

# NASA SATELLITES ALLOW USDA TO SEE WORLD'S LAKES RISE AND FALL

August 30 2004

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A few [NASA](#) satellites designed to study heights of Earth's ocean surfaces are now also coming in handy for tracking water levels of inland lakes and reservoirs.

When analysts at the United States Department of Agriculture (USDA) Foreign Agriculture Service (FAS) learned that NASA satellites could be used for measuring lake water heights, they saw a chance to get vital information for managing irrigation and forecasting crop production in out-of-the way places.



August 1999 May 2001 May 2003

Since early this year, NASA has supplied the USDA with near-real time data on lake and reservoir heights from around the world. The USDA has posted this information on a web site that allows users with a computer and Internet to access it for their varied uses. Analysts who forecast crop production, scientists, in-country water and irrigation managers, those involved in fishing industries, and the general public have all been making use of the site.

NASA and the French space agency Le Centre National d'Etudes Spatiales (CNES) teamed up to design, build and launch the TOPEX/Poseidon and the Jason-1 satellites. These satellites were designed to study many aspects of the ocean. The TOPEX/Poseidon satellite, for example, orbits at a height of 1336 kilometers (830 miles) above Earth, and can measure the height of the ocean surface directly underneath the satellite with an accuracy of 4-5 centimeters (better than 2 inches). Jason-1 and TOPEX/Poseidon cover the global oceans every 10 days. With these capabilities, this technology is surprisingly valuable for looking at larger areas of inland water.

"The satellites were designed with oceanographic objectives in mind, so the fact that they can be used for lakes and rivers are an added bonus," said Charon Birkett, a University of Maryland researcher based at NASA's Goddard Space Flight Center in Greenbelt, Md. It was Birkett's

work with satellites and inland water sources that caught the USDA's interest.

Water level data for many lakes can be hard to get. Lakes may be located within inhospitable regions. Terrain may make it hard to install water level gauges, or some countries may not have the money for proper equipment. Even if there is equipment, someone must be available to regularly record the measurements. For an international agency like the USDA FAS, information on water levels in remote lakes in Africa or Asia, for example, may only be possible if a researcher happens to be passing by the area.

"Now we have this dataset which gives you a global picture of irrigation capabilities," said Brad Doorn, Remote Sensing Technical Coordinator for the FAS. "It's very much a night and day perspective as it relates to global irrigation potential."

NASA/CNES satellites fly over 350 of the world's largest lakes. The USDA decided to focus on about 150 of those that are important for agriculture. Of those, about 70 are currently online, with more being regularly added as Birkett and co-worker, Brian Beckley, from Raytheon's Information Technology and Scientific Services (ITSS) team learn to extract information on the smaller lakes. Fifteen of the lakes that are currently online are in Africa.

The records begin with archived data from TOPEX/Poseidon, launched in 1992. They continued with data from the Jason-1 satellite, launched in December 2001. The two stayed in the same orbit for about 7 months, before the TOPEX/Poseidon satellite's orbit was changed. These months of cross-over data were crucial for validating each of the satellites and for making sure the data records from Jason-1 were compatible with the TOPEX/Poseidon archive.

The information provided by the satellites, and made public through the web site, is a blessing to those who manage water for irrigation. Irrigated areas generally have less rainfall, and therefore crops in these drier regions are dependent on stores of water, like lakes, reservoirs and rivers.

The FAS analyzes crop production around the world. They regularly use computer models that simulate agricultural production based on inputs that include weather information. In this way they can examine global crop conditions and production. But in irrigated areas that are not rain fed, these methods are limited. For irrigated areas, you have to be able to determine how much water is actually stored, after seasonal precipitation passes.

"Satellite records of lake and reservoir water levels give you a good indication of whether there is going to be a systematic or major problem in water supply," said Doorn. "If water is low, there may be problems for agricultural production." This type of information is especially important for food aid partners, who must budget ahead for how much and where food aid is distributed.

Lake Tharthar in Central Iraq provides irrigation water to areas downstream. It is also linked to the Tigris and Euphrates Rivers. A drought that carried over many years severely cut grain output between 1999 and 2001. But since then, rainfall has increased, allowing grain production to recover and even surpass pre-drought levels. Knowledge of water levels in a region like this is crucial for the people who divvy out water for irrigation, and for those who plan aid.

The satellites have noticed some striking changes in lake levels around the world. In Iran, Lake Urmia has steadily decreased over the last 5 years. Also, between 1999 and 2001, Lake Hamoun in Iran near the Afghanistan border all but dried up and disappeared. By May 2003,

water had returned to the lake. In that same time period, Lake Michigan levels have also declined.

On the other hand, when there is plenty of water, irrigation managers and farmers can assess the potential for more agriculture. When Caspian Sea levels rose in 1994, spill-over created a reservoir where little water existed before. As a result, the Kara Bogaz reservoir that borders the Caspian Sea was once largely desert and is now a large inland water body. Lake Nasser in Egypt also exists in a desert area where water supplies have increased.

As can be seen, the new technology allows researchers to get water level records regularly, globally, and in places where it is very hard to maintain or even acquire measurements. At the same time, there are also some limitations to the technology. For example, lake elevations can only be obtained during the lifetime of the satellite mission. Also, a satellite must pass directly over a lake for the radar to record water heights. But since the primary mission of these satellites is for studying the oceans, the fixed satellite orbit is determined by the community of oceanographers. That means people studying inland water have less input into the lakes that are monitored. In addition, some water bodies are simply too small for the instruments to pick up. These factors limit the number of observable lakes. "Sometimes, the lake that you want information about is the one you can't get," said Doorn.

Despite the current limitations, users like the FAS are thrilled to have access to the technology. Their web site provides new measurements to the public about a week to ten days after the satellite passes over.

"When USDA approached us, we told them the satellite record is not as accurate as a gauge sitting in a lake, but we can get good information within one to two weeks for many lakes in data-poor regions such as Africa and Asia," said Birkett.

"It's been a great USDA and NASA cooperative effort," said Doorn. "It's exactly what we needed and the type of cooperation provided has made it a real win-win situation."

The project has been a collaborative effort between the NASA GSFC, USDA FAS, the University of Maryland, and Raytheon ITSS. The project was funded by the USDA/FAS.

For more pictures and details visit this link:

[www.gsfc.nasa.gov/topstory/200.../0826reservoirs.html](http://www.gsfc.nasa.gov/topstory/200.../0826reservoirs.html)

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Citation: NASA SATELLITES ALLOW USDA TO SEE WORLD'S LAKES RISE AND FALL (2004, August 30) retrieved 26 April 2024 from <https://phys.org/news/2004-08-nasa-satellites-usda-world-lakes.html>

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