing, Geographic Information System, and state-of-the-art models) and innovative, multidisciplinary, experimental designs in a powerful synthesis that creates new knowledge to address long-standing scientific issues and controversies. LBA provides new understanding of the environmental controls on flows of energy, water, carbon, nutrients, and trace gases among the atmosphere, hydrosphere, and biosphere of Amazonia. It is anticipated that this information will help to provide the scientific basis for making decisions concerning climate change effects and forming sustainable use policies for Amazonian natural resources. Participants also sponsor activities to enhance research capacities and networks within Brazil and among the Amazonian countries associated with LBA. Training and education are conducted to advance global change science and applied research into sustainable development.

For information regarding the LBA project, please visit the following Web sites: ***http://www.lbaeco.org/lbaeco/*** and ***http://daac.ornl.gov/lba_cptec/lba/indexi.htm***.

This map is derived from satellite radar data showing central Amazon rivers and wetlands in purple. The calculated percentage of the region occupied by wetlands, 17 percent, is much greater than had been assumed previously and will significantly improve model estimates of methane fluxes.

Brasil

LBA
EXPERIMENTO EM LARGA ESCALA NA BIOSFERA-ATMOSFERA DA AMAZÔNIA

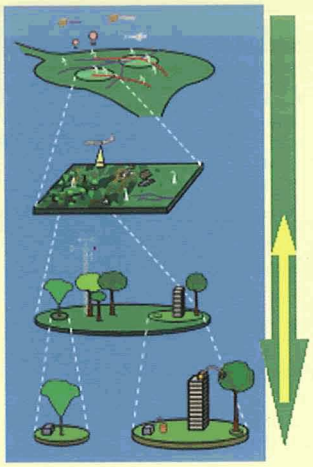
O LBA analisará todas as escalas, examinando fluxos na escala da bacia e validando as medições do satélite TRMM.

Satélites
100–10.000 km
Região Pan-Americana

Aviões
1–100 km
Áreas de Estudo

Torres
≈1 km
Sítios das Torres de Fluxo

Plataformas in Loco
1–100 m
Gráficos dos estudos em processo
Sítios de Validação

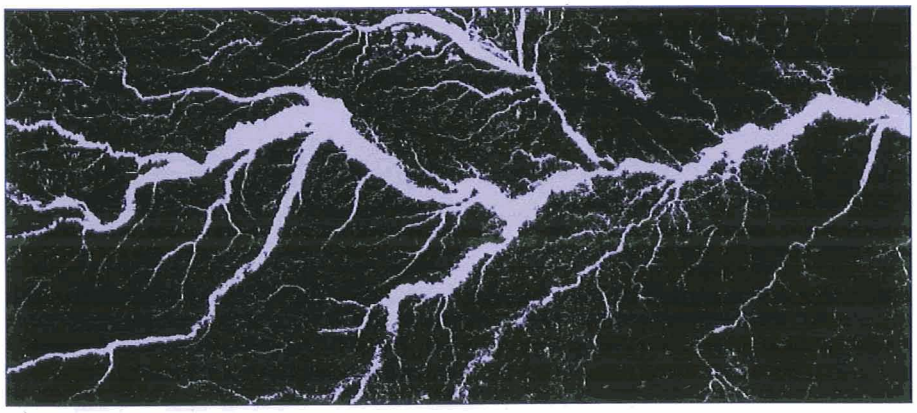


Gráficos dos estudos em processo nos sítios de validação

O experimento em larga escala na Biosfera-Atmosfera da Amazônia (LBA) é uma iniciativa multidisciplinar internacional de pesquisas em vários anos (1998–2005) liderada pelo Brasil. A meta do experimento é obter um conhecimento ampliado do funcionamento climatológico, ecológico, biogeoquímico e hidrológico da Amazônia; a sua interação com o sistema terrestre; e a sua resposta às mudanças de utilização agrária. Este projeto é o maior projeto científico internacional de cooperação criado para estudar a interação entre as florestas tropicais do Amazonas e as atmosferas regionais e globais. O Ministério de Ciência e Tecnologia do Brasil é responsável pelo gerenciamento da política do LBA e o Instituto Nacional de Pesquisa na Amazônia é responsável pela coordenação e pela implantação científica do LBA no Brasil. Muitas instituições brasileiras, européias e dos Estados Unidos contribuem com investigações de pesquisas científicas para o LBA. A NASA lidera a participação científica dos Estados Unidos que se concentra, no momento, no desenvolvimento do conhecimento da humanidade com relação aos efeitos da conversão da floresta tropical para uma função de ecossistema (carbono, nutrientes, vestígios de gases) e a sustentabilidade do uso agrário. De 1998 a 1999, foi realizada uma campanha de validação de campo liderada pela NASA para a Missão de Medição da Precipitação Pluviométrica.

O LBA fusiona recém-criadas ferramentas analíticas (sensor remoto de satélite e aerotransportado, Sistema de Informações Geográficas e modelos de vanguarda) e desenhos inovadores, multidisciplinares e experimentais em uma síntese poderosa que criarão um conhecimento novo para abordar as questões e controvérsias científicas existentes. O LBA provê um novo conhecimento dos controles ambientais nos fluxos de energia, água, carbono, nutrientes e vestígios de gases entre a atmosfera, hidrosfera, e biosfera da Amazônia. Prevê-se que esta informação ajudará a prover a base científica para que decisões sejam tomadas com referência aos efeitos de mudança climática e a formação de políticas de uso sustentável para os recursos naturais da Amazônia. Os participantes também patrocinarão atividades para realçar as capacidades de pesquisa e redes no Brasil e entre os países amazônicos associados ao LBA. Treinamento e estudos são conduzidos para desenvolver a ciência de mudanças globais e a pesquisa aplicada a um desenvolvimento sustentável.

Para obter mais informações a respeito do projeto LBA, visite os seguintes websites: ***http://www.lbaeco.org/lbaeco/*** e ***http://daac.ornl.gov/lba_cptec/lba/indexi.htm***



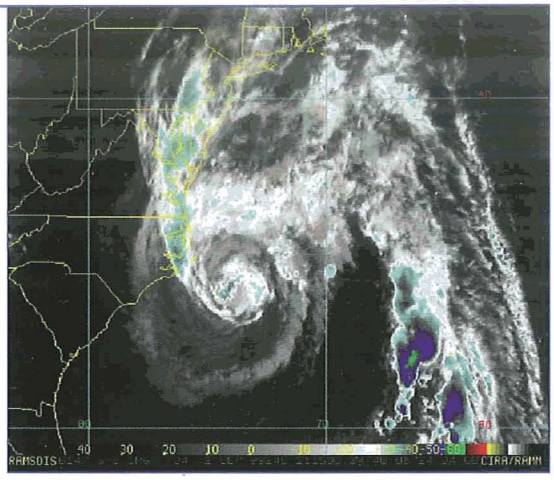
Este mapa é o resultado de dados de satélite mostrando os rios centrais e pântanos do Amazonas em roxo. A percentagem de 17 por cento calculada para a região ocupada pelos pantanais é mais alta do que se presumia anteriormente e melhorará consideravelmente as estimativas dos modelos de fluxos de metano.

NASA, the United States Air Force, and the Canadian Space Agency (CSA) are cooperating on the CloudSat mission scheduled for launch in 2005. CloudSat is an experimental satellite designed to measure the vertical structure of clouds from space. It will be the first satellite to fly a millimeter-wave radar that is capable of seeing a large fraction of clouds and precipitation, ranging from very thin cirrus clouds to thunderstorms producing heavy precipitation.

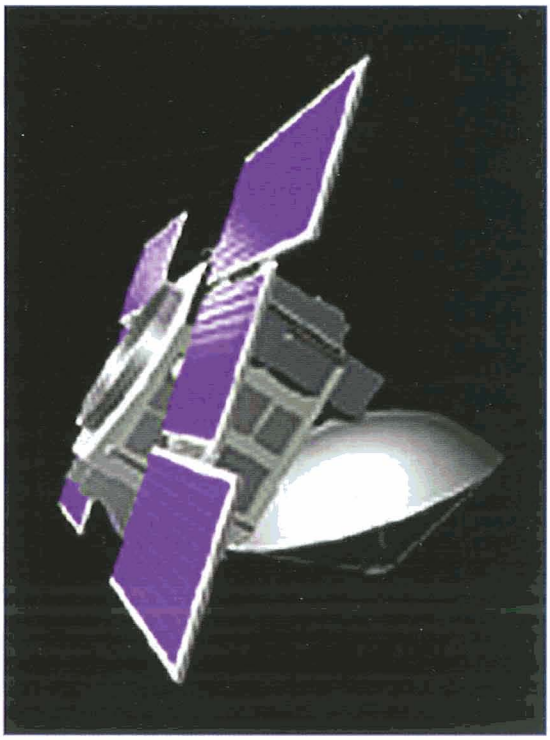
CloudSat's primary goal is to furnish data needed to evaluate and improve the way clouds are represented in global models, thereby contributing to better predictions of clouds and a complete knowledge of their poorly understood role in climate change and the cloud-climate feedback.

CloudSat will be launched together with Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) on a Delta launch vehicle from Vandenberg Air Force Base in California and will fly in orbital formation as part of a constellation of satellites including Aqua and Aura, CALIPSO (a NASA-French Space Agency, Centre National d'Études Spatiales (CNES), light detection and ranging (lidar) satellite), and Polarization and Anisotropy of Réflectances for Atmospheric Sciences coupled with Observations from a Lidar (PARASOL) (a CNES satellite carrying a polarimeter). CloudSat will maintain a tight formation with CALIPSO, with a goal of overlapping measurement footprints at least 50 percent of the time. CALIPSO will carry a dual-wavelength polarization-sensitive lidar that provides high-resolution vertical profiles of aerosols and clouds.

For more information regarding CloudSat, please visit the following Web site: ***http://cloudsat.atmos.colostate.edu/*** or ***http://essp.gsfc.nasa.gov/cloudsat/***.



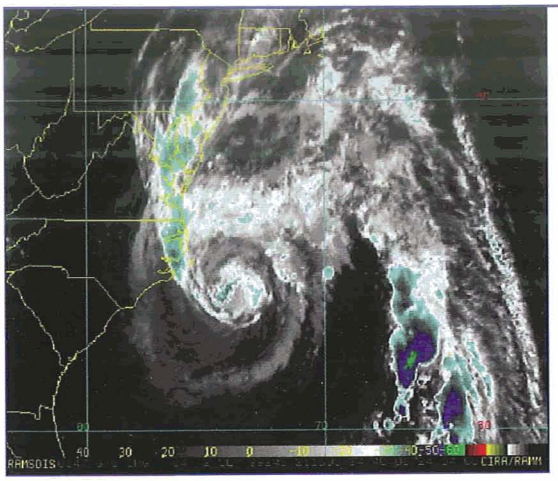
Existing space-based systems can only observe the uppermost layer of clouds and cannot reliably detect the presence of multiple cloud layers, nor can they determine the cloud water and ice content.



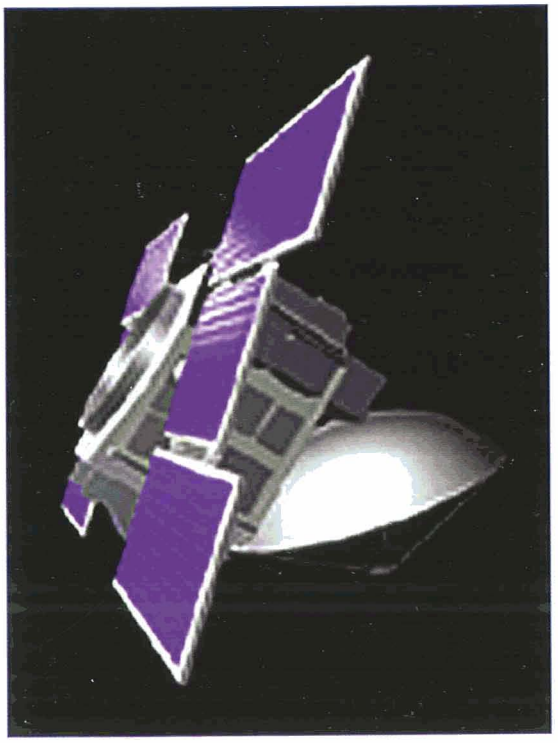
CloudSat satellite.

CloudSat collaborators.

Canada



Les systèmes spatiaux actuels ne peuvent qu'observer la couche de nuages la plus élevée et ne peut détecter la présence de multiples couches de nuages ou encore la quantité de glace ou d'eau dans les nuages.



Satellite CloudSat.

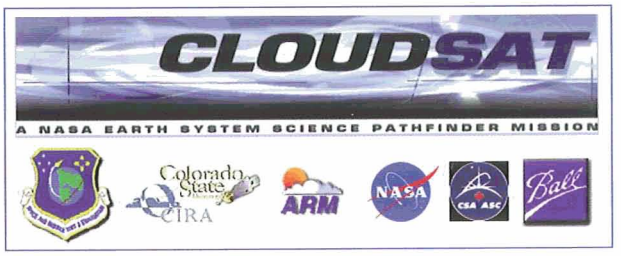
CLOUDSAT

NASA, les Forces armées américaines et l'Agence spatiale canadienne (ASC) collaborent actuellement à la mission CloudSat dont le lancement est prévu en 2005. CloudSat est un satellite expérimental conçu pour mesurer la structure verticale des nuages depuis l'espace. Ce sera le premier satellite doté d'un radar à ondes millimétriques capable d'observer une grosse partie des nuages et des précipitations, des nuages cirrus très épais aux orages produisant de fortes précipitations.

L'objectif principal de CloudSat consiste à fournir les données nécessaires pour évaluer et améliorer la façon dont les nuages sont représentés dans les modèles universels, ce qui aide à mieux prédire les nuages et comprendre à fond leur influence méconnue sur les changements climatiques et le feed-back nuage-climat.

CloudSat sera lancé conjointement avec Cloud-Aerosol Lidar et Infrared Pathfinder Satellite Observations (CALIPSO) sur un véhicule de lancement Delta depuis la base aérienne Vanderberg en Californie. Il volera en formation orbitale au sein d'une constellation de satellites, y compris Aqua et Aura, CALIPSO (un satellite de détection et télémétrie par la lumière (lidar) conçu par la NASA et le Centre National d'Études Spatiales (CNES)), et Polarisation et Anisotropie de Réflectances pour Sciences Atmosphériques avec Observations d'un Lidar (PARASOL) (un satellite CNES doté d'un polarimètre). CloudSat maintiendra une formation serrée avec CALIPSO afin de chevaucher les zones de couverture au moins 50 pour cent du temps. CALIPSO transportera un lidar sensible à la polarisation à double longueur d'onde qui fournit des profils verticaux à haute résolution d'aérosols et de nuages.

Pour de plus amples renseignements concernant CloudSat, visitez le site Web suivant : ***http://cloudsat.atmos.colostate.edu/*** or ***http://essp.gsfc.nasa.gov/cloudsat/***.



Collaborateurs CloudSat.

MOPITT
MEASUREMENTS OF POLLUTION IN THE TROPOSPHERE

NASA and the CSA cooperated on the flight of Canada's Measurements of Pollution in the Troposphere (MOPITT) instrument. MOPITT was launched aboard NASA's Terra satellite on December 18, 1999.

MOPITT is Canada's first major instrument to measure the pollution of Earth's atmosphere from space and the first satellite sensor to use gas correlation spectroscopy. The sensor measures emitted and reflected radiance from Earth in three spectral bands to determine the concentration of carbon monoxide and methane. MOPITT's spatial resolution is 22 kilometers at nadir, and it "sees" Earth in swaths that are 640 kilometers wide.

MOPITT continuously scans the atmosphere below it to provide the world with the first long-term global measurements of carbon monoxide and methane gas levels in the atmosphere. Together with other NASA Earth Science Enterprise sensor measurements, these data will help form the first long-term integrated measurements of the land, air, water, and life processes. The data will be used by scientists to predict long-term effects of pollution, to understand the increase of ozone in the lower atmosphere, and to guide the evaluation and application of shorter term pollution controls.

For more information regarding MOPITT, please visit the following Web site: ***http://terra.nasa.gov***.

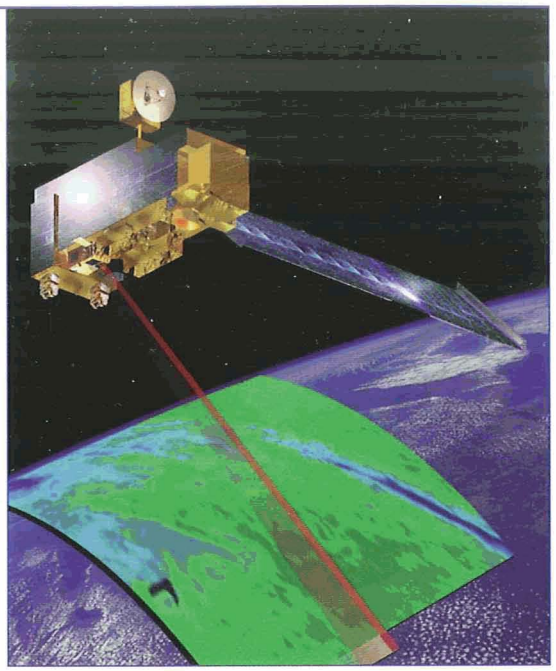
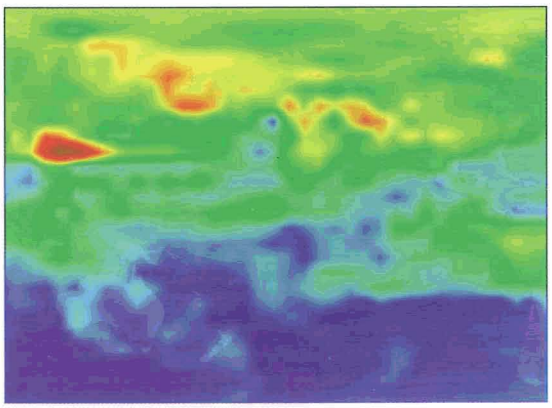


Illustration of how MOPITT scans a swath of Earth's atmosphere.



A MOPITT image of the atmosphere over the Pacific Ocean.

MOPITT
MESURE DE LA POLLUTION DANS LA TROPOSPHÈRE

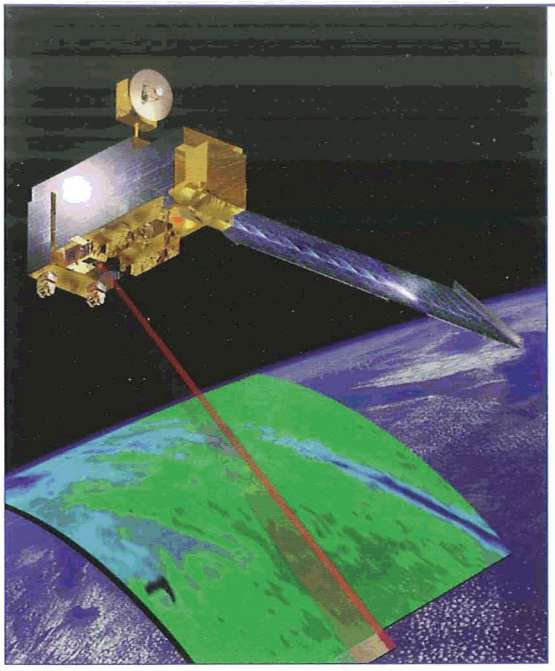


Illustration sur la façon dont MOPITT balaie un couloir de l'atmosphère de la Terre.

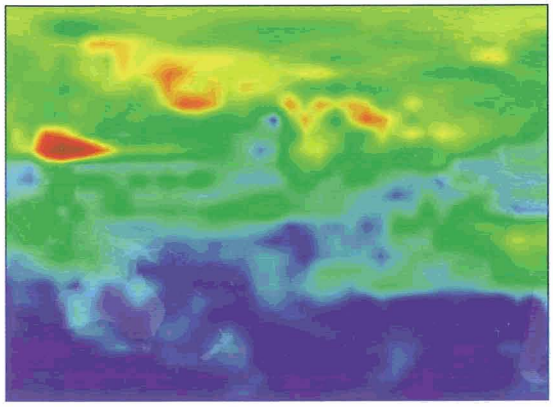


Image MOPITT de l'atmosphère au-dessus de l'Océan Pacifique.

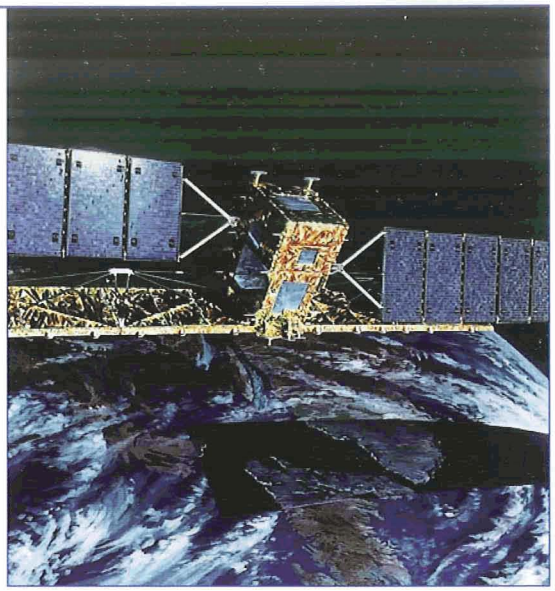
La NASA et l'ASC ont collaboré au lancement de l'instrument de mesure de la pollution dans la troposphère (MOPITT). MOPITT a été lancé à bord du satellite Terra de la NASA le 18 décembre 1999.

MOPITT est le premier instrument canadien d'importance à mesurer la pollution dans l'atmosphère terrestre depuis l'espace et le premier capteur à utiliser la spectroscopie de corrélation de gaz. Le capteur mesure la luminance énergétique émise et réfléchie par la Terre dans trois bandes spectrales pour déterminer la concentration de monoxyde de carbone et de méthane. La résolution spatiale de MOPITT est de 22 kilomètres au nadir, et il "voit" la Terre sous forme de couloirs d'une largeur de 640 kilomètres.

MOPITT balaiera continuellement l'atmosphère sous lui pour fournir au monde entier les premières mesures à long terme et à l'échelle mondiale des concentrations de monoxyde de carbone et de méthane dans la basse atmosphère. Jointes à d'autres données de mesure de NASA Earth Science Enterprise, les données recueillies par MOPITT aideront à constituer le premier ensemble de mesures intégrées à long terme des paramètres biosphériques, atmosphériques et océaniques de la planète ainsi que des processus de vie qui s'y déroulent. La base de données sera utilisée par les scientifiques pour prévoir les effets à long terme de la pollution, pour comprendre l'accroissement des concentrations d'ozone dans la basse atmosphère et pour orienter l'évaluation et l'application des contrôles de la pollution à plus court terme.

Pour de plus amples renseignements sur MOPITT, visitez le site Web suivant : ***http://terra.nasa.gov***.

NASA and the CSA cooperate on the RADARSAT-1 satellite that was launched by NASA in 1995. RADARSAT-1 is an advanced Earth observation satellite system developed by Canada to monitor environmental change and to support resource sustainability. RADARSAT-1 is equipped with a single-frequency SAR. The SAR is a powerful microwave instrument that transmits and receives signals to "see" through clouds, haze, smoke, and darkness; it obtains high-quality images of Earth's surface in all weather, day or night.



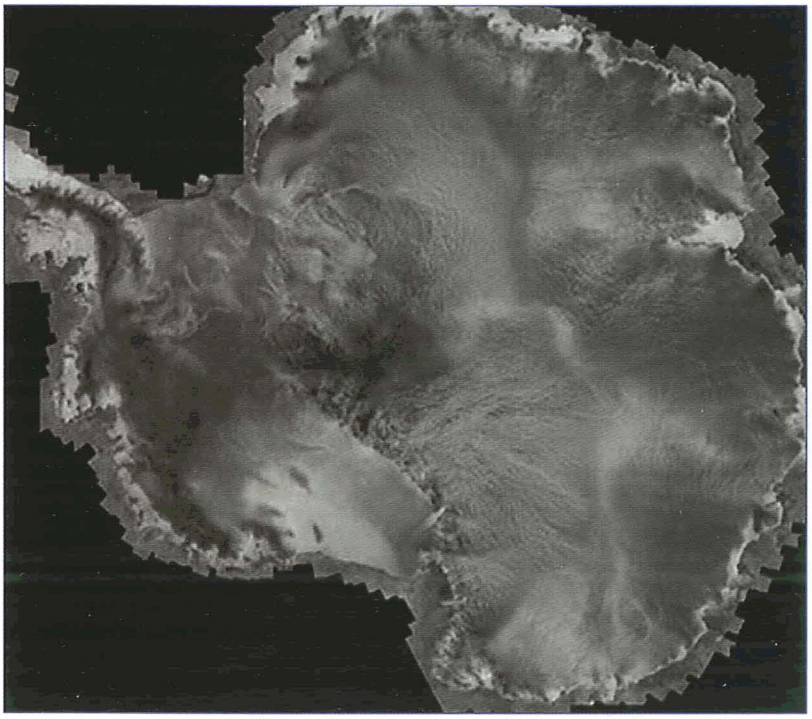
Canada's RADARSAT-1 satellite.

With this launch, the world has gained access to the first fully operational civilian radar satellite system capable of imaging the entirety of Earth at a very high resolution. The data from the satellite meet the needs of commercial, Government, and scientific programs, and they provide a reliable source of high-quality radar data.

The Antarctic Mapping Mission (AMM) was conducted using the RADARSAT-1 satellite to collect radar images to produce the first high-resolution mapping of the entire continent of Antarctica. A second mission provided data suitable for interferometry over the borders of the continent.

The Application Development Research Program (ADRO) promoted the use of data captured by RADARSAT-1. The ADRO-1 program stimulated the research community to develop new applications and operational programs that use Earth observation data derived from RADARSAT-1. ADRO-2 targeted projects to demonstrate the ability of RADARSAT-1 to support disaster assessment or relief efforts.

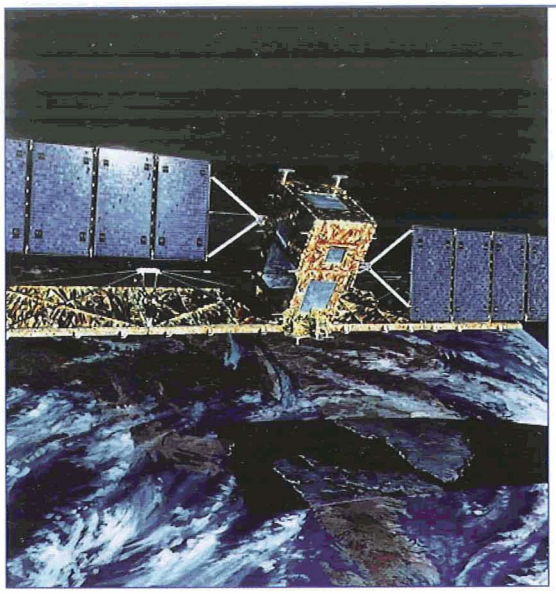
For more information regarding RADARSAT-1, please visit the following Web site: ***http://www.space.gc.ca***.



A RADARSAT image of Antarctica.

Canada

RADARSAT-1



Satellite canadien RADARSAT-1

La NASA et l'ASC ont collaboré au lancement du satellite RADARSAT-1 par la NASA en 1995. RADARSAT-1 est un satellite d'observation terrestre évolué développé par le Canada pour observer le changement environnemental et assurer la continuité des ressources. RADARSAT-1 est doté d'un SAR à fréquence unique. SAR est un puissant instrument à micro-ondes qui transmet et reçoit les signaux pour "voir" à travers les nuages, la brume, la fumée et la noirceur ; il fournit des images de qualité de la surface de la Terre peu importe la température, autant le jour que la nuit.

Suite à ce lancement, le monde a pu profiter d'un système satellite radar civil entièrement fonctionnel, capable de fournir des images de la Terre à très haute résolution. Les données provenant du satellite répondent aux exigences des programmes scientifiques, commerciaux et gouvernementaux, et constituent une source fiable de données radar de haute qualité.

La Mission Antarctic Mapping (AMM) fut lancée grâce au satellite RADARSAT-1 pour recueillir des images radar pour produire du repérage sur carte à haute résolution à haute résolution de l'Antarctique. Une deuxième mission a fourni des données convenant à l'interférométrie au-delà des frontières du continent.

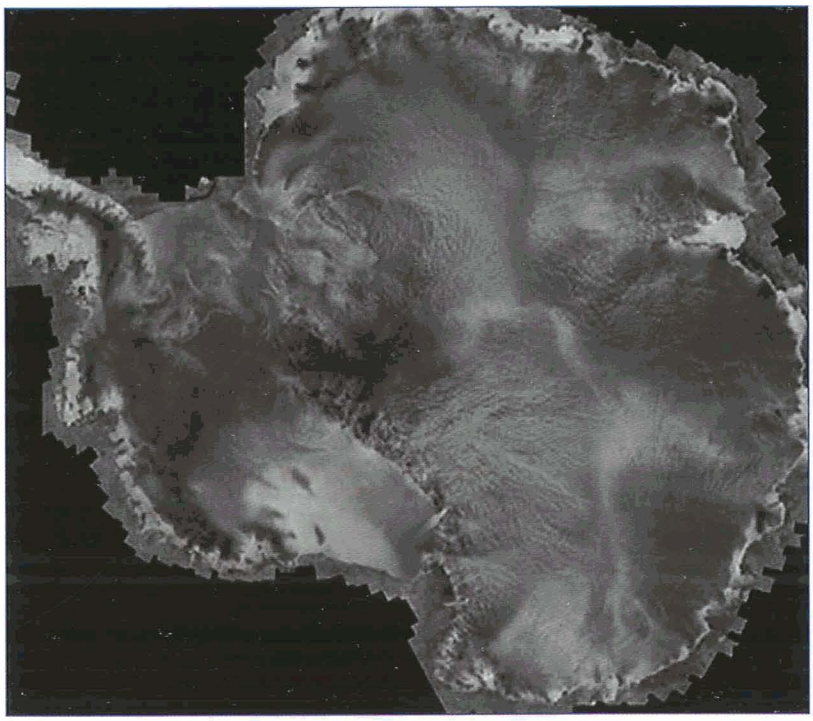


Image RADARSAT de l'Antarctique

Le Programme de recherche et développement d'application (ADRO) encourage l'utilisation des données saisies par RADARSAT-1. Le programme ADRO-1 a stimulé les chercheurs à développer de nouvelles applications et programmes opérationnels qui utilisent les données d'observation de la Terre dérivées de RADARSAT-1. ADRO-2 a ciblé des projets visant à démontrer la capacité de RADARSAT-1 d'évaluer les catastrophes ou appuyer les secours.

Pour de plus amples renseignements sur RADARSAT-1, visitez le site Web suivant : ***http://www.space.gc.ca***.

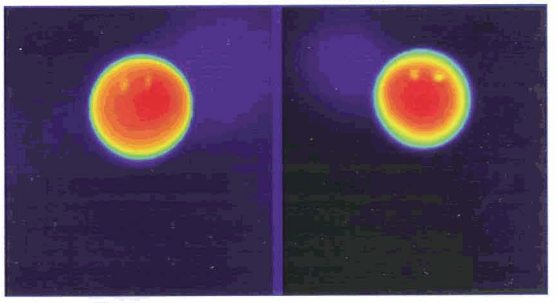
NASA and the CSA cooperated on the SciSat-1 Atmospheric Chemistry Experiment (ACE) mission that was launched on August 12, 2003, from Vandenberg Air Force Base in California. In addition to NASA's contribution of a Pegasus launch, NASA also provided expert advice on how to design aspects of Canada's Fourier Transform Spectrometer (FTS) instrument, along with algorithm development and science team support.

The overall objective of the ACE mission is to improve humanity's understanding of the depletion of the ozone layer, focusing close attention over Canada and the Arctic. The measurements obtained by the FTS and the Measurements of Aerosol Extinction in the Stratosphere and Troposphere Retrieved by Occultation (MAESTRO) instruments will be combined with data gathered by ground-based, balloon-based, and other space-based projects in order to obtain the best possible information to predict future trends relating to the ozone layer and its dynamics. SciSat-1 will provide near-global coverage, with observations of aerosols and clouds, including observations in the troposphere. A key capability of the measurements will be to validate the upcoming measurements from NASA's Aura mission.

In conjunction with other instruments and missions planned by NASA, the European Space Agency, and other international partners, this mission aims to gain a better understanding of the chemistry and dynamics of the atmosphere that affect Earth's protective ozone layer.

For more information regarding SciSat-1, please visit the following Web site: ***http://www.space.gc.ca***.

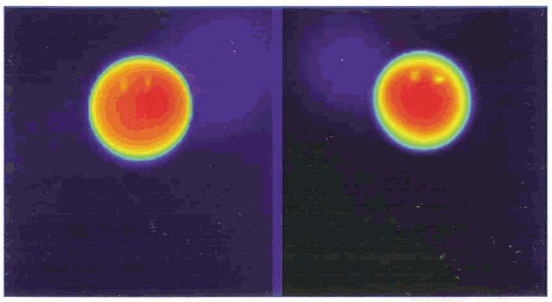
ACE-FTS and MAESTRO instrument.



This image of the recent solar storms was captured in mid-November 2003 during the commissioning activities of the FTS instrument aboard SciSat. The sunspots are in fact areas where the magnetic field, which is very strong, produces magnetic storms. The FTS instrument can produce this type of image but will mainly be used to produce interferograms.

Canada

Instrument ACE-FTS et MAESTRO



Cette image des récents orages solaires fut saisie à la mi-novembre 2003 durant les activités de lancement de l'instrument FTS bord de SciSat. Les taches solaires sont en fait des régions où le champ magnétique, qui est très puissant, produit des orages magnétiques. L'instrument FTS peut produire ce type d'image mais sera surtout utilisé pour produire des interférogramnes.

SCISAT-1

MISSION EXPÉRIENCE SUR LA CHIMIE ATMOSPHÉRIQUE (ACE)

La NASA et l'ASC ont collaboré à la mission Expérience sur la chimie atmosphérique (ACE) SciSat-1 qui fut lancée le 12 août 2003 depuis la base aérienne Vanderberg en Californie. En plus de la contribuer au lancement de Pegasus, la NASA a émis des conseils relativement à la conception du Spectromètre à transformée de Fourier (FTS), de même qu'au développement de l'algorithme et à l'équipe de chercheurs.

L'objectif de la mission ACE consiste à mieux faire comprendre l'appauvrissement de la couche d'ozone, surtout en Arctique et au Canada. Les mesures obtenues par le FTS et l'instrument de mesure de l'extinction des aérosols par occultation dans la stratosphère et dans la troposphère (MAESTRO) seront ajoutées aux données recueillies par les autres projets terrestres et spatiaux afin d'obtenir les meilleurs renseignements possibles pour prédire les tendances futures concernant la couche d'ozone et sa dynamique. SciSat-1 fournira une couverture globale avec des observations sur les nuages et les aérosols, y compris des observations dans la troposphère. Les mesures pourront valider les futures mesures de la mission Aura de la NASA.

De concert avec les autres instruments et missions planifiés par la NASA, l'Agence Spatiale Européenne et autres partenaires internationaux, cette mission a pour objet de mieux comprendre la chimie et la dynamique de l'atmosphère qui affectent la couche d'ozone.

Pour de plus amples renseignements concernant SciSat-1, visitez le site Web : ***http://www.space.gc.ca***.

BELIZE, COSTA RICA, EL SALVADOR, GUATEMALA, HONDURAS, NICARAGUA, PANAMA MESOAMERICAN BIOLOGICAL CORRIDOR

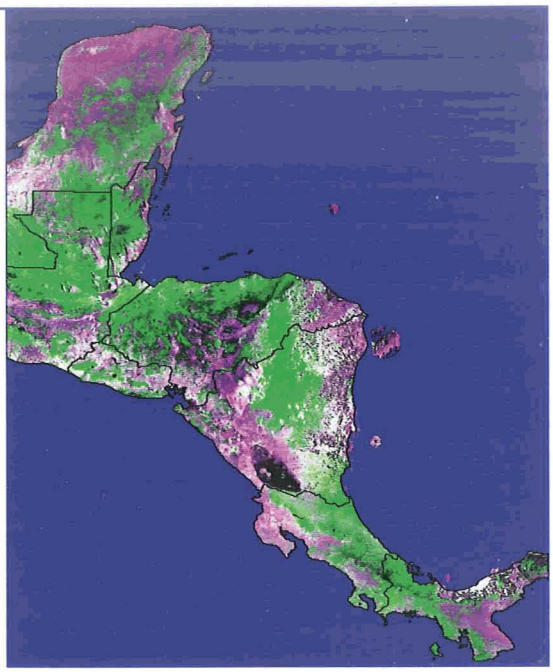
Central America

In 1998, NASA teamed up with the Central American Commission for Environment and Development (CCAD) to cooperate in establishing the Mesoamerican Biological Corridor. The Corridor links hundreds of protected areas from Mexico to Colombia; conserving the region's remarkably rich biological diversity, which is vital for the sustainable economic development of its people. This partnership combines NASA's expertise in space-based observation with the intimate knowledge of local ecosystems held by a multinational cadre of Central American researchers.

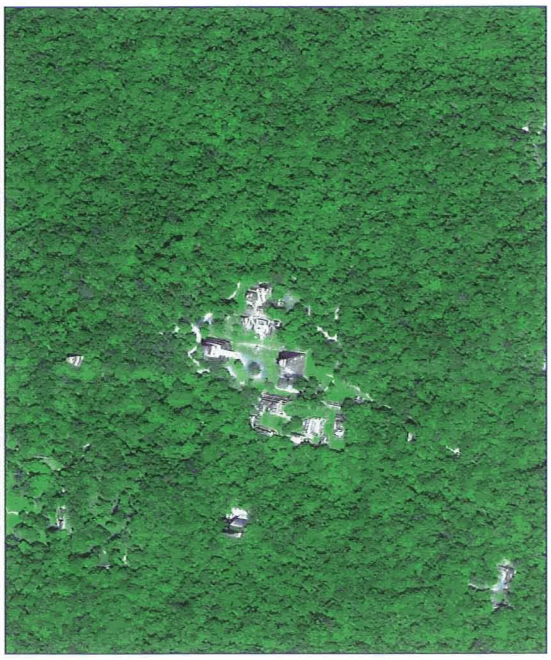
As a result of the successful collaboration between NASA and the CCAD, NASA expanded its efforts in the region in 2002 and 2003 by joining forces with the USAID and the World Bank to develop an advanced decision-support system for Mesoamerica. This decision-support system, called SERVIR (Spanish acronym for "Regional Visualization & Monitoring System"), will be used by scientists, educators, and policymakers to monitor and forecast ecological changes, respond to natural disasters (earthquakes, hurricanes, drought, and volcanic eruptions), and better understand both natural and human-induced effects upon the regional climate.

The SERVIR decision-support system will intensively utilize current and historic data sets acquired from NASA's constellation of Earth-imaging satellites. This support includes the use of NASA's Moderate Resolution Imaging Spectroradiometer for fire detection and carbon management, and Japan's Advanced Spaceborne Thermal Emission and Reflection Radiometer and Landsat data for tracking changes to the landscape, such as deforestation, over the past 30 years. Instruments aboard NASA's Tropical Rainfall Measuring Mission and Aqua satellites will also be used to understand mechanisms driving the past, present, and potential future climate variability of Mesoamerica.

For information regarding the Mesoamerican Biological Corridor, please visit the following Web site: ***http://www.ghcc.msfc.nasa.gov/corredor/corredor.html***.

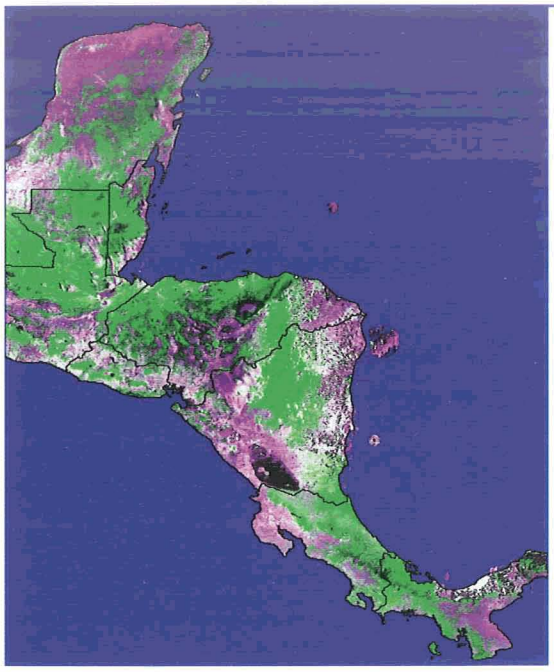


This mosaic of Central America, created using 250-meter-resolution MODIS data, is being used to assess land cover and land use, forest fires, and deforestation. Similar mosaics will be created every year to monitor environmental changes in the Mesoamerican Biological Corridor.

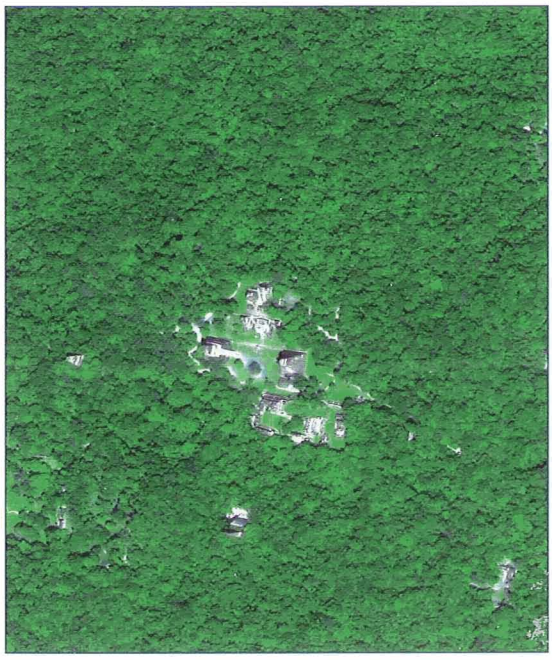


IKONOS true-color composite of the Mayan city Tikal in Peten, Guatemala. *(Source: Space Imaging)*

América Central



Este mosaico de América Central, creado utilizando datos MODIS de resolución espacial de 250 metros, está siendo utilizado para evaluar la corteza terrestre, y la utilización de tierras, incendios forestales, y deforestación. Se crearán mosaicos similares cada año para monitorear los cambios del medio ambiente en el Corredor Biológico Mesoamericano.



Composición de imágenes IKONOS a color real de la ciudad Maya de Tikal en Petén, Guatemala (obtenida por Space Imaging).

BELICE, COSTA RICA, EL SALVADOR, GUATEMALA, HONDURAS, NICARAGUA, PANAMÁ CORREDOR BIOLÓGICO MESOAMERICANO

En 1998, la NASA formó un equipo con la Comisión Centroamericana de Ambiente y Desarrollo (CCAD) para cooperar en el establecimiento del Corredor Biológico Mesoamericano. El Corredor es el vínculo de cientos de áreas protegidas desde México hasta Colombia para conservar la notoria riqueza de la diversidad biológica de la región, que es de vital importancia para el desarrollo económico sostenible de sus pobladores. Esta sociedad combina la experiencia de la NASA en la observación desde el espacio, con el conocimiento profundo de los ecosistemas locales de un grupo multinacional de investigadores de América Central.

Como resultado de la colaboración exitosa entre la NASA y la CCAD, en el año 2002 y 2003 la NASA amplió los esfuerzos que desplegaba en la región, uniendo sus fuerzas con la AID y el Banco Mundial para desarrollar un sistema avanzado de apoyo de toma de decisiones para el Corredor Biológico Mesoamericano. Este sistema de apoyo de toma de decisiones denominado SERVIR (acrónimo en español de "Sistema de Visualización y Monitoreo"), será utilizado por los científicos, educadores, y tomadores de decisiones para monitorear y pronosticar los cambios ecológicos, responder a los desastres naturales (terremotos, huracanes, sequías, y erupciones volcánicas), y poder llegar a una mejor comprensión tanto de los efectos naturales como de aquellos producidos por el hombre sobre el clima regional.

El sistema SERVIR de apoyo a la toma de decisiones utilizará de forma intensiva los grupos de datos actuales e históricos de imágenes adquiridos por la constelación de satélites de la NASA para la observación de la tierra. Esta ayuda incluye la utilización del Espectroradiómetro de Imagen de Resolución Moderada (MODIS) de la NASA para la detección de incendios y manejo del carbón, y, los datos del Radiómetro Reflector Avanzado de Infrarrojos Térmicos en el Espacio y Landsat del Japón para hacer un seguimiento de los cambios del paisaje, como la deforestación, durante los últimos 30 años. Se utilizarán también los instrumentos que utilizan los satélites de la Misión de Medición de Lluvia Tropical y el satélite Aqua de la NASA para comprender los mecanismos que rigen las variables del clima en el pasado, presente y futuro potencial del Corredor Biológico Mesoamericano.

Para obtener información adicional relativa al Corredor Biológico Mesoamericano, sírvase visitar: ***http://www.ghcc.msfc.nasa.gov/corredor/corredor.html.***

Central America and Mexico

In March 2004, NASA flew a unique radar system known as AirSAR (Airborne Synthetic Aperture Radar) over a number of archeological and conservation sites in Central America. The main purpose of this flight campaign is to further our scientific understanding of complex vegetation structures using advanced radar techniques. Furthermore, it is a technology demonstration mission that will test the ability of the radar to provide useful data to archeologists and conservationists in a variety of locations for different purposes.

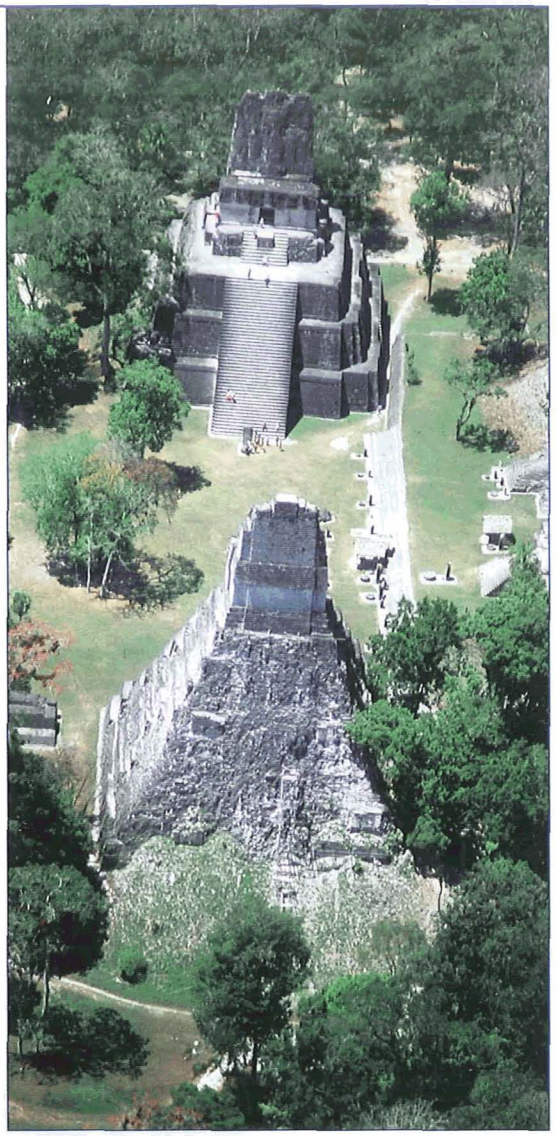
AirSAR has a unique capability to collect polarimetric data with P-, L-, and C-band radar; this capability allows a detailed study of the vertical structure of both the forest and structures hidden beneath it. In 1996, as part of the PacRim air campaign, radar images from AirSAR were used to detect previously undiscovered temples at Angkor Wat in Cambodia.

The success of the AirSAR campaign at Angkor Wat indicates that AirSAR may also be effective at discovering buried archeological mounds in other environments. However, its effectiveness cannot be known until data from a variety of sites are tested. The selected test sites for this campaign included both well-documented "control" areas and unexplored areas, thereby allowing for potential discovery distributed over a range of vegetative and hydrologic regions.

NASA is working with a number of international and domestic partners on this campaign, including the United Nations Educational Scientific and Cultural Organization, the Centro Nacional de Alta Technologia, the CCAD, and the Guatemalan Ministries of Agriculture and Culture, through a grant from the Inter-American Development Bank.

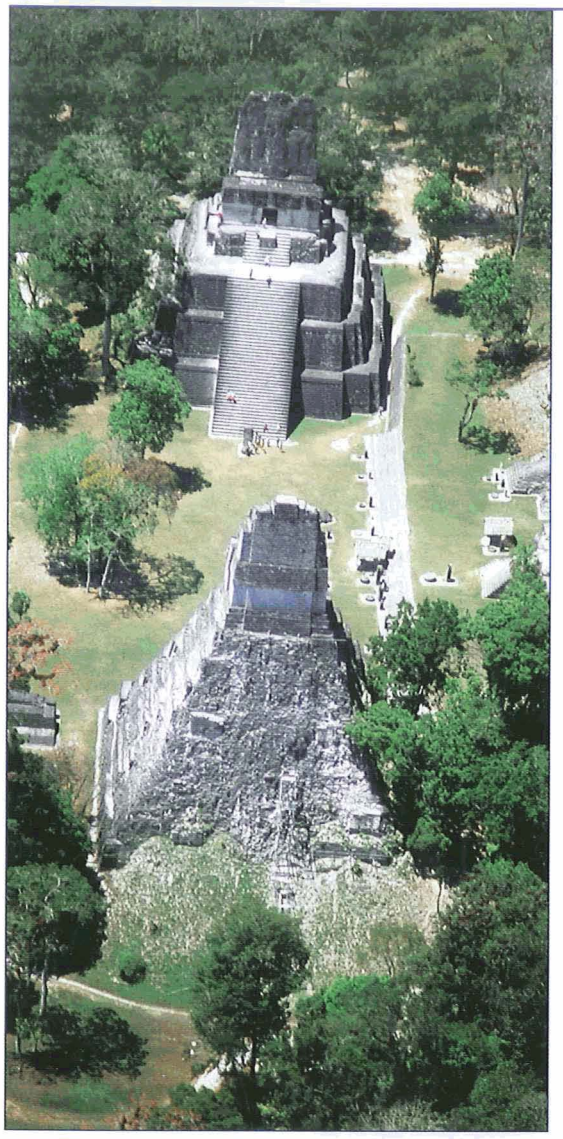
The flightpath for this campaign covers all of the countries in Central America and Mexico.

For more information regarding AirSAR, please visit the following Web site: ***http://airsar.jpl.nasa.gov/***.



A photograph of the ancient Mayan city of Tikal, located in Peten, Guatemala. The AirSAR mission flew over the Peten region in order to study the complex vegetation structure of the pristine tropical forest surrounding the ruins and to detect previously undiscovered Mayan structures.

América Central y México



Una fotografía de la ancestral ciudad Maya de Tikal, ubicada en Petén, Guatemala. La misión AirSAR sobrevoló la región de Petén para poder estudiar la compleja estructura primitiva de la vegetación de la selva tropical que rodea las ruinas, y detectar algunas estructuras Mayas no descubiertas con anterioridad.

BELICE, COSTA RICA, EL SALVADOR, GUATEMALA, HONDURAS, NICARAGUA, PANAMÁ, MÉXICO

CAMPAÑA AIRSAR

En marzo de 2004, la NASA utilizó un sistema de radar único conocido como el AirSAR (Radar de Apertura Aerotransportado Sintético) sobrevolando una cantidad de regiones arqueológicas y de conservación en América Central. El propósito principal de esta campaña de vuelo es incrementar nuestros conocimientos científicos de las estructuras complejas de la vegetación, utilizando técnicas avanzadas de radar. Además, se trata de una misión de demostración tecnológica que probará la habilidad del radar para proporcionar datos útiles para los arqueólogos y los conservacionistas en una diversidad de ubicaciones y para diferentes propósitos.

AirSAR posee la facultad única de coleccionar datos polarimétricos con banda de radar P-, L- y C; esta facultad permite un estudio detallado de la estructura vertical tanto de los bosques como de las estructuras ocultas en el subsuelo. En 1996, como parte de la Misión PacRim, se utilizaron imágenes de radar de AirSAR para detectar templos no descubiertos con anterioridad en Angkor Wat en Camboya.

El éxito de la Misión AirSAR en Angkor Wat indica que el AirSAR podría también ser efectivo para el descubrimiento de montículos arqueológicos enterrados en otros lugares. Sin embargo, no se puede determinar su efectividad hasta que se hagan pruebas comparativas de los datos de varias ubicaciones. Las áreas seleccionadas para esta misión comprendieron tanto áreas de "control" bien documentadas, como áreas sin explorar, que posibilitan descubrimientos potenciales distribuidos en un rango de regiones vegetativas e hidrológicas.

La NASA se encuentra trabajando con varios asociados internacionales y locales en esta misión, incluyendo el Centro Nacional de Alta Tecnología, y los Ministerios de Agricultura y Cultura de Guatemala, a través de un préstamo del Banco Interamericano de Desarrollo.

La ruta de vuelo para esta campaña abarca todos los países de América Central y México.

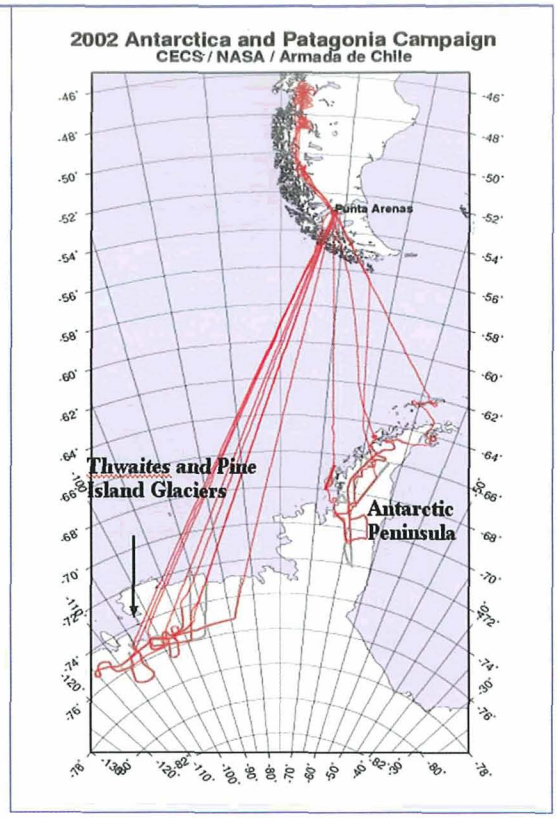
Para obtener información adicional relativa a AirSAR, sírvase visitar: ***http://airsar.jpl.nasa.gov/***.

In November and December 2002, NASA, in a joint effort with Centro de Estudios Cientificos (CECS) and the Chilean Navy, undertook a very successful field campaign to map the precise elevation and thickness of the ice in the Antarctic Peninsula, the Thwaites and Pine Island Glacier region, and the Patagonian ice fields. The Antarctic Peninsula, which contains enough ice to raise sea levels by nearly half a meter, has undergone tremendous warming in the last several decades. The Peninsula has recently experienced the collapse of a major ice shelf that had been restraining glacier discharge; the collapse led to accelerated deterioration of some of the major drainage glaciers. These observations have provided the most precise elevation information in the region, which is being compared to previous measurements to determine the extent to which these glaciers and the floating ice are shrinking or growing.

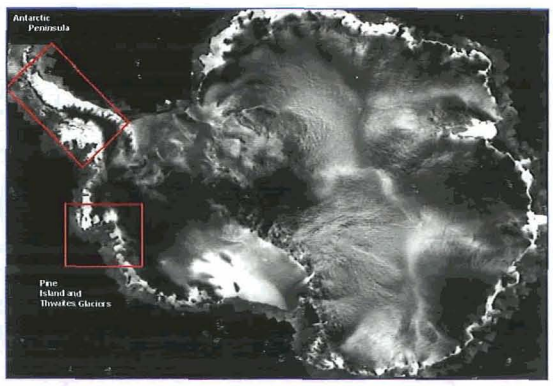
The area around Thwaites and Pine Island Glaciers has been referred to as the "weak underbelly of the West Antarctic Ice Sheet" because it is recognized as a likely point of potential instability where a collapse of the ice sheet may originate. The glacier flow has accelerated in recent years. Due to persistent cloud cover in this region and its inaccessibility by conventional means, reliable data on ice elevation and thickness are very sparse. Using satellite observations and model predictions for weather forecasting, and taking advantage of the long-range capabilities of NASA's P3 aircraft, researchers acquired approximately 10 flight-hours of data. The data acquired from this unprecedented volume of observations are being incorporated into models to assess changes and stability in the region.

The Patagonian ice fields have been shown to be losing mass at an alarming rate that has accelerated in recent years. The new measurements of elevation acquired during this campaign are being compared to historical mapping data acquired since the 1970s, and important changes in the region are being examined.

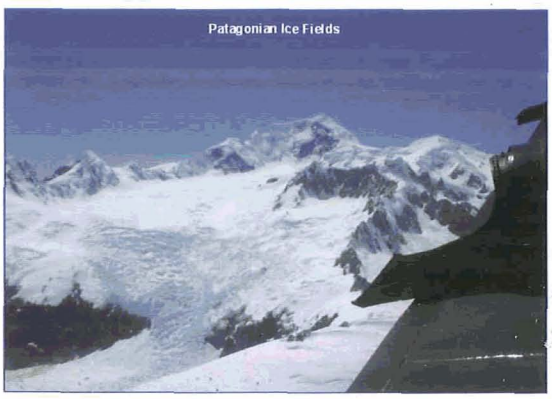
By sharing expenses and risks, the U.S. and Chile have made this collaborative effort a tremendous success; this endeavor will continue to greatly advance our understanding of some of the most important ice masses in the Southern Hemisphere.



Map showing the flight lines of the surveys over Patagonia, the Antarctic Peninsula, and the Thwaites and Pine Island Glacier region. Surveys were based out of Punta Arenas, Chile.

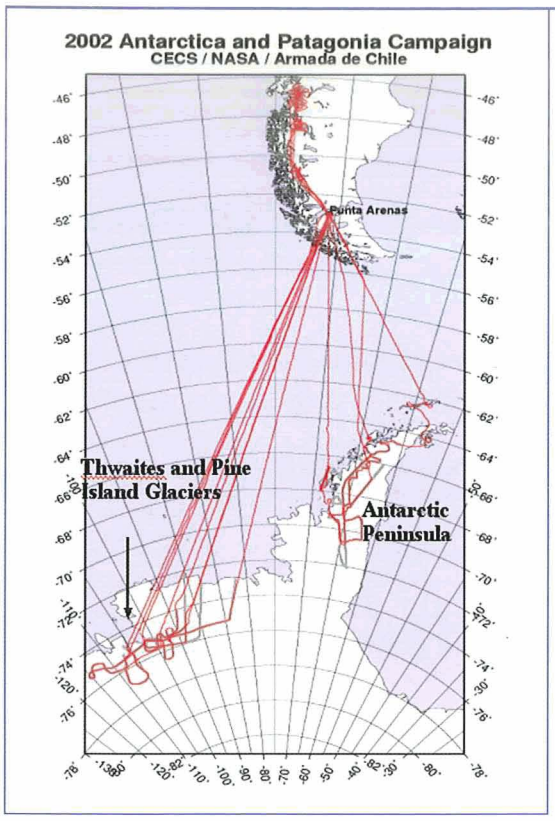


This RADARSAT mosaic of Antarctica was developed as part of the RADARSAT Antarctic Mapping Project (RAMP) and shows another view of the regions in Antarctica that were surveyed. The Antarctic Peninsula and the Thwaites and Pine Island Glacier region are shown in red boxes. RAMP is a joint effort between NASA and the Canadian Space Agency.

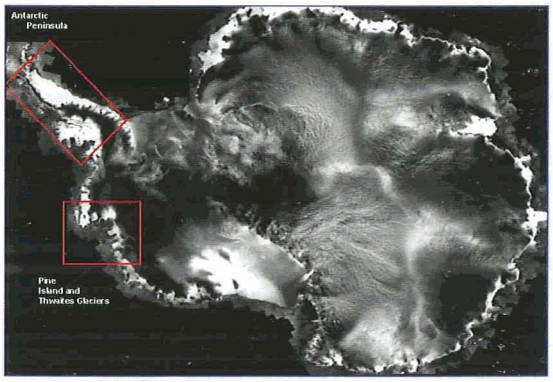


A photograph taken during the surveys of the Patagonian ice fields.

NASA-CHILE MISIÓN A LA ANTÁRTICA



Mapa que muestra las líneas de vuelo de los reconocimientos sobre la Patagonia, la Península Antártica, y la región de los glaciares de Thwaites y Pine Island. El punto de partida de los reconocimientos fue Punta Arenas, Chile.



El mosaico RADARSAT de la Antártica se desarrolló como parte del Proyecto de Cartografía de la Antártica RADARSAT (RAMP) y muestra otra vista de las regiones en las que se realizaron reconocimientos en la Antártica. La Península Antártica y la región de glaciares de Thwaites y Pine Island se muestran en los recuadros de color rojo. El proyecto RAMP fue el resultado de un esfuerzo conjunto entre la NASA y la Agencia Espacial Canadiense.

En noviembre y diciembre de 2002, la NASA, en un esfuerzo conjunto con el Centro de Estudios Científicos (CECS) y la marina chilena, llevó a cabo una campaña de campo muy exitosa para levantar planos de la elevación exacta y grosor de la capa de hielo de la Península Antártica, la región de los glaciares de Pine Island y Thwaites, y los campos de hielo de la Patagonia. La Península Antártica, que contiene suficiente cantidad de hielo para elevar los niveles del mar hasta cerca de medio metro, ha sufrido durante las últimas décadas un inmenso calentamiento. La Península ha experimentado recientemente el colapso de una importante repisa de hielo que había estado conteniendo la descarga de los glaciares; el colapso produjo como consecuencia un deterioro acelerado de algunos de los más importantes glaciares de drenaje. Estas observaciones han brindado la información más precisa de elevación de la región, la cual se está comparando con mediciones previas para determinar el grado en que estos glaciares y el hielo flotante están retrayéndose o creciendo.

Se ha referido a la región alrededor de los glaciares Thwaites y Pine Island como "el punto débil de la capa de hielo de la Antártica Occidental" debido a que se ha identificado como un punto probable de inestabilidad donde puede originarse un colapso de la capa de hielo. La velocidad del flujo del glaciar se ha acelerado en los últimos años. Debido a la persistente capa de nubes e inaccesibilidad por métodos convencionales, los datos confiables sobre la elevación y el grosor son muy escasos. Por medio de las observaciones satelitales y modelos de predicciones para los pronósticos climatológicos, y aprovechando la capacidad de largo alcance de la aeronave P3, adquirimos aproximadamente 10 horas de vuelo de datos. Los datos adquiridos de este rango de tiempo de observación sin precedentes se están incorporando a los modelos para evaluar los cambios y estabilidad en la región.

Se ha comprobado que los campos de hielo de la Patagonia están perdiendo masa a un ritmo alarmante que se ha visto acelerado durante los últimos años. Las nuevas mediciones de elevación obtenidas en esta campaña se están comparando con los datos cartográficos históricos obtenidos desde los años de la década de 1970, al mismo tiempo que se examinan los cambios importantes ocurridos en la región.

Al compartir los gastos y riesgos de esta misión, los Estados Unidos y Chile han hecho de este esfuerzo de colaboración un éxito increíble; este emprendimiento seguirá contribuyendo inmensamente a aumentar nuestros conocimientos sobre las más importantes masas glaciares del Hemisferio Sur.

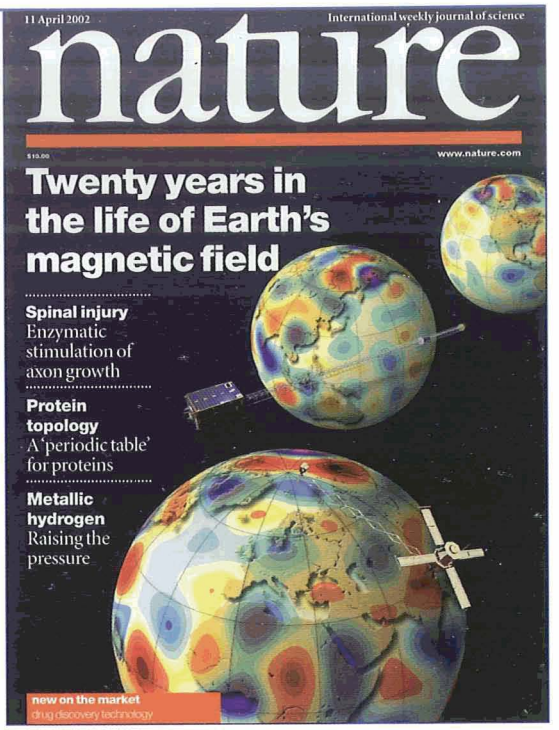
Una fotografía tomada durante los reconocimientos sobre los campos de hielo de la Patagonia.

The Danish Meteorological Institute (DMI) manages the Ørsted satellite program. Ørsted-1, Denmark's first satellite, was launched on February 23, 1999, in cooperation with NASA. Ørsted is a microsatellite designed to map Earth's magnetic field and measure high-energy particles in Earth's environment. At the time of its launch, Ørsted-1 was the first satellite since the Magsat project (a joint NASA-United States Geological Survey mission to measure near-Earth magnetic fields on a global basis) to provide the high-accuracy geomagnetic field measurements necessary for studying the geomagnetic field arising from Earth's geomagnetic dynamo, mantle, and crust. The instruments aboard Ørsted-1 include an Overhauser magnetometer supplied by France and a scientific TurboRogue GPS receiver provided by NASA's Jet Propulsion Laboratory. The TurboRogue GPS measures ionospheric and atmospheric structure and dynamics through GPS limb sounding techniques.

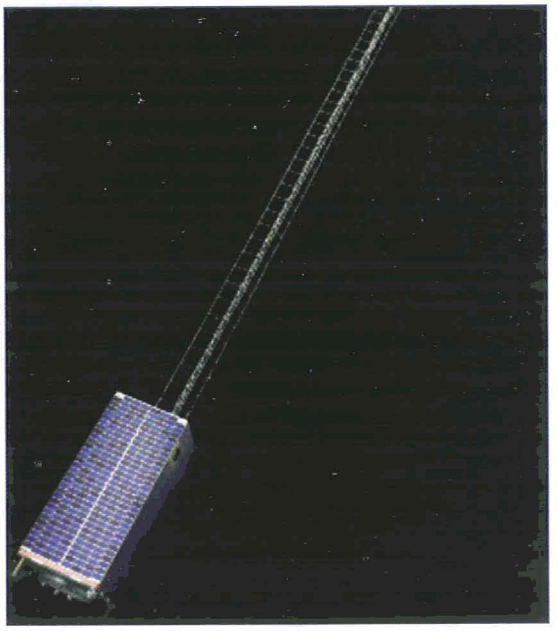
Ørsted-1 was the first contribution to the International Union of Geodesy and Geophysics (IUGG) International Decade of Geopotential Research, which began in 1999. The satellite continues to function successfully, well beyond its designed 14-month lifetime. Ørsted, along with NASA's Magsat, has provided a 20-year baseline of geomagnetic field change measurements and continues to provide basic data for the geomagnetic reference field used in most navigation. Ørsted satellite operations are managed jointly by the Danish industrial company TERMA and DMI. DMI also houses the ground station for the mission, as well as the Ørsted Science Data Center, where the satellite data are processed and distributed to the science community.

An advanced version of the Ørsted measurement system called the Magnetic Mapping Payload (MMP)—also known as Ørsted-2—is currently flying aboard the Argentine-built SAC-C spacecraft. The MMP carries a helium magnetometer supplied by NASA. NASA launched SAC-C, co-manifested with NASA's advanced land imager EO-1 in November 2000. Ørsted-2 is managed by the Danish Space Research Institute.

For more information regarding Ørsted, please visit the following Web sites: ***http://www.dmi.dk/projects/oersted*** and ***http://genesis.jpl.nasa.gov/html/missions/OERSTED.html***.

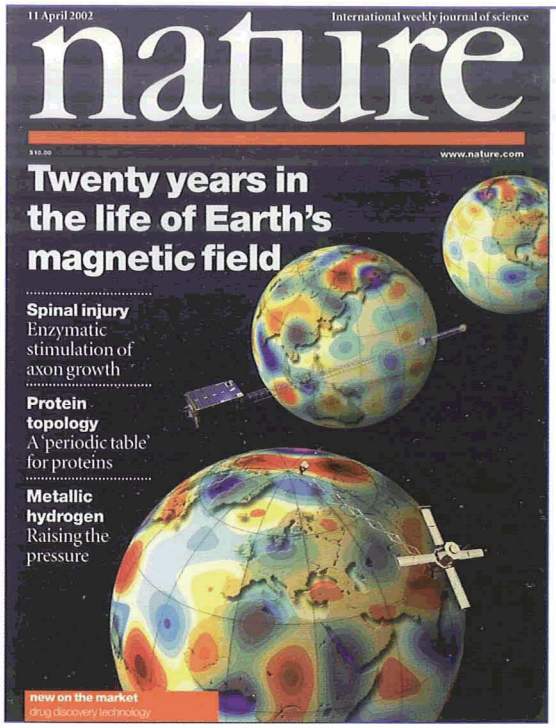


The Ørsted-1 satellite and magnetic field data results from the mission were featured in the April 11, 2002, issue of *Nature*. These data, along with data from NASA's Magsat satellite in 1980, provided a unique 20-year perspective on changes in Earth's magnetic field. *(Reprinted with permission from* Nature *(Vol. 416, No. 6881), copyright 2007, Macmillan Publishers Ltd.)*

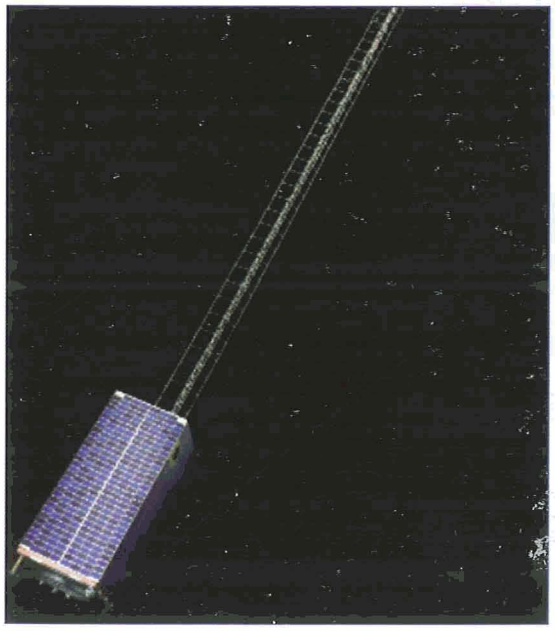


The Ørsted satellite. *(Courtesy of DMI)*

Danmark



Ørsted-1 satellitten og de magnetiske feltdata resultater fra programmet var hovedemne i tidsskriftet *Nature* d. 11. april, 2002. Disse data har sammen med data fra NASAs MAGSAT-satellit i 1980 givet et 20-års perspektiv over forandringer inden for jordens magnetiske felt. (*Gentrykt med tilladelse fra Nature (Vol. 416, No. 6881), beskyttet ved copyright 2007, Macmillan Publishers Ltd.*)



Ørsted satelliten. *(Skænket af DMI)*

ØRSTED-1

Det danske meteorologiske institut (DMI) styrer Ørsteds satellitprogram. Ørsted-1, Danmarks første satellit, blev opsendt d. 23.2.1999 i samarbejde med NASA. Ørsted er en microsatellit udviklet til at kortlægge jordens magnetiske felt og måle partikler med et højt energiniveau inden for jordens omgivelser. Ved opsendelsen var Ørsted-1 den første satellit siden Magsat-projektet (et samarbejde mellem NASA og United States Geological Survey med henblik på måling af de magnetiske felter nær jorden på et globalt grundlag), der skulle udføre geomagnetiske feltmålinger med høj præcision, som er nødvendige for at kunne studere de geomagnetiske felter, som udmunder fra jordens dynamo, kappe og skorpe. Instrumenterne ombord Ørsted-1 omfatter et Overhauser magnetometer fra Frankrig og en videnskabelig TurboRogue GPS-modtager fra NASAs Jet Propulsion Laboratory. TurboRogue GPS måler den ionosfæriske og atmosfæriske struktur og dynamik v.h.a. GPS svagtlydende teknikker.

Ørsted-1 udgjorde det første bidrag til den Internationale Union for Geodæsi og Geofysiks (IUGG) Internationale Tiår for Geopotential Forskning, som begyndte i 1999. Satellitten fortsætter med at fungere succesrigt ud over dens forventede levetid på 14 måneder. Ørsted har sammen med NASAs Magsat leveret et 20 års basis af geomagnetiske feltændringsmålinger og forstsætter med at levere basisdata til det geomagnetiske referencefelt, der anvendes mest inden for navigation. Ørsteds satellitprogrammer styres i fællesskab af den danske virksomhed TERMA og DMI. DMI huser både modtagerstationen for programmet og Ørsteds videnskabelige datacenter, hvor satellitdata behandles og sendes videre til videnskabelige kredse.

En avanceret version af Ørsteds målingssystem, kaldet Magnetic Mapping Payload (MMP) - også kendt som Ørsted-2 - er p.t. i kredsløb ombord den argentinskbyggede SAC-C satellit. MMP er udstyret med et helium magnetometer fra NASA. NASA opsendte SAC-C, sammen med deres jordobservations-satellit EO-1 i november 2000. Ørsted-2 styres af Dansk Rumforskningsinstitut.

For yderligere oplysninger om Ørsted, kan du besøge følgende websider:
http://www.dmi.dk/projects/oersted og
http://genesis.jpl.nasa.gov/html/missions/OERSTED.html.

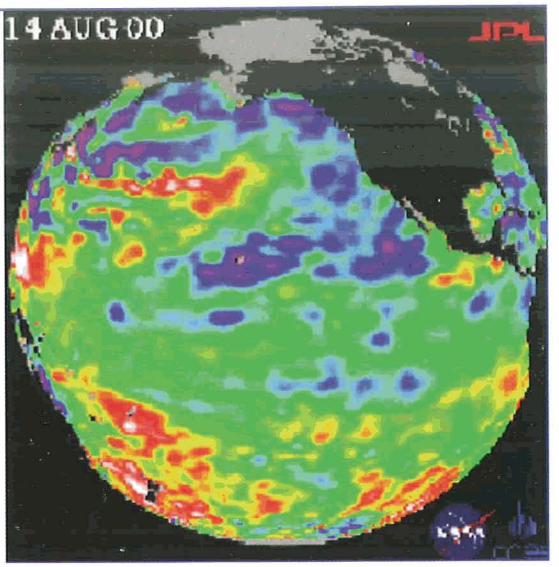
TOPEX/Poseidon is a highly successful collaboration between NASA and the French Space Agency, Centre National d'Études Spatiales (CNES). TOPEX/Poseidon is an oceanography satellite designed to monitor global ocean circulation and to increase humanity's understanding of the role of oceans in Earth's climate. Launched in 1992 from French Guiana, TOPEX/Poseidon was designed to operate for 3 years, but it has lasted more than 9 years with flawless performance. TOPEX/Poseidon continues to provide ocean scientists with a unique, revolutionary view of our ocean waters, which are so vital to all life.

TOPEX/Poseidon uses a radar altimeter to measure sea surface topography over 90 percent of Earth's ice-free oceans. TOPEX/Poseidon has accomplished the following:

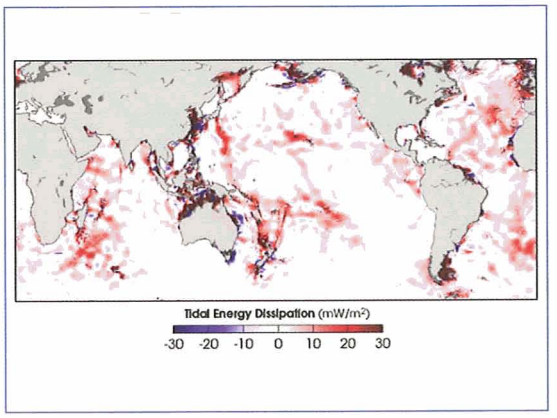
- measured sea levels with unprecedented accuracy to better than 5 centimeters and continuously observed global ocean topography;
- monitored effects of ocean currents on global climate change and produced the first global views of seasonal changes of currents;
- monitored large-scale ocean features like Rossby and Kelvin waves and enabled the study of such phenomena as El Niño, La Niña, and the Pacific Decadal Oscillation;
- mapped basin-wide current variations and provided global data to validate models of ocean circulation;
- mapped year-to-year changes in heat stored in the upper ocean;
- produced highly accurate global maps of tides; and
- improved humanity's knowledge of Earth's gravity field.

TOPEX/Poseidon has become the longest running Earth-orbiting radar satellite in history. The NASA-CNES team has worked diligently to maximize satellite performance and data return throughout the satellite's life. The TOPEX/Poseidon satellite flies in tandem with the NASA-CNES Jason mission for a period of 6 to 9 months to intercalibrate the two satellites' instruments. The Jason satellite was launched in 2001 to extend sea surface height measurements into the next decade.

For more information regarding TOPEX/Poseidon, please visit the following Web site: ***http://topex-www.jpl.nasa.gov/mission/topex.html.***



Satellite image of TOPEX/Poseidon showing oceanographic temperature patterns.



TOPEX/Poseidon image showing total energy dissipation throughout the world's oceans.

France

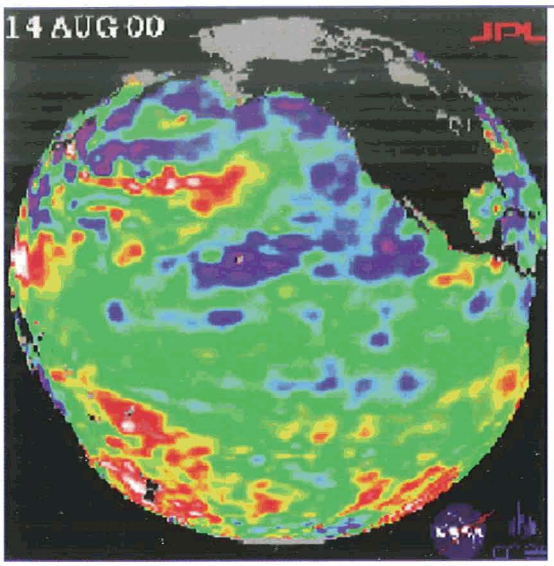


Image satellite de TOPEX/Poseidon illustrant les écarts des températures océanographiques.

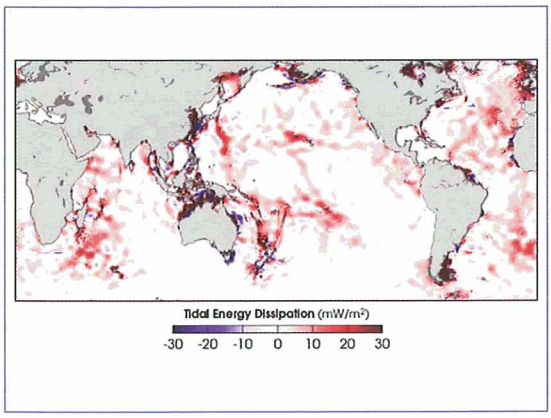


Image de TOPEX/Poseidon montrant la dissipation totale de l'énergie à travers les océans de la planète.

TOPEX/POSEIDON
TOPOGRAPHY EXPERIMENT

TOPEX/Poseidon est une collaboration parfaitement réussie entre la NASA et le Centre National d'Études Spatiales (CNES). TOPEX/Poseidon est un satellite d'océanographie, conçu pour surveiller la circulation des océans à l'échelle de la planète et permettre à l'humanité de mieux comprendre le rôle des océans par rapport au climat de la Terre. Lancé en 1993 en Guinée Française, TOPEX/Poseidon a été conçu pour fonctionner pendant 3 ans, mais il a été exploité pendant plus de 9 années sans aucune anomalie. TOPEX/Poseidon continue d'offrir aux chercheurs qui étudient les océans une vision unique et révolutionnaire de nos océans, qui sont essentiels à la vie.

TOPEX/Poseidon utilise un altimètre radar pour mesurer la topographie de la surface des mers sur plus de 90 pour cent des océans sans glace de la Terre. TOPEX/Poseidon a accompli les tâches suivantes :

- évaluation des niveaux des mers avec une précision sans précédent à 5 cm près et observation en continu de l'ensemble de la topographie des océans ;
- surveillance des effets des courants des océans sur les changements climatiques et production des premières visions d'ensemble des changements saisonniers des courants.
- surveillance à grande échelle des caractéristiques des océans comme les vagues Rossby et Kelvin et étude de phénomènes tels que El Niño, La Niña, et la Pacific Decadal Oscillation ou PDO (Oscillation décennale du Pacifique).
- élaboration de cartes illustrant les variations des courants des bassins et réunion de données générales en vue de valider les modèles de circulation des océans.
- élaboration de cartes illustrant l'évolution année par année de la chaleur emmagasinée dans la couche supérieure des océans.
- réalisation de cartes géographiques précises des marées ; et
- amélioration des connaissances humaines dans le domaine de la gravité de la Terre.

TOPEX/Poseidon est devenu le satellite radar ayant gravité le plus longtemps autour de la Terre. L'équipe conjointe du CNES et de la NASA a travaillé avec diligence pour optimiser les performances du satellite et les résultats issus des données tout au long de la vie du satellite. Le satellite TOPEX/Poseidon vole en tandem avec la mission Jason du CNES et de la NASA pendant une période de 6 à 9 mois pour intercalibrer les instruments des deux satellites. Le satellite Jason a été lancé en 2001 pour poursuivre la mesure de la hauteur des mers au cours de la prochaine décennie.

Pour plus de renseignements concernant TOPEX/Poseidon, consultez le site Web suivant : ***http://topex-www.jpl.nasa.gov/mission/topex.html***.

Jason is a joint project between NASA and the French Space Agency, Centre National d'Études Spatiales (CNES). The Jason satellite monitors global ocean circulation and researches the role of oceans in Earth's climate. Jason is a follow-on mission to the highly successful U.S./French TOPography EXperiment (TOPEX)/Poseidon mission that measured ocean surface topography to an accuracy of better than 5 centimeters, and it enabled scientists to forecast the 1997–1998 El Niño. Jason was launched on December 7, 2001, on a Delta II rocket from Vandenberg Air Force Base in California.

TOPEX/Poseidon and Jason gather data on a parallel path providing maximum coverage of the ocean floor.

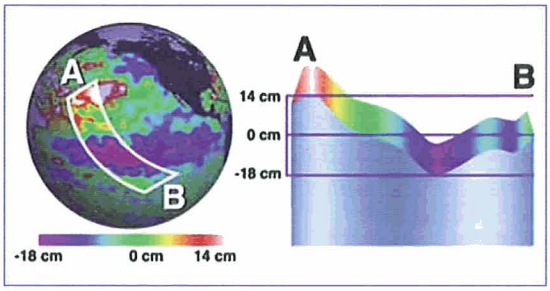
The primary requirement for Jason is to provide a continuation of the TOPEX/Poseidon mission's high-accuracy radar altimetry measurements. A secondary requirement is to provide near-real-time data for operational marine nowcasting and numerical prediction of sea state, ocean circulation, and weather.

The Jason satellite carries both U.S. and French instruments. CNES provides the satellite bus (PROTEUS), the Poseidon-2 Altimeter (C- and Ku-band), and Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS), a Doppler tracking antenna that receives ground signals for precise orbit determination, satellite tracking, and ionospheric correction data for the CNES altimeter. NASA provides the microwave radiometer, the BlackJack Global Positioning System receiver, and the laser retroreflector array. NASA also provides the launch vehicle, launch services, and mission operations. Jason's radar altimeter measures the precise distance between the satellite and the sea surface by determining the round-trip travel time of microwave pulses bounced from the spacecraft to the sea surface and back to the spacecraft.

Depiction of Jason-1 in space.

Jason flies in tandem with the TOPEX/Poseidon satellite for a period of 6 to 9 months to intercalibrate the two satellites' instruments, and it will eventually replace TOPEX/Poseidon in gathering important ocean altimetry data.

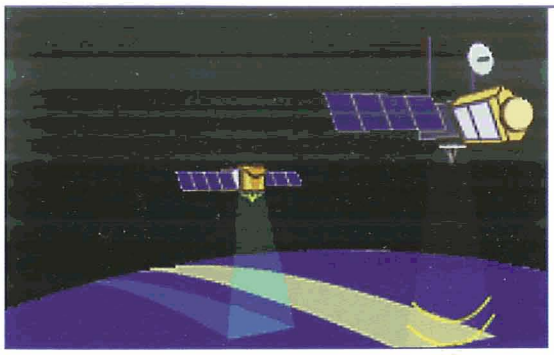
For more information regarding the Jason mission, please visit the following Web site: ***http://topex-www.jpl.nasa.gov/mission/jason-1.html***.



These images show sea surface height anomalies with the seasonal cycle (the effects of summer, fall, winter, and spring) removed. The differences between what we see and what is normal for different times and regions are called anomalies, or residuals. When oceanographers and climatologists view these "anomalies," they can identify unusual patterns and tell how heat is being stored in the ocean to influence future planetary climate events.

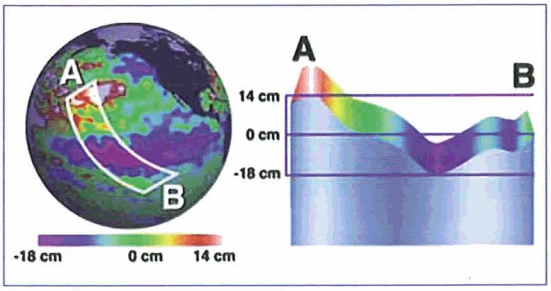
France

JASON



TOPEX/Poseidon et Jason recueillent des données sur un chemin parallèle, offrant ainsi une couverture optimale des fonds océaniques.

Représentation de Jason-1 dans l'espace.



Ces images montrent les anomalies au niveau de la hauteur de la surface de la mer dans le cas d'une disparition des cycles saisonniers (incidences de l'été, de l'automne, de l'hiver et du printemps). Les différences entre ce que nous voyons et ce qui est normal pour les différentes époques et régions sont appelées « anomalies » ou résidus. Lorsque les océanographes et les climatologues voient ces « anomalies », ils peuvent identifier les schémas inhabituels et déterminer la quantité de chaleur emmagasinée dans les océans et son incidence future au niveau des événements climatiques de la planète.

Jason est un projet commun à la NASA, à l'Agence spatiale française et au Centre National d'Études Spatiales (CNES). Le satellite Jason surveille la circulation des océans à l'échelle de la planète et effectue des recherches sur le rôle des océans par rapport au climat de la Terre. Jason est une mission qui suit la mission TOPography EXperiment (TOPEX)/Poseidon qui fût un franc succès et dont l'objectif était de mesurer la topographie de la surface des océans avec une précision supérieure à 5 cm et grâce à laquelle les chercheurs ont pu prévoir le, phénomène El Niño de 1997 et 1998. Jason a été lancé le 7 décembre 2001 à bord d'une fusée Delta II de la base militaire aérienne Vanderberg, en Californie.

Le rôle de Jason consiste avant tout à poursuivre la mission de TOPEX/Poseidon qui fournissait des mesures d'altimétrie par radar hautement précises. Jason doit également fournir en temps quasi-réel des données permettant d'émettre des prévisions numériques et immédiates sur l'état de la mer, la circulation des océans et la météo.

Le satellite Jason contient des instruments américains et français. CNES fournit le bus satellite (PROTEUS), l'altimètre Poseidon-2 (Bande C et Ku) et Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS), une antenne Doppler qui reçoit les signaux de la terre pour déterminer l'orbite avec précision, assurer la suivi du satellite et émettre des données correctives ionosphériques pour l'altimètre du CNES. La NASA fournit le radiomètre à micro-ondes, le récepteur du Système de Positionnement Global BlackJack et la matrice du rétroréflecteur laser. La NASA fournit également le véhicule de lancement, les services de lancement et les opérations de la mission. L'altimètre radar de Jason mesure la distance précise entre le satellite et la surface de la mer en déterminant la durée du voyage aller-retour des pulsions micro-ondes entre la navette spatiale et la surface de la mer, puis de retour à la navette spatiale.

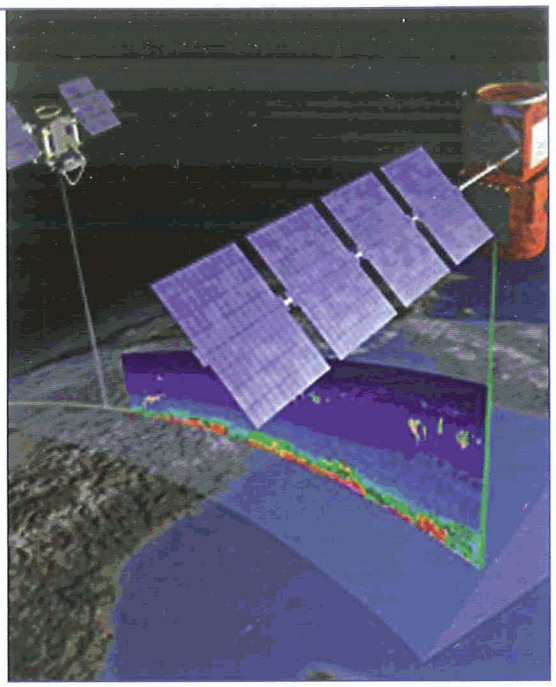
Jason vole en tandem avec le satellite TOPEX/Poseidon sur une période de 6 à 9 mois pour intercalibrer les instruments des deux satellites, et remplacera éventuellement TOPEX/Poseidon pour la collecte des données d'altimétrie des océans.

Pour plus de renseignements concernant la mission Jason, veuillez consulter le site Web suivant : ***http://topex-www.jpl.nasa.gov/mission/jason-1.html.***

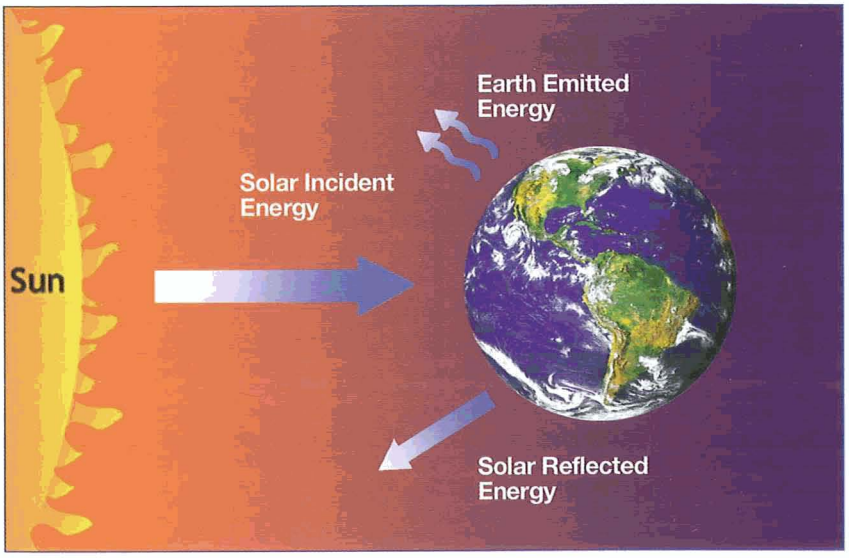
The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) is a joint mission between NASA and the French Space Agency, Centre National d'Études Spatiales (CNES). NASA is providing mission management and systems engineering, a three-channel lidar, a wide field camera, payload operations, data downlink, data management, algorithm development, data archival and distribution, and launch. CNES is providing the PROTEUS platform, satellite engineering, satellite operations, the Imaging Infrared Radiometer (IIR), algorithm development for the IIR, and a data site. CALIPSO will be launched from Vandenberg Air Force Base in California.

CALIPSO, together with the CloudSat satellite, will be launched on a Delta II launch vehicle in 2005 and will fly in formation with CloudSat and NASA's Earth Science Enterprise Aqua satellite to provide a unique 3-year coincident set of global data on aerosol and cloud properties, radiative fluxes, and atmospheric state. The data provided by CALIPSO will greatly improve predictions of the regional impacts of long-term climate change, allowing a scientific basis for understanding and assessing the impact of climate change. The scientific advances enabled by this coincident data set will also result in the improvement of short-term (days) weather forecasts, as well as forecasts on seasonal-to-interannual time scales. CALIPSO will augment the capabilities of the civilian operational Earth-observing satellite used by the National Weather Service, providing a unique capability to monitor volcanic plumes and the long-range transport of pollutants that impact air quality and visibility.

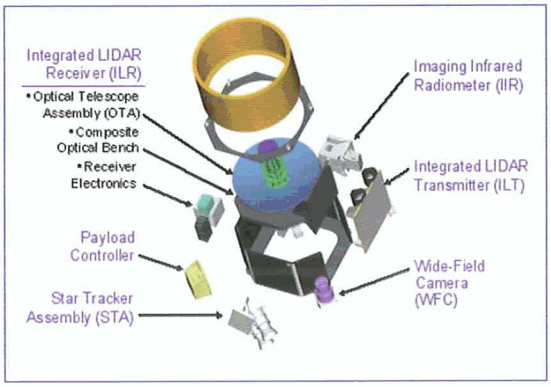
For more information regarding CALIPSO, please visit the following Web site: ***http://essp.gsfc.nasa.gov/essp3/index.html***.



The satellites of the constellation will fly in a 705-kilometer, circular, Sun-synchronous polar orbit, providing nearly simultaneous observations and combining CALIPSO observations with complementary observations from other platforms. This unique data set of aerosol and cloud optical and physical properties and aerosol-cloud interactions will substantially increase our understanding of the climate system and the potential for climate change.



Earth's radiation budget is a balance between incoming and outgoing radiation. Clouds affect the radiation budget directly by reflecting sunlight into space (cooling Earth) or absorbing energy and heat emitted by Earth. When clouds absorb sunlight and heat, less energy escapes to space, and the planet warms. To understand how clouds impact the energy budget, scientists need to know the composition of cloud particles, the altitude of clouds, and the extent to which clouds at different altitudes overlap each other.

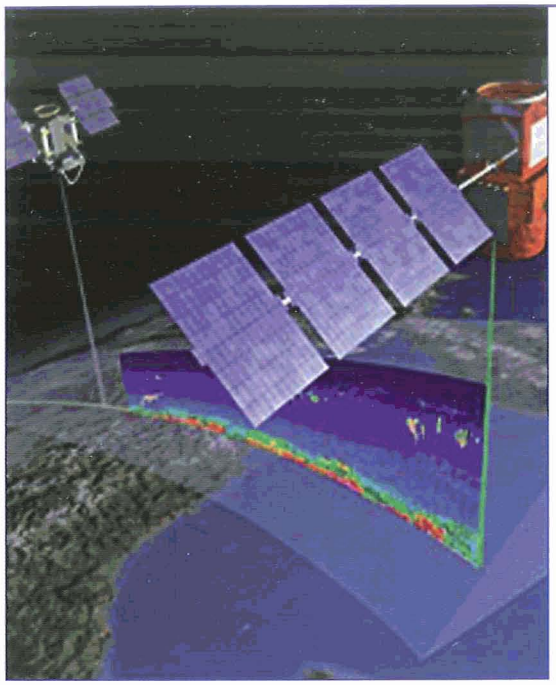


CALIPSO will fly a three-channel lidar and passive instruments in formation with Aqua and CloudSat to obtain coincident observations of radiative fluxes and atmospheric state.

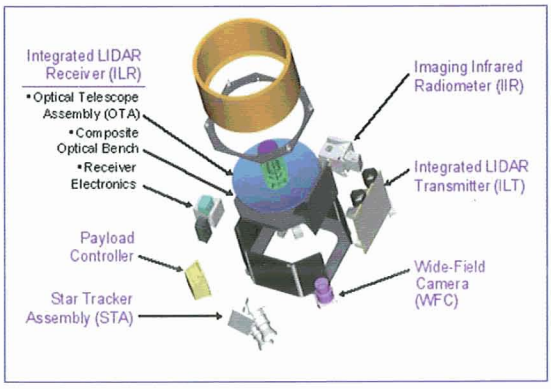
France

CALIPSO

CLOUD-AEROSOL LIDAR AND INFRARED PATHFINDER SATELLITE OBSERVATIONS



Les satellites de la constellation voleront en orbite polaire circulaire de 705 km, synchronisée avec le soleil, et procureront des observations quasi-simultanées, et combineront les observations de la CALIPSO aux observations complémentaires issues des autres plates-formes. Ces données uniques sur les propriétés physiques et optiques des aérosols et des nuages, et les interactions aérosol-nuage augmenteront substantiellement notre compréhension en ce qui concerne le système climatique et l'éventualité d'un changement de climat.

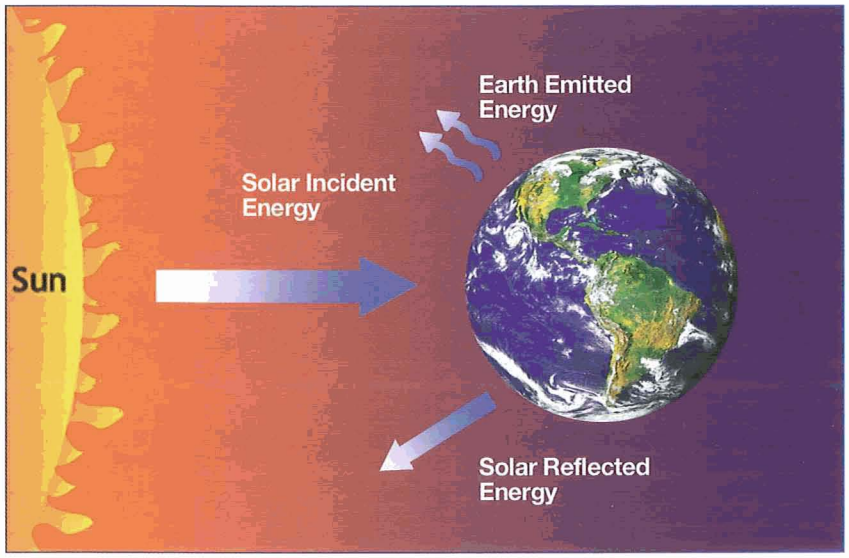


CALIPSO fera voler un linar à trois canaux et des instruments passifs en formation avec Aqua et Cloudsat pour obtenir des observations coïncidentielles sur les flux de rayonnement et sur les données atmosphériques.

Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) est une mission commune entre la NASA, l'Agence spatiale française et le Centre d'Études Spatiales (CNES). La NASA gère la mission et fournit l'ingénierie des systèmes, un lidar à trois canaux, une caméra à champ élargi, des opérations de charge utile, des données à liaison descendante, la gestion des données, le développement des algorithmes, l'archivage et la distribution des données, et le lancement. CNES fournit la plate-forme PROTEUS, l'ingénierie satellite, les opérations du satellite, le radiomètre d'image à infrarouge (IIR), le développement des algorithmes pour l'IIR et un site de données. CALIPSO sera lancée à partir de la base militaire aérienne de Vanderberg, en Californie.

CALIPSO, sera lancée en tandem avec le satellite CloudSat à bord d'un véhicule de lancement Delta II en 2005 et volera en formation avec CloudSat et le satellite Earth Science Enterprise Aqua de la NASA, en vue de fournir un ensemble unique de données globales recueillies sur une période de 3 ans sur les propriétés des nuages et des aérosols, les flux de rayonnement et l'état de l'atmosphère. Les données fournies par Calipso amélioreront grandement les prédictions sur les impacts régionaux à long terme du changement climatique, permettant ainsi de mieux comprendre et d'évaluer scientifiquement l'impact du changement climatique. Les progrès scientifiques réalisés grâce à ces données coïncidentielles permettront également d'améliorer à court terme (en nombre de jours) les prévisions météorologiques, de même que les prévisions sur les échelles saisonnières à interannuelles. CALIPSO augmentera la capacité du satellite d'observation de la Terre utilisé par le National Weather Service car il permettra de surveiller les aigrettes volcaniques et le transport de polluants qui influent la qualité de l'air et la visibilité.

Pour plus de renseignements sur CALIPSO, veuillez consulter le site Web suivant : ***http://essp.gsfc.nasa.gov/essp3/index.html.***



Le calcul des radiations de la Terre consiste en un équilibre entre les radiations entrantes et les radiations sortantes. Les nuages affectent le calcul des radiations directement en reflétant la lumière du soleil dans l'espace (phénomène qui aboutir à un refroidissement de la Terre) ou en absorbant l'énergie et la chaleur émises par la Terre. Lorsque les nuages absorbent la lumière du soleil et la chaleur, une quantité moindre d'énergie est dégagée dans l'espace, phénomène qui donne lieu à un réchauffement de la planète. Pour comprendre comment les nuages influencent le calcul de l'énergie, les chercheurs doivent connaître la composition des particules des nuages, l'altitude des nuages et le degré de chevauchement des nuages entre eux à différentes altitudes.

The Challenging Mini-Satellite Payload for Geoscientific Research and Applications Program (CHAMP) is a small satellite designed for geoscientific and atmospheric research and applications managed by the GeoForschungsZentrum Potsdam (GFZ) and the German Aerospace Center (DLR). Launched on July 15, 2000, in response to the International Decade of Geopotential Field Research, CHAMP maps the gravity and magnetic fields of Earth and performs atmospheric and ionospheric sounding. NASA provided a TurboRogue GPS receiver for this mission, and France provided a precision STAR accelerometer. In addition, the U.S. Air Force Research Laboratory provided a Digital Ion Drift Meter to measure electric currents flowing within Earth's ionosphere. CHAMP was launched from Plesetsk Cosmodrome aboard a Russian Cosmos launch vehicle.

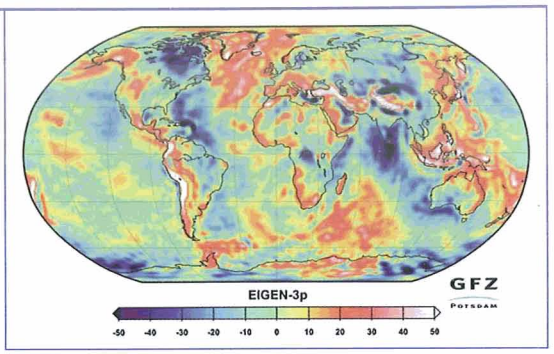
With its highly accurate, multifunctional, and complementary payload elements (magnetometer, accelerometer, star sensor, GPS receiver, laser retroreflector, ion drift meter) and its orbit characteristics (near-polar, low-altitude, long-duration), CHAMP is generating highly accurate gravity and magnetic field measurements of Earth over a 5-year period. This allows for detection not only of spatial variations in both fields, but also their variability over time.

The primary science objectives of the CHAMP mission are to provide the following:

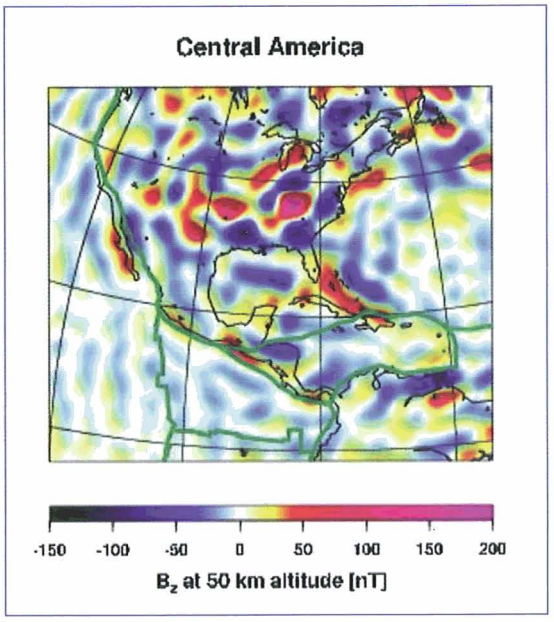
- mapping of Earth's global long- to medium-wavelength gravity field and temporal variations with applications in geophysics, geodesy, and oceanography;
- mapping of Earth's global magnetic field and temporal variations with applications in geophysics and solar terrestrial physics; and
- atmospheric/ionospheric sounding with applications in global climate studies, weather forecasting, and navigation.

The CHAMP satellite remains in healthy condition and has been followed by a second, equally compelling U.S.-German gravity mission called the Gravity Recovery and Climate Experiment (GRACE), launched in 2002. Together, data from these two missions will provide needed constraints on low-order gravity effects. In addition to this shared objective, CHAMP continues to provide magnetic field measurements that help map the ionospheric and magnetospheric current system and detect the magnetic signal of ocean tidal flow. Global profiles of dry temperature and humidity are also obtained from radio occultation of CHAMP using GPS technology.

For more information regarding CHAMP, please visit the following Web sites: ***http://op.gfz-potsdam.de/champ/index_CHAMP.html*** and ***http://genesis.jpl.nasa.gov/html/missions/CHAMP.html***.

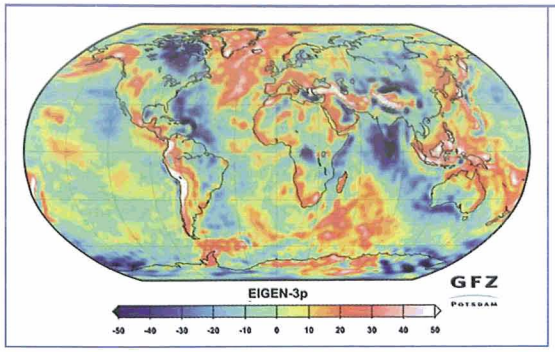


Gravity anomaly image derived from CHAMP GPS satellite-to-satellite and accelerometer data from the period July 2000 to June 2003.

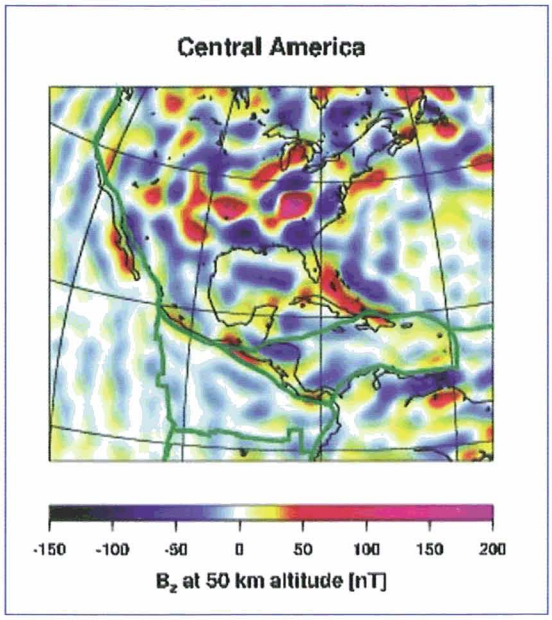


Magnetic protocol field (to 90°) from a model derived from 3 years of CHAMP data. *(Courtesy of GFZ Potsdam)*

Deutschland



Schwerkraftanomalieabbildung von CHAMP GPS-Satellit-zu-Satellit-Daten und Beschleunigungsmesserdaten von Juli 2000 bis Juni 2003



Magnetisches Protokollfeld (bis 90°) von einem Modell, das aus CHAMP-Daten über einen Zeitraum von drei Jahren ermittelt wurde (*freundlicherweise von GFZ Potsdam zur Verfügung gestellt*)

CHAMP

CHALLENGING MINI-SATELLITE PAYLOAD-PROGRAM FÜR GEOWISSENSCHAFTLICHE FORSCHUNG UND ANWENDUNG

Das Challenging Mini-Satellite Payload-Programm für geowissenschaftliche Forschung und Anwendung (CHAMP) ist ein kleiner Satellit für geowissenschaftliche und atmosphärische Forschung und Anwendungen und wird vom GeoForschungsZentrum Potsdam (GFZ) und dem Deutschen Zentrum für Luft- und Raumfahrt (DLR) geleitet. CHAMP wurde am 15. Juli 2000 als Antwort auf das Internationale Jahrzehnt der geopotenziellen Primärerhebung abgeschossen. CHAMP stellt die Schwerkraft und die magnetischen Felder der Erde kartografisch dar und führt atmosphärische und ionosphärische Sondierungen durch. Die NASA lieferte einen TurboRogue GPS-Empfänger für diese Mission und Frankreich stellte einen STAR Präzisions-Beschleunigungsmesser zur Verfügung. Des Weiteren lieferte das amerikanische Air Force Research Laboratory einen digitalen Ionen-Abdriftmesser, der elektrische Strömungen misst, die innerhalb der Ionosphäre fließen. CHAMP wurde vom Plesetsk Cosmodrome an Bord einer russischen Cosmos Abschussrampe abgeschossen.

Mit seinen sehr genauen, multifunktionalen und sich ergänzenden Nutzlastelementen (Magnetometer, Beschleunigungsmesser, Sternrichtungsgeber, GPS-Empfänger, Laser-Rückstrahler, Ionen-Abdriftmesser) und seinen Erdumlaufbahn-Eigenschaften (nahe dem Pol, niedrige Höhe, langlebig) generiert CHAMP über einen Zeitraum von fünf Jahren sehr genaue Messungen der Schwerkraft und des magnetischen Felds der Erde. Dies ermöglicht nicht nur das Erkennen räumlicher Veränderungen in beiden Bereichen, sondern auch ihrer Veränderlichkeit über die Jahre.

Die wichtigsten wissenschaftlichen Ziele der CHAMP-Mission sind:

- die kartografische Darstellung des langfristigen bis mittelfristigen Wellenlängenfelds der Erde und die zeitlichen Veränderungen in der Geophysik, Geodäsie und Ozeanografie,
- die kartografische Darstellung des globalen magnetischen Felds und der zeitlichen Veränderungen in der Geophysik und der solarterrestrischen Physik und
- die atmosphärische/ionosphärische Sondierung mit Anwendungen bei globalen Klimastudien, Wettervorhersagen und der Navigation.

Der CHAMP-Satellit ist nach wie vor einsatzfähig und eine zweite ebenso eindrucksvolle amerikanisch-deutsche Schwerkraftmission folgte, die Gravity Recovery and Climate Experiment (GRACE) heißt und im Jahre 2002 abgeschossen wurde. Die Daten dieser beiden Missionen werden gemeinsam die benötigten Begrenzungen der geringfügigen Schwerkraftwirkungen liefern. Zusätzlich zu diesem gemeinsamen Ziel liefert CHAMP weiterhin magnetische Feldmessungen, die bei der kartografischen Darstellung des ionosphärischen und magnetosphärischen Strömungssystems und bei der Entdeckung der magnetischen Signale von Ozeangezeitenströmungen helfen. Globale Profile der trockenen Temperaturen und der Luftfeuchtigkeit werden auch von der Funkabdeckung von CHAMP mittels der GPS-Technologie erhalten.

Weitere Informationen zu CHAMP finden Sie auf den folgenden Websites: ***http://op.gfz-potsdam.de/champ/index_CHAMP.html*** und ***http://genesis.jpl.nasa.gov/html/missions/CHAMP.html***

The Gravity Recovery and Climate Experiment (GRACE) is a joint partnership between NASA and the German Aerospace Center (DLR) in Germany. GRACE operates a pair of identical satellites flying in a precisely controlled (to within microns over a distance of more than 220 kilometers between the two satellites) tandem formation to provide a new model of Earth's gravity field, with unprecedented accuracy, every 30 days. The two satellites and instruments are provided by NASA's Jet Propulsion Laboratory (JPL). Germany provides satellite operations and data downlink facilities; Germany also provided the launch on a Russian Rockot vehicle on March 17, 2002, from Plesetsk Cosmodrome in Russia.

The gravity field of Earth is variable in both space and time and is a major constraint on the knowledge of mean and time-variable mass distribution of Earth. GRACE is mapping Earth's gravity field by making repeated measurements of the distance between the mission's two satellites, using range measurements from GPS and an intersatellite microwave ranging system. In 2003, using only 111 days of GRACE satellite data, the GRACE science team released a preliminary model of Earth's gravity field 10 to 100 times more accurate than the previous model, which was constructed using decades of geodetic data.

GRACE data are yielding crucial information about the distribution and movement of mass within the solid Earth and its fluid surroundings and are also supporting a number of important studies on global climate variability and change. GRACE is the newest tool helping oceanographers unlock the secrets of ocean circulation and its effect on climate. The gravity variations that GRACE measures enable the monitoring of changes due to deep currents in the ocean runoff and groundwater storage on land masses, mass exchanges between ice sheets or glaciers and the oceans, and variations of mass within Earth and its influence on long-term sea-level change. The geoid heights derived from GRACE gravity models will allow improved determination of ocean circulation from the decade-long, altimeter-derived mean sea surface record and will improve understanding of atmosphere-ocean heat exchange. An additional goal of the mission is to create a better profile of Earth's atmospheric temperature.

