CloudSat exits the 'A-train'

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Artist's illustration of NASA's Cloudsat satellite. Credit: Graeme L. Stephens

Mission managers at NASA's Jet Propulsion Laboratory in Pasadena, California, this week lowered the orbit of the nearly 12-year-old CloudSat satellite following the loss of one of its reaction wheels, which control its orientation in orbit. While CloudSat's science mission will continue, it will no longer fly as part of the Afternoon Constellation, or

A-Train—six Earth-monitoring satellites that fly in a coordinated orbit to advance our understanding of how Earth functions as a system.

CloudSat launched in 2006 to improve understanding of the role clouds play in our climate system. It joined the A-Train about a month later. In April 2011, the spacecraft experienced a technical issue affecting the ability of the battery to provide enough current to power all spacecraft systems during the time in each orbit when the spacecraft is on the dark side of the planet and the spacecraft's solar panels are not illuminated. In response, spacecraft engineers at Ball Aerospace in Boulder, Colorado, developed a new operational mode for CloudSat that enabled it to continue science operations, but only during the part of each orbit when the spacecraft is in sunlight.

Recognizing the vulnerable nature of the spacecraft battery and the age of other spacecraft systems, the CloudSat project developed a set of criteria under which they would exit the A-Train. One criterion was the loss of one of CloudSat's four reaction wheels. Although CloudSat can conduct science operations using only three reaction wheels, a subsequent loss of a second reaction wheel could leave the spacecraft unable to maneuver or change its orientation. Without the capability to maneuver, the satellite could drift too close to another A-Train satellite.

In June 2017, one of CloudSat's reaction wheels displayed significant friction. It was subsequently determined that the wheel would no longer be usable, thus triggering preparations to exit the A-Train.

On Feb. 22, CloudSat successfully executed two thruster burns, placing the satellite in an orbit below the altitude of the A-Train. After telemetry has been analyzed, mission managers will determine if a third orbit trim burn is necessary. CloudSat will remain in this "safe-exit orbit" while the project studies orbit options for continuing science operations even farther below the A-Train.

CloudSat is the first satellite to use an advanced cloud-profiling radar to "slice" through clouds to see their vertical structure, providing a completely new observational capability from space. The mission furnishes data that evaluate and improve the way clouds and precipitation are represented in global models, contributing to better predictions of clouds and their role in climate change.

Among the mission's many science accomplishments to date, CloudSat has provided the capability to look jointly at clouds and at the precipitation that comes from them, spotlighting flaws in climate model physics: models produce precipitation too frequently, and the modeled precipitation is lighter than actual observations. CloudSat directly quantified, for the first time, global snowfall and found that climate models overestimate Antarctic snowfall, many by more than 100 percent.

The A-Train satellites rush along together like a train on a "track" 705 miles (438 kilometers) above Earth's surface, flying minutes, and sometimes seconds, behind one another. Together, the satellites and their more than 15 scientific instruments work as a united, powerful tool to examine many different aspects of our home planet. The A-Train has proven to be a successful integrated approach to observing Earth because it allows multiple instruments to observe the same location on Earth nearly simultaneously as they pass overhead. In addition to CloudSat (a partnership with the Canadian Space Agency and the U.S. Air Force), the other satellites currently in the A-Train include NASA's Aqua, Orbiting Carbon Observatory-2 and Aura spacecraft; the NASA/Centre National d'études Spatiales (CNES) Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) spacecraft; and the Japan Aerospace Exploration Agency's Global Change Observation Mission—Water (GCOM-W1) satellite.

With CloudSat now in an orbit below the A-Train, it will occasionally

pass beneath the constellation, enabling the mission to collect data in support of some of its pre-A-Train-exit data products.

More information: For information on CloudSat and the A-Train, visit www.nasa.gov/CloudSat

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