A Closer Look at Global Warming: Aerospace Engineers from The University of Texas at Austin launch NASA climate study satellites from Russia

Some people believe the Earth is growing warmer. Others say, nonsense. Some researchers think Earth's polar ice caps are melting. Others insist they're getting thicker. To some, El Niño is more frequent and fiercer than ever before. Others don't believe it.

Answers to questions like these, which affect the well-being of our entire planet, will start to roll in from space soon, thanks to the Gravity Recovery and Climate Experiment (GRACE) project. GRACE deploys twin satellites to gather detailed information about the familiar yet uneven gravitational forces that not only bind us to Earth's surface but tell us much about its interior and exterior features, oceans, atmosphere and climate patterns.

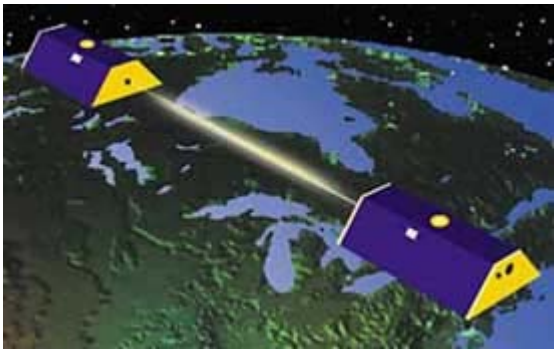

Photo courtesy of GRACE

Identical twins GRACE 1 and GRACE 2 will travel in tandem, separated from each other by a distance of 137 miles. They will act together as a single instrument, employing ultra-precise microwave ranging technology and global positioning systems to measure and map variations in the Earth's gravitational field with an accuracy 100 times better than has ever been done before.

Dr. Byron Tapley, a top university aerospace engineer and a worldwide expert on precision orbit determination, is the principal investigator for the international collaboration between NASA and German space scientists. Tapley, director of the UT Austin-based Center for Space Research (CSR), will become the first non-NASA employee to direct a NASA mission when the project takes flight from Russian soil on March 16.

In contrast to previous gravity measurements taken from the influence on a single satellite of Earth's gravitational pull, GRACE will measure the reactions of a pair of satellites to Earth's pull as gravity varies the distance between them.

Once launched into a polar orbit 300 miles above Earth, identical twins GRACE 1 and GRACE 2 will travel in tandem, separated from each other by a distance of 137 miles. They will act together as a single instrument, employing ultra-precise microwave ranging technology and global positioning systems to measure and map variations in the Earth's gravitational field with an accuracy 100 times better than has ever been done before. Equipment sensitive to one micron (1/50th the width of a human hair) will detect and record deviations in the satellites' relative paths due to changes in the surrounding gravitational field.

"Producing a precise model of the fluctuations in gravity, the invisible force that pulls two masses together, over the Earth's surface has proven a formidable task," Tapley said. "Currently, data from several dozen satellites must be combined to produce a model of Earth's gravitational field. These models do a good job at replicating the large-scale features, but cannot resolve finer-scale features or detail the small month-to-month variations in the gravity field associated with the water cycle."

Why is it important to map gravity with this precision?

1. A highly detailed map of Earth's gravitational field will relate minute

File photo UT Austin

Tapley

fluctuations of gravity to the planet's physical features, such as ice caps, continental water storage, or environmental events such as storms.
A precise record of gravity's footprint allows scientists to better trace the transport of water and heat between the oceans, atmosphere and land—information vital to the study of global climate change.
GRACE will generate a new map of Earth's gravity, which changes in time as well as by location, every month during the mission's expected five-year lifetime.

Here's how it works: As the front satellite approaches an area of higher gravity, such as a mountain, it will be pulled toward the area of higher gravity and speed up. This increases the distance between the two satellites. As the satellites straddle the area of higher gravity, the front satellite will slow down and the trailing satellite will speed up. As the trailing satellite passes the area of higher gravity, it will slow down and the lead satellite will not be affected. As the satellites move around the Earth, the speeding up and slowing down of the satellites will allow scientists to measure the distance between the two satellites and use this information to map the Earth's gravity field.

"We will be able to measure the distance between them with a precision better than 10 microns. That's like measuring the distance between Bastrop and Houston to within the width of 1/10 of a human hair," Tapley said.

The GRACE satellites, blasting off from Eurockot's dedicated launch facilities in Plesetsk, Russia, aboard the Rockot, represent a four-year, $150 million partnership between NASA in the United States and Deutsches Zentrum fur Luft und Raumfahrt (DLR) in Germany. Led by The University of Texas at Austin, the partners in the project include Jet Propulsion Laboratory in Pasadena, Calif., and GeoForschungsZentrum in Potsdam, Germany.

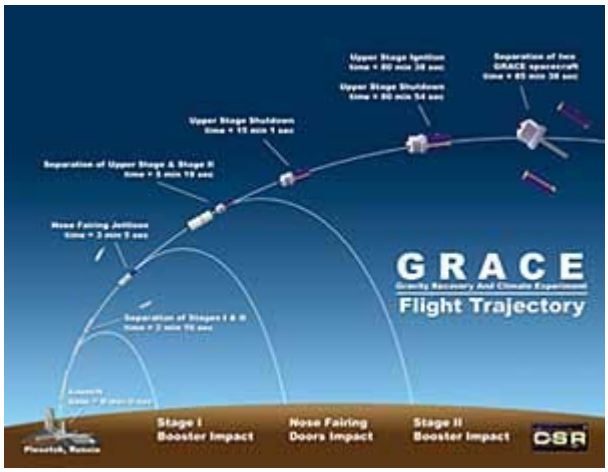

Photo courtesy of GRACE

Diagram showing the phases of the GRACE launch. Click the image for a larger version.

After viewing the launch via live feed from a satellite operations center in Germany, Dr. Tapley will return to his home base, The University of Texas at Austin's Center for Space Research. He'll continue to carry out his principal investigator duties for the next five years—the duration of the joint NASA/German commitment. Information pouring in from GRACE will be analyzed by researchers at CSR.

At the end of five years, if the satellites still remain operative in orbit, their status will be reassessed. "It's possible Austin could become GRACE's central control," said Dr. Wallace Fowler, associate director of the Texas Space Grant Consortium, whose students have been heavily involved in the project from its outset.

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- **NASA**
- **NASA Earth System Science Pathfinder Project**

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