The Principal Investigator for the GRACE mission is Dr. Byron Tapley at the University of Texas Center for Space Research. The Co-Principal Investigator, Dr. Christoph Reigber, is at the GeoForschungsZentrum Potsdam in Germany. Project management and systems engineering activities are carried out by JPL.

For more information regarding GRACE, please visit the following Web sites: ***http://www.csr.utexas.edu/grace/*** and ***http://www.dlr.de***.

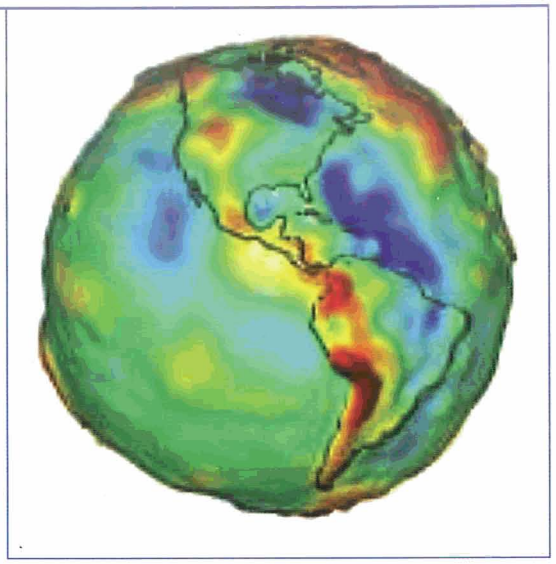
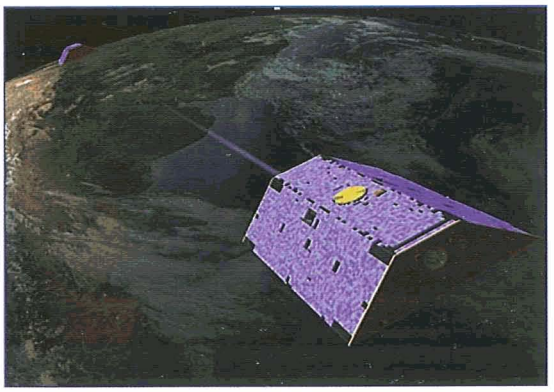


Image of Earth colored according to relative gravity, as measured by GRACE. This model was based upon a preliminary analysis of 111 days of in-flight data gathered during the commissioning phase of the GRACE mission.



The twin GRACE satellites circling the globe in tandem.

Deutschland

GRACE
GRAVITY RECOVERY AND CLIMATE EXPERIMENT

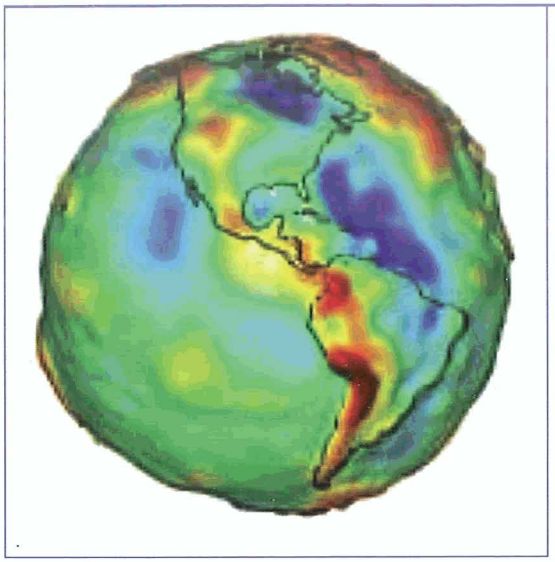
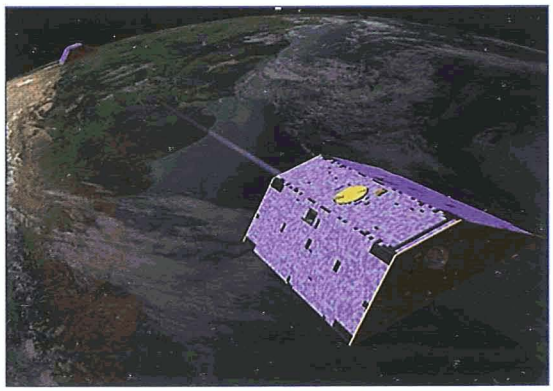


Bild der Erde, das entsprechend der relativen Schwerkraft gefärbt ist, wie sie von GRACE gemessen wurde. Dieses Modell basiert auf einer vorläufigen Analyse von Flugdaten über 111 Tage, die während der Inbetriebnahmephase der GRACE-Mission gesammelt wurden.



Die GRACE-Zwillingssatelliten umkreisen die Erde im Tandem.

Das Gravity Recovery and Climate Experiment (GRACE) ist ein gemeinsames Projekt der NASA und des Deutsches Zentrums für Luft- und Raumfahrt (DLR) in Deutschland. GRACE betreibt zwei identische Satelliten, die in einer genau gesteuerten (bis zu mikrometergenau bei einem Abstand von 220 Kilometern zwischen den beiden Satelliten) Tandemformation fliegen, um alle 30 Tage ein neues Modell des Schwerefelds der Erde mit beispielloser Genauigkeit zu liefern. Die beiden Satelliten und die Instrumente werden vom Jet Propulsion Laboratory der NASA geliefert. Deutschland stellt den Satellitenbetrieb und die Geräte für die Datenanbindung zur Verfügung. Deutschland war auch für den Abschuss auf einer russischen Rockot-Rampe am 17. März 2002 vom Plesetsk Cosmodrome in Russland verantwortlich.

Das Schwerefeld der Erde ist in Raum und Zeit veränderlich und bildet eine Hauptbeschränkung der Kenntnisse über die durchschnittliche und zeitvariable Masseverteilung der Erde. GRACE stellt kartografisch das Schwerefeld der Erde dar, indem wiederholte Messungen des Abstands zwischen den beiden Satelliten dieser Mission unter Verwendung von Bereichsmessungen von GPS und eines Mikrowellenentfernungsmesssystems zwischen den Satelliten durchgeführt werden. Unter Verwendung der GRACE-Satellitendaten von nur 111 Tagen veröffentlichte das Wissenschaftlerteam von GRACE 2003 ein vorläufiges Modell des Schwerefelds der Erde, das 10 bis 100 Mal genauer als das vorherige Modell ist, das nach Jahrzehnten der geodätischen Datensammlung erstellt wurde.

Die GRACE-Daten liefern ausschlaggebende Informationen über die Verteilung und Bewegung von Massen der festen Erde und ihrer flüssigen Umgebung und unterstützen eine Anzahl von wichtigen Studien über die globale Klimaveränderlichkeit und den Klimawechsel. GRACE ist das neueste Hilfsmittel, das den Ozeanografen hilft, die Geheimnisse der ozeanischen Zirkulation und ihrer Wirkung auf das Klima zu lüften. Die von GRACE gemessenen Variationen der Schwerkraft ermöglichen die Überwachung der Änderungen, die auf den tiefen Strömungen im Ozeanablauf und Grundwasser auf den Landmassen, den Masseaustauschen zwischen den Eisplatten oder Gletschern und den Ozeanen und auf den Änderungen der Masse innerhalb der Erde und dem Einfluss der langfristigen Meereshöhe beruhen. Die von den GRACE-Schwerkraftmodellen abgeleiteten geoiden Höhen werden eine bessere Bestimmung der Ozeanzirkulation ermöglichen als die Aufzeichnungen der Höhenmessung der durchschnittlichen Meeresoberfläche, die jahrzehntelang durchgeführt wurden, und das Verständnis des Hitzeaustauschs von Atmosphäre und Ozean verbessern. Ein weiteres Ziel der Mission bildet die Erstellung eines besseren Profils der atmosphärischen Temperatur der Erde.

Der leitende Forscher der GRACE-Mission ist Dr. Byron Tapley vom Zentrum für Weltraumforschung der University of Texas. Der Co-leitende Forscher ist Dr. Christoph Reigber, vom GeoForschungsZentrum Potsdam in Deutschland. Die Projektleitung und die Systemingenieuraktivitäten werden von JPL durchgeführt.

Weitere Informationen zu GRACE finden Sie auf den folgenden Websites: ***http://www.csr.utexas.edu/grace/*** und ***http://www.dlr.de***.

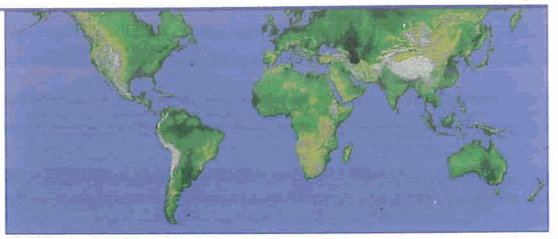
The Shuttle Radar Topography Mission (SRTM) is an international collaborative project among NASA, the National Imagery and Mapping Agency (NIMA), the German Aerospace Center (DLR), and the Italian Space Agency (ASI). The purpose of the SRTM mission, which flew successfully on the Space Shuttle Endeavour (STS-99) in February 2000, was to map Earth's land surface in three dimensions. Using sophisticated radar instruments, SRTM produced, in a single 10-day Shuttle flight, data sufficient to produce a mosaic of 80 percent of Earth's land surface at 30-meter resolution. When data processing is completed, these data will compose the most complete near-global, high-resolution database of Earth's topography. To date, SRTM has produced 900-meter-resolution topography data for the entire globe through a merger with GTOPO 30 data, a popular topographic data set of variable quality. SRTM-derived research-quality data at 90-meter resolution are available for Asia, North and South America, and Africa. It is anticipated that all 90-meter SRTM research-quality data will be publicly available by September 2004.

To acquire this topographic data, the SRTM payload was outfitted with two radar antennas—one in the Shuttle payload bay, the other on the end of a 60-meter (200-foot) mast that extended from the payload bay once the Shuttle was in space. Using the technique of interferometry, SRTM collected data over Earth's landmass, home to nearly 95 percent of the world's population.

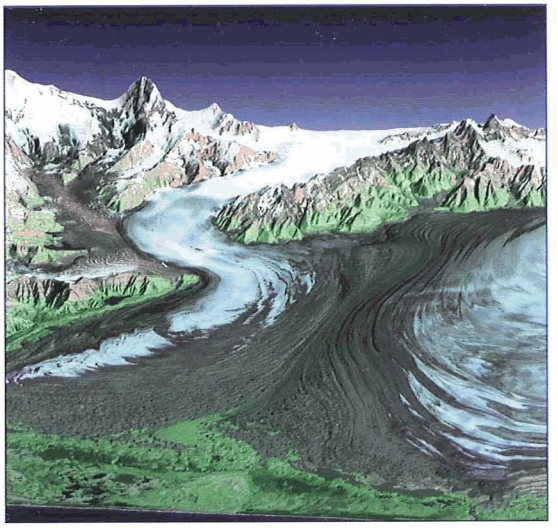
The technical objectives of SRTM were to develop and demonstrate the capability of obtaining single-pass interferometric SAR data in both C- and X-band and to process consistently these data on a global scale. NASA provided the C-band SAR. The German satellite company Dornier Satellitensysteme, together with ASI, was responsible for the development of the X-band SAR (X-SAR) instrument. DLR, as the project lead, was responsible for systems engineering, mission operation, calibration, data processing, archiving, distribution, and data utilization of X-band SAR. DLR also provided science teams for the SRTM mission.

The Shuttle Radar Topography Mission represents a breakthrough in the science of remote sensing and will lead to the production of topographic maps of the entire Earth that are 30 times more precise than the best global maps previously available. SRTM data products are enhancing scientific, commercial, and military activities, with applications such as natural-hazard monitoring, urban planning, and improved air navigation.

For more information regarding SRTM, please visit the following Web sites: ***http://www.jpl.nasa.gov/srtm/***, ***http://photojournal.jpl.nasa.gov/mission/SRTM***, and ***http://www.dlr.de/srtm/***.

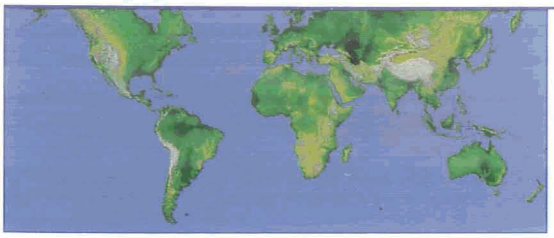


World in Mercator Projection, Shaded Relief, and Colored Height. Earth's landforms, between latitudes 60° north and 56° south, as mapped by SRTM in February 2000.

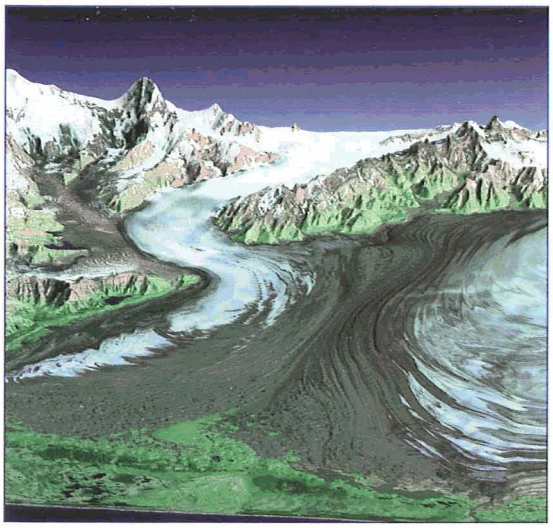


Malaspina Glacier, Alaska, Perspective with Landsat Overlay. Perspective view of Malaspina Glacier in southeastern Alaska, created from a Landsat image and a SRTM elevation data set. Rocks carried by the glacier form spectacular patterns of huge contortions that result from the glacier crinkling as it gets pushed from behind by the faster-moving valley glaciers.

Deutschland



Welt in der Mercator Projektion, schattiertes Relief und gefärbte Höhen
Die Landformen der Erde, zwischen den geografischen Breiten 60° Nord und 56° Süd, kartografiert im Februar 2000 von SRTM



Malaspina Gletscher, Alaska, Perspektive mit Landsat-Überlagerung
Perspektivische Ansicht des Malaspina-Gletschers im südöstlichen Alaska, erstellt aus einem Landsat Bild und einem SRTM-Höhendatensatz. Die vom Gletscher getragenen Felsen bilden aufgrund der Spaltenbildung, die dadurch entsteht, dass der Gletscher von hinten durch sich schneller bewegende Talgletscher angeschoben wird, eindrucksvolle, verzerrte Muster.

SRTM
SHUTTLE RADAR TOPOGRAPHY MISSION

Die Shuttle Radar Topography Mission (SRTM) ist ein internationales gemeinschaftliches Projekt der NASA, der National Imagery and Mapping Agency (NIMA), des Deutschen Zentrums für Luft- und Raumfahrt (DLR) und der italienischen Weltraumagentur (ASI). Der Zweck der SRTM-Mission, die erfolgreich im Februar 2000 auf dem Space Shuttle Endeavour (STS-99) flog, war die kartografische dreidimensionale Darstellung der Landoberflächen der Erde. Unter Verwendung von komplizierten Radarinstrumenten generierte SRTM in einem einzigen 10-tägigen Shuttleflug genügend Daten, um ein Mosaik von 80 Prozent der Landoberfläche der Erde mit einer 30-Meter-Auflösung zu erstellen. Wenn die Datenverarbeitung beendet ist, werden diese Daten die vollständigste, beinahe globale Hochauflösungsdatenbank der Topografie der Erde bilden. Bis jetzt hat SRTM durch eine Fusion mit den GTOPO 30 Daten (populärer topografischer Datensatz von unterschiedlicher Qualität) Topografiedaten mit einer 900-Meter Auflösung für die gesamte Erde erstellt. Daten zur Forschungsqualität von SRTM mit einer 90-Meter-Auflösung sind für Asien, Nord- und Südamerika und Afrika verfügbar. Es wird erwartet, dass alle Daten zur Forschungsqualität von SRTM im September 2004 öffentlich zugänglich sein werden.

Um die topografischen Daten zu erhalten, wurde die SRTM-Nutzlast mit zwei Radarantennen ausgestattet - eine in der Ladebucht des Shuttles und die andere am Ende eines 60 Meter langen Masts, der aus der Ladebucht ausgefahren wurde, nachdem sich der Shuttle im Weltraum befand. Unter Verwendung von Interferenzmessverfahren sammelte SRTM Daten über der Landmasse der Erde, auf der beinahe 95 Prozent der Weltbevölkerung leben.

Die technischen Ziele von SRTM waren die Entwicklung und die Demonstration der Fähigkeiten, bei einem einzigen Überflug die interferometrischen SAR-Daten sowohl bei C- und X-Bandweiten zu erhalten und diese Daten ständig auf einer globalen Basis zu verarbeiten. NASA lieferte die C-Bandweite SAR. Die deutsche Satellitenfirma Dornier Satellitensysteme war gemeinsam mit ASI für die Entwicklung des X-Bandweite SAR (X-SAR) Instruments verantwortlich. Das Deutsche Zentrum für Luft- und Raumfahrt (DLR) hatte die Projektleitung inne und war für die Systemtechnologie, den Missionsbetrieb, die Kalibrierungen, Datenverarbeitung, Archivierung, Verteilung und Datenausnutzung der X-Bandweite SAR verantwortlich. Das Deutsche Zentrum für Luft- und Raumfahrt (DLR) stellte auch die Wissenschaftlerteams für die SRTM-Mission zur Verfügung.

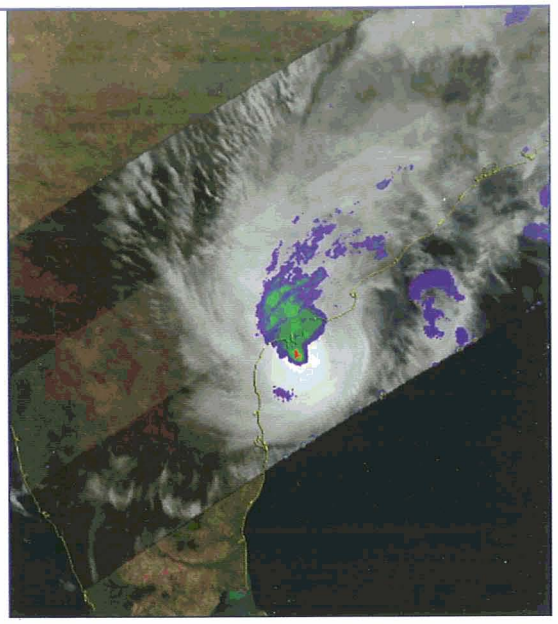
Die Shuttle Radar Topography Mission stellt einen Durchbruch in der Fernerkundungswissenschaft dar und wird zur Produktion von topografischen Karten für die gesamte Erde führen, die 30-mal genauer sind als die besten globalen Landkarten, die bis jetzt verfügbar waren. SRTM-Datenprodukte fördern wissenschaftliche, kommerzielle und militärische Aktivitäten, wie die Überwachung von Naturgefahren, Städteplanung und verbesserte Luftnavigation.

Weitere Informationen zu SRTM finden sich auf den folgenden Websites:
http://www.jpl.nasa.gov/srtm/,
http://photojournal.jpl.nasa.gov/mission/SRTM, und
http://www.dlr.de/srtm/.

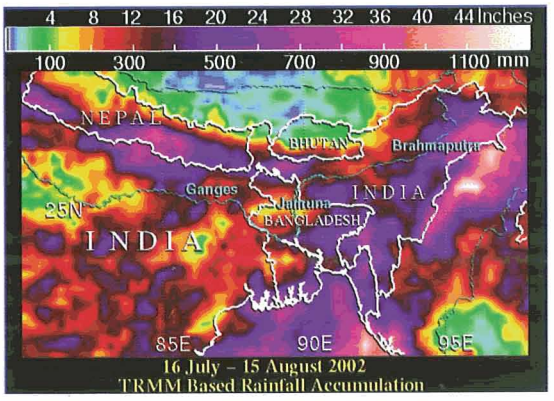
In December 1997, NASA, the National Oceanic and Atmospheric Administration (NOAA), India's Department of Space, and India's Department of Science and Technology signed a Memorandum of Understanding for Scientific Cooperation in the Areas of Earth and Atmospheric Sciences. This agreement initiated a long-awaited Earth and atmospheric scientific cooperation among these four agencies and established communication lines for the exchange of Earth science data between India and the United States.

Under the agreement, the India Meteorological Department joined the international effort to calibrate and validate Tropical Rainfall Measuring Mission (TRMM) data and has provided essential rainfall data over the Indian subcontinent for this purpose. TRMM is an innovative science mission involving the joint NASA-JAXA research satellite that is studying rainfall and the associated release of energy in the tropical and semitropical regions of Earth. TRMM contributes to the understanding of how clouds affect climate and how much energy is transported in the global water cycle. In coordination with other NASA satellites and with the help of worldwide ground validation efforts, TRMM scientists are studying the interactions among water vapor, clouds, and precipitation, along with their role in regulating the climate system.

For more information regarding TRMM, please visit the following Web site: ***http://trmm.gsfc.nasa.gov***.



A tropical cyclone with reported winds of up to 75 miles per hour hit the east coast of India just after midnight local time on December 16, 2003. At least 11 people perished in the storm, which brought heavy rains to the region. The TRMM satellite obtained this image of the cyclone just as the center was approaching the coastline. The image was taken at 12:00 universal time coordinated (UTC) on December 15, 2003. It shows the cyclone's rainfall distribution from above as seen by the TRMM Precipitation Radar in the inner swath and the TRMM Microwave Imager in the outer swath overlaid on infrared data from the TRMM Visible Infrared Scanner in white.



The TRMM satellite measured rainfall accumulation over India and Bangladesh in the summer of 2002.

NASA and the Israel Space Agency (ISA) cooperated on the flight of Israel's Tel Aviv University's Mediterranean Israel Dust Experiment (MEIDEX), on board Columbia, mission STS-107, in January 2003. Although the mission ended with the tragic loss of Columbia and its crew, some of the research data collected during MEIDEX were retained. The data will be used to develop new methods to observe dust from space and to understand the effect of dust on weather and climate. Dust affects Earth's energy balance and contributes to changes in surface and atmospheric temperature and precipitation. It is an important fertilizer of the oceans.

Measurements from MEIDEX were made with a camera consisting of six spectral channels. These channels included the ultraviolet, for measurements of dust similar to those of the Total Ozone Mapping Spectrometer (TOMS), and the visible to near-infrared channel, for measurements similar to those of the Moderate Resolution Imaging Spectroradiometer (MODIS). Analysis of the data and comparison to the ground and aircraft measurements indicated how to better use TOMS and MODIS data. Several secondary goals have also been established, including measurements of the reflective properties of Earth's surface, visibility in the atmosphere, and nighttime spectral observations of Transient Luminous Events (TLEs, often called sprites) above the tops of thunderclouds. The data from the visibility experiment were lost in the accident; however, an unexpectedly large number of TLEs were observed. These will lead to a better understanding of the geographical distribution and energies of these mesospheric phenomena and their role in the global electrical circuit.

For more information regarding MEIDEX or Fast Reaction Experiments Enabling Science, Technology, Applications and Research (FREESTAR), please visit the following Web sites: ***http://luna.tau.ac.il/~peter/MEIDEX/home.htm*** and ***http://sspp.gsfc.nasa.gov/hh/freestar/overview.html***.

MEIDEX work station in Space Shuttle Columbia.

Dust plume over the Red Sea.

מיידקס (MEIDEX)

ניסוי האבק הישראלי בים-התיכון

סוכנות החלל האמריקאית (נאס"א) וסוכנות החלל הישראלית (סל"ה) שיתפו פעולה בהטסת ניסוי האבק הישראלי בים-התיכון (מיידקס) של אוניברסיטת תל-אביב במעבורת החלל קולומביה, משימה מס' STS-107, בינואר 2003. אף-על-פי שהמשימה הסתיימה באובדן הטראגי של קולומביה ושל כל אנשי צוותה, חלק מנתוני המחקר שנאספו במהלך ניסוי המיידקס נשמרו. הנתונים ישמשו לפיתוח שיטות חדשות לצפייה באבק מהחלל ולהבנת השפעת האבק על מזג האוויר ועל האקלים. אבק משפיע על מאזן האנרגיה של כדור הארץ ותורם לשינויים בטמפרטורת פני השטח, בטמפרטורת האטמוספרה ובכמות המשקעים. הוא גם מהווה חומר דשן חשוב לאוקיינוסים.

המדידות בניסוי המיידקס בוצעו באמצעות מצלמה בעלת שישה ערוצים ספקטראליים, ובכללם ערוץ אולטרה-סגול למדידות אבק דומות לאלה של הספקטרומטר למיפוי טוטלי של האוזון (TOMS—Total Ozone Mapping Spectrometer) וכן ערוצים בתחום הספקטרום של האור הנראה עד לאינפרא-אדום הקרוב, למדידות דומות לאלה של הספקטרו-ראדיומטר ההדמיה בעל כושר ההפרדה הממוצע (MODIS—Moderate Resolution Imaging Spectroradiometer). ניתוח הנתונים והשוואתם למדידות מהקרקע ומהאוויר הצביעו על דרכים לניצול משופר של הנתונים מ-TOMS ומ-MODIS. נקבעו גם כמה מטרות משניות, וביניהן מדידת תכונות החזר הקרינה של פני כדור הארץ, מדידת הראות באטמוספירה ותצפיות ספקטרליות של אירועי אור חולפים מעל לענני סופה, המכונים שדונים (TLEs—Transient Luminous Events). נתוני מדידות הראות אבדו בתאונה ולא הגיעו לידי החוקרים. אולם הנתונים מהתצפיות הליליות שהתקבלו כוללים מספר גבוה מהמצופה של TLEs. הם יביאו להבנה טובה יותר של התפוצה הגיאוגרפית ושל האנרגיות של תופעות מזוספיריות אלה ושל תפקידן במעגל החשמלי של כדור הארץ.

לקבלת מידע נוסף על ניסוי המיידקס או על FREESTAR (Fast Reaction – Experiments Enabling Science, Technology, Applications and Research ניסויים בעלי תגובה מהירה המאפשרים מדע, טכנולוגיה, יישומים (ומחקר), נא בקרו באתרי האינטרנט הבאים:

http://luna.tau.ac.il/~peter/MEIDEX/home.htm
http://sspp.gsfc.nasa.gov/hh/freestar/overview.html

תחנת העבודה של מיידקס במעבורת החלל קולומביה.

תימרת אבק מעל ים סוף

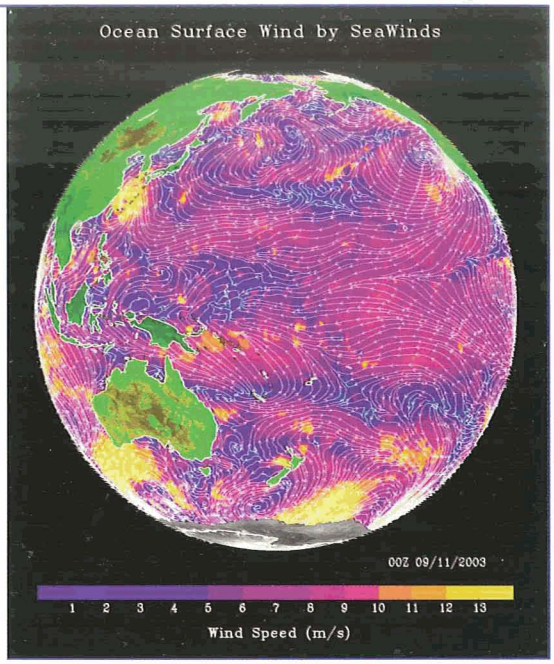
NASA and the Japan Aerospace Exploration Agency (JAXA) cooperated on the flight of NASA's SeaWinds scatterometer on JAXA's Advanced Earth Observing Satellite II (ADEOS-II, also known as Midori-II). ADEOS-II launched on JAXA's H-IIA launch vehicle on December 14, 2002. JAXA lost contact with ADEOS-II in October 2003.

NASA's SeaWinds scatterometer is a specialized microwave sensor that measures near-surface wind velocity (speed and direction) over Earth's oceans under clear-sky and cloudy conditions. On ADEOS-II, SeaWinds continued the similar measurements obtained by the NASA scatterometer on ADEOS and the SeaWinds scatterometer on NASA's Quick Scatterometer (QuikSCAT) satellite. The SeaWinds broad measurement swath provided accurate, frequent, high-resolution measurements of ocean surface wind velocities and direction; this capability enabled the instrument to cover 90 percent of Earth's surface on a daily basis. These observations play an increasingly important role in oceanographic, meteorological, and climatic research.

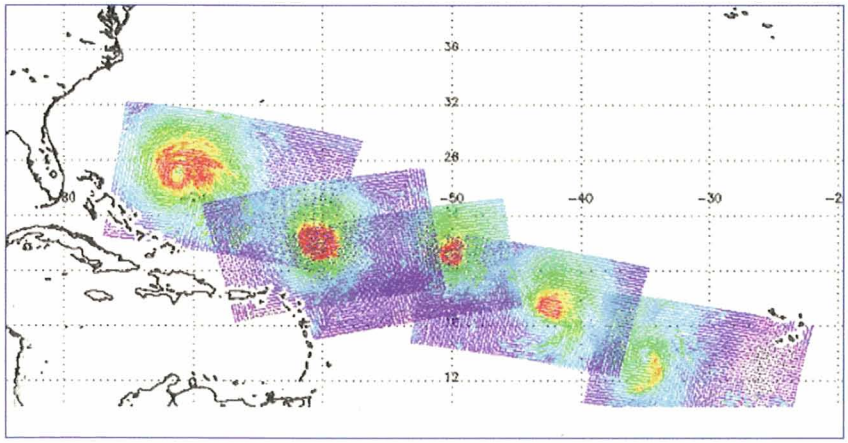
NASA's SeaWinds instrument provided beneficial data to operational communities. The data were used to characterize and track several hurricanes, including Hurricane Isabel's path across the Atlantic Ocean in September 2003. SeaWinds data are also used by the National Ice Center to generate accurate daily maps of sea ice extent over Earth's polar regions.

JAXA's ADEOS-II satellite monitored global climate and environmental changes and expansion of the ozone holes, and it investigated the causes of these changes. ADEOS-II was equipped with two JAXA core sensors: the Advanced Microwave Scanning Radiometer for the observation of the physical aspects of the water cycle, both during the day and at night, and the Global Imager for measurements of ocean, land, and cloud properties. In addition to these instruments, ADEOS-II carried the Environment Agency of Japan's Improved Limb Atmospheric Spectrometer for monitoring the ozone layer and the French Space Agency's Polarization and Directionality of Earth's Reflectance sensor for studying the atmosphere and land surface.

For more information regarding SeaWinds or ADEOS-II, please visit the following Web sites: ***http://winds.jpl.nasa.gov*** and ***http://www.jaxa.jp/index_e.html***.

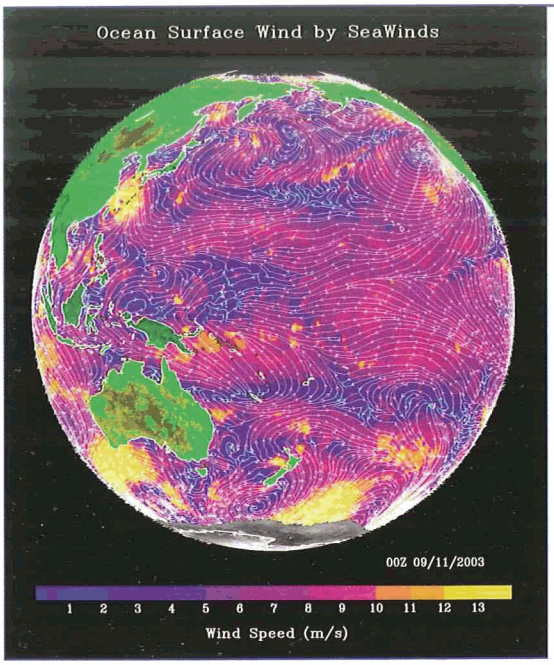


NASA/JPL scatterometers QuikSCAT and SeaWinds track Hurricane Isabel in 2003 from formation near the Cape Verde Islands along its track across the Atlantic Ocean toward the U.S. eastern seaboard.



日本

ADEOS-II
環境観測技術衛星「みどりII」



米国航空宇宙局（NASA）と日本航空研究開発機構（JAXA）は、共同でNASA海上風観測装置（Seawinds）のJAXA環境観測技術衛星（ADEOS-II、別称「みどりII」）への搭載飛行を行いました。ADEOS-IIは、JAXAのH-IIAロケットにより2002年12月14日に打ち上げられており、JAXAは2003年10月にADEOS-IIと通信不能となりました。

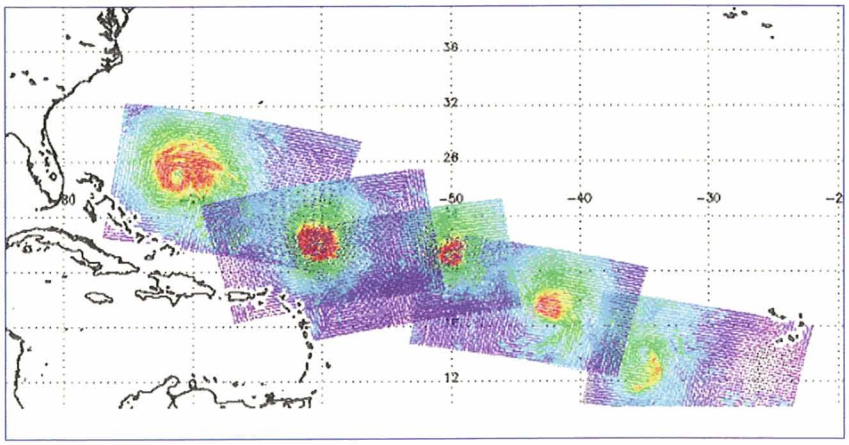
NASAの海上風観測装置（Seawinds）は、特殊マイクロ波センサーであり、快晴または曇りの条件下で地球上海洋での海上風の速度（風速および風向）を測定します。ADEOS-IIに搭載のSeawindsは、ADEOSに搭載のNASA散乱計およびNASAクイック散乱計（QuickSCAT）衛星に搭載のSeawinds散乱計が行ったような観測を継続して行いました。Seawindsの広範にわたる観測データにより、海洋表面の風速および風向に関する高精度、高頻度、高分解能の観測結果が得られました。この装置はその性能により1日あたり全地球表面の90％の海域の観測が可能です。これらの観測は、海洋学、気象学および気候に関する研究分野でますます重要な役割を果たしています。

NASAのSeaWindsは、その観測結果の運用団体・機関にとって有益なデータを提供しており、そのデータは2003年9月に大西洋上におけるハリケーン・イザベルの通過経路など、いくつかのハリケーンの分析や追跡に用いられました。またSeawindsのデータは、米国National Ice Centerによる南極・北極エリアにおける高精度の日測海氷分布図の作成にも用いられています。

JAXAのADEOS-II衛星は、グローバルな気候や環境の変化およびオゾン・ホールの拡大をモニターし、これらの変化の原因を調査しました。ADEOS-IIには、水循環に関する物理的性質の観測に昼夜の別なく用いられる高性能マイクロ波走査放射計（Advanced Microwave Scanning Radiometer）、および海域、陸域、雲の性質を測定するグローバルイメージャ（Global Imager）といった、2つのコア・センサーが装備されていました。　これらに加え、ADEOS-IIには日本の環境省が開発したオゾン層観測用の改良型大気周縁分光計、フランス国立宇宙研究センターが開発した大気・地表調査用の地球反射率偏極方位センサーが装備されていました。

SeawindsまたはADEOS-IIに関する詳しい情報は、下記のウェブサイトをご覧ください。 ***http://winds.jpl.nasa.gov***
http: //www.jaxa.jp/index_e.html

NASAジェット推進研究所（JPL）の散乱計QUIKSCATおよびSeawindsにより、2003年のハリケーン・イザベルのカボヴェルデ諸島付近での発生から米国東海岸線に向かって大西洋を横断する様子をたどったもの。



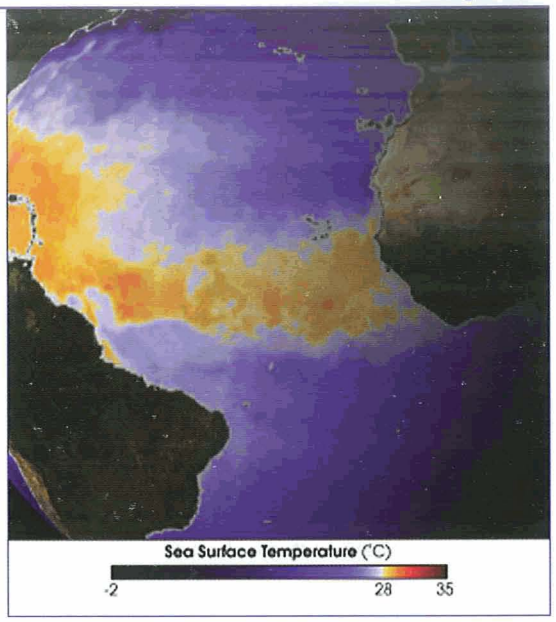
NASA and the Japan Aerospace Exploration Agency (JAXA) are cooperating on NASA's Earth Science Enterprise Aqua satellite, launched on May 4, 2002. Aqua carries JAXA's Advanced Microwave Scanning Radiometer (AMSR-E). AMSR-E is a passive, forward-looking scanning radiometer with 12 channels at six discrete microwave frequencies in the range of 6.9 to 89 gigahertz. AMSR-E data are providing information on atmospheric water vapor, cloud water, near-surface wind speed, sea surface temperature, precipitation, soil moisture, snow cover, and sea ice.

