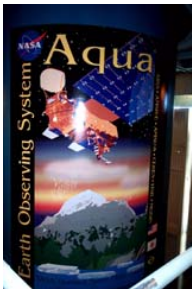
AQUA: IN ORBIT AND READY FOR THE SCIENTISTS

Claire L. Parkinson
NASA Goddard Space Flight Center

After over a decade of development, the Aqua spacecraft was finally launched on May 4, 2002, from Vandenberg Air Force Base in California.



Dozens of Code 400 personnel were critical to its success; and now, as many of them move on to other projects, the core of the Aqua work passes to mission operations, data handlers, and scientists. This article presents an overview of the Aqua mission from the science perspective, emphasizing the Earth-observing instruments and science teams to the exclusion of the equally fascinating and numerous additional aspects of the mission.

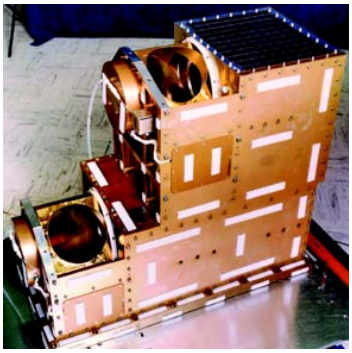
Aqua carries six distinct Earth-observing instruments, all placed on board the spacecraft in order to help scientists examine and further understand the Earth's global climate system. As the name suggests, the Aqua mission has a particular concentration on water, with Aqua scientists examining ocean surface water, evaporation from the oceans, water vapor in the atmosphere, clouds, precipitation, soil moisture, snow cover and glacial ice on land, and sea ice in the oceans. In addition to water in all its forms, scientists are also analyzing Aqua data for information on vegetation, ocean productivity, trace gases and aerosols in the atmosphere, and other elements of the Earth's climate system.

Launch of the Aqua spacecraft, May 4, 2002. (Photo by Bill Ingalls/NASA.)

AIRS/AMSU/HSB

AIRS. (Photo courtesy of BAE Systems.)

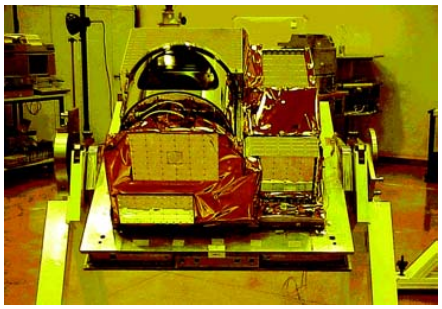
Of the six Aqua instruments, the one with the greatest technological advances made as part of the Aqua program is the Atmospheric Infrared Sounder (AIRS). AIRS is a high-resolution sounder with 2378 channels measuring infrared radiation at wavelengths in the range 3.74-15.4 μm and four channels measuring visible/near-infrared radiation at wavelengths in the range 0.4-1.1 μm.



AMSU-A1. (Photo courtesy of Aerojet.)

AIRS is joined on Aqua by two micro-wave sounders: a 15-channel Advanced Microwave Sounding Unit (AMSU, consisting of two separate units, AMSU-A1 and AMSU-A2) and a four-channel Humidity Sounder for Brazil (HSB), provided by the Instituto Nacional de Pesquisas Espaciais (INPE), the Brazilian National Institute for Space Research. The AMSU and HSB are similar to instruments flying on satellites of the National Oceanic and Atmospheric Administration (NOAA) since May 1998, but when linked with the AIRS on Aqua, they become vital components of the most advanced sounding system ever flown in space: Aqua's AIRS/AMSU/HSB triplet.

The central purpose of the AIRS/AMSU/HSB combination is to obtain accurate atmospheric temperatures and humidities throughout the atmosphere, from the surface upward to an altitude of 40 km



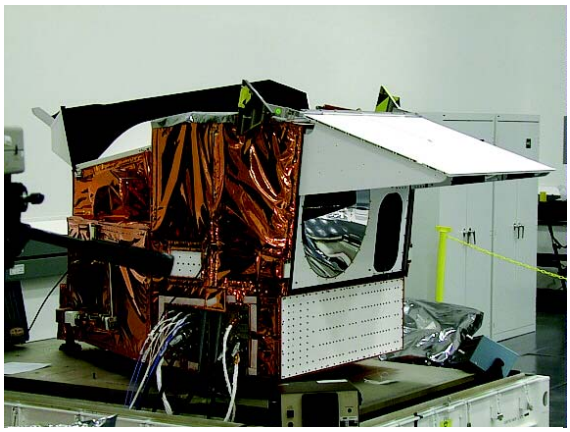
HSB. (Photo courtesy of Brazil's Instituto Nacional de Pesquisas Espaciais.)

MODIS

The other three instruments on Aqua, outside of the AIRS/AMSU/HSB sounding suite, are the Moderate Resolution Imaging Spectroradiometer (MODIS), the Clouds and the Earth's Radiant Energy System (CERES), and the Advanced Microwave Scanning Radiometer for EOS (AMSR-E). MODIS and CERES instruments are also on Terra, launched in December 1999, and are provided by NASA, while AMSR-E is new and is provided by Japan's National Space Development Agency (NASDA).

Early Data

All six Earth-observing instruments on Aqua (or seven, when counting the two CERES individually) are now operating and sending down high quality data. The first instrument to be turned on was the



MODIS. (Photo courtesy of Raytheon.)

AMSU, on May 12, followed two days later by the HSB. Within days, the AIRS/AMSU/HSB science team had created first-light images from these data streams, mapping color-coded brightness temperatures (reflecting the radiation values received) for individual channels of data across the eastern U.S., the western U.S., and, for the HSB, Brazil. The next instrument to be turned on was NASDA's AMSR-E, with its data flow beginning on May 24. Some initial complications with the AMSR-E data were quickly solved by NASDA, who by June 1 had adjusted the automatic gain control (AGC), correcting the data flow. Days later NASDA created two global maps illustrative of the high quality data from the AMSR-E instrument, one map showing sea surface temperatures and the other showing a color-composite produced from three of the AMSR-E channels.

The AIRS visible data started flowing on May 26, and the AIRS infrared data started to flow on June 12. The CERES data started to flow on June 18, and the MODIS data started on June 24. In each case, very quickly after the instrument was turned on, the relevant science team had created first-light images illustrating the fact that the instrument is working and is obtaining high quality data. The MODIS team has indicated the clearly superior quality of the initial Aqua images versus the initial MODIS images from Terra, where there was an undesired striping; and the AIRS team, in addition to creating images, has plotted infrared spectra at individual points, establishing that every one of the 2378 infrared channels on AIRS is working.