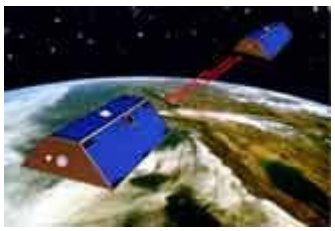

Researchers to Use Satellite Duo to Measure Earth's Gravity Field

SCIENCE TUESDAY

By Tariq Malik
Staff Writer
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With gravity, that omnipresent force that keeps humans firmly on the Earth and prevents planets from careening out of their orbits, it's the little things that researchers are interested in.

Like how melting ice reduces the force of gravity at planet's poles.

On Earth, for the most part, the tug of gravity is nearly uniform. But in some places, as with the poles, changes in the amount or density of material can create pockets of high or low gravity that change from month to month. Relatively permanent differences exist, too, caused by differing densities of material deep within the planet under certain locations.

Scientists hope to map these tiny variations, both in time and location, from space, using the Gravity Recovery and Climate Experiment, or GRACE.

The pair of satellites, which will stare at each other instead of Earth, is set for launch in March.

The novel setup, designed to measure gravity-induced fluctuations in distance between the two spacecraft, should also help create a better profile of the planet's atmosphere and contribute to global climate studies, researchers said.

"GRACE measurements are going to be 100 times more accurate than those we have now," said Michael Watkins, project scientist for the experiment at NASA's Jet Propulsion Laboratory. "They are going to revolutionize our understanding of Earth's structure, oceans and climate and how they are changing."

Measuring gravity

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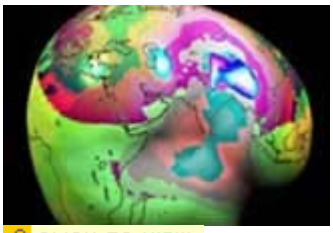

An exaggerated map of the Earth's gravity field. High elevations indicate an area of increased gravity, while low elevations show areas of decreased gravity. Credit:JPL Click to enlarge.

The two GRACE satellites during construction. Project researchers expect the spacecraft to spend five years mapping the Earth's gravity field from orbit. Credit: GFZ Click to enlarge.

An artist's conception of the GRACE satellites in orbit. The duo will trail each other by 137 miles (220 kilometers) and measure changes in the distance between them with microwave range finders during the gravity study.

The modern concept of gravity is credited to Sir Isaac Newton of 17th century England, who derived the law of universal gravitation stating that all objects attract each other with a force, gravity, proportional to the product of their masses and also dependent on the distance between them.

Since Newton's time, scientists have come up with a couple of ways to measure gravity. The use of gravimeters, earthbound devices that can determine the gravitational pull at a specific location, are accurate but have limited reach.

Scientists looking to study Earth's gravity field on a larger scale ultimately look toward the skies in order to see the field's effect on satellite in orbit.

Such studies led to the discovery of lower than normal gravity off India's shores, apparently due to the structure of mantle material beneath the Earth's crust. Similarly, investigators have reported a "gravity high" in the South Pacific resulting from the same sort of phenomena. The variations, however, are very small, with a difference of less than one percent.

But those differences, researchers said, can reveal much about the structure of the Earth interior, as well as its oceans.

They can tell of Earth's past, too, as well as help researchers study current climate and sea-level change.

CLICK TO VIEW Credit: JPL Click to enlarge.

Project scientist Michael Watkins, of NASA's Jet Propulsion Laboratory. Watkins believes that the GRACE project will yield gravity field measurements 100 times more accurate that current methods. Credit: JPL Click to enlarge.

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Earth's polar ice caps used to be larger than they are today, and the weight of that ice flattened the Earth a bit at the poles, Watkins explains. As ice melted off, the land beneath it -- such as Northern Canada and Scandinavia -- rebounded and the planet grew more spherical, resulting in changes to the gravity field.

Such uprisings continue today.

Not only will GRACE be able to measure these variations, Watkins added, but it will allow researchers to weigh Earth's ice sheets and study sea level changes by tracking the mass of ice.

Staring at each other, not Earth

Once launched into Earth orbit, the project's satellites will be separated by a distance of 137 miles (220 kilometers).

The two spacecraft will use microwave range finders to measure the distance between each other. The instruments will sense a difference in position of one micron, or about one-fiftieth the width of a human hair.

As the GRACE satellites orbit Earth, areas of stronger gravity will affect the leading craft first, pulling it a bit away from the trailing one. By measuring this small change in distance, scientists will be able to see fluctuations in the Earth's gravity field and create a new map of the field every 30 days.

Watkins said the constantly updated maps would give researchers a better idea of how the mass of the Earth changes due to the movement of magma beneath the surface, the thinning of ice sheets at the poles or even ocean water currents.

GRACE is a joint effort by the NASA and the German Aerospace Center. The science mission is led by the University of Texas Center for Space Research. GRACE scientists expect their project to run about five years, but they're not alone in their mission to map Earth's gravity field.

Researchers with the European Space Agency hope to launch the Gravity Field and Steady State Ocean Circulation Explorer, a one-year mission to map the planet's gravitational field and physical shape, by 2005.

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