AMSR-E observations support the study of hydrologic processes that exert a strong influence on Earth's climate and weather. For example, atmospheric water vapor is Earth's primary greenhouse gas; wind speed at the ocean surface helps control evaporation; sea surface temperature changes influence atmospheric circulation; and precipitation replenishes water supplies. AMSR-E measurements of soil moisture are relevant to the study of photosynthesis in plants, and AMSR-E measurements of snow cover and sea ice support research on their influence on Earth's water cycle, radiation, and energy budgets.

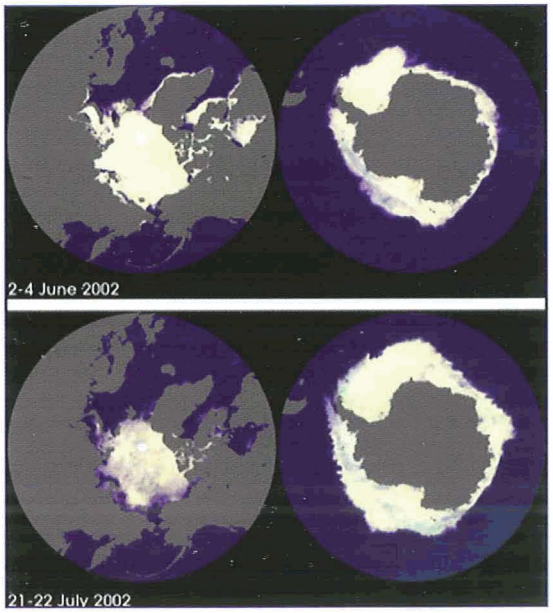
AMSR-E is obtaining global observations on a routine basis, including surface information, even in the presence of clouds and/or darkness. Furthermore, it is collecting these observations at a higher spatial resolution than done by previous satellite passive-microwave instruments, revealing details in such phenomena as tropical instability waves in the eastern tropical Pacific Ocean. The products derived from the AMSR-E data are being compared with in situ and aircraft observations through a series of validation campaigns that began with a joint U.S.-Japanese precipitation campaign in Wakasa Bay, Japan, in January 2003. This campaign was followed in the same year by sea ice validation campaigns in the Sea of Okhotsk in February and in the Arctic Ocean in March; snow campaigns in Colorado in February and March; and soil-moisture campaigns in Alabama, Georgia, and Oklahoma in June and July and in Brazil in December.

Other instruments on Aqua provide information on atmospheric temperature and humidity profiles, clouds, Earth's radiative balance, sea surface temperature and ocean biology, and land vegetation.

For more information regarding AMSR-E or Aqua , please visit the following Web sites: ***http://www.ghcc.msfc.nasa.gov/AMSR/***, ***http://sharaku.eorc.jaxa.jp/AMSR/index_e.htm***, and ***http://aqua.nasa.gov***.



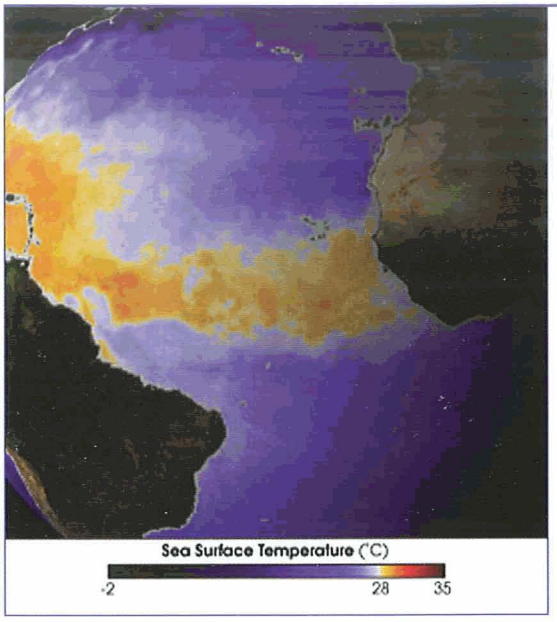
Sea surface temperatures along the main thoroughfare of emerging Atlantic hurricanes, as derived from AMSR-E data composited for June 2002.



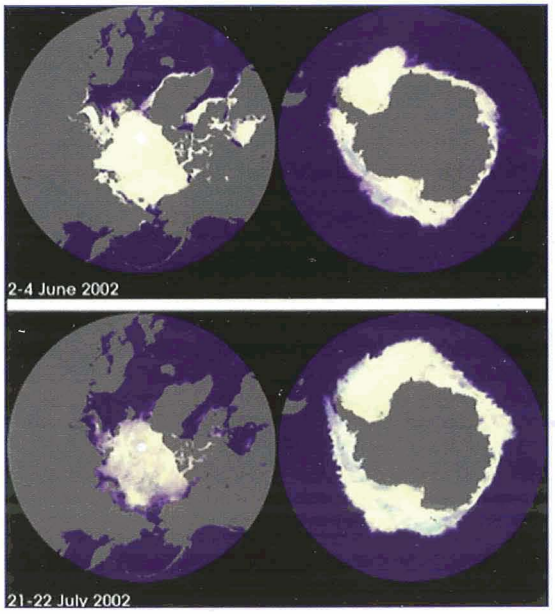
AMSR-E measures sea ice extent: white signifies the sea ice cover, and gray indicates land. The time period depicted is late spring to summer in the Northern Hemisphere, with declining sea ice coverage, and late fall to winter in the Southern Hemisphere, with advancing sea ice.

日本

AMSR-E
改良型高性能マイクロ波放射計-E



大西洋で発生するハリケーンの主な通過経路に沿って測定した海面温度。2002年6月にまとめたAMSR_Eデータに基づく。



AMSR-Eは海氷分布を測定します。白色部分は海氷域、灰色部分は陸域を示しています。この画像は、晩春から夏季にかけての北半球での海氷域の後退、晩秋から冬季にかけての南半球での海氷域の前進を示しています。

米国航空宇宙局（NASA）と日本航空研究開発機構（JAXA）は、2002年5月4日に打ち上げられたNASA地球科学観測事業（Earth Science Enterprise）のAqua衛星 に共同で取り組んでおり、Aquaには、JAXAが開発した改良型高性能マイクロ波放射計（AMSR-E）が搭載されています。AMSR-Eは、6.9_89 GHzの範囲にある6種のマイクロ波の離散周波数を12チャンネルで測定する受動型の前方走査放射計であり、AMSR-Eのデータにより大気中の水蒸気、雲水、海上風速、海面温度、降水、土壌水分、積雪および海氷に関する情報が得られます。

AMSR-Eの観測は地球の気候や気象に強い影響を及ぼす水循環プロセスの研究を裏付けています。例えば、大気中の水蒸気は地球の主な温室ガスであり、海洋面の風速は蒸発の調節を助長しており、海面温度変化は大気の循環に影響を与え、降水によって水が供給されているのです。AMSR-Eによる土壌水分の測定は植物の光合成の研究に関連しており、AMSR-Eによる積雪や海氷の測定は、それらが地球の水循環、放熱、およびエネルギー供給に及ぼしている影響の研究に役立っています。

AMSR-Eは、雲や暗がりの有無に関わらず、地表情報を含む全球規模の観測結果を日常的に得ています。そのうえ、先の衛星に搭載された受動型マイクロ波機器に比べ、高い空間分解能で観測データを収集でき、東部熱帯太平洋における熱帯不安定波のような現象の詳細を明らかにしています。AMSR-Eデータをもとにしてできたプロダクツは、2003年1月に日本の若狭湾における日米共同の降水活動で始まった一連の検証観測実験を通して、地上・航空機による実測データと比較されています。この観測実験に引き続き同年には、2月にオホーツク海、3月に北極海における海氷の検証観測実験が行われ、2，3月にコロラドで雪の観測実験、6，7月にアラバマ州、ジョージア州、オクラホマ州、12月にブラジルで土壌水分の観測実験が行われました。

Aquaに搭載の他の機器により、大気温と湿度プロファイル、雲、地球の放射バランス、海面温度、海洋生物学、陸性植物に関する情報を得ています。

AMSR-EやAquaに関するより詳しい情報は、下記のウェブサイトをご覧ください。
http://www.ghcc.msfc.nasa.gov/AMSR/
http://sharaku.eorc.jaxa.jp/AMSR/index_e.htm
http://aqua.nasa.gov.

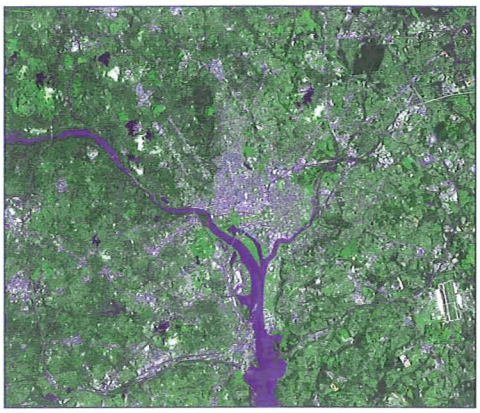
NASA and Japan's Ministry of Economy, Trade and Industry (METI) are cooperating on the flight of METI's Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) instrument aboard NASA's Terra satellite. ASTER provides high-spatial-resolution, multispectral images of Earth's surface and clouds. It has 14 spectral bands in the visible to the thermal infrared wavelength region and high spatial resolutions of 15 to 90 meters. ASTER was launched on NASA's Terra spacecraft on December 18, 1999. Terra is NASA's first Earth Observing System platform providing global data on major aspects of the biosphere, atmosphere, and oceans' atmosphere. It carries five state-of-the-art sensors that study the interactions among Earth's atmosphere, lands, and oceans.

ASTER is the high-spatial-resolution instrument on the Terra satellite. ASTER's ability to serve as a "zoom" lens for the other Terra instruments is particularly important for change detection, calibration/validation, and land surface studies. All three ASTER telescopes (visible and near-infrared, short-wavelength infrared, and thermal infrared) are pointable in the crosstrack direction. In addition, a second visible and near-infrared camera looks aft along a track and provides the capability to produce high-quality digital terrain topography.

Operating on an 8-percent duty cycle, more than 700,000 ASTER scenes covering Earth's landmasses were scheduled and acquired since launch. More than 1,500,000 ASTER scenes and derived products have been distributed to users around the world through the Ground Data System at Japan's Earth Remote Sensing Data Analysis Center and the U.S. Land Processes Distributed Active Archive Center in Sioux Falls, SD. ASTER data and derived products, which include detailed maps of land surface temperature, emissivity, reflectance, and elevation, are important scientific tools to users from many Earth science disciplines. They are routinely used in studying geologic processes, monitoring land-cover conditions and change, investigating hydrologic resources and processes, monitoring crop condition and development, studying natural disasters (e.g., flooding and volcanic activity), and performing many other important research and practical applications.

NASA's Jet Propulsion Laboratory leads the U.S. ASTER Science Team, which coordinates investigations using ASTER products for geological, ecological, and other research activities. The U.S. team assists its Japanese ASTER Team colleagues with the calibration and validation of the ASTER instrument and its data products.

For more information regarding ASTER or NASA's Terra mission, please visit the following Web sites: ***http://terra.nasa.gov***, ***http:/asterweb.jpl.nasa.gov***, and ***http://www.ersdac.or.jp/eng/index.E.html***.



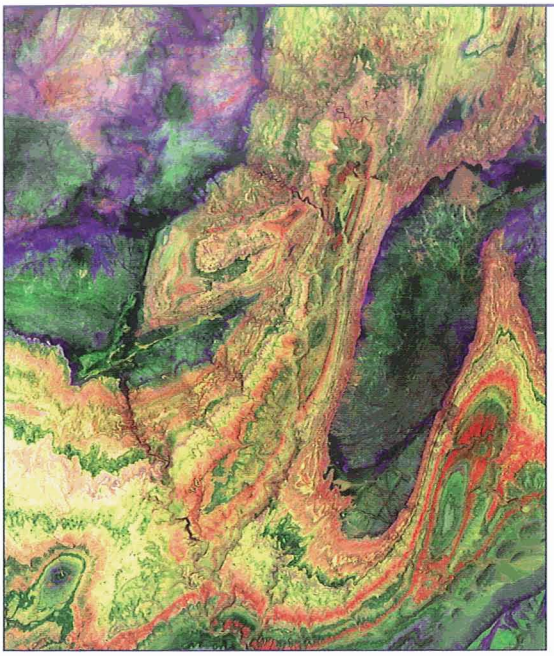
ASTER image of Washington, DC.

ASTER image: short-wavelength infrared bands are combined to highlight the different rock types and illustrate the complex folding of the Anti-Atlas Mountains in Morocco. The yellowish, orange, and green areas are limestones, sandstones, and gypsum; the dark blue and green areas are underlying granitic rocks.

ASTER image of Tokyo, Japan.

日本

ASTER
資源探査用将来型センサー



ASTER画像：短波長赤外バンドは、その組み合わせにより岩石の種類の違いを際立たせ、モロッコのアンチアトラス山脈の複雑な褶曲を画像化します。帯黄色、橙色、緑色の部分は、石灰岩、砂岩、石膏を示し、濃青色と緑色部分は下層にある花崗岩を示しています。

米国航空宇宙局（NASA）と日本の通商産業省（METI）は、NASAの衛星テラ（TERRA）に搭載した資源探査用将来型センサー（Advanced Spaceborne Thermal Emission and Reflection Radiometer, ASTER）の飛行に共同で取り組みました。ASTERにより高空間解像度の地球表面・雲のマルチスペクトル画像が得られます。このセンサーは可視から熱赤外領域の範囲で14スペクトルバンドを有し、また15-90 mの高空間解像度を有しています。ASTERはNASAの衛星テラに搭載され、1999年12月18日に打ち上げられました。テラは、生物圏、大気、海洋大気の主な性質に関する全球的なデータを得るためNASAが開発した最初の地球観測システムプラットホームです。テラは地球の大気、陸域、海洋域間の相互作用を調査するための5つの最高技術水準センサーを備えています。

ASTERは、衛星テラに搭載された高空間分解能機器であり、他のテラ搭載機器のズームレンズとして利用されるASTERの性能は、変化探知、較正・検証、そして地表面の研究にとって特に重要です。ASTERの3つの望遠鏡（可視近赤外、短波長赤外、熱赤外）全てが軌道の交差方向にポインティングできます。その上、第2の可視近赤外カメラは軌道に沿って衛星後部方向をとらえ、地表の地形・地質に関する高品質なデジタル画像データが得られます。

打ち上げ以来、8％デューティサイクルで作動させることで、地球の大陸部分をとらえた700,000以上ものASTER画像の収集が予定され、収集されました。150,000以上のASTER画像とその派生プロダクツは、日本の財団法人である資源環境観測解析センターと米国のサウスダコタ州スーフォールズにあるLand Processes Distributed Active Archive Centerの地表データシステムを通じて、世界中のユーザーに配信されてきました。ASTERのデータや、地表温度・放射率・反射率・高度に関する詳細地図等のASTERデータの派生プロダクツは、数々の地球科学分野で研究を行うユーザーにとって重要な科学的ツールとなっています。これらのデータは地質学的プロセスの研究、陸地部分の状況や変化のモニタリング、水源や水循環の調査、穀物生育の状態や発達のモニタリング、自然災害（洪水、火山活動など）の研究、その他多くの重要な研究や実用的応用に日常的に利用されています。

NASAのジェット推進研究所（JPL）は、ASTERプロダクツを地質学、生態学、その他の研究活動に利用する調査をコーディネートする米国ASTER科学チームを指揮しています。米国のこのチームはASTER機器とそのデータプロダクツの較正・検証の面で、日本のASTERチームの構成員をサポートしています。

ASTERまたはNASAのテラミッションに関するより詳しい情報は、下記のウェブサイトをご覧ください。
http://terra.nasa.gov
http:/asterweb.jpl.nasa.gov
http://www.ersdac.or.jp/eng/index.E.html.

東京（日本）のASTER画像。

ワシントンDCのASTER画像。

Japan, Hong Kong, and Taiwan

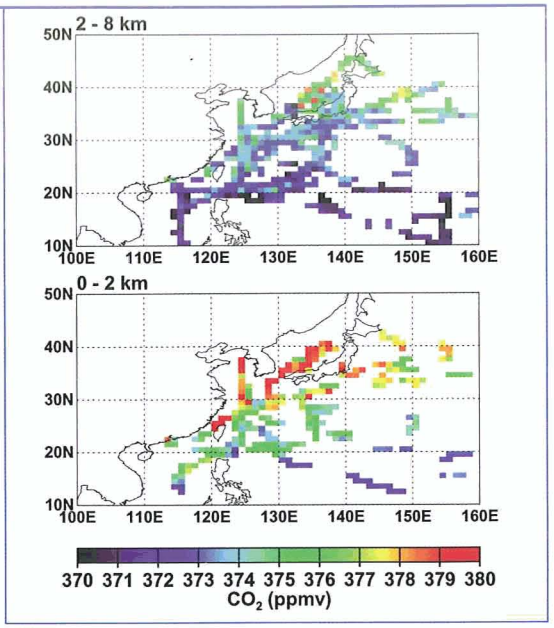
NASA's Transport and Chemical Evolution over the Pacific (TRACE-P) coordinated field experiment was a cooperative project with Japan, Hong Kong, and Taiwan. Scientists from Japan, Germany, France, and Norway joined TRACE-P as Principal Investigators and participants.

Conducted in April and May 2001, TRACE-P is the latest in a series of coordinated field experiments aimed at studying the impact of natural and human contributions to atmospheric chemistry and global climate change. Using NASA's specially equipped DC-8 and P-3B aircraft and supported by a team of international Earth scientists, the TRACE-P mission took air samples over the Pacific. The airborne research was supported by ground-based facilities in Hong Kong, Japan, and Taiwan, plus satellite observations. Because of the current rapid industrialization of Asian cities, scientists chose the Pacific region for study in an effort to better understand the implications of this industrialization for global atmospheric composition and climate. The goal of TRACE-P is to characterize the composition of Asian outflow to the Pacific and relate it quantitatively to its sources. Integration of the aircraft observations with satellite observations (from the Total Ozone Mapping Spectrometer, Global Ozone Monitoring Experiment, Measurement of Pollution in the Troposphere (MOPITT), and Moderate Resolution Imaging Spectroradiometer (MODIS)) and with three-dimensional atmospheric models is a critical component of the approach.

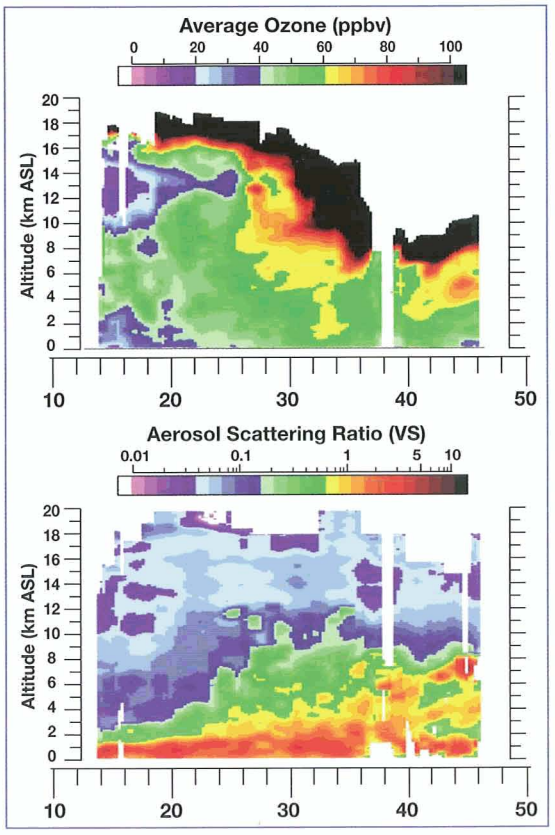
A first series of reports on TRACE-P results was published in the October–November 2003 issues of the *Journal of Geophysical Research—Atmospheres*. A second series has been submitted for publication in the same journal. Significant accomplishments to date include the following:

- finding that combustion and halocarbon emissions are much higher than previously expected, while regional biogenic emission of CO_2 is lower than expected over the China peninsula;
- identifying the critical role of aerosols, including dust and pollution components, in contributing to the Asian outflow and its chemical evolution;
- indicating a leveling off of Asian emissions over the past decade; and
- successfully validating the MOPITT satellite instrument for CO measurements and integrating TRACE-P and MOPITT data to map the transpacific transport and aging of Asian air masses over the Pacific.

For more information regarding the TRACE-P mission, please visit the following Web sites: ***http://www.earth.nasa.gov/*** and ***http://www-gte.larc.nasa.gov/gte_fld.htm***.



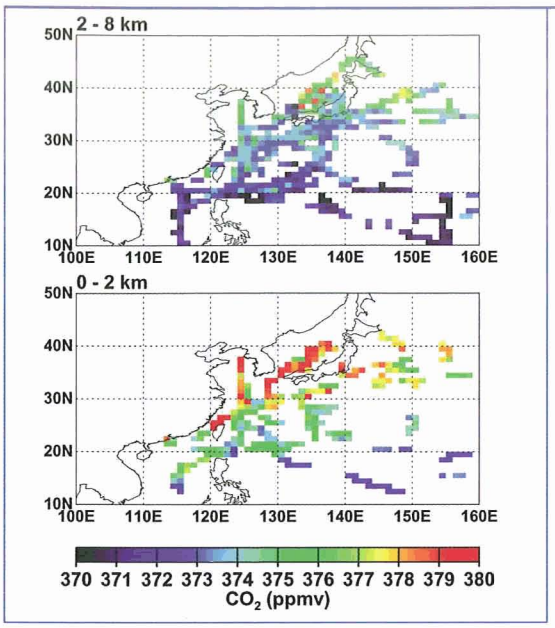
Distributions of CO_2 concentrations measured in TRACE-P in two altitude ranges. Asian outflow at 0–2 kilometers was mainly from fossil fuel combustion and respiration, while outflow at 2–8 kilometers had an important component from biomass burning in Southeast Asia. Data from S.A. Vay (NASA).



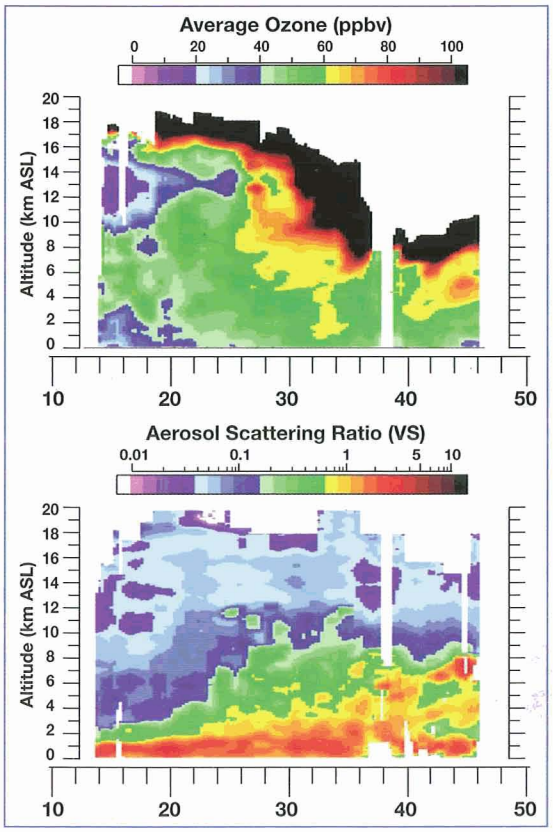
Large-scale distribution of ozone and aerosol concentrations measured by Differential Absorption Lidar (DIAL) over the northwestern Pacific during TRACE-P, as a function of altitude and latitude (in degrees). The ozone data illustrate the transition between tropical and midlatitude airmasses. The aerosol data illustrate the strong Asian pollution outflow at 0–6 kilometers. This outflow was not generally associated with elevated ozone. Data from Edward V. Browell (NASA).

日本、香港、そして台湾で

TRACE-P
太平洋上における大気汚染物質の輸送と汚染物質の化学的変質に関する観測



2つの高度領域でTRACE-Pが測定したCO_2濃度分布。高度0-2 kmで観測されたアジアからの流出物質は、主に化石燃料の燃焼と呼吸によるものであるのに対して、高度2-8 kmでの流出物質は、東南アジアでのバイオマス燃焼由来の重要成分を含有しています。データ提供：S.A. Vay (NASA)



NASAのTRACE-P（Transport and Chemical Evolution Over the Pacific）観測計画に基づいて行われた現場実験は、日本、香港そして台湾の共同プロジェクトです。日本、ドイツ、フランス、ノルウェイの科学者らが、主任研究者および参加者として、TRACE-Pに参加しました。

2001年の4，5月に行われたTRACE-P観測実験は、大気の化学および地球全体の気候変化への自然と人間の関与の影響力を研究することを目的として行われた、一連の現場実験のうちの最後の観測実験です。NASAの特殊装備DC-8やP-3B航空機を利用し、世界の地球科学者らで構成されるチームの協力を得て、TRACE-Pミッションは、太平洋上空の空気サンプルを採取しました。この航空機による研究は、香港、日本、台湾にある地上施設および衛星の観測結果により、裏づけられました。現在のアジアの都市における急激な工業化を理由に、科学者らは地球規模での大気の組成と気候にこの工業化がいかに密接に関わりあっているかをよりよく理解するため、太平洋地域を選びました。TRACE-Pの目標は、アジアが太平洋に放出している物質組成を分析し、定量的にその放出源と関係付けることです。航空機による観測結果を衛星観測結果（オゾン全量分光計（Total Ozone Mapping Spectrometer, TOMS）オゾン観測機器GOME（Global Ozone Monitoring Experiment）対流圏大気汚染物質衛星センサー（Measurement of Pollution in the Troposphere, MOPITT）中分解能撮像分光放射計（Moderate Resolution Imaging Spectro-radiometer, MODIS）による観測結果）、および3次元大気モデルと組み合わせることは、この研究アプローチにおいて大変重要な位置を占めています。

TRACE-P観測についての研究報告の第1報は、2003年10-11月号のJournal of Geophysical Research-Atmospheresに掲載されました。第2報は同雑誌に掲載するため、すでに提出されています。TRACE-Pがこれまでにあげた素晴らしい成果には、以下のようなものがあります。

- 地域的な生物起源のCO2放出が中国・半島地域の上空で予想より低いのに対して、燃焼や含ハロゲン炭素化合物の放出が以前に予想していたよりもかなり高いことを発見しました。
- アジアからの流出物質やその化学的変質の面で、粉塵や大気汚染成分等のエアロゾルが果している重要な役割を明らかにしました。
- アジアからの放出が過去10年間で横ばい状態になっていることを示しました。
- CO測定用のMOPITT衛星機器の検証の成功、およびTRACE-PとMOPITTのデータを統合し、太平洋上空アジア気団の太平洋横断輸送と経時変化を作図することに成功しました。

TRACE-Pミッションに関するより詳しい情報は、下記のウェブサイトをご覧ください。
http://www.earth.nasa.gov/
http://www-gte.larc.nasa.gov/gte_fld.htm.

TRACE-P観測中に差分吸収ライダー（Differential Absorption Lidar, DIAL）によって高度と緯度（度数表示）の関数として測定された、北西太平洋上空における大規模なオゾンとエアロゾルの濃度分布。このオゾンデータは、熱帯気団と中緯度気団間の遷移を示し、エアロゾルデータは、高度0-6 kmにおける強力なアジアの大気汚染流出を示しています。この流出は一般に高度オゾンには関連していません。
データ提供：　Edward V. Browell (NASA)

The Tropical Rainfall Measuring Mission (TRMM) is a joint NASA-JAXA mission launched November 27, 1997, aboard a Japanese H-II rocket. NASA provided the spacecraft and four instruments, including the TRMM Microwave Imager, the Visible Infrared Scanner, the Clouds and Earth's Radiant Energy System, and a Lightning Imaging Sensor. JAXA provided the Precipitation Radar and the launch.

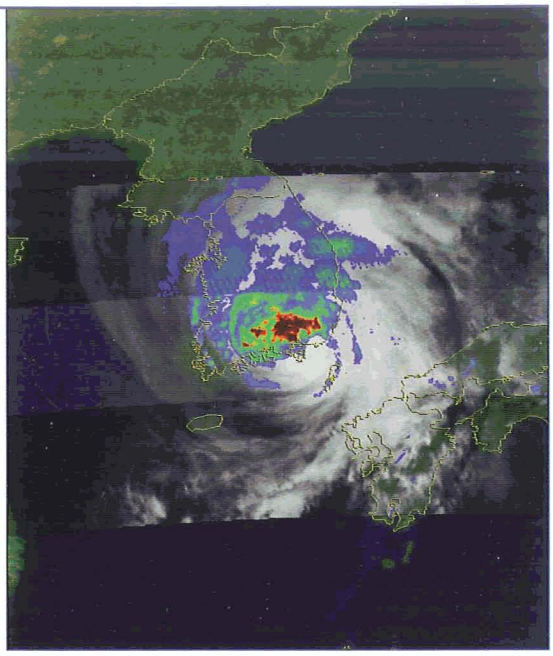
TRMM is a research satellite designed to study tropical rainfall and the associated release of energy that helps power the global atmospheric circulation, thereby shaping both weather and climate around the globe. TRMM contributes to the understanding of how clouds affect climate and how much energy is transported in the global water cycle. In coordination with other NASA satellites, TRMM scientists are studying the interactions among water vapor, clouds, and precipitation, as well as their role in regulating the climate system.

TRMM is currently in its seventh year of successful operation. This mission has succeeded beyond expectations, producing significant precipitation data and real-time data to operational agencies worldwide. TRMM was boosted to a higher orbit in August 2001 to conserve the onboard fuel necessary for stationkeeping maneuvers and to extend its life.

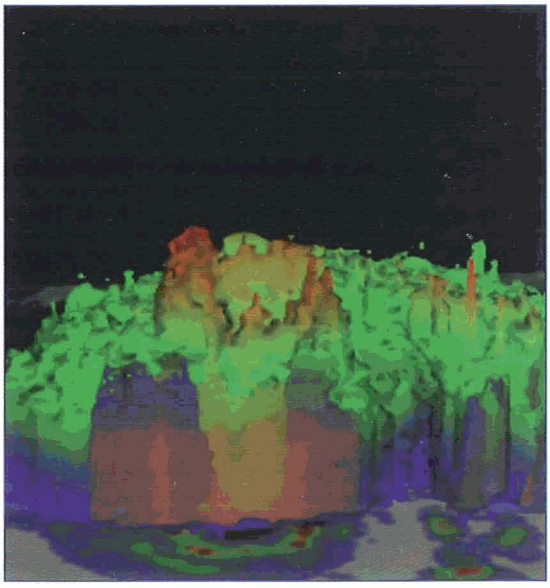
Significant accomplishments of TRMM include the following:

- TRMM provided the first radar and radiometer observation of precipitation from space.
- TRMM measurements helped scientists reduce the uncertainty in tropical rainfall estimates from 50 percent to better than 25 percent.
- TRMM has provided a 6-year climatology of tropical rainfall, spanning the years 1998 to 2003. Such information is critical to understanding the distribution of tropical rainfall and how its associated energy impacts global atmospheric circulation.
- TRMM observations have been used to monitor El Niño/La Niña events, including the major 1997–1999 El Niño to La Niña transition and the weak 2002 El Niño, thereby demonstrating the ability to resolve climate signals using rainfall data.
- Assimilation of TRMM rainfall data into global models shows significant improvements in representing the hydrologic cycle, clouds, and radiation in such models.
- TRMM is contributing to improved hurricane and flood analysis and forecasting. Civilian and military operational centers (e.g., the National Hurricane Center, Joint Typhoon Warning Center, and Aviation Weather Center) routinely use TRMM data in day-to-day assessment of hurricane and typhoon intensities, and the assimilation of TRMM data in research mesoscale models has been shown to reduce uncertainty in tropical cyclone tracks.
- TRMM observations have been used to compile the first global climatology of lightning occurrence in the tropics and subtropics, highlighting a remarkable disparity in lightning activity between land and oceans and among the various continents.
- TRMM rainfall data, in combination with data from other rainfall remote sensors, are being used to generate near-real-time, 3-hourly estimates of precipitation intensity across much of the globe; this type of multisatellite precipitation analysis is paving the road for more extensive monitoring of rainfall during the upcoming Global Precipitation Measurement mission.

For more information regarding the TRMM mission, please visit the following Web site: ***http://trmm.gsfc.nasa.gov***.



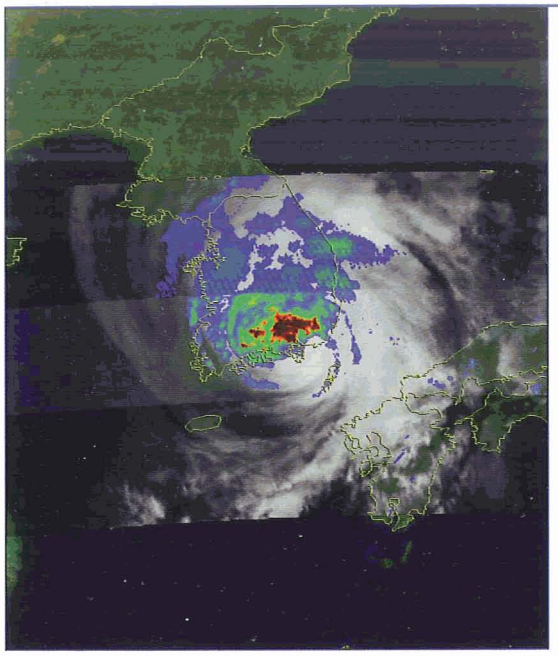
The September 2003 TRMM image shows Typhoon Maemi in South Korea and part of Japan.



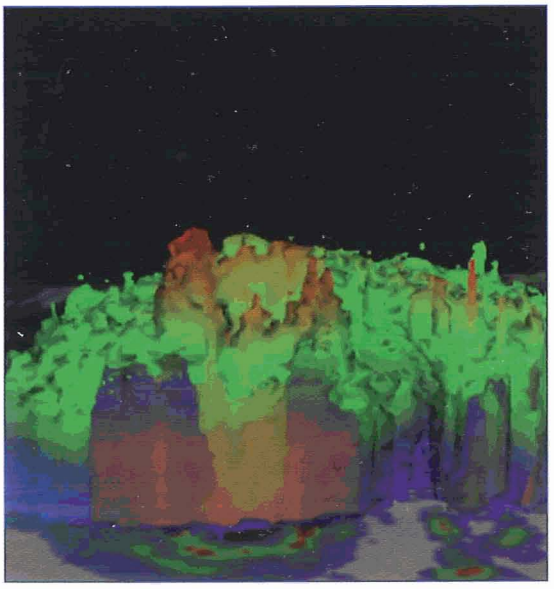
TRMM image of Hurricane Isabel in the United States, September 12, 2003.

日本

TRMM
熱帯降雨観測衛星



2003年9月、韓国および日本の一部で観測された台風14号（マエミー、MAEMI）のTRMM画像。



2003年9月12日米国で観測されたハリケーン・イザベルのTRMM画像。

熱帯降雨観測衛星（Tropical Rainfall Measuring Mission, TRMM）は、米国航空宇宙局（NASA）と日本航空研究開発機構（JAXA）の共同ミッションであり、1997年11月28日（日本時間）に日本のH-IIロケットにより打ち上げられました。この計画で、NASAが衛星、およびTRMMマイクロ波観測装置（Microwave Imager）、可視赤外観測装置（Visible Infrared Scanner）、雲・地球放射エネルギー観測装置（Clouds and Earth1s Radiant Energy System）、雷観測装置（Lightning Imaging Sensor）の4種の測定機器を提供し、JAXAは降水レーダを提供しTRMMを打ち上げました。

TRMMは、研究用衛星であり、熱帯地方の降雨と、地球全体の大気循環の駆動源であり地球上の気象や気候を形成する熱帯降雨によるエネルギーの放出の研究を目的としています。TRMMは、雲がどのように気象に影響を与えるのか、どの程度のエネルギーが地球の水循環において輸送されたかを把握するのに役立ちます。また、他のNASAの衛星と連携させて、TRMM研究者は水蒸気、雲、降水の相互作用、および気候システムの調整におけるそれらの役割について研究しています。

TRMMは、現在順調運転中で、運転7年目に突入しています。このミッションは、予想以上の成功をおさめ、世界中のデータ運用機関に向けて、有意義な降水データやリアルタイムのデータを配信しています。TRMMは2001年8月に、軌道保持操作に必要な搭載燃料の保存と衛星の延命のため、高軌道に押し上げられました。

TRMMがあげた目ざましい成果として、以下のようなものがあります。

- TRMMは、降水に関するレーダーおよび放射計の観測結果を初めて宇宙から提供しました。
- TRMMの測定結果によって、研究者らは熱帯地方の降雨推定の不確かさを50パーセントから25パーセント以下にすることができました。
- TRMMは1998-2003年の6年間にわたり、熱帯地方の降雨に関する気候学的観測結果を提供してきました。この情報は熱帯降雨の分布やその降雨に伴うエネルギーが地球の大気循環に与える影響を把握するのに重要です。
- TRMMの観測結果は、1997年から1999年にかけての大型のエルニーニョからラニーニャへの移行や、2002年の小型のエルニーニョといった、エルニーニョ／ラニーニャ現象の監視に利用され、降雨データを用いた気象兆候の解明能力を証明しました。
- TRMMの降雨データをグローバルモデルに組み込むことで、水循環、雲および放熱の説明が飛躍的に進歩しました。
- TRMMはハリケーンおよび洪水の分析・予報の改善に貢献しています。民間および軍のデータ運用センター(米国ハリケーンセンター（National Hurricane Center）、米海軍合同台風警報センター（Joint Typhoon Warning Center）、米国航空気象センター（Aviation Weather Center）など）は、TRMMのデータをハリケーンや台風の強度を日々評価するのに利用しており、研究用の中規模気象モデルにTRMMデータを組み込むことで、熱帯地方のサイクロンの進路予測の不確かさを減らすことができることを示しました。
- TRMMの観測結果は、熱帯・亜熱帯地方における雷の発生に関する最初の地球気象学的観測情報をまとめることに利用され、陸海間あるいは種々の大陸間で雷の活動が著しく異なることを明らかにしました。
- TRMM降雨データは、他の降雨リモートセンサで得られたデータと組み合せることで、ほぼ全球を網羅する降水強度の推定を3時間毎という準リアルタイムで行うことに利用されています。来る全球降水測定計画ではさらに広範にわたって降雨が監視されますが、この種の複数衛星による降水分析はそのための基礎となります。

TRMMミッションに関するより詳しい情報は、下記のウェブサイトをご覧ください。***http://trmm.gsfc.nasa.gov.***

The Netherlands

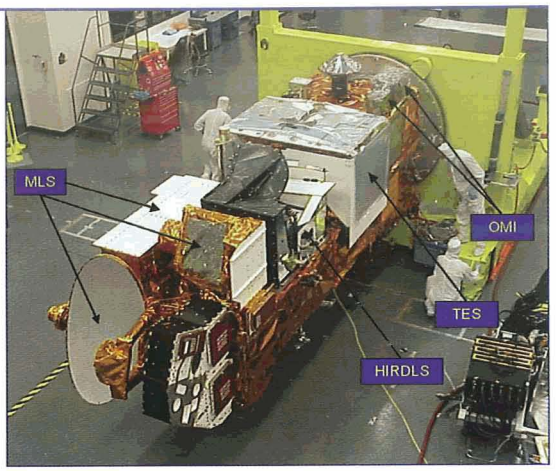
NASA and the Netherlands Agency for Aerospace Programs (NIVR) are cooperating on an ozone-monitoring project. NASA has a long-running global record of total ozone and surface ultraviolet measurements from its series of Total Ozone Mapping Spectrometer (TOMS) missions. Continuation of these important measurements will be ensured by the Ozone Monitoring Instrument (OMI)—the contribution of NIVR, in collaboration with the Finnish Meteorological Institute (FMI) and Dutch and Finnish industries to NASA's Earth Science Enterprise Aura mission.

