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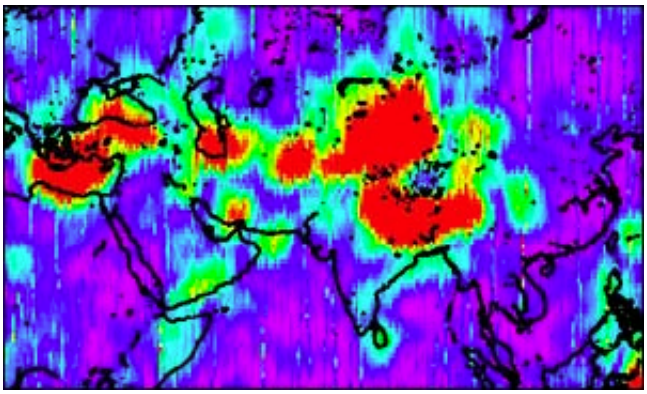
Earth's equatorial 'obesity'



Grace maps will be far more detailed

By Molly Bentley
BBC News Online, in San Francisco

Fluctuations associated with climate warming are behind the Earth's mysteriously expanding waistline, scientists said at the American Geophysical Union (AGU) fall meeting in San Francisco this week.

> **One has to be concerned for the health of the planet**
>
> **Dr Jean Dickey**

A surge in sub-polar glacier melting, along with shifts in ocean circulation, had forced massive redistributions of water away from the poles to the Earth's midsection, said physicist Jean Dickey of the Jet Propulsion Laboratory (JPL) in Pasadena.

The result is a planet shaped increasingly like a pumpkin.

"Some people refer to it as equatorial obesity," said Dr Dickey, co-author of a study recently published in the journal Science.

Researchers from JPL and the Royal Observatory in Belgium sought to explain the increasing oblateness of the Earth after scientists first reported on it in this summer.

Earth 'getting fatter'

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In that study, gravity measurements revealed an abrupt reversal of post-glacial rebound, which for millennia had produced a rounder Earth.

Planet's health

The reversal stunned scientists, but they puzzled over its cause.

The new study links a tripling in the average glacial melt rate - from 100 cubic kilometres in 1989 to 320 cubic kilometres in 1998 - to the squishing of the planet and the subsequent changes in the gravity field.

"The gravity measurements suggest there is a big change in the Earth, both in its oceans and its ice," said Dr Dickey. "One has to be concerned for the health of the planet."

OPEN IN NEW WINDOW : In Pictures

The first image from the Grace spacecraft

For that reason, scientists are anxious for more sophisticated climate monitoring. The AGU conference highlighted two important new space missions that will do just that.

The Gravity Recovery and Climate Experiment (Grace) is already underway.

The US space agency (Nasa) and German Aerospace Center mission aims to create the most accurate gravitational maps to date by measuring minute shifts in mass over the Earth's surface.

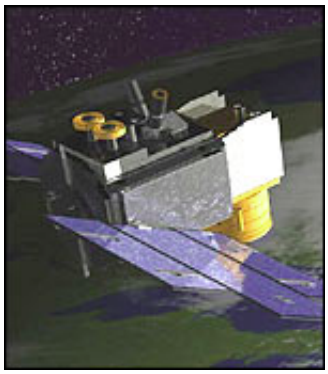
Bouncing beams

AGU participants saw the first image from Grace - a map (see pop-up for full image) of colour gradations that reveals gravitational hot spots around the planet. Areas of strongest gravitational pull - such as the

Himalayas or the Pacific Ocean - appear in red.

The map shows accuracy that is unprecedented in gravitational monitoring, according to Byron Tapley, the project's principal investigator at the Center for Space Research at the University of Texas at Austin.

"With roughly three months of Grace data," he said, "we've done an order of magnitude better than we've been able to do with some 30 years of satellite data."


ICESat: Soon to launch

That includes satellite laser ranging - the technique that detected the Earth's growing bulge - which relies on bouncing laser beams between numerous satellites and ground stations, and is accurate to within two to three millimetres.

By contrast, Grace relies on microwaves, shooting them back and forth between twin satellites which orbit the poles nose-to-tail, 220 kilometres apart.

Water movement

As the first satellite lurches and drags through the Earth's uneven gravity field, the second follows in a calibrated pursuit, measuring the intervening distance to the micron (a thousandth of a millimetre).

Since the predominant movement in the Earth's mass comes from water, Grace mainly tracks weight redistribution associated with shifts such as ocean circulation, glacial melt or the depletion of an aquifer.

"It gives us another remote sensing tool to understand the Earth's climate and how water is moving around the Earth," said Michael Watkins, Grace project scientist at JPL.

> **We actually have better information of planet Mars than we do Earth**
>
> **Dr Jay Zwally**

"If water were to melt from the poles and go into the ocean, we could detect that change."

Another unique remote sensing tool will soon join Grace in space as scientists anticipate the launch of the Ice, Cloud and Land Elevation Satellