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1. INTRODUCTION

Aqua, a major satellite of the Earth Observing System (EOS), was launched on May 4, 2002, to study the Earth's water cycle and other aspects of the Earth/atmosphere system. Aqua carries six Earth-observing instruments collecting global data on water in the atmosphere, on the land, and in the surface layer of the oceans, including water in the solid and vapor forms as well as water in the liquid form. Aqua data will also be used to determine atmospheric and surface temperatures and global vegetation. Particular goals of the Aqua mission include improved weather forecasts, through improved measurements of atmospheric temperatures, humidities, and winds, and improved understandings of climate and climate change, through analyses of the coordinated measurements of dozens of climate variables. Although centered at NASA, Aqua has major international participation, particularly from Japan and Brazil, and major participation by other agencies, universities, and private companies within the U.S.

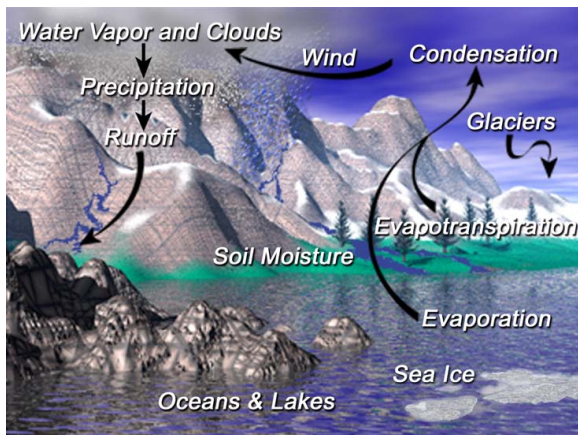


Figure 1. Schematic of the water cycle.

Considerable effort has gone into educational outreach activities for the Aqua mission, both to inform the public about the mission and also to educate them regarding Earth sciences. These efforts will be described here, starting with relatively traditional printed products and proceeding to more innovative web casts and other internet-based activities.

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2. PRINTED PRODUCTS

Key printed educational products connected with the Aqua mission are:

a. An Aqua brochure. This heavily illustrated 41-page color brochure gives an overview of the mission and its intended science, data flow, and validation activities. It is also a convenient place to find photographs and technical specifications of the spacecraft and its six Earth-observing instruments.

b. Brochures for each of the four U.S. and one Japanese Aqua science teams. These brochures, created through the outreach efforts of the individual science teams, discuss many of the science issues being addressed with Aqua data and provide details about the Aqua instruments being used. The science issues include, as examples, the role of clouds in the climate system, the possibility of an acceleration of the water cycle, and specifics of the interactions amongst the atmosphere, oceans, land, ice, and biosphere.

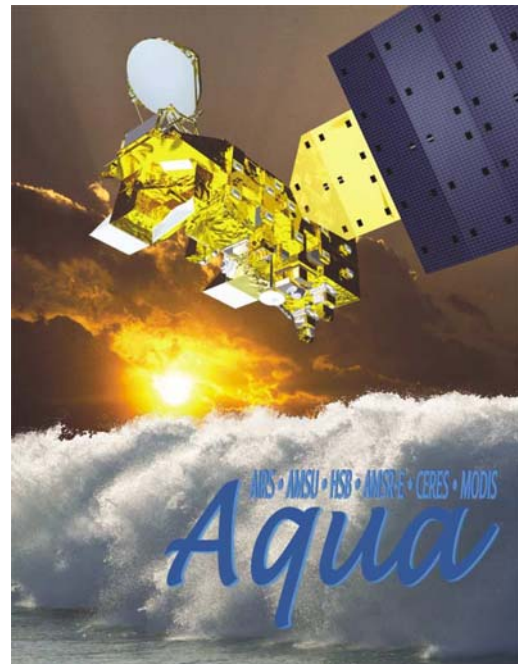


Figure 2. Cover of the Aqua brochure.

c. An Aqua lithograph, with a glossy color image of Aqua on the front and a one-page description of the mission on the back.