OMI will continue the TOMS record for total ozone mapping and other atmospheric parameters related to ozone chemistry in the stratosphere and troposphere, as well as those related to climate. OMI measurements will be highly synergistic with those of the other instruments on the Aura platform, which is designed to study ozone change, air quality, and climate. The Aura mission is scheduled for launch in mid-2004 and is one of NASA's primary contributions to a larger international effort to advance the multidisciplinary study of Earth and long-term systematic monitoring of changes in Earth's system.

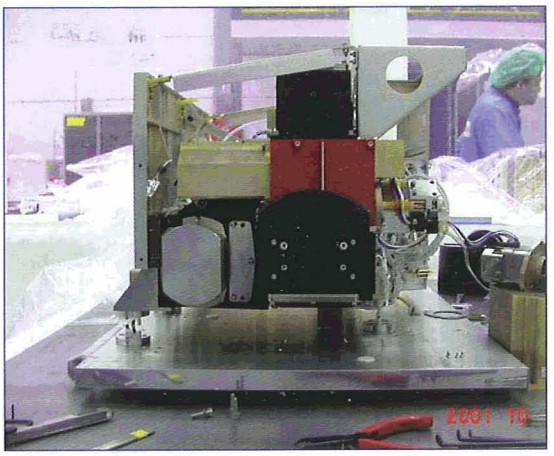
The OMI instrument employs hyperspectral imaging in a push-broom mode to observe solar backscatter radiation in the visible and ultraviolet spectra. Earth will be viewed in 740 wavelength bands along the satellite track, with a swath large enough to provide global coverage in 14 orbits (1 day). The nominal 13x24-kilometer spatial resolution can be zoomed to 13x13 kilometers for detecting and tracking urban-scale pollution sources. The hyperspectral capabilities will improve the accuracy and precision of the total ozone amounts and other OMI data products. These capabilities will also allow for accurate radiometric and wavelength self-calibration over the long term.

The OMI international science team, consisting of participants from Europe and the United States, is led by the Principal Investigator from The Netherlands in collaboration with Co-Principal Investigators from Finland and the United States. The science teams have responsibility for algorithm development, calibration, data processing, validation, and analysis.

For more information regarding OMI and NASA's Aura mission, please visit the following Web sites: ***http://aura.gsfc.nasa.gov/instruments/index.html*** and ***http://www.nivr.nl/index.html***.

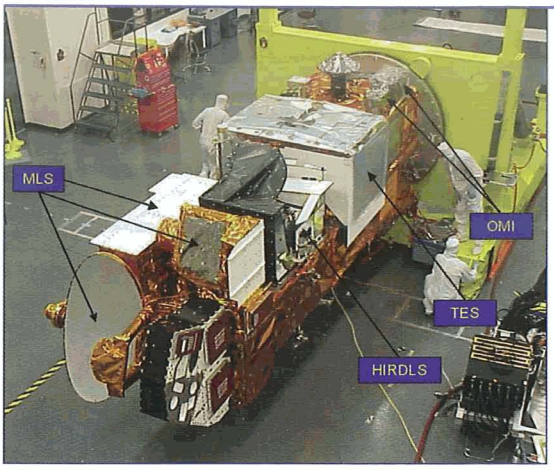


Scientists working on the Aura satellite. The location of the OMI instrument is shown.

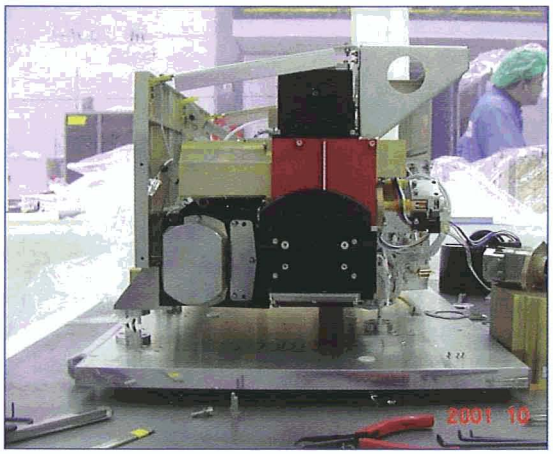


Head-on view of OMI flight model.

Nederland



Wetenschappers werken aan de Aura-satelliet. Men ziet de locatie van het OMI-instrument.



Vooraanzicht van het vluchtmodel van OMI.

OMI

OZON METING INSTRUMENT

NASA en het Nederlandse Instituut voor Vliegtuigontwikkeling en Ruimtevaart (NIVR) werken samen aan een project voor het verrichten van ozonmetingen vanuit de ruimte. NASA heeft met zijn serie van Totale Ozon Mapping Spectrometer (TOMS) missies een jarenlange meetreeks opgebouwd van de opbouw van de ozonlaag en van de hoeveelheid ultravioletstraling aan de oppervlakte. Deze belangrijke metingen worden nu voortgezet door het Ozon Monitor Instrument (OMI). OMI is de bijdrage van NIVR, in samenwerking met het Finse Meteorologische Instituut (FMI), en van de Nederlandse en Finse industrie aan de Earth Science Enterprise Aura missie van NASA.

OMI zal het werk van TOMS voortzetten om de totale hoeveelheid ozon in kaart te brengen, evenals andere atmosferische parameters die verband houden met het chemische gedrag van ozon in de stratosfeer en de troposfeer, en die invloed hebben op het klimaat. De OMI metingen zullen een grote synergie hebben met die van de andere instrumenten op de Aura-satelliet. Die is ontworpen om veranderingen in ozonlaag, luchtkwaliteit en klimaat te bestuderen. De lancering van de Aura missie is gepland voor het midden van 2004 en is één van de voornaamste bijdragen van NASA aan de grotere internationale inspanning om het multidisciplinaire onderzoek van de aarde te bevorderen en systematisch lange termijn metingen te verrichten van het systeem-Aarde.

Het OMI instrument maakt een hyperspectrale opname van de Aarde, door het meten van door de atmosfeer weerkaatste en verstrooide zonnestraling, in het zichtbare en het ultraviolette licht. De aarde wordt langs de baan van de satelliet geobserveerd in 740 golflengtegebieden. De gemaakte afbeelding is zo breed dat in 14 banen (dit is een dag) de hele aarde wordt waargenomen. De normale ruimtelijke resolutie van 13 x 24 kilometer kan worden verhoogd tot 13 x 13 kilometer voor het opsporen en volgen van vervuilingsbronnen ter grootte van steden. De hyperspectrale mogelijkheden zullen de nauwkeurigheid en precisie verbeteren van de metingen van de totale hoeveelheden ozon en andere OMI-gegevens. Ook zullen gedurende lange tijd nauwkeurige radiometrische en golflengte calibraties mogelijk zijn.

Het internationale wetenschappelijk team van OMI, bestaande uit deelnemers uit Europa en de Verenigde Staten, wordt geleid door de hoofdonderzoeker van het KNMI uit Nederland in samenwerking met mede-hoofdonderzoekers uit Finland en de Verenigde Staten. De wetenschappelijke teams hebben de verantwoordelijkheid voor de ontwikkeling van algoritmes, kalibratie, het verwerken van gegevens, de validatie en de uiteindelijke analyse van de metingen met OMI.

Voor meer informatie over OMI en de Aura-missie van NASA kunt u de volgende website raadplegen:
http://aura.gsfc.nasa.gov/instruments/index.html en http://www.nivr.nl.

METEOR-3M/SAGE III
STRATOSPHERIC AEROSOL AND GAS EXPERIMENT

NASA and the Russian Aviation and Space Agency (Rosaviakosmos) are collaborating on the Meteor-3M/Stratospheric Aerosol and Gas Experiment (SAGE) III. SAGE III is a fourth-generation, satellite-borne instrument and a crucial element in NASA's Earth Science Enterprise. Its primary objective is to enhance our understanding of natural and human-derived atmospheric constituents by providing accurate long-term measurements of the vertical structure of aerosols, ozone, water vapor, and other important trace gases in the upper troposphere and stratosphere. SAGE III's role in the Earth Science Enterprise program is to provide global, long-term measurements of these key components of Earth's atmosphere.

NASA's SAGE III instrument is flying aboard a Russian Meteor-3M spacecraft. The satellite was launched aboard a Russian Zenit rocket from the Baikonur Cosmodrome in Kazakhstan in December 10, 2001. The spacecraft operates from a Sun-synchronous orbit that provides primarily high-latitude measurements. The high northern latitude coverage will provide insight into the processes leading to ozone depletion.

SAGE III data have been validated with extensive ground-based, airborne, and satellite-borne measurements, including a dedicated field campaign that took place during the winter of 2002. SAGE III data are available at the Atmospheric Sciences Data Center (ASDC) through the Web site at ***http://eosweb.larc.nasa.gov***.

Early results from the SAGE III measurements indicate that

- SAGE III data can be used to distinguish the presence of different types of polar stratospheric clouds that exist in the winter polar vortex;
- SAGE III data will extend the long-term ozone trend data first recorded during SAGE II; and
- SAGE III measurements have provided the first-ever accurate, space-based upper tropospheric ozone data with high vertical resolution.

For more information regarding SAGE-III, please visit the following Web site: ***http://www-sage3.larc.nasa.gov/***.

For more information regarding NASA Langley Research Center's Atmospheric Sciences Data Center, please visit the following Web site: ***http://eosweb.larc.nasa.gov/PRODOCS/sage3/table_sage3.html***.

Computer-generated image of the SAGE-III in orbit.

Scientists working on SAGE-III.

Россия

Метеор-3М/SAGE III

Эксперимент по стратосферным аэрозолям и газам

Компьютерное изображение SAGE-III на орбите.

Ученые, занятые в эксперименте SAGE-III.

НАСА и Российское авиационно-космическое агентство (Росавиакосмос) сотрудничают в эксперименте по исследованию стратосферных аэрозолей и газов (SAGE) III с привлечением спутника Метеор-3М. SAGE III - это инструмент четвертого поколения, размещенный на борту спутника, являющийся одним из критически важных элементов в программах НАСА по наукам о земле. Основной целью этого этапа является углубление нашего понимания природных составляющих атмосферы и ее элементов, являющихся результатом деятельности человека, при помощи произведения замеров содержания аэрозолей, озона, водяных паров и других важных незначительных газовых примесей в верхних слоях тропосферы и стратосферы на протяжении длительного периода времени. В ходе эксперимента SAGE III будут проводиться глобальные долгосрочные замеры этих основных компонентов атмосферы Земли.

Инструмент SAGE III НАСА размещен на борту российского спутника Метеор-3М. Этот спутник был запущен в декабре 2001 года при помощи российской ракеты "Зенит" с космодрома Байконур в Казахстане. Спутник находится на гелиосинхронной орбите, откуда он и производит замеры, в основном, в высоких широтах. Проведение работ в этих северных широтах поможет углубить наши знания о процессах, вызывающих истощение озонового слоя.

Данные, полученные в результате эксперимента SAGE III, подтверждаются различными измерениями, произведенными на земле, в воздухе и со спутников, в том числе и в ходе выездной программы, которая проводилась зимой 2002 года и была посвящена этому вопросу. Данные, полученные в ходе эксперимента SAGE III, имеются в Центре атмосферных научных данных (ASDC) на сайте Интернета по адресу: ***http://eosweb.larc.nasa.gov***.

Предварительные результаты замеров, произведенных в ходе эксперимента SAGE III, свидетельствуют о том, что

- Данные эксперимента SAGE III можно использовать для определения наличия различных типов полярных стратосферных облаков, присутствующих в зимнем полярном вихре;
- Данные эксперимента SAGE III позволят продолжить определение долговременных тенденций в озоновом слое, которые впервые были зарегистрированы во время эксперимента SAGE II; и
- Замеры, произведенные в ходе эксперимента SAGE III, сделали возможным впервые получить точные данные об озоне, находящемся в высших слоях тропосферы, с высокой разрешающей способностью по вертикали.

Дополнительную информацию об эксперименте SAGE-III можно получить, подключившись к сайту на Интернете по адресу: ***http://www-sage3.larc.nasa.gov/***.

Для получения дополнительной информации о Центре атмосферных научных данных при Исследовательском Центре НАСА имени Лэнгли следует подключиться к сайту Интернета по адресу: ***http://eosweb.larc.nasa.gov/PRODOCS/sage3/table_sage3.html***.

NASA and Russia cooperated in the Stratospheric Aerosol and Gas Experiment (SAGE III) Ozone Loss and Validation Experiment (SOLVE), an international scientific field campaign in the Arctic that involved over 350 scientists from Canada, Europe, Iceland, Japan, Norway, Poland, Russia, Switzerland, and the United States. This campaign was the largest effort ever to assess ozone changes in the polar regions.

The goals of the campaign included examining the processes controlling ozone levels at mid- to high latitudes and acquiring correlative data needed for the validation of the SAGE III satellite measurements. Composed of a NASA instrument on board a Russian Meteor-3 Satellite platform, SAGE-III is primarily used to quantitatively assess high-latitude ozone loss. The SOLVE II mission was primarily conducted during January 2003. Measurements were made in the Arctic high-latitude region during winter using the NASA DC-8 aircraft, as well as two heavy-lift balloon flights, a number of smaller balloon packages, and ground-based instruments. The NASA DC-8 arrived in Kiruna, Sweden, slightly north of the Arctic Circle on January 9, 2003. A total of 11 science flights were conducted in Kiruna, and the DC-8 returned to NASA Dryden Flight Research Center on February 6, 2003.

The large Arctic losses observed over the last decade cannot be explained adequately by current atmospheric models. This inability to quantitatively explain present-day ozone losses undercuts the ability to predict ozone responses in a future atmosphere containing increased concentrations of greenhouse gases.

Ozone loss in the polar stratosphere is directly caused by catalytic chlorine and bromine reactions. The high levels of reactive chlorine occur because of reactions of reservoir chlorine species on the surfaces of polar stratospheric clouds (PSCs). PSCs were observed by the NASA DC-8 lidar systems on several flights at altitudes between 65,000 and 80,000 feet. This evidence of ozone depletion is vital for future environmental decisions.

For more information regarding the SOLVE II mission, please visit the following Web site: ***http://cloud1.arc.nasa.gov/solveII/index.html***.

Sunrise from the DC-8 cockpit. A polar stratospheric cloud can be seen on the right.

The NASA DC-8 at Kiruna Airport, Sweden.

Россия

SOLVE II
SAGE III Эксперимент по изучению и подтверждению данных о потерях озона

Восход солнца, наблюдаемый из кабины самолета DC-8. Справа видно полярное стратосферное облако.

НАСА и Россия сотрудничали в эксперименте по изучению и подтверждению данных о потерях озона (SOLVE) программы SAGE III. Это международная научная экспедиционная программа, которая проходила в Арктике с участием 350 ученых из Канады, стран Европы, Исландии, Японии, Норвегии, Польши, России, Швейцарии и Соединенных Штатов. Эта программа была самой крупной из когда-либо проводимых программ по изучению изменений озонового слоя в полярных регионах.

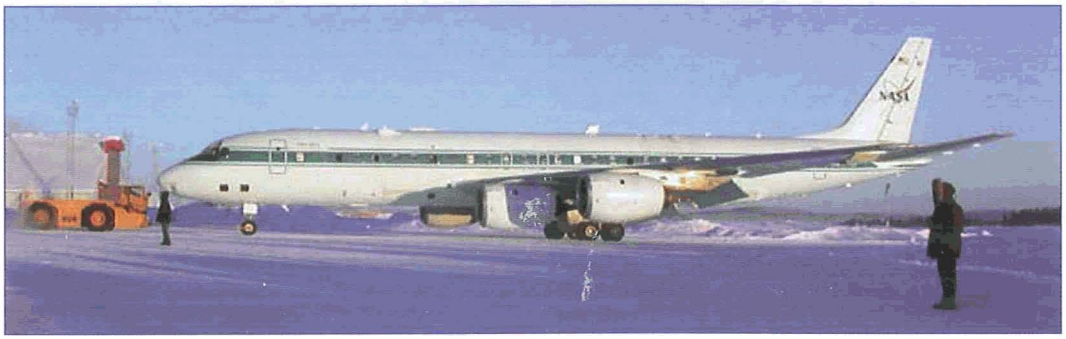
Цели этой программы включали изучение процессов, контролирующих уровень озона в средних и высоких широтах, и сбор соответствующих данных, необходимых для сопоставления и подтверждения данных, полученных в ходе спутниковых замеров, произведенных в эксперименте по стратосферным аэрозолям и газам (SAGE) III. Эксперимент SAGE-III основан на приборе НАСА, который размещается на борту российского спутника Метеор-3. Основной целью данного эксперимента было проведение количественной оценки потерь озона в высоких широтах. Основная задача программы SOLVE II была, в основном, выполнена в январе 2003 года. Были произведены измерения в высоких арктических широтах в зимнее время. Измерения производились с борта самолета НАСА DC-8, при помощи запусков двух мощных аэростатов, способных нести тяжелую нагрузку, и нескольких групп более мелких аэростатов, а также при помощи приборов, находящихся на земле. 9 января 2003 года самолет DC-8 НАСА прибыл в Кируну, Швеция, которая расположена чуть севернее Полярного круга. Из Кируны было произведено в общей сложности 11 научных вылетов и после окончания полетов 6 февраля 2003 года самолет DC-8 вернулся в Научно-исследовательский центр полетов им. Драйдена.

Крупные потери озона в арктических широтах, наблюдающиеся последнее десятилетие, не могут быть адекватно объяснены при помощи имеющихся атмосферных моделей. Поскольку в настоящее время невозможно количественно объяснить потери озона, невозможно также и предсказать поведение озона в атмосфере в будущем, когда возрастут концентрации газов, способствующих созданию тепличного эффекта.

Потери озона в стратосфере над полярным регионом являются прямым результатом каталитических реакций хлора и брома. Высокий уровень химически активного хлора появляется в результате реакций резервуарного хлора на поверхности стратосферных облаков в полярных широтах. Наблюдение за полярными стратосферными облаками производилось при помощи систем лидаров на борту самолета DC-8 НАСА в нескольких полетах на высоте от 65,000 до 80,000 футов. Это свидетельство об истощении озонового слоя является жизненно важным для принятия будущих решений в области охраны окружающей среды.

Дополнительную информацию об основной цели программы SOLVE II можно получить, подключившись к сайту на Интернете по адресу: ***http://cloud1.arc.nasa.gov/solveII/index.html***.

Самолет DC-8 НАСА в аэропорту а Кируне, Швеция.



SIBERIAN LEAF AREA INDEX STUDY

NASA and the Sukachev Institute of Forest Research of the Siberian Branch of the Russian Academy of Sciences are cooperating in a research effort to understand the role of Siberian boreal forests in cycling Earth's carbon, especially when derived naturally after a fire. The primary goal is to determine leaf area index (LAI) across the central Siberian region of Krasnoyarsk. LAI is the leaf area per unit area of soil surface and is a fundamental biophysical parameter through which vegetation canopy physiological functioning can be related to remotely sensed observations. LAI is the green surface area that is vital for absorbing the energy of the Sun for photosynthesis and production of food and fiber.

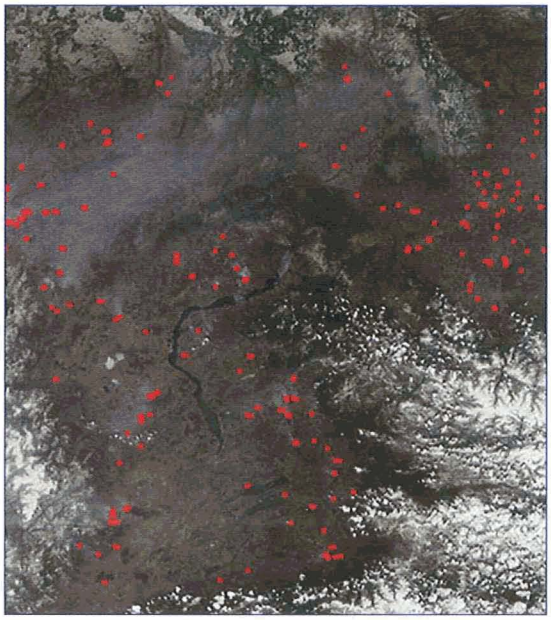
Siberian boreal forests have been and continue to be shaped by the complex interactions of climate, fires, insects, and humans. With global climate variability and change, shifts in disturbance regimes may occur, creating a need for better detection and understanding of the role of disturbances on these systems. Remotely sensed data provide appropriate spatial and temporal coverage needed to adequately characterize the changes that result from fire in these forests. A number of parameters can be derived from remotely sensed data, but one that is particularly useful is the LAI.

This collaborative project established the first Earth Science Enterprise core site in central Asia and is a node in NASA's Aerosol Robotic Network (AERONET) program. The development of LAI estimates across the region enables scientists to provide validation for LAI products from the Moderate Resolution Infrared Scanner (MODIS) flying aboard NASA's Terra satellite.

Field campaigns were conducted in 1999, 2000, and 2001 to establish sites in mixed dark coniferous forests northwest of the central Siberian city of Krasnoyarsk and to collect surface measurements of LAI and a number of general forest characteristics necessary for satellite data interpretation. The results of the investigation roughly follow theoretical predictions for postfire coniferous forests. One key difference that scientists discovered is that peak LAI in these forests occurs in the primarily coniferous forests rather than in the deciduous broadleaf forests. This distinction may be related to the observation that these forests have greater LAI than previously studied forests in Canada and elsewhere. Analyses of Landsat data show good correlation between surface LAI and two remotely sensed vegetation indices, the enhanced vegetation index and the normalized difference vegetation index. Several manuscripts are currently in preparation and planned for publication in both Russian and U.S. journals in 2004.

For more information regarding the Siberian LAI, please visit the following Web site: ***http://ltpwww.gsfc.nasa.gov/bsb/lai/SibLAI.html***.

The Siberian LAI study focuses on complex interactions in boreal forests.



On May 6, 2002, the fires in the Krasnoyarsk region of Siberia were captured by MODIS on NASA's Terra satellite.

Изучение индекса хвойного и лиственного покрова Сибири

Изучение индекса хвойного и лиственного покрова Сибири базируется на сложном сплетении процессов, происходящих в бореальных лесах.

6 мая 2002 года пожары в Красноярской области в Сибири были зарегистрированы при помощи сканера MODIS, находящегося на борту спутника "Терра", принадлежащего НАСА.

НАСА и Научно-исследовательский институт леса им. Сукачева Сибирского отделения Российской академии наук участвуют в совместной программе исследований в целях изучения роли сибирских бореальных лесов в циркуляции углерода Земли, в частности, когда углерод образуется естественным путем в результате пожаров. Основной целью данного исследования является определение индекса хвойного и лиственного покрова (LAI) в центральной Сибири в районе Красноярска. Индекс хвойного и лиственного покрова представляет собой площадь покрова, приходящуюся на единицу площади поверхности почвы. Это один из основных биофизических параметров, с помощью которого можно провести соотношение между физиологическими функциями растительного покрова и наблюдениями, проводимыми дистанционными датчиками. Индекс хвойного и лиственного покрова - это зеленая поверхность, которая является жизненно необходимой для фотосинтеза, происходящего под воздействием солнечной энергии и способствующего образованию пищевых продуктов и волокна.

Сибирские бореальные леса образовались и продолжают развиваться под воздействием сложного сплетения различных факторов: климата, пожаров, насекомых и воздействия человека. С глобальными изменением климата Земли происходят различные сдвиги в режимах вмешательства в окружающую среду, поэтому необходимо лучше обнаруживать подобное вмешательство и понимать, как оно влияет на данные системы. Данные, полученные при помощи дистанционных датчиков, дают нам необходимые замеры площади и времени для того, чтобы дать соответствующую характеристику изменениям, происходящим в этих лесах в результате пожаров. При анализе данных, полученных при помощи дистанционных датчиков, можно получить целый ряд параметров, но особенно важным из них является индекс хвойного и лиственного покрова.

В рамках этой программы сотрудничества был создан первый базовый Центр исследований в области наук о Земле в Центральной Азии; на базе этого центра проводятся исследования НАСА по программе АЭРОНЕТ (Аэрозольная робототехническая сеть). Вычисление индекса хвойного и лиственного покрова по всему региону позволит ученым подтвердить результаты вычисления этого индекса, полученные при помощи инфракрасного сканера со средней степенью разрешения (MODIS), который находится на борту спутника "Терра", принадлежащего НАСА.

В 1999, 2000 и 2001 годах состоялось несколько экспедиций, в ходе которых было оборудовано несколько площадок в смешанных темно-хвойных лесах к северо-западу от города Красноярска, расположенного в Центральной Сибири. В ходе этих исследований были проведены поверхностные замеры индекса хвойного и лиственного покрова и ряда других общих лесных характеристик, необходимых для интерпретации данных, полученных при помощи спутника. Результаты исследований в целом подтверждают теоретические прогнозы для пострадавших от пожара хвойных лесов. Ученые обнаружили одно важное отличие, которое заключается в том, что наивысшее значение индекса хвойного и лиственного покрова в этих лесах встречается в основном в хвойных лесах, а не в лиственных широколистных лесах. Возможно, что это отличие связано с тем, что в этих лесах индекс хвойного и лиственного покрова выше, чем в ранее изученных лесах Канады и других стран. Анализ данных, полученных с борта спутника "Ландсат", показывает хорошее соответствие между поверхностным индексом хвойного и лиственного покрова и двумя индексами растительности, полученными при помощи дистанционных датчиков - повышенный индекс растительности и индекс растительности с нормализованным различием. В настоящий момент готовятся к публикации несколько работ, которые будут опубликованы в российских и американских журналах в 2004 году.

Дополнительную информацию об индексе лиственного покрова Сибири можно получить, подключившись к сайту Интернета по адресу: ***http://ltpwww.gsfc.nasa.gov/bsb/lai/SibLAI.html***.

MEKONG MALARIA AND FILARIASIS DISEASE RESEARCH PROJECT USING REMOTE SENSING

Thailand

NASA and Thailand's Mahidol University started a joint project to study Mekong Malaria in March 2001, after the Mahidol University made a request to NASA for assistance in malaria control using remote sensing technologies. Satellite data with high spatial resolution are used for habitat mapping, and meteorological data are obtained from NASA and National Oceanic and Atmospheric Administration (NOAA) satellites and from surface networks.

The Greater Mekong Subregion, the geographical area consisting of Cambodia, Laos, Myanmar, Thailand, Vietnam, and the Yunnan Province of the People's Republic of China, has the highest concentration of the world's multi-drug-resistant falciparum malaria. Approximately 90 percent of all cases in Cambodia, Laos, and Myanmar, and approximately 50 percent of all cases in Thailand, are caused by this strain of malaria. In spite of extensive international efforts, progress in malaria control has been limited.

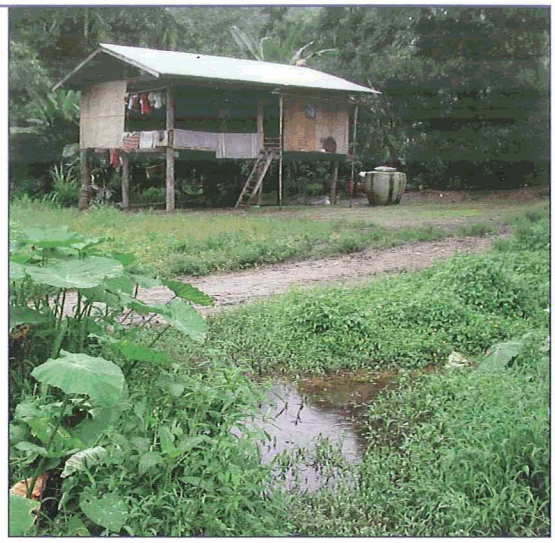
NASA and Mahidol University expanded the project to include research on filariasis, a lymphatic disease also transmitted by mosquitoes. The same remote sensing technology for malaria control can be used to study filariasis. Although it is not as deadly as falciparum malaria, approximately 50 million people are permanently disfigured and disabled by lymphatic filariasis globally.

The objectives of the Mekong Malaria and Filariasis Project are to accomplish the following:

- identify the potential sites for larvicide and insecticide applications by mapping the habitats of major vector species;
- develop a malaria transmission model characterizing interactions among hosts, parasites, land cover, and environment; and
- develop a risk model to predict the occurrence of malaria and its transmission intensity.

For more information regarding NASA's Environment and Health Program, please visit the following Web site: ***http://healthyplanet.gsfc.nasa.gov***.

For more information regarding Mahidol University's Faculty of Tropical Medicine, please visit the following Web site: ***http://www.tm.mahidol.ac.th***.



Malaria research is vital to the health of residents of the many villages along the Greater Mekong Subregion.

Researchers look for mosquito larvae as they cross through a swampy jungle.

ประเทศไทย

โครงการค้นคว้าวิจัยเกี่ยวกับโรคแม่โขงมาลาเรีย และโรคเท้าช้าง โดยใช้เทคโนโลยีการตรวจจับระยะไกล

การวิจัยโรคมาลาเรียเป็นสิ่งจำเป็นสำหรับสุขภาพของผู้อยู่อาศัยในหมู่บ้านต่างๆ ในเขตพื้นที่ลุ่มแม่น้ำโขง

องค์การ NASA และมหาวิทยาลัยมหิดลได้ร่วมกันริเริ่มโครงการเพื่อศึกษาวิจัยเกี่ยวกับโรคแม่โขงมาลาเรียตั้งแต่เดือนมีนาคม ค.ศ. 2001 หลังจากที่มหาวิทยาลัยมหิดลได้ขอความช่วยเหลือจากองค์การ NASA ให้มีการควบคุมโรคมาลาเรียโดยใช้เทคโนโลยีการตรวจจับระยะไกล ข้อมูลดาวเทียมที่มีความแม่นยำสูงใช้สำหรับการตรวจหาที่อยู่ของโรค ส่วนข้อมูลอุตุนิยมวิทยาได้มาจากดาวเทียมของ NASA และ NOAA (National Oceanic and Atmospheric Administration) และจากเครือข่ายพื้นผิวโลก

ในเขตพื้นที่ลุ่มแม่น้ำโขง ประกอบด้วยประเทศ กัมพูชา ลาว เมียนมา ไทย เวียดนาม และจังหวัดยูนานในประเทศจีน ตรวจพบโรคมาลาเรียฟัลซิพารัมที่ดื้อยาหลายชนิด มีจำนวนมากที่สุดในโลก ประมาณ 90 เปอร์เซ็นต์ของผู้ป่วยโรคนี้ทั้งหมดในประเทศกัมพูชา ลาว เมียนมา และประมาณ 50 เปอร์เซ็นต์ของผู้ป่วยในประเทศไทยได้รับเชื้อมาลาเรียสายพันธุ์นี้ แม้ว่านานาประเทศมีความพยายามให้ความช่วยเหลือ แต่ความก้าวหน้าในการควบคุมโรคมาลาเรียยังคงจำกัดอยู่

NASA และมหาวิทยาลัยมหิดลขยายโครงการให้ครอบคลุมถึงการวิจัยเกี่ยวกับโรคเท้าช้าง และโรคต่อมน้ำเหลืองอักเสบที่เกิดจากยุงเทคโนโลยีการตรวจจับระยะไกลสำหรับการควบคุมโรคมาลาเรียนี้สามารถใช้ในการศึกษาโรคเท้าช้างแม้ว่าจะไม่ได้เป็นโรคที่ร้ายแรงถึงแก่ชีวิตเหมือนกับโรคมาลาเรียฟัลซิพารัม แต่ผู้คนประมาณ 50 ล้านคนทั่วโลกจะพิการอย่างถาวรจากโรคเท้าช้างและโรคต่อมน้ำเหลืองอักเสบ

ผู้วิจัยค้นหาไข่ยุงที่มาจากเขตพื้นที่ป่าที่มีหนองน้ำ

วัตถุประสงค์ของโครงการค้นคว้าวิจัยเกี่ยวกับโรคแม่โขงมาลาเรีย และโรคเท้าช้างมีดังต่อไปนี้:

- ค้นหาแหล่งที่สามารถใช้ยากำจัดไข่ยุงและยาฆ่าแมลง โดยการตรวจหาที่อยู่อาศัยของพันธุ์ยุงจำนวนมาก
- พัฒนาแบบทดลองการแพร่เชื้อมาลาเรียที่แสดงปฏิสัมพันธ์ระหว่างเชื้อโรค การแพร่เชื้อโรคบนผิวดิน และสภาพแวดล้อม และ
- พัฒนาแบบทดลองเพื่อทำนายการแพร่เชื้อมาลาเรีย ความเสี่ยงและความเข้มข้นของการแพร่เชื้อ

สำหรับข้อมูลเพิ่มเติมเกี่ยวกับโครงการเพื่อสิ่งแวดล้อมและสุขภาพของ NASA โปรดเยี่ยมชมเว็บไซต์: ***http://healthyplanet.gsfc.nasa.gov***

สำหรับข้อมูลเพิ่มเติมเกี่ยวกับคณะเวชศาสตร์เขตร้อน มหาวิทยาลัยมหิดล โปรดเยี่ยมชมเว็บไซต์: ***http://www.tm.mahidol.ac.th***

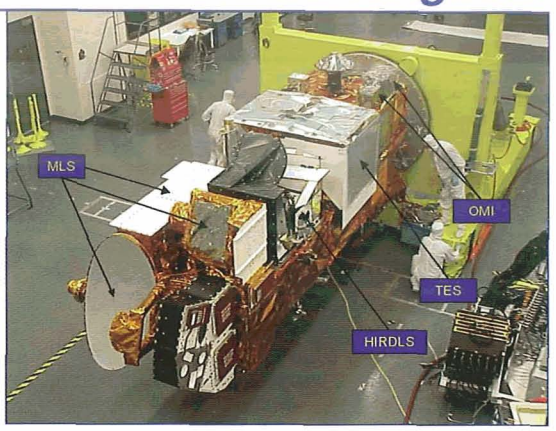
United Kingdom

The High Resolution Dynamics Limb Sounder (HIRDLS) is a cooperative project sponsored by NASA, the British National Space Centre, and the Natural Environment Research Council in the United Kingdom (U.K.). HIRDLS is the U.K.'s major contribution to NASA's Earth Science Enterprise Aura satellite. The Aura mission is scheduled for launch in mid-2004 and is one of NASA's primary contributions to a larger international effort to advance the multidisciplinary study of Earth and long-term systematic monitoring of changes in Earth's system.

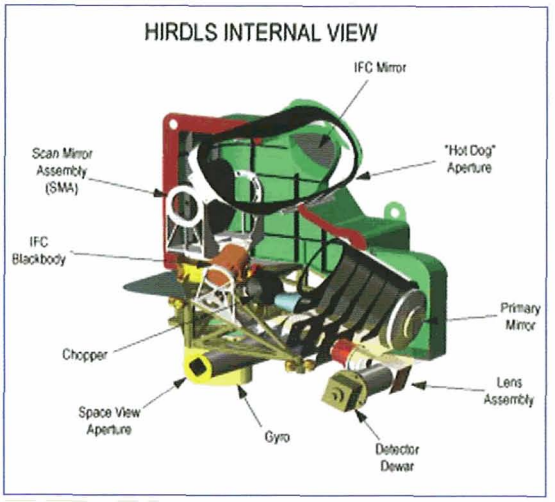
The science goal of HIRDLS is to observe the global distribution of temperature and the trace gas species in the stratosphere and upper troposphere at high vertical and horizontal resolution. HIRDLS will obtain vertical distributions of these gases over the entire globe, including the poles, both day and night. Complete Earth coverage can be obtained in 12 hours. The HIRDLS instrument is an infrared limb-scanning radiometer designed to measure concentrations of O_3, H_2O, CH_4, N_2O, NO_2, HNO_3, N_2O_5, CFC_{11}, CFC_{12}, $ClONO_2$, and aerosols and to identify the locations of polar stratospheric clouds and cloud tops. HIRDLS will provide data on how these trace gases are transported throughout the stratosphere and upper troposphere. Because of the HIRDLS crosstrack scanning capability (2,500 kilometers) and high vertical resolution (approximately 1.5 kilometers), these measurements will reveal chemical and dynamic processes that are not observable by current satellite instruments.

