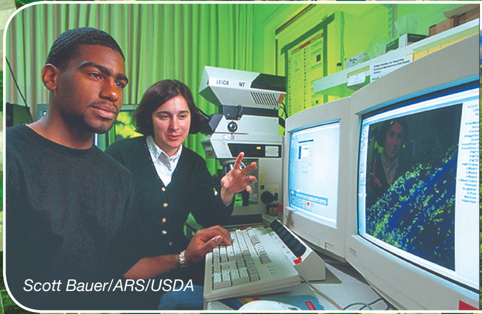
National Aeronautics and Space Administration

SCIENCE SERVING SOCIETY: AGRICULTURAL COMPETITIVENESS

This is not a work of modern art, but rather an image from a NASA Earth observing satellite. Variegated green crop circles cover what was once shortgrass prairie in southwest Kansas. The most common crops in this region—Finney County—are corn, wheat, and sorghum. Each crop was at a different phase in its development when the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) obtained this image on June 24, 2001, accounting for the varying shades of green and yellow. The perfectly circular fields are the result of central pivot irrigation. As is the case throughout the U.S. Midwest, these crops are also partly fed by water from the Ogallala Aquifer, a giant layer of underground water covering about 450,000 square kilometers of the Great Plains. NASA satellites not only monitor the crops as they mature as shown here, but they also monitor the aquifer to see how the water supply is changing with time.



Scott Bauer/ARS/USDA

The results of NASA research and developments in Earth science and technology can be integrated into local and regional decision support systems addressing issues related to weather and climate predictions in agriculture management.

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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.

Agricultural Competitiveness

One of our nation's most vital needs is a stable and dependable food supply for an ever-increasing population. The Midwest United States is known as America's "Breadbasket" because it is home to the vast majority of America's productive farmland and is vital to the American economy.

Any disruption to the productivity of these lands can have devastating economic consequences. For example, in the summer of 1988, the Midwest United States experienced its worst dry spell since the 1930s causing an estimated $40 billion in crop damages. In contrast, summer 1993 was exceptionally wet, with flooding on the Missouri and Mississippi rivers that wreaked havoc on agricultural lands and caused extensive crop damage.

These contrasting examples illustrate that the Midwest is subject to a wide range of climatic extremes ranging from scorching summer heat to bitter Arctic cold, from abundant rains to parched soils. Research indicates that many of these year-to-year changes in local weather conditions can be associated with changes in global scale climatic phenomena such as the El Niño/La Niña cycle in the Pacific Ocean. Further complicating the matter, every El Niño/La Niña episode is different (in strength or duration, for example) and so their effects on weather around the world are not always the same.

In order to improve our agricultural competitiveness as a nation, scientists need to improve their understanding of the ties between global phenomena and local weather effects so that weather extremes such as the ones mentioned above can be predicted further in advance. These scientific advances can have a significant impact on our society. As an example, imagine the enormous global economic impact that would result if farmers could receive reliable forecasts of precipitation and surface temperatures a season ahead of when they actually occurred. Farmers would have more lead-time and could plan for and even possibly lessen some of the harmful impacts that extreme weather can have on their crops.

NASA recently signed an agreement with the U.S. Department of Agriculture (USDA) establishing a series of programs to help protect the environment and enhance American agriculture. The new collaboration allows for the use of NASA's capabilities in monitoring, mapping, modeling and systems engineering to enhance USDA's ability to predict climate, weather and natural hazards. NASA also collaborates with the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) in an effort to better understand the complexities of the seasonal variability of climate. The overarching goal of all these endeavors is to provide accurate and timely information to farmers and organizations responsible for food and water management decisions that can potentially impact millions of people worldwide.

Space provides an ideal vantage point for the collection of critical data for agricultural applications, such as precipitation, soil moisture, snow water content, and vegetation maps, as well as ocean surface temperatures and ocean biology, to help monitor existing anomalies and improve climate forecasts. Measurements obtained by satellite sensors such as the sophisticated Moderate Resolution Imaging Spectroradiometer (MODIS) on both Terra and Aqua, and the Advanced Microwave Scanning Radiometer for EOS (AMSR-E) on Aqua make important contributions to these studies. The Enhanced Thematic Mapper Plus (ETM+) on Landsat 7 and the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) on Terra—see front—provide high-resolution images of the Earth's surface that are useful for identifying how the land surface is changing with time, and can be used for monitoring agriculture. Future observations, planned as a continuation of Landsat, should further enhance our ability to monitor land surface change from space. The Gravity Recovery and Climate Experiment (GRACE) provides a new means of calculating water storage changes over continents, particularly in underground aquifers that are a source of water for agriculture in the U.S. Great Plains. The Tropical Rainfall Measuring Mission (TRMM) provides information on global precipitation, and will eventually be succeeded by the Global Precipitation Measurement (GPM) mission, a constellation of satellites that will provide more information on precipitation.

However, the story doesn't end with the collection of the data. These scientific observations only truly begin to serve society when they are linked to real-world applications. NASA provides data to its partners at USDA, EPA, and NOAA that become input for computer simulations used for agricultural decision making. These simulations attempt to recreate the actual atmospheric conditions as they are at the present (i.e., what the weather is now) and to predict what the weather will be in the future. By incorporating NASA data into these models, forecasters hope to be able to issue increasingly accurate long-term weather forecasts that can be used for agricultural applications.

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