d. NASA Fact Sheets on Aqua, the water cycle, and the history of weather forecasting. These black and white "Fact Sheets" provide short (4-6 pages) descriptions of the topic in question, written as background material for a general audience.

e. An Aqua Science Writers' Guide. This booklet describes, for science writers in particular, some of the science topics that the Aqua data will be used to examine.

f. Aqua trading cards. So far these include seven cards—one for the mission as a whole and one for each of the six Earth-observing instruments. The cards have a picture on the front and text on the back. The plan is to expand this 7-card set approximately one year after launch, adding cards showing sample images of many of the Aqua data products.



Figure 3. Aqua trading cards.

g. Posters. Several posters have been or are being created, highlighting the mission and its data products.

The Aqua brochure, the brochures for the four U.S. science teams, the lithograph, the Fact Sheets, and the Science Writers' Guide are all available at <http://aqua.nasa.gov/publications.html> and can be downloaded from that site.

3. WEB CASTS

One of the highlights of Aqua outreach has been a series of web casts produced by the Goddard Space Flight Center Special Project Initiatives (SPI) Office. These web casts are live, interactive programs with a solid education content that are broadcast via the internet to a variety of formal and informal education audiences, including classrooms. The subject matter focuses on the connection between Aqua science and engineering and high school Earth science curriculum. The web casts provide the opportunity for viewers to watch NASA scientists discuss their work, sometimes in remote and/

or restricted areas, and to ask questions through a chat session, with answers coming live on the internet.

Topics explored and on-site locations for the web casts have included:

- Aqua engineering from the cleanroom at TRW in Redondo Beach, California, where the Aqua spacecraft was built and the instruments integrated (December 19, 2001).



Figure 4. Live interview taking place during the Aqua web cast from the TRW cleanroom on December 19, 2001.



Figure 5. Equipment setup for the December 19, 2001 Aqua web cast from the TRW cleanroom.

- Earth science subjects, including clouds and the Earth's radiation budget, advanced weather forecasting, phytoplankton and ocean color, and precipitation and the water cycle, addressed from 9,000 feet above sea level on the Mauna Kea volcano and from the Snug Harbor Marine Optical Buoy (MOBY) facility, both in Hawaii (February 5 and 8, 2002).

- A discussion and demonstration of the physics involved in the launch and deployment of a satellite, broadcast from the launch site at Vandenberg Air Force Base in Lompoc, California (May 2 and 4, 2002).

Preliminary planning is underway for a possible future web cast from the Chesapeake Lighthouse, a heavily instrumented platform off the coast of Virginia, being used in the validation activities for Aqua and other satellites. Archives of the completed web casts are available at <http://aqua.nasa.gov/outreach/webcast.html> in a unique video indexed format that allows the user to access and view specific segments of the web cast based on a hyperlink menu. Viewing the archived versions does not allow participation in the popular chat sessions but does allow a great deal of flexibility in selecting segments and re-running them.

4. "COOL SCIENCE" WEB SITE

In addition to the web casts, the SPI Office has produced an innovative web site for the Aqua program entitled "Cool Science." To do so, they have filmed many Aqua scientists answering questions about a variety of Earth science topics and have organized clips from these interviews into a dynamic and interactive web site (<http://aqua.nasa.gov/outreach/coolscience.html>) that showcases the scientists and engineers as well as the science and imagery that define the Aqua mission. The visitor to the web site determines his or her path of discovery using a non-linear graphical user interface designed with the intention of promoting science inquiry. Selecting one of nine science areas (spacecraft, atmosphere, clouds, precipitation, land ice, vegetation, soil, water, and sea ice) will launch a multimedia experience that includes streaming video interview clips of Aqua scientists supported by a slide show consisting of satellite imagery, pictures, graphics, animations, web links, and text abstracts. Each of the nine science areas addresses National Academy of Sciences Science Content Standards for grades 9-12 and contains ten tiered questions that are designed to provide background information on the topic and then advance the user to higher-level concepts and analysis within the science area. This combines to a total of 90 video clips with

supporting slide shows that are meant to be educationally sound and of interest to a wide range of audiences.