Contributions to building the HIRDLS instrument were made by the United Kingdom and the United States, with the instrument integrated and tested in the United States. There are two Co-Principal Investigators for the mission, one from Oxford University in the U.K. and the other from the University of Colorado in the United States Science teams from both nations are responsible for algorithm development, instrument calibration, data validation, and analysis.

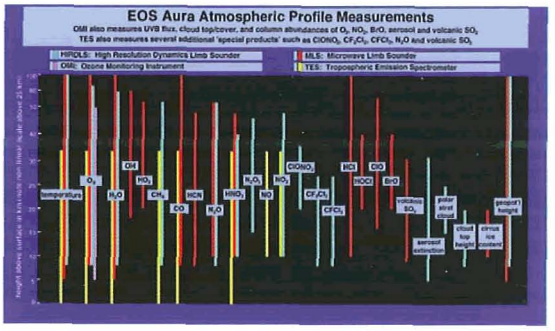
For more information regarding HIRDLS and NASA's Aura mission, please visit the following Web sites: ***http://aura.gsfc.nasa.gov/instruments/index.html***, ***http://eos-chem.gsfc.nasa.gov/***, ***http://www.atm.ox.ac.uk/hirdls/***, and ***http://www.ssd.rl.ac.uk/hirdls/***.



Scientists working on the Aura satellite. The location of the HIRDLS instrument is shown.



A detail of the HIRDLS instrument.

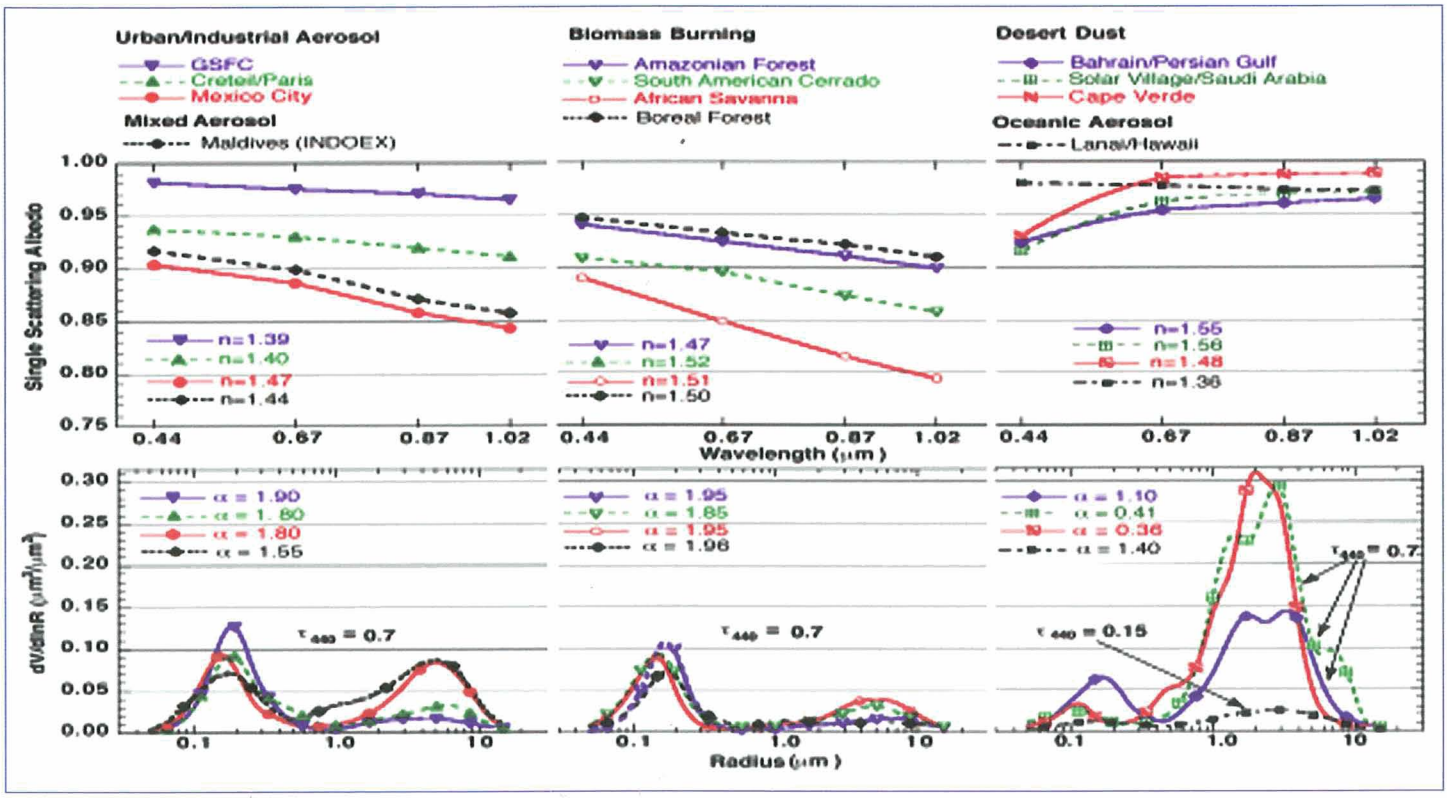


This table summarizes the atmospheric parameters measured by HIRDLS, MLS, OMI, and TES on the Aura spacecraft. The altitude range where these parameters are measured is shown as the vertical scale. In several cases, the measurements overlap, which provides independent perspectives and cross calibration of the measurements.

The Aerosol Robotic Network (AERONET) is an optical, ground-based aerosol-monitoring network and data archive system supported by NASA's Earth Observing System and expanded by a federation of over 40 countries/regions. The network consists of identical automatic Sun- and sky-scanning spectral radiometers. Data from this collaboration provide globally distributed near-real-time observations or aerosol spectral optical depths, aerosol size distributions, and precipitable water in diverse aerosol environments. The data undergo preliminary processing (real-time data), reprocessing (final calibration approximately 6 months after data collection), quality assurance, archiving, and distribution from NASA's Goddard Space Flight Center master archive and several identical databases maintained globally. The data provide algorithm validation of satellite aerosol retrievals, as well as characterization of aerosol properties unavailable from satellite sensors.

The AERONET Web site provides access to the preliminary data and describes the program objectives, affiliations, instrument description, data products, AERONET browser research activities, and personnel involved in AERONET.

For more information regarding AERONET, please visit the following Web site: ***http://aeronet.gsfc.nasa.gov/***.



AERONET retrievals of aerosol.

Worldwide

Global Learning and Observations to Benefit the Environment (GLOBE) is a hands-on, school-based science and education program that unites primary and secondary school students, teachers, and scientists in 105 countries in study and research about the dynamics of Earth's environment.

GLOBE is an education program providing science-based, nonadvocacy information about the environment and about how Earth functions as a system. GLOBE has hundreds of thousands of students in more than 14,000 schools around the world taking important science-quality environmental measurements. To date, GLOBE students have reported over 10 million in situ measurements in atmosphere/climate, hydrology, soils, land cover/biology, and phenology. These GLOBE student data are reported to the GLOBE database on the Web and are freely available for use in student research activities and by scientists around the world.

Scientists and educators have developed environmental science educational materials as a resource for GLOBE teachers. More than 24,000 teachers in over 14,000 schools worldwide have attended week-long professional development workshops in their own regions. At these workshops, they learn to guide their students in taking measurements according to scientific protocols, in using the Internet to report and analyze scientific data, and in creating partnerships among students at GLOBE schools around the world.

GLOBE was designed and has been implemented as an international program since its initiation in 1994. Bilateral agreements establish partnerships between the United States Government and its international partner countries. International partners sponsor GLOBE activities in their countries, designing (and funding) their own implementation strategies to be compatible with their own educational programs.

For more information regarding GLOBE, please visit the following Web site: ***http://www.globe.gov***.

University Corporation for Atmospheric Research

Colorado State University

NASA
National Aeronautics & Space Administration

NSF
National Science Foundation

U. S. Department of State

The GLOBE Program

The Direct Access System for the Earth Science Enterprise satellites provides a means of transmitting EOS observations directly via X-band to the ground for near-real-time applications and emergency purposes. The Direct Access System is a Direct Broadcast (DB) service that transmits real-time data from the satellite to any location on Earth's surface within the line of sight during most of the satellite's orbit. NASA transmits data from EOS satellites openly and continuously with no restrictions. EOS DB data can be received with a relatively small dish measuring about 3 meters in diameter and supported by personal computers or UNIX workstations.

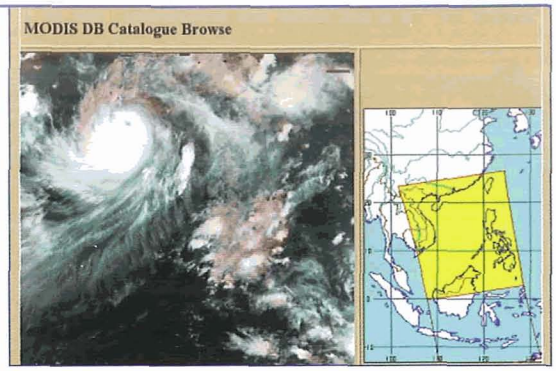
There are currently 76 sites worldwide that are known to be receiving EOS DB data or are planning to receive it within the next year. The location of these sites include 16 in the United States, 1 in Argentina, 4 in Australia, 1 in Belarus, 1 in Brazil, 5 in China, 1 in France, 2 in Germany, 2 in India, 1 in Iran, 2 in Italy, 5 in Japan, 1 in Kazakhstan, 1 in South Korea, 1 in Norway, 22 in Russia, 1 in Scotland, 1 in Singapore, 1 in South Africa, 2 in Spain, 2 in Sweden, 1 in Thailand, 1 in Taiwan, and 1 in Vietnam.

Currently, data are transmitted from the Moderate Resolution Imaging Spectroradiometers (MODIS) on board NASA's Terra and Aqua spacecraft and from the Atmospheric Infrared Sounder (AIRS), Advanced Microwave Sounding Unit-A (AMSU-A), Clouds and the Earth's Radiant Energy System (CERES), and the Advanced Microwave Scanning Radiometer-EOS (AMSR-E) instruments on Aqua. The Humidity Sounder for Brazil instrument on Aqua is no longer functioning; however, real-time atmospheric temperature and moisture soundings can be obtained from AIRS using Direct Broadcast data and software, made available through a NASA sponsorship, from the University of Wisconsin.

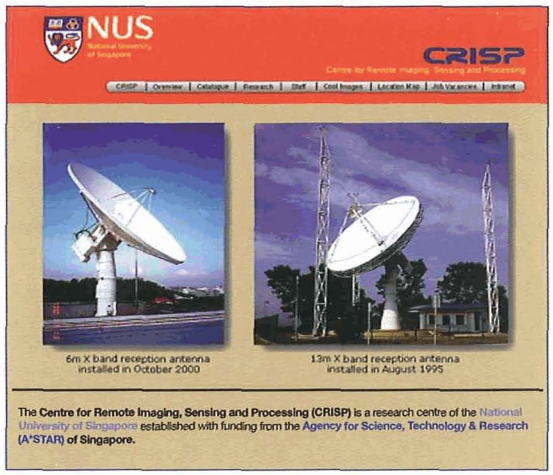
These EOS DB data are valuable for large-area surveys of current conditions and for monitoring change. Given the increased interest in the potential for global change, the EOS Direct Access system allows regional and local users to measure the variability in their particular environments. Recent software algorithms, provided through NASA, allow the interpretation of data in terms of quantitative measurements of the environment.

The DB system and its data and products are most useful for those aspects of the environment where Earth's surface and atmosphere conditions change rapidly, such as severe weather systems, floods, sandstorms, coastline algal blooms, forest fires, air pollution events, snow and ice conditions, and applications projects in which rapidly updated information is essential.

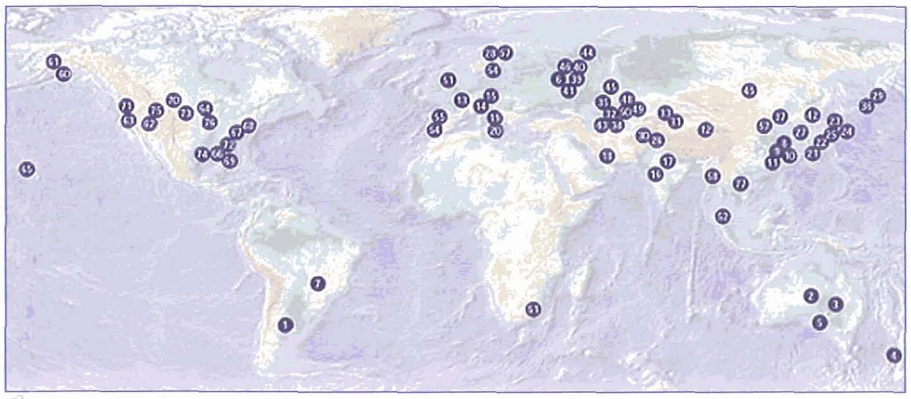
For more information regarding NASA's Direct Access System, please visit the following Web site: ***http://directreadout.gsfc.nasa.gov/***.



Typhoon over the South China Sea. Image produced using MODIS data downlinked at the University of Singapore DB site.



Antenna station in Singapore.



EOS Direct Broadcast worldwide sites.

Initiated by NASA's Goddard Space Flight Center in 1998, in collaboration with the National Oceanic and Atmospheric Administration (NOAA) and meteorological and space agencies from around the world, Southern Hemisphere Additional Ozonesondes (SHADOZ) augments balloon-borne ozonesonde launches in the tropics and subtropics.

In recent years, a number of methods have been developed for estimating tropical tropospheric and stratospheric ozone from satellites. Several of these methods are based on the Total Ozone Mapping Spectrometer (TOMS) instruments. However, there has not been a consistent verification data set from balloon-borne ozonesondes. SHADOZ is designed to remedy this data discrepancy by coordinating launches, supplying additional balloons, and providing a central archive location to those sites already deploying ozonesondes. This added effort to ensure the continuation of the data set has seen numerous benefits. In addition, NASA seeks to derive and validate ozone measurements using instruments planned for launch in 2004 on board NASA's Aura satellite.

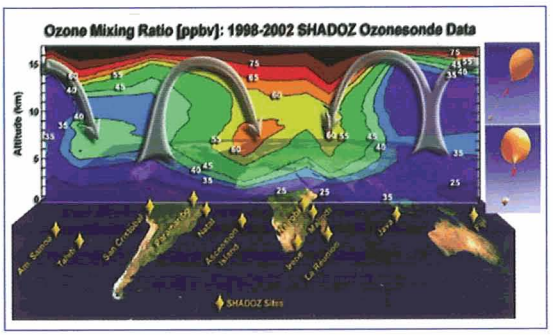
SHADOZ has led to significant scientific advances. This is the first instance, for example, of satellite retrievals using longitudinal and seasonal variations in tropical ozone. In addition, by having so many profiles, it has been possible to improve the accuracy and precision of the ozonesonde measurement under tropical conditions.

SHADOZ measurements are made using weekly, balloon-borne ozonesonde launches at each site. Data from these launches help to answer questions related to how ozone and climatic pressure are related, whether the ozone climatology for satellite and model evaluation can be improved, and how the tropical ozone in the stratosphere and troposphere vary seasonally.

SHADOZ sites have been operational since 1998 and have returned valuable data from 11 sites mostly in the Southern Hemisphere. Currently, participating sites include Ascension Island; American Samoa; Fiji; Irene, South Africa; Java, Indonesia; Nairobi, Kenya; Natal, Brazil; Paramaribo, Surinam; La Réunion, France; San Cristóbal, Galapagos; and Tahiti. As there is a need for more data from sites in the Northern Hemisphere, the newest agreement, completed in January 2004, is with the Malaysian Meteorological Society in Kuala Lumpur.

For more information regarding SHADOZ, please visit the following Web site: ***http://croc.gsfc.nasa.gov/shadoz/***.

Launching an ozonesonde on the Island of Crete.



Vertical structure of tropical tropospheric ozone from balloon-borne ozonesondes.

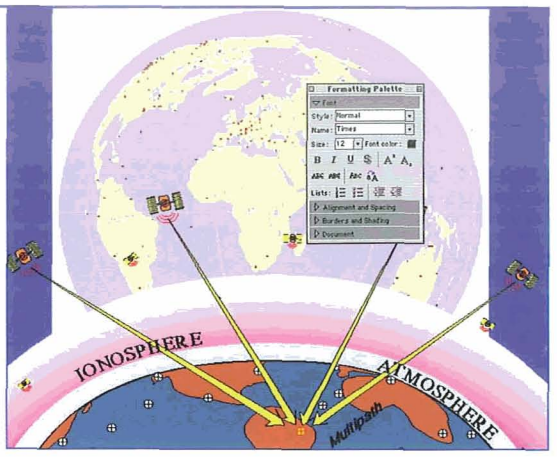
The space geodetic network combines three techniques, Satellite Laser Ranging (SLR), Very Long Baseline Interferometry (VLBI), and the Global Positioning System (GPS) to define the terrestrial and celestial reference frames and Earth's orientation in space. Among the many important applications of these two products are the study of ocean circulation, sea level change, changes in Earth's ice caps, deformation leading to earthquakes, volcanic eruptions, and landslides. The space geodetic networks also enable precision deep space, air, and land navigation used in most scientific and commercial applications.

NASA cooperates with over 30 countries in space geodesy research. These cooperative efforts recognize that geodetic networks are vital for understanding global change phenomena, assessing natural hazards, providing support for local geodetic control, and supplying ground support to space missions. NASA also strongly supports the International GPS Service (IGS), the International VLBI Service (IVS), and the International Laser Ranging Service (ILRS). These three organizations place geodetic network operations, analysis, and standards within an international framework of cooperation and collaboration under the aegis of the International Association of Geodesy.

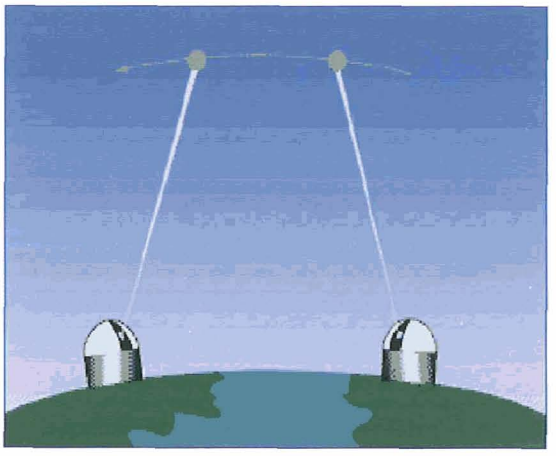
As part of the cooperation, NASA loans equipment to a host country and the host country provides utilities, security, housing, operation, and maintenance of the equipment. These ground stations provide critical geodetic reference points within the host country. The inclusion of the stations within the global geophysical network significantly improves the accuracy of the global and regional geodetic measurements.

All preprocessed and analyzed NASA space geodetic data are available from the Crustal Dynamics Data Information System (CDDIS) at NASA Goddard Space Flight Center in Greenbelt, MD.

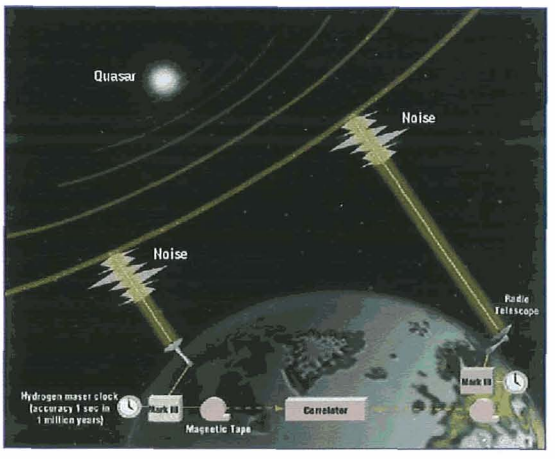
For more information regarding the Space Geodetic Network, please visit the following Web site: ***http://cddisa.gsfc.nasa.gov/***.



GPS.



SLR.



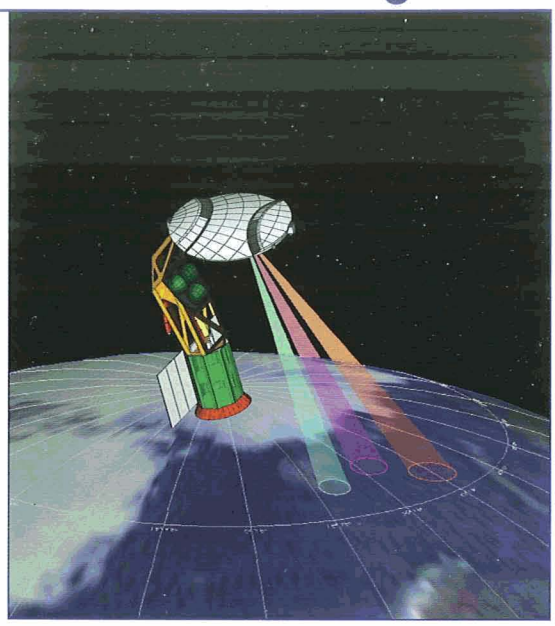
VLBI.

Future Missions

NASA selected the Aquarius mission as part of its Earth System Science Pathfinder Earth Explorer class of Earth-observing satellites. This mission will be a joint venture between CONAE and NASA. The Aquarius mission is slated to fly aboard CONAE's Satelite de Aplicaciones Cientificas-D (SAC-D) in late 2008.

Aquarius will make space-based measurements of sea surface salinity with the precision, accuracy, resolution, and coverage needed to characterize salinity variations and their impact on ocean circulation; it will also investigate the related physical processes that link Earth's water cycle, climate, and ocean. These measurements will contribute to a better understanding of ocean circulation and the prediction of changes in this circulation and its impact on Earth's climate and water cycle.

For more information regarding Aquarius, please visit the following Web site: ***http://www.earth.nasa.gov/ese_missions/satellites.html***.



Artist's concept of Aquarius.

The figure on the left shows sea surface salinity measurements from 100 years of ship-based measurements.
The figure on the right shows the resolution of the data that will be obtained from just 1 week of sea surface salinity measurements from space.

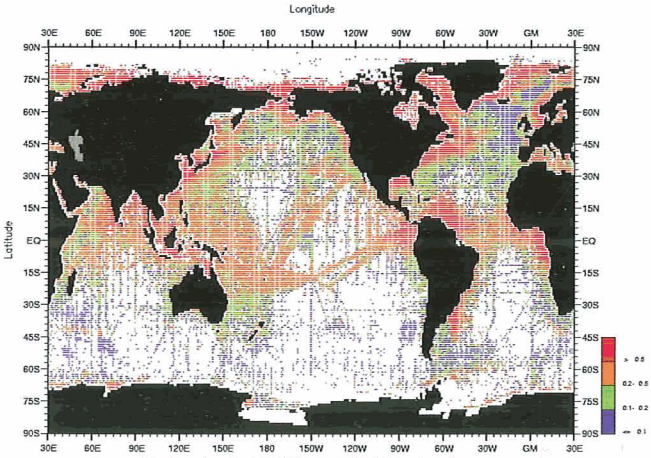


Fig. A4-1. Annual salinity (PSS) standard deviation at the surface.

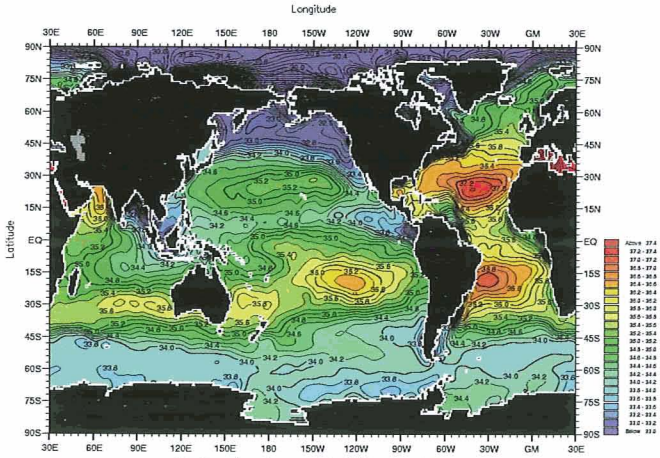
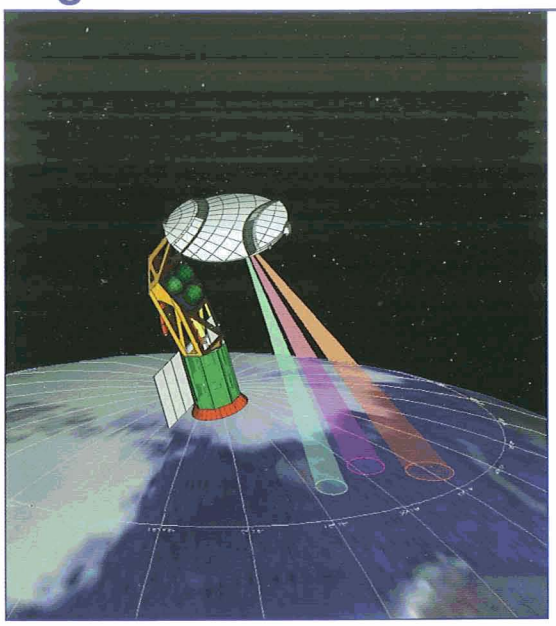


Fig. A2-1. Annual mean salinity (PSS) at the surface.
Minimum Value= 3.57 Maximum Value= 40.02 Contour Interval: 0.20

Argentina

SAC-D/AQUARIUS
SATÉLITE DE APLICACIONES CIENTÍFICAS



La NASA ha seleccionado formalmente a la Misión Aquarius para formar parte del programa de satélites de observación terrestre "Earth System Science Pathfinder Earth Explorer". Esta misión se realizará por medio de una asociación entre la CONAE y la NASA. Se ha nombrado a la misión Aquarius para volar en el Satélite de Aplicaciones Científicas-D (SAC-D) del CONAE, a fines de 2008.

La misión Aquarius hará mediciones desde el espacio de la salinidad de la superficie marina, con la precisión, exactitud, resolución y cobertura necesarias para caracterizar las variaciones salinas y su impacto en la circulación del océano; asimismo, investigará los procesos físicos relacionados que enlazan el ciclo hidrológico, clima y océanos de la Tierra. Estas mediciones contribuirán a lograr una mejor comprensión de la circulación oceánica y la predicción de cambios de esta circulación, así como su impacto en el clima y ciclo hidrológico de la Tierra.

Para obtener mayor información relativa a la misión Aquarius, sírvase visitar: ***http://essp.gsfc.nasa.gov/aquarius/ y http://aquarius.gsfc.nasa.gov***.

La imagen a la izquierda muestra mediciones de la salinidad de la superficie marina que datan de 100 años atrás realizadas a bordo de buques. La imagen de la derecha muestra la resolución de los datos que se obtendrá solamente en 1 semana de mediciones de la salinidad de la superficie marina captadas desde el espacio.

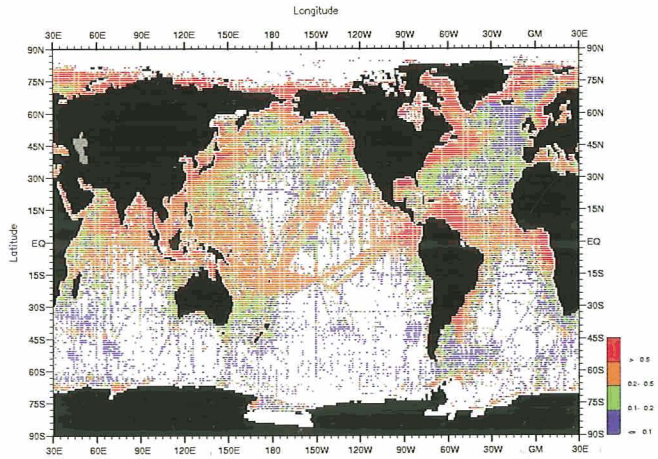


Fig. A4-1. Annual salinity (PSS) standard deviation at the surface.

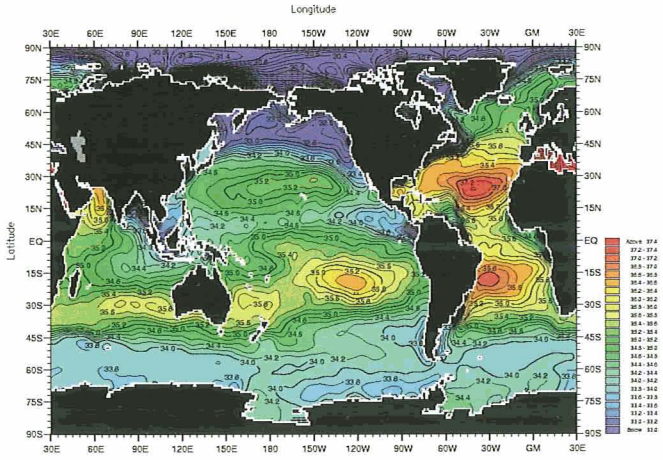


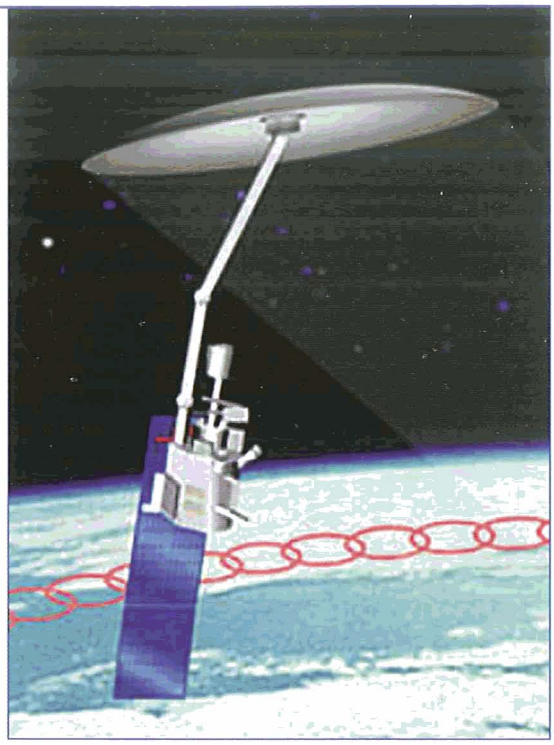
Fig. A2-1. Annual mean salinity (PSS) at the surface.
Minimum Value= 3.57 Maximum Value= 40.02 Contour Interval: 0.20

NASA and the Canadian Space Agency (CSA) are cooperating on the Hydrosphere State Mission (HYDROS). HYDROS is being developed to investigate how precipitation, evaporation, and the global water cycle are changing and how ecosystems are responding to and affecting global environmental change and the carbon cycle. To do this, HYDROS will provide the first-ever global observations of Earth's changing soil moisture and land surface freeze/thaw state conditions, leading to breakthroughs in weather and climate prediction and in the understanding of processes linking water, energy, and carbon cycles.

The science objectives of HYDROS are to enhance human understanding of processes that link water, energy, and carbon cycles and to improve weather and climate prediction. HYDROS is scheduled to be launched in 2010.

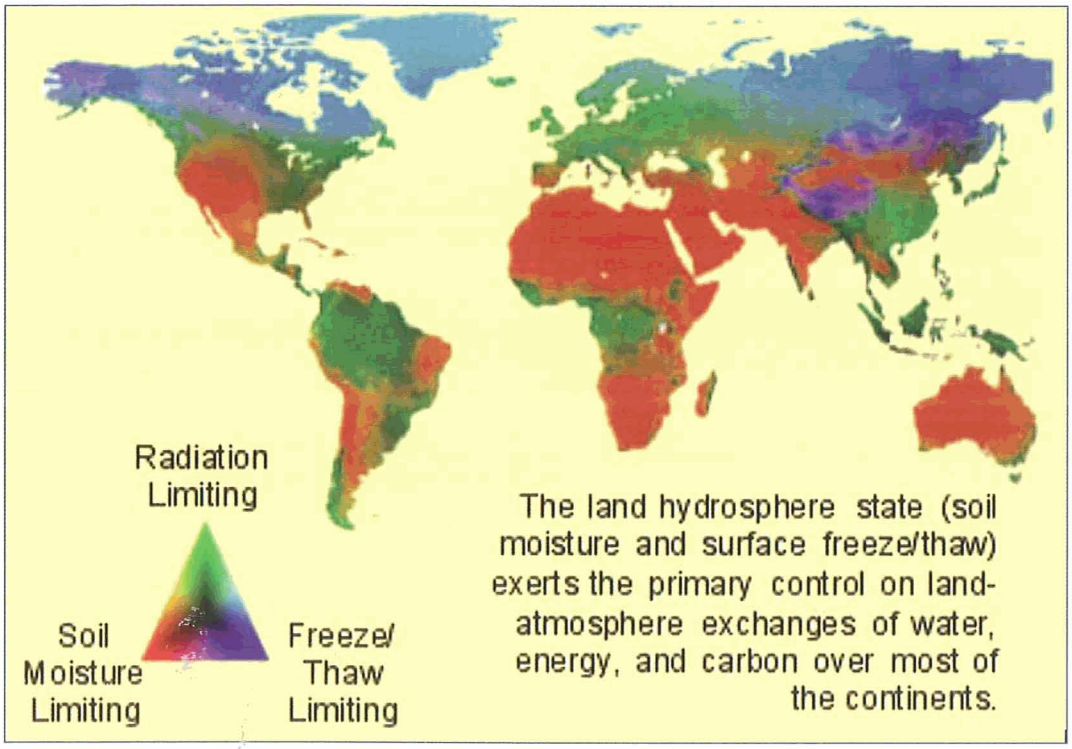
HYDROS will measure soil moisture to a depth of 2 inches over Earth's land surface every 2 to 3 days and will determine whether the moisture is frozen or thawed. HYDROS will be in a Sun-synchronous polar orbit at 670 kilometers of altitude. It will carry a 6-meter deployable L-band reflector antenna cocked at 35 degrees and rotating at 15 revolutions per minute to produce a 1,000-kilometer-wide conical swath (to allow the 2- to 3-day revisits). There will be two instruments on board sharing the rotating antenna: radiometer and radar, to provide 10-kilometer spatial resolution with 4 percent accuracy over 64 percent of the land surface.

CSA will provide onboard hardware (antenna feed assembly) and ground data processing of the radar data.



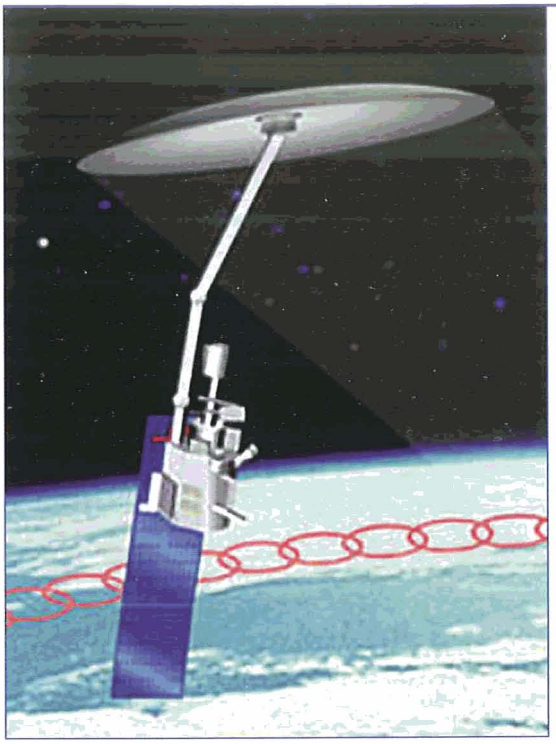
HYDROS instrument.

For more information regarding HYDROS, please visit the following Web sites: ***http://hydros.gsfc.nasa.gov/*** or ***http://essp.gsfc.nasa.gov/hydros/***.



Canada

HYDROS
MISSION SUR L'ÉTAT DE L'HYDROSPHÈRE



Instrument HYDROS.

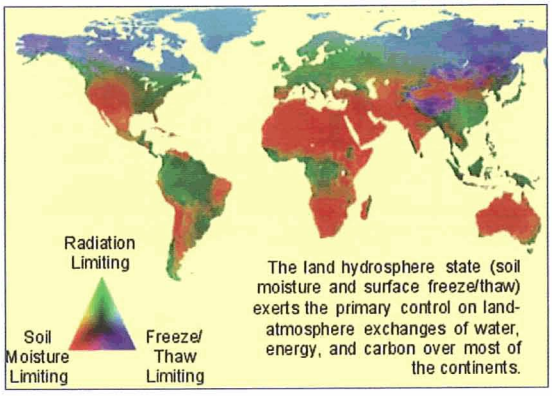
La NASA et l'Agence spatiale canadienne (ASC) collaborent à l'élaboration de la Mission sur l'état de l'hydrosphère (HYDROS). HYDROS a pour objet de déterminer comment les précipitations, l'évaporation et le cycle de l'eau évoluent, et comment les écosystèmes réagissent et influencent le changement climatique mondial et le cycle du carbone. À cette fin, HYDROS fournira les premières observations jamais réalisées sur l'humidité des sols et les zones de gel/dégel à la surface de la planète, ce qui permettra de mieux prédire le climat et la température, et à comprendre les processus reliant les cycles de l'eau, de l'énergie et du carbone.

Les objectifs scientifiques d'HYDROS consistent à améliorer la compréhension humaine de sprocessus qui relient les cycles de l'eau, de l'énergie et du carbone, et à mieux prédire le climat et la température. HYDROS devrait être lancée en 2010.

