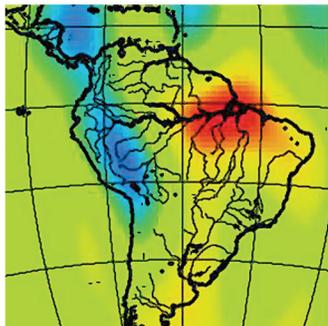


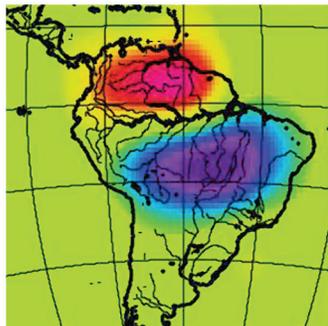


SCIENCE SERVING SOCIETY: WATER MANAGEMENT

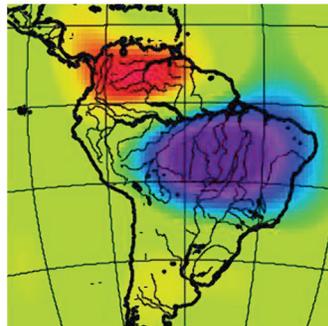
January 2004



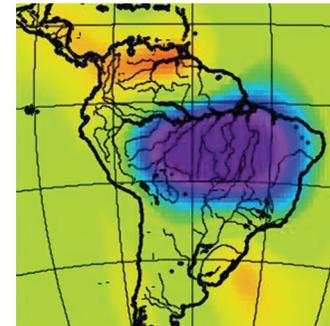
February 2004



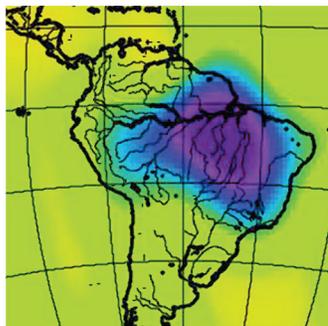
March 2004



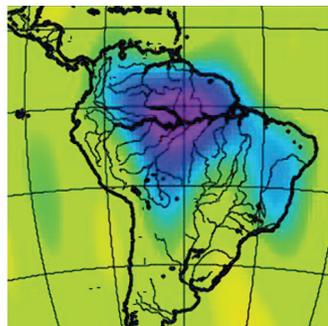
April 2004



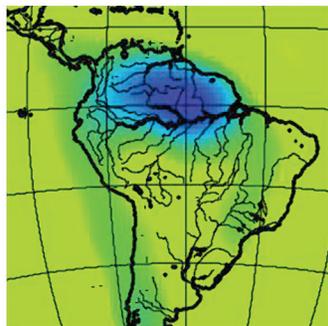
May 2004



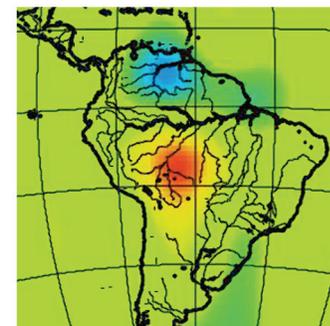
June 2004



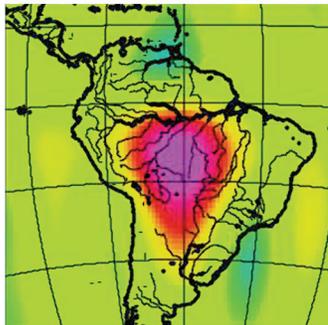
July 2004



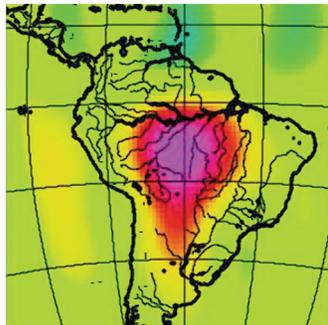
August 2004



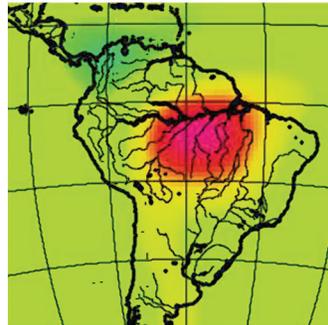
September 2004



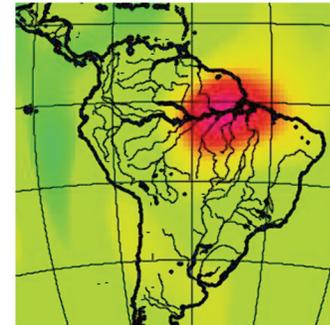
October 2004



November 2004



December 2004



Water Layer Height (Departure from Average) in centimeters



The amount of water flowing through the Amazon Basin varies from month-to-month, and can be monitored from space by looking at how it alters the Earth's gravity field. This series of images was produced using data from NASA's Gravity Recovery and Climate Experiment (GRACE) and shows month-by-month water mass changes (relative to a 3-year average) over the Amazon and neighboring regions. Oranges, reds, and pinks show where gravity is lower than average; greens, blues, and purples show where gravity is higher than average. The Amazon has distinct rainy and dry seasons, and the seasons show up clearly in the monthly maps. Notice also that the smaller Orinoco Basin to the north of the Amazon has a distinctly different seasonal pattern. (Image credit: University of Texas Center for Space Research)



SCIENCE SERVING SOCIETY: WATER MANAGEMENT

Overview of the Program

At present, an array of Earth observing satellites are in orbit, and additional launches both by NASA and others will continue throughout the next decade. Our ability to observe our home planet from space has never been greater. Increasingly, studies of the Earth focus on understanding the Earth's land, atmosphere, oceans, and life as a whole integrated system rather than as individual independent elements. NASA is an important contributor in this systems approach to Earth science studies.

In addition to providing Earth observing capabilities, NASA forms strategic partnerships with other government, academic, private, and international organizations. Through these partnerships, NASA's Earth science observations and measurements are linked to practical applications. NASA data, information, and predictive models help NASA's partners, and nontraditional users of Earth science, make timely and accurate decisions regarding management of resources and development of policy. The agency's goal is to maximize the benefit of science and technology to stakeholders by smoothly flowing Earth science data and information from NASA satellites to society.

Water Management

The Earth is easily distinguishable from other planets in our solar system by the abundance of water on its surface. Water covers approximately 70% of our world's surface, so it would seem that finding enough water suitable for human consumption, commerce, and ecosystems is a trivial task. However, only 2.5% of the Earth's water is fresh and, of that amount, more than two-thirds is locked away in glaciers and polar ice caps and is not available for use by society. Therefore, fresh water is actually a limited resource, and increased demand from an ever-growing population threatens to deplete precious water resources.

Not only is having water in sufficient quantity a concern, but there is also a need to ensure the quality of the available water supply. The nation must protect the quality of water flowing above ground in oceans, lakes, rivers, and streams, as well as water stored deep beneath the surface in aquifers. Decision makers need accurate and dependable information on water availability (e.g., from surface reservoirs, snowpack, underground aquifers, etc.) and on water quality to help them respond to the needs of society.

The water management program element in the Applied Sciences Program of the Earth Science Division in NASA's Science Mission Directorate responds to society's need for accurate information on fresh water availability and quality. It extends products that result from NASA's Earth science research models, technology, etc., into tools that decision makers can use to help with water management issues such as:

- Estimating water storage—e.g., snowpack, soil moisture, aquifers, lakes.
- Assessing, modeling and predicting water fluxes—e.g., evapotranspiration, precipitation, river runoff.
- Remote sensing of water quality—e.g., turbidity, dissolved oxygen.

NASA's Earth observing satellites contribute important environmental information concerning the availability of fresh water. The Moderate Resolution Imaging Spectroradiometer (MODIS) and Clouds and the Earth's Radiant Energy System (CERES) instruments on the Terra and Aqua satellites are helping to refine our estimates of the Earth's surface energy balance, which helps improve our understanding of evaporation over the Earth's surface. The Advanced Microwave Scanning Radiometer-EOS (AMSR-E) instrument on Aqua measures surface soil moisture and snow-liquid water equivalent. This information should help scientists better understand the processes that affect soil moisture, so that they can be accurately represented in models.

Data from the Gravity Recovery and Climate Experiment (GRACE) helps scientists monitor changes in water storage over large areas as illustrated on the front of this lithograph. Gravity changes correspond to mass changes and scientists can isolate the portion of the total mass change caused by the movement of water. Hydrologists go a step further and combine information from GRACE with soil moisture and other data to isolate changes in groundwater storage, allowing them to monitor monthly water storage changes in aquifers. The Tropical Rainfall Measuring Mission (TRMM) satellite monitors tropical/subtropical precipitation and provides important new information on rainfall properties and their variation. The Global Precipitation Measurement (GPM) mission is planned as a follow-on to TRMM and will provide much-improved spatial coverage and round-the-clock observations of precipitation.

With regard to monitoring the quality of water from space, MODIS is useful for monitoring water quality in larger lakes, sediments both along the coast and in larger rivers, and pollutants (e.g., red tide). In addition, the Enhanced Thematic Mapper Plus (ETM+) on Landsat 7 and the Hyperion instrument on the Earth Observing-1 satellite obtain visual images of the surface of the Earth at a higher spatial resolution than MODIS that can be analyzed to track changes in water quality over time. Future observations, planned as a continuation of Landsat, should further enhance our ability to monitor water quality from space.

NASA Earth observing satellites thus provide a unique viewpoint for collecting information that is useful for water management decision making. The real value of this information is realized when data collected by these NASA missions are input into models that simulate the actual conditions and the results are used to serve society. Incorporating this information into computer simulations used to aid water management decision making as described above will lead to improved capability to predict water availability, protect water quality, and plan water conservation. NASA partners with Federal agencies such as the Environmental Protection Agency and the Bureau of Reclamation and with other organizations that have water management responsibilities and mandates to support water resource managers. The program also includes activities with international organizations, particularly through involvement of U.S. partner organizations.