In order to provide longevity and download capability to the products produced for *Cool Science* as well as other digital NASA resources, the SPI Office has developed an interactive searchable database. The online database enables teachers and students to search by topic and concept to find resources for use in lessons and presentations. Resources include video interviews with NASA scientists and engineers, satellite images, data charts and graphs, animations, photos, and an abstract for each item. Materials included in the database are some of the most recent NASA resources, are linked to National Science Education Content Standards, and are available for download through the database program.

5. PRESENTATIONS

Presentations describing the Aqua mission and its science have been given at numerous schools, colleges, universities, and conferences, and to groups of teachers. Hundreds of students, teachers, and others have thereby become exposed to the Aqua mission and the Earth science topics being addressed with the space-based Aqua data. Interest has been particularly keen since the Aqua launch on May 4, 2002, and in the few months prior to the launch.

The presentations have benefited significantly from a set of sophisticated computer animations created as part of the Aqua outreach effort. These include an animation of the launch, an animation of the unfurling of the solar array and on-orbit instrument deployments, animations of the Aqua orbit and the scanning patterns of the Aqua instruments, and an animation of a constellation of satellites expected in the 2004 time frame, led by Aqua. These animations were created using the sophisticated software animation packages "Maya" from Alias Wavefront and "Lightwave" from New Tek.

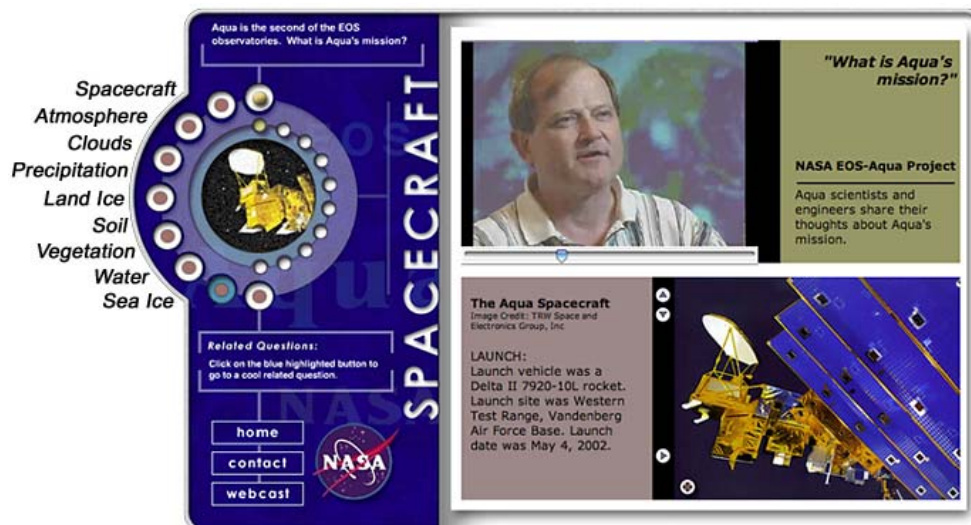


Figure 6. Annotated lead page of the "Cool Science" web site.

6. ADDITIONAL ACTIVITIES

Each of Aqua's five science teams has its own outreach efforts, and these include a variety of activities. Of particular note is the Students' Cloud Observations On-Line (S'COOL) program, led from NASA's Langley Research Center and involving students from over 1000 schools around the world, each making local observations of cloud properties to compare with the cloud data from Aqua and other satellites.

7. SUMMARY

The Aqua mission has a variety of educational outreach activities, aimed at informing students and the general public about the Aqua mission and educating them about some of the Earth science topics that the Aqua mission is addressing. These activities include printed materials, web casts, web sites, and presentations. The interested reader can learn more about each of these by going to the Aqua web site <http://aqua.nasa.gov>.