HYDROS mesurera l'humidité des sols à une profondeur de 5 cm (2 po) au-dessus de la surface de la Terre à tous les 2 ou 3 jours, et déterminera si l'humidité est gelée ou dégelée. HYDROS sera en orbite polaire à ensoleillement constant à 670 km d'altitude. Elle transportera un réflecteur d'antenne à bande de 1 000 MHz déployable de 6 mètres, inclinée à 35 degrés et effectuant 15 révolutions à la minute, pour produire un couloir conique d'une largeur de 1 000 km (pour faciliter les visites à tous les 2 ou 3 jours). Il y aura deux instruments à bord qui partageront l'antenne rotative : un radar et un radiomètre, qui fourniront une résolution spatiale de 10 km avec une précision de 4 pour cent sur 64 pour cent de la surface terrestre.

L'ASC fournira le matériel à bord (assemblage antenne-source) et effectuera le traitement des données radar au sol.

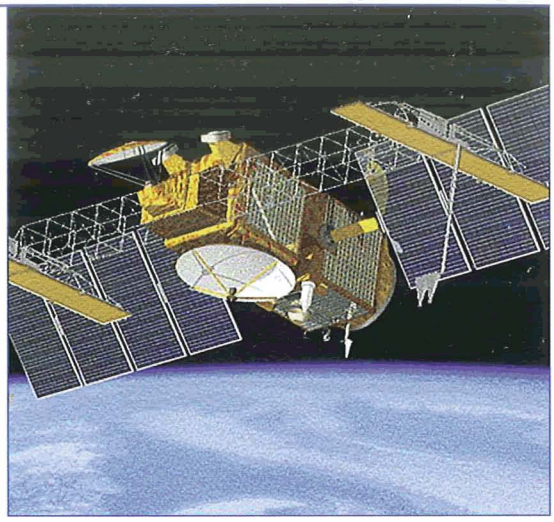
Pour de plus amples renseignements sur HYDROS, visitez le site Web suivant : ***http://hydros.gsfc.nasa.gov/ or http://essp.gsfc.nasa.gov/hydros/***.



Limitation de l'humidité des sols
Limitation de la radiation
Limitation du gel/dégel

L'état de l'hydrosphère terrestre (humidité des sols et gel/dégel de la surface) contrôle les échanges de l'eau, de l'énergie et du carbone entre la terre et l'atmosphère sur la plupart des continents.

The Ocean Surface Topography Mission (OSTM) builds on the Jason and TOPEX/Poseidon ocean altimetry missions. OSTM features two new operational partners—the European Meteorological Satellite Organization (EUMETSAT) and the National Oceanic and Atmospheric Administration (NOAA)—and is a joint project among the French Space Agency, Centre National d'Études Spatiales (CNES), NASA, NOAA, and EUMETSAT. This mission intends to illustrate a clear transition from research and development agencies to operational agencies for ocean surface topography measurements in both Europe and the U.S. OSTM will be managed by NASA's Jet Propulsion Laboratory for the NASA Earth Science Enterprise Program.

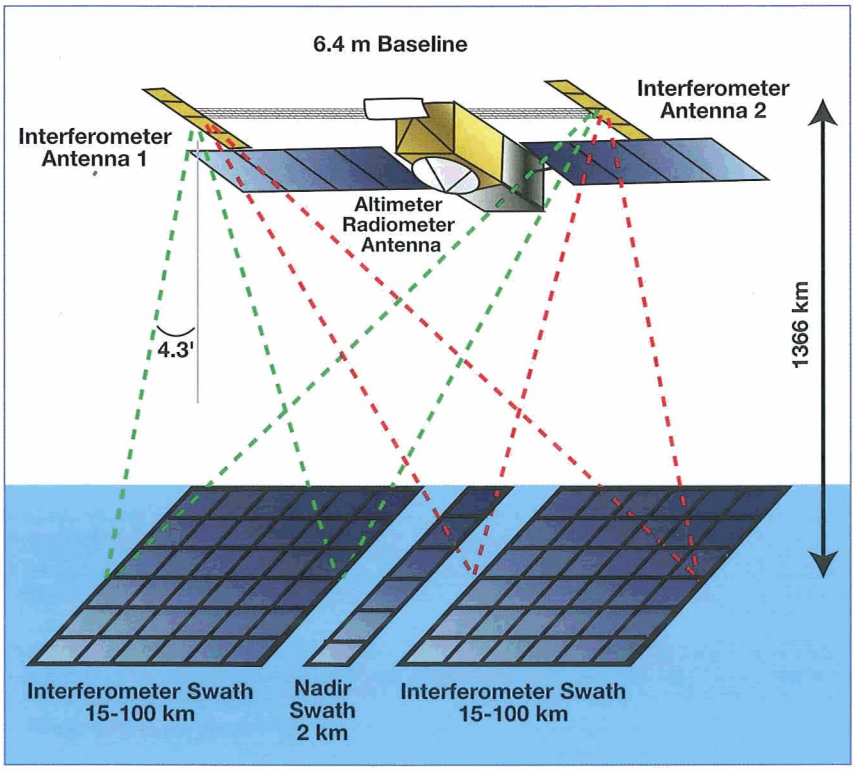


Computer simulation of the Ocean Surface Topography Mission Satellite.

The objective of the OSTM is to bring high-precision altimetry to a full operational status through the continuation of the TOPEX/Poseidon-3 and Jason missions, along with their collection of measurements of sea surface height, significant wave height, wind speed at the ocean surface, and other parameters. The OSTM will deliver near-real-time and offline services to the operational and research user communities, in support of the following:

- marine meteorology and sea state forecasting;
- operational oceanography;
- the development of seasonal forecasting;
- climate monitoring; and
- Earth system and seasonal forecasting research.

NASA and CNES will jointly provide the payload instruments. CNES will provide the PROTEUS platform and payload module, a Poseidon-3 dual-frequency radar altimeter and its antenna, and the Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) receiver package. NASA will provide a microwave radiometer and its antenna, a laser retroreflector, a GPS receiver package, and a compatible launch service for the satellite. NASA may also provide a Wide Swath Ocean Altimeter instrument as a technology demonstration and forerunner to the next-generation altimeters and to fulfill the operational needs of EUMETSAT and NOAA as a major component of the mission.



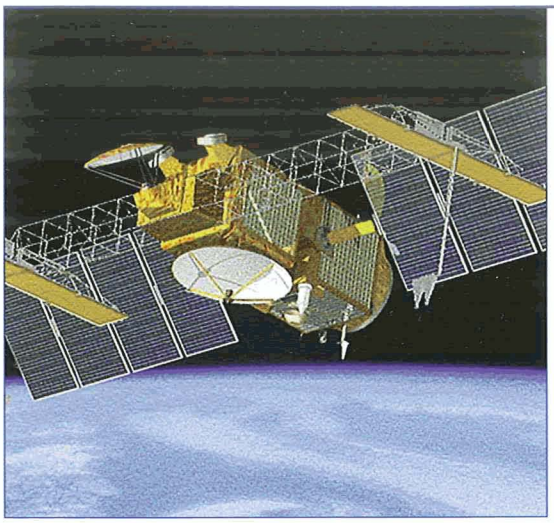
WSOA is an altimeter/interferometer project. Several altimeters mounted on masts will acquire measurements simultaneously, thus providing continuous single- or multi-altimeter wide-area coverage.

The two operational partners, EUMETSAT and NOAA, will archive data, support the ground systems, and maintain operations of the OSTM satellite. NOAA will establish an Operations Control Center, along with communication and data acquisition stations, and will operate and control the OSTM satellite after CNES hands over this responsibility. EUMETSAT will maintain an online storage of OSTM telemetry data and data products acquired or produced by EUMETSAT. OSTM's anticipated launch date is October 2007.

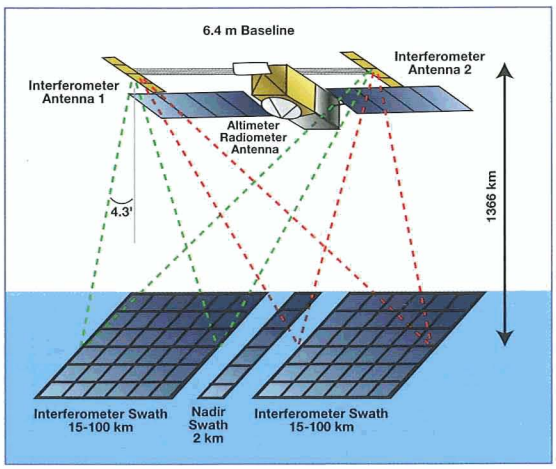
For more information regarding OSTM, please visit the following Web site: ***http://sealevel.jpl.nasa.gov/mission/ostm.html***.

France

OSTM
OCEAN SURFACE TOPOGRAPHY MISSION



Simulation par ordinateur du satellite de l'Ocean Surface Topography Mission.



WSOA est un projet d'altimètre/interféromètre. Plusieurs altimètres installés sur des pylônes obtiennent simultanément des mesures, permettant ainsi d'obtenir en permanence une large couverte de la zone avec un ou plusieurs altimètres.

L'Ocean Surface Topography Mission (OSTM) est centrée sur les missions Jason et TOPEX/Poseidon d'altimétrie des océans. L'OSTM possède désormais deux nouveaux partenaires d'exploitation : la European Meteorological Satellite Organization (EUMESTAT) et la National Oceanic and Atmospheric Administration (NOAA). Ce projet est réalisé en collaboration avec la France (CNES), les Etats-Unis (NASA et NOAA) et EUMESTAT. Cette mission a pour objet d'illustrer une transition nette entre les organismes de recherche et de développement (R&D) et les organismes opérationnels en ce qui concerne les évaluations topographiques sur la surface des océans tant en Europe qu'aux Etats-Unis. L'OSTM sera dirigée par le laboratoire Jet Propulsion de la NASA pour le compte du Programme NASA Earth Science Enterprise.

L'objectif de l'OSTM consiste à rendre pleinement opérationnelle l'altimétrie de haute précision grâce aux missions Jason et TOPEX/Poseidon-3, et à exploiter efficacement leur éventail de mesures sur la hauteur de la surface de la mer, la hauteur significative des vagues, la vitesse du vent en surface des océans et autres paramètres. L'OSTM offrira des services hors ligne en temps quasi-réel aux groupes d'utilisateurs spécialisés en recherche et en opérations, dans les domaines suivants :

- météorologie marine et prévisions de l'état de la mer
- océanographie opérationnelle
- développement de prévisions saisonnières
- surveillance du climat
- système terrestre et recherche sur les prévisions saisonnières

La NASA et le CNES fourniront conjointement les instruments de charge utile. Le CNES fournira la plate-forme PROTEUS et le module de charge utile, un altimètre radar à double fréquence Poseidon-3 et son antenne, et le récepteur Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS). La NASA fournira un radiomètre à micro-ondes avec antenne, un rétroréflecteur laser, un récepteur GPS et un service de lancement compatible pour le satellite. La NASA pourrait également fournir un un altimètre Wide Swath Ocean à titre de technologie de démonstration de la prochaine génération d'altimètres, et pour répondre aux besoins opérationnels d'EUMESTAT et de la NOAA en tant que composante importante de la mission.

Les deux partenaires opérationnels, l'EUMESTAT et la NOAA, archiveront les données, apporteront leur soutien aux systèmes au sol et veilleront aux activités du satellite OSTM. La NOAA établira un centre de contrôle des opérations, de même que des postes de communication et d'acquisition de données, et veillera au fonctionnement et au contrôle du satellite OSTM, prenant ainsi la relève de CNES. EUMESTAT conservera en ligne les données de télémétrie issues de l'OSTM et les données acquises ou produites par l'EUMESTAT. La date de lancement prévue par l'OSTM est fixée au mois d'octobre 2007.

Pour plus de renseignements concernant l'OSTM, veuillez consulter le site Web suivant : ***http://sealevel.jpl.nasa.gov/mission/ostm.html***.

OCO
ORBITING CARBON OBSERVATORY

The Orbiting Carbon Observatory (OCO) will provide the first global, space-based measurements of atmospheric carbon dioxide (CO_2), the principal anthropogenic driver of climate variability and change. Using these precise measurements, scientists will produce global maps of the CO_2 distribution in Earth's atmosphere. OCO data will improve our understanding of the natural processes and human activities that regulate the distribution and abundance of carbon dioxide in the atmosphere. They will also enable more reliable forecasts of CO_2 changes in the atmosphere and the effect that these changes may have on Earth's climate.

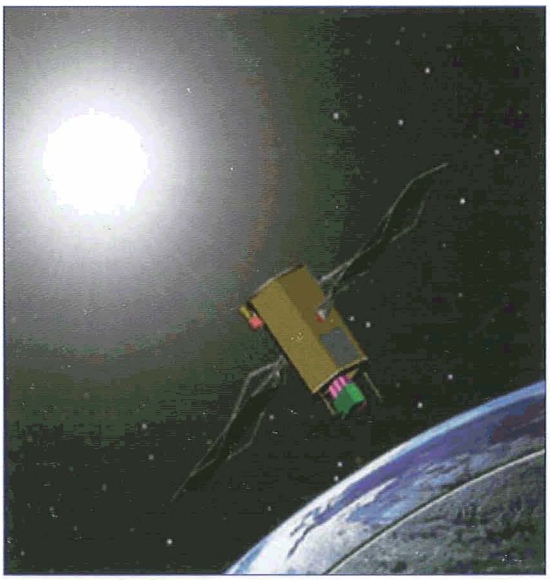
Carbon dioxide is produced every time someone starts a car, lights a fire, or exhales. These and other human activities have increased the atmospheric carbon dioxide concentration by about 25 percent since the dawn of the industrial age, raising concerns about CO_2's effects on Earth's climate. Precise ground-based measurements collected since the 1970s indicate that only about half of the carbon dioxide emitted into the atmosphere by fossil fuel combustion has remained there. The rest has apparently been absorbed by the oceans and the land biosphere. Unfortunately, existing measurements are not adequate to determine how or where this absorption is occurring. These uncertainties compromise our ability to predict atmospheric carbon dioxide concentrations in the future and their effects on Earth's climate.

The OCO mission consists of a dedicated spacecraft and a single instrument containing three classical grating spectrometers. OCO is currently scheduled for launch in late 2007 and will fly in formation with a series of Earth-orbiting satellites known as the Earth Observing System Afternoon Constellation. This coordinated constellation will enable researchers to correlate OCO data with data acquired by other Earth-observing instruments. The carbon dioxide measurements collected during this 2-year operational mission will be analyzed with sophisticated environmental models to yield comprehensive global maps of the processes that regulate atmospheric carbon dioxide and determine how their efficiency varies through the seasons. The measurement and analysis techniques developed through this effort will pave the way for future long-term carbon dioxide measurement missions.

NASA's Jet Propulsion Laboratory will lead the OCO mission, with cooperation from more than 19 universities and corporate and international partners. The OCO science team includes participants from Germany, France, Australia, and New Zealand, as well as the United States.

For more information regarding OCO, please visit the following Web sites: ***http://oco.jpl.nasa.gov/*** and ***http://essp.gsfc.nasa.gov/oco/***.

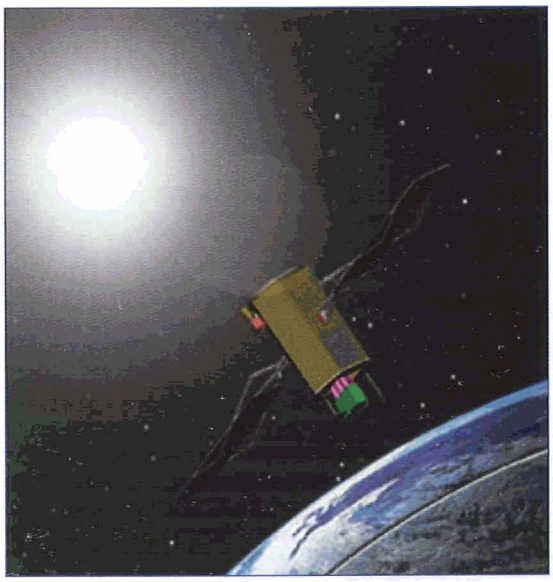
Earth's atmospheric carbon dioxide concentration is regulated by both natural processes associated with the global carbon cycle and human activities, including land-use practices and fossil fuel and biomass burning.



An artist's concept of the Orbiting Carbon Observatory in orbit.

Deutschland, Frankreich, Australien und Neuseeland

Die atmosphärische Kohlendioxidkonzentration wird von natürlichen Prozessen, die mit dem globalen Kohlenstoffzyklus zusammenhängen, und menschlichen Aktivitäten, u. a. der Bodennutzung und der Verbrennung von fossilen und biologische Brennstoffen, geregelt.



Konzept eines Künstlers zum Kohlenstoff-Orbitalobservatorium in der Umlaufbahn

OCO (ORBITING CARBON OBSERVATORY)

KOHLENSTOFF-ORBITALOBSERVATORIUM

Das Kohlenstoff-Orbitalobservatorium (OCO) wird die ersten globalen, weltraumbasierenden Messungen des atmosphärischen Kohlendioxids (CO_2), dem wichtigsten vom Menschen verursachten Auslöser der klimatischen Schwankungen und Änderungen liefern. Mit diesen genauen Messungen werden die Wissenschaftler globale Landkarten der CO_2-Konzentration in der Erdatmosphäre erstellen. Die OCO-Daten werden die Kenntnis der natürlichen Prozesse und der menschlichen Aktivitäten erweitern, die die Verteilung und Menge des Kohlendioxids in der Atmosphäre steuern. Sie werden ebenfalls zuverlässigere Prognosen der CO_2-Veränderungen in der Atmosphäre und der Auswirkungen dieser Änderungen auf das Klima der Erde ermöglichen.

Kohlendioxid bildet sich jedes Mal, wenn ein Auto gestartet, ein Feuer entzündet oder ausgeatmet wird. Diese und andere menschlichen Aktivitäten haben seit Beginn des Industriezeitalters die atmosphärische Kohlendioxid-Konzentration um etwa 25 Prozent erhöht, wodurch auch die Besorgnis über die Wirkung von CO_2 auf das Klima der Erde zugenommen hat. Genaue bodenbasierte Messungen, die seit den 70er Jahren durchgeführt wurden, zeigen, dass nur etwa die Hälfte des Kohlendioxids, das durch die Verbrennung fossiler Brennstoffe in die Atmosphäre emittierte, dort verblieben ist. Der Rest wurde offensichtlich von den Ozeanen und der Landbiosphäre gebunden. Leider sind die existierenden Messungen nicht ausreichend, um zu bestimmen, wie oder wo diese Absorption stattfindet. Durch diese Unsicherheiten ist es nicht möglich, die atmosphärischen Kohlendioxidkonzentrationen in der Zukunft und ihre Auswirkungen auf das Klima der Erde vollständig vorherzusagen.

Die OCO-Mission besteht aus einem speziellen Raumflugkörper und einem einzigen Instrument, das aus drei klassischen Gitterspektrometern besteht. Derzeit ist geplant, OCO Ende 2007 zu starten, und es wird in Formation mit einer Reihe von erdumkreisenden Satelliten fliegen, die als Erdbeobachtungssystem (Earth Observing System – EOS) Afternoon Constellation bekannt ist. Diese koordinierte Konstellation wird den Forschern ermöglichen, die OCO-Daten mit den Daten anderer erdbeobachtender Instrumente zu vergleichen. Die während dieser 2-jährigen Betriebsmission gesammelten Kohlendioxidmessungen werden mit hoch entwickelten Umweltmodellen analysiert, um umfassende globale Landkarten von den Prozessen zu erstellen, die das atmosphärische Kohlendioxid regeln und die bestimmen, wie sich seine Wirkung über die Jahreszeiten ändert. Die für diesen Einsatz entwickelten Messungs- und Analysemethoden werden den Weg für zukünftige langfristige Missionen zur Kohlendioxidmessung ebnen.

Das Jet Propulsion Laboratory der NASA wird die OCO-Mission in Zusammenarbeit mit mehr als 19 Universitäten sowie Unternehmen und internationalen Partnern leiten. In dem wissenschaftlichen Team des OCO arbeiten Teilnehmer aus Deutschland, Frankreich, Australien, Neuseeland und den Vereinigten Staaten.

Nähere Informationen zu OCO finden Sie auf den folgenden Websites: ***http://oco.jpl.nasa.gov/*** und ***http://essp.gsfc.nasa.goc/oco/***.

OCO
ORBITING CARBON OBSERVATORY

L'Orbiting Carbon Observatory (OCO) permettra d'obtenir les premières mesures spatiales d'anhydride carbonique (CO_2), élément déclencheur anthropogène principal des changements et variations de climat. Grâce à ces mesures précises, les chercheurs vont pouvoir établir des cartes planétaires indiquant la répartition du CO_2 dans l'atmosphère terrestre. Les données de l'OCO nous permettront de mieux comprendre les processus naturels et les activités humaines qui régulent la répartition et l'abondance de l'anhydride carbonique dans l'atmosphère. Cela permettra également d'obtenir des prévisions plus fiables sur les changements de CO_2 dans l'atmosphère et les conséquences de ces changements sur le climat terrestre.

L'anhydride carbonique est produit chaque fois que quelqu'un démarre une automobile, allume un feu ou expire. Ces activités humaines ainsi que bien d'autres ont fait augmenter la concentration d'anhydride carbonique atmosphérique d'environ 25 pour cent depuis le début de l'ère industrielle, soulevant ainsi des inquiétudes concernant les conséquences du CO_2 sur le climat terrestre. Les mesures précises au sol recueillies depuis les années 70 démontrent que seulement la moitié de l'anhydride carbonique émis dans l'atmosphère par la combustion des combustibles fossiles y demeure. Le reste est apparemment absorbé par les océans et la biosphère terrestre. Malheureusement, ces mesures actuelles ne sont pas suffisantes pour permettre de déterminer comment et où cette absorption se produit. Ces incertitudes nous empêchent de prédire les concentrations d'anhydride carbonique à venir ainsi que leurs conséquences sur le climat terrestre.

La mission de l'OCO consiste en un vaisseau spatial et un instrument unique contenant trois spectromètres à réseau traditionnels. L'OCO sera lancé vers la fin de l'année 2007 et volera en tandem avec une série de satellites gravitant autour de la Terre et connus sous le nom de Earth Observing System (EOS) Afternoon Constellation. Cette association coordonnée permettra aux chercheurs de corréler les données de l'OCO avec les données recueillies par les autres instruments gravitant autour de la Terre. Les mesures de l'anhydride carbonique recueillies durant cette mission opérationnelle de 2 ans seront analysées à l'aide de modèles environnementaux sophistiqués pour définir des cartes planétaires des processus qui réglementent l'anhydride carbonique atmosphérique et déterminent comment l'efficacité varie d'une saison à l'autre. Les techniques de mesure et d'analyse élaborées grâce à cet effort prépareront le terrain pour les futures missions à long terme destinées à mesurer l'anhydride carbonique.

Le laboratoire Jet Propulsion de la NASA dirigera la mission OCO avec la coopération de plus de 19 universités, entreprises et partenaires internationaux. L'équipe scientifique de l'OCO est composée de participants provenant de l'Allemagne, de la France, de l'Australie et de la Nouvelle-Zélande, de même que des Etats-Unis.

Pour plus de renseignements sur l'OCO, consultez les sites Web suivants : ***http://oco.jpl.nasa.gov/*** et ***http://essp.gsfc.nasa.gov/oco/***.

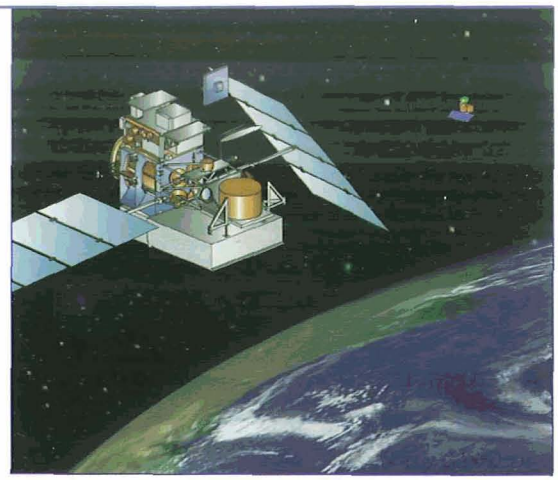
La concentration d'anhydride carbonique atmosphérique est régulée par des processus naturels liés aux activités humaines et au cycle du carbone, dont les pratiques d'utilisation des sols, la combustion de la biomasse et les combustibles fossiles.

Conception d'un artiste de l'Orbiting Carbon Observatory en orbite.

Japan, European Space Agency, and Worldwide

GPM
GLOBAL PRECIPITATION MEASUREMENT

Access to and knowledge about clean water is a vital international issue. To address this need, NASA is working with the Japan Aerospace Exploration Agency (JAXA), the European Space Agency, and other international partners in the development of the Global Precipitation Measurement (GPM) mission. GPM will improve the understanding of the global water cycle and fresh water availability, advance the accuracy of precipitation forecasts and precipitation's impact on weather, and provide frequent and complete sampling of Earth's precipitation. As a follow-on to the successful NASA-JAXA Tropical Rainfall Measuring Mission, GPM will expand observations from the tropics and subtropics to the entire globe, improve observing frequency, produce updated global precipitation maps every 3 hours, and enhance measuring methods to identify and characterize rain and snow. GPM is currently in the formulation phase.



The GPM core spacecraft and international constellation satellites will provide frequent global sampling of Earth's precipitation.

GPM is global in its observations and in its partnerships, and it will serve as a benchmark for a coordinated international approach to precipitation observation. The mission will include a core spacecraft carrying a dual-frequency precipitation radar. The radar is to be provided by JAXA and the Communications Research Laboratory of Japan. JAXA is also expected to launch the core spacecraft. NASA plans to provide the core spacecraft, a multichannel passive microwave radiometer, a constellation spacecraft and its launch, microwave radiometers, the precipitation processing system, the mission operations system, and an array of ground calibration and validation sites. NASA is targeting launches in 2011–12.

A critical part of GPM will be the international constellation of satellites carrying passive microwave radiometers. Through this constellation architecture, GPM will provide frequent precipitation measurements on a global scale. NASA and JAXA are in discussions with other international partners to include their participation in GPM. The European Space Agency is studying a European constellation satellite contribution. The GPM mission is seeking participation ranging from spacecraft and instrument contributions to calibration and validation from all areas of the globe. With the potential to vastly improve water resource management, climate research, weather forecasting, and a host of other applications, GPM will have far-reaching and global environmental benefits. For more information regarding GPM, please visit the following Web site: ***http://gpm.gsfc.nasa.gov***.

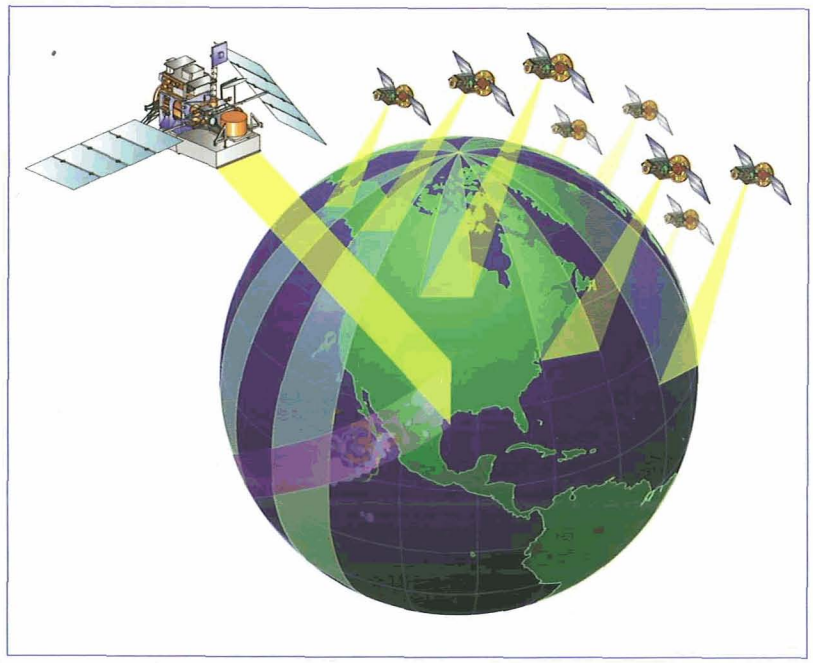
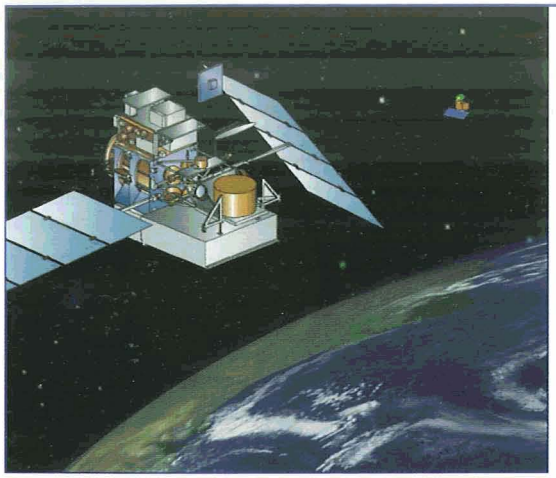


Illustration of the GPM core spacecraft and international constellation satellites.

日本、欧州宇宙機関、そして世界で

GPM
全球降水観測計画



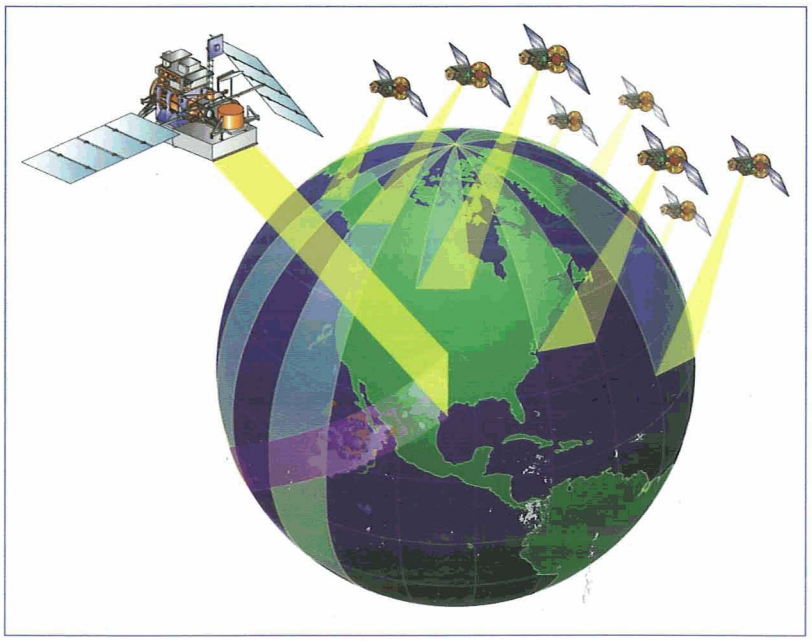
GPMの主衛星と国際協力による複数の副衛星が、地球の降水に関する地球規模のサンプリングを高頻度に行います。

清浄な水の確保および知識は、生命維持に不可欠な国際的な問題です。この必要性に取り組むため、米国航空宇宙局（NASA）は日本航空研究開発機構（JAXA）、欧州宇宙機関およびその他の世界の宇宙関連機関と共に、全球降水測定（GPM）ミッションの開発に取り組んでいます。GPMによって、地球規模での水循環と淡水資源の確保に関する人類の理解を深め、降水予測および降水が気象へ及ぼす影響の予測を高精度化し、地球上における降水の高頻度で完全なサンプリングを提供することになります。先に成果をあげたNASA-JAXAの熱帯降雨観測衛星（Tropical Rainfall Measuring Mission）の後継計画として、GPMでは、その観測範囲を熱帯・亜熱帯地域から全球範囲へと拡張し、観測頻度を改善して3時間ごとに更新されたグローバル降水分布を配信し、雨と雪を識別し分析する測定方法を強化します。GPMは、現在考案段階にあります。

GPMはその観測および提携機関の面でグローバル化されており、降水観測に関して連携した国際的なアプローチの基準点となります。この計画の一部としてJAXAおよび日本の通信総合研究所（CRL）提供の2周波降水レーダ(dual-frequency precipitation radar, DPR)を備えた主衛星があり、JAXA　はこの主衛星の打ち上げを予定しています。NASAは、この主衛星、多チャンネル受動マイクロ波放射計、副衛星群およびその打ち上げ、マイクロ波放射計、降水プロセスシステム、そしてミッション作動システム、データの較正・検証のための多数の地上拠点を提供することを計画しています。NASAは、これらの打ち上げを2011年12月に行うことを目標としています。

GPMでは、受動マイクロ波放射計を備えた国際協力による副衛星群が重要な位置を占めます。この副衛星群を構成することで、GPMは全球規模で高頻度な降水観測を行うことになります。NASAとJAXAは他の国際提携機関がこのGPMに参加するかをこれらの国際機関と協議しています。欧州宇宙機関は、欧州の副衛星がこの計画に参加できるかを現在検討中です。GPMのミッションは、衛星・機器の提供からデータの較正・検証に及ぶ協力を地球の全地域から求めています。水資源の管理、気候研究、気象予報および他の多くの応用分野を向上させる可能性を秘めているGPMは、広範で地球規模の環境便益をもたらすでしょう。GPMに関する詳しい情報は、下記のウェブサイトをご覧ください。
http://gpm.gsfc.nasa.gov.

GPMの主衛星と国際協力による複数の副衛星のイラスト。

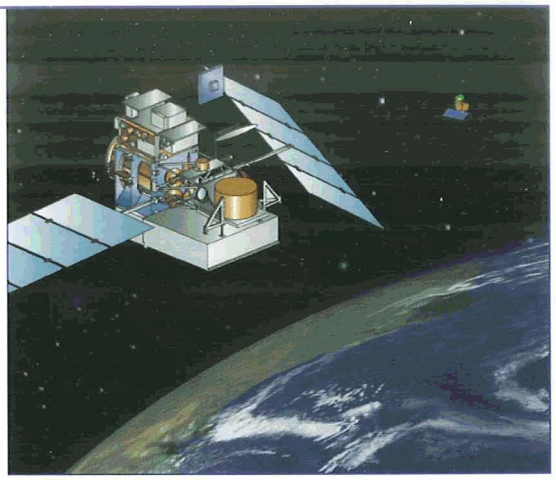


Japon l'Agence, Spatiale Européenne et la mission universelle

L'accès à l'eau potable et les connaissances en la matière constituent une préoccupation vitale à travers la planète. Pour répondre à ce besoin, la NASA, en collaboration avec l'Agence Japonaise d'Exploration Spatiale (JAXA), l'Agence Spatiale Européenne (ESA) et d'autres partenaires internationaux, travaille au développement de la mission d'étude des précipitations à l'échelle planétaire (GPM). La mission GPM permettra à l'humanité de mieux comprendre le cycle de l'eau et la disponibilité en eau douce, de prévoir avec plus d'exactitude les précipitations et leur incidence sur le plan météorologique, et fournira un échantillon complet et fréquent des précipitations terrestres. La mission GPM, qui succède à la Tropical Rainfall Measuring Mission (mission d'étude des précipitations tropicales), menée à terme avec succès par la NASA et la JAXA, permettra de réaliser des observations partout dans le monde, et pas uniquement dans les zones intertropicale et subtropicale, d'améliorer la fréquence des observations, d'obtenir des cartes géographiques sur les précipitations toutes les trois heures, et d'améliorer les méthodes servant à identifier et à caractériser la pluie et la neige. La mission GPM est actuellement en phase d'élaboration.

Grâce à ses observations et ses partenariats, la mission GPM se présente comme une mission universelle et servira de point de référence à la méthode internationale coordonnée d'observation des précipitations. La mission comprendra un satellite transportant un radar de précipitation à double fréquence fourni par la JAXA et le Communications Research Laboratory of Japan (Laboratoire japonais de recherche sur les communications). La JAXA devrait également procéder au lancement du satellite. La NASA prévoit de fournir le satellite, un radiomètre multifréquence à micro-ondes passif, une constellation de satellites et son lancement, des radiomètres à micro-ondes, le système de traitement des précipitations, le système d'exploitation de la mission et plusieurs sites de validation et d'étalonnage au sol. La NASA prévoit d'effectuer le lancement en 2011 ou en 2012.

L'un des éléments cruciaux de la mission GPM sera la constellation internationale de satellites transportant des radiomètres à micro-ondes passifs. Grâce à cette architecture de constellation, GPM permettra d'obtenir fréquemment des mesures sur les précipitations à l'échelle mondiale. La NASA et la JAXA discutent actuellement avec d'autres partenaires internationaux intéressés à participer à la mission GPM. L'Agence Spatiale Européenne étudie la possibilité de fournir une constellation de satellites européens. La mission GPM recherche des partenaires aux quatre coins de la planète, et ce pour une participation active aux divers aspects de l'entreprise, tels que le satellite, les instruments, l'étalonnage et la validation. Cette mission a pour objectif d'améliorer la gestion de l'eau, la recherche sur le climat, les prévisions météorologiques et d'autres applications. La mission GPM aura des répercussions positives sur l'environnement à travers le monde. Pour plus de renseignements à propos de la mission GPM, veuillez consulter le site Web suivant : ***http://gpm.gsfc.nasa.gov***



Le satellite de la mission GPM et la constellation internationale de satellites de la mission GPM fourniront des échantillons des précipitations terrestres.

Illustration du satellite GPM et de la constellation internationale de satellites.

National Aeronautics and
Space Administration

Earth Science Enterprise and
Office of External Relations

NASA Headquarters
Washington, DC 20546
NP-2004-03-348-HQ

202-358-0793
http://www.nasa.gov