Braced in space

Boeing's newest Earth observation satellites are providing the most precise weather information ever. That's important for people preparing for storms.

PHOTOS:

RIGHT: The third of three new Boeing-built GOES satellites finishes thermal-vacuum testing at Boeing's satellite factory in El Segundo, Calif. **BOB FERGUSON/BOEING**

ABOVE: Betty Kwan is responsible for GOES' suite of sensors used to track space weather. **GLADYS WICKERING/BOEING**

By Dave Garlick

When a major storm is looming, people and authorities depend on accurate weather information to make the right preparations. Knowing where and when a hurricane or an outbreak of severe weather will hit helps forecasters give more accurate warnings—which potentially can save lives and property.

To meet this important need, Geostationary Operational Environmental Satellites (GOES) were built for NASA to help National Oceanic and Atmospheric Administration (NOAA) scientists and weather forecasters produce real-time weather and environmental data and solar imaging. That data also provides support for U.S. Coast Guard search and rescue missions.

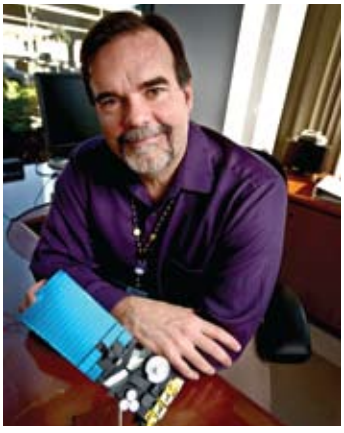
To provide forecasters with even more accurate information, Boeing is building and fielding the world's most advanced multimission weather and Earth observation satellites. Boeing built and launched the trailblazing satellite GOES-13 in 2006; it's currently in a geostationary "storage" orbit waiting for the opportunity to replace one of two existing weather satellites nearing the end of their useful lives. To round out this service, GOES-13 will be followed by GOES-14 and GOES-15 (currently called GOES-O and GOES-P), identical satellites also built by Boeing. These spacecraft will produce data that is two to three times more precise because of their stability in space.

"When you do a side-by-side comparison of the previous series of GOES satellites, their pictures move around significantly. Ours stay steady as a rock," said Doug Hein, a Boeing technical fellow. "The effect is like watching video shot from a tripod versus the same video shot from a hand-held camera. The steadiness comes from precision spacecraft pointing technologies."

STABLE AT ANY TEMPERATURE

Most materials used to build satellites will twist and distort as the temperature in space fluctuates from 200 degrees Celsius (392 degrees Fahrenheit) in full sunlight to -200 C (-328 F) in Earth's shadow. Even a slight warp will throw off the satellite's aim from 22,300 miles (35,900 kilometers) up in geosynchronous orbit.

With the new GOES spacecraft, Boeing engineers solved this problem by using a thermally stable platform called the optical bench, which can handle the huge temperature swings without distortion. All GOES' instruments that need stability, such as the imager, sounder and the "star tracker," are attached to it.



The imager produces visible and infra-red pictures of Earth's surface while the sounder looks down through the atmosphere to gauge temperature and moisture levels. Star trackers—officially known as the Stellar Inertial Attitude Determination system—use the stars to determine where the satellite is pointing.

"The instruments and the pointing sensors don't move relative to each other, so in effect what you're doing is flying the bench," said GOES program director Charlie Maloney.

TV-ready weather video is really a series of pictures taken every 15 minutes or so by a weather satellite and strung together for a time-lapse effect. Combine that with data from the sounder and you get invaluable information forecasters can use to predict a storm's direction and speed. Taking steady time-lapse pictures from a free-floating platform such as a satellite in geosynchronous orbit requires extraordinary accuracy and repeatability. Indeed, from its orbit 22,300 miles above Earth, GOES-13 can point its imager at a spot on Earth and keep it there so accurately that it would be like focusing on the winning side of the coin tossed at the Super Bowl while flying in a plane 4,500 feet above the stadium.

Boeing engineer Betty Kwan has been working on GOES almost since its inception 10 years ago. She is responsible for the 12 different sensors on the space-facing side of GOES that monitor space weather and magnetic fields. Scientists and forecasters at the Colorado Space Weather Prediction Center use the data to watch for solar flares, which can erupt at any time with a force equal to 100 million hydrogen bombs and blast a huge amount of highly charged particles out into the solar system. This electromagnetic soup can damage satellites, disrupt power grids and radio communications, and pose a radiation hazard to astronauts or aircraft flying near the poles.

"GOES contributes to the planet and our national interests, and ultimately it can save lives," Kwan said. "Those who are working on GOES feel they're providing a critical service to the nation, something we're all very proud of."

Boeing's GOES team now is preparing for the launch of the second satellite in late April. GOES-O, which will be renamed GOES-14 after launch, was completed in 2005 and has been in storage waiting for an available Delta IV launch vehicle.

"We put GOES-13 up, there were a lot of doubters about whether or not it would perform like we said it would," said Maloney. "GOES-O is our opportunity to prove that GOES-13 wasn't a fluke. Our satellites are that good." ■

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PHOTO: GOES Program Director Charlie Maloney and his team completed GOES-O in 2005. The spacecraft, which has been in storage since then, is slated to be launched in April.
GLADYS WICKERING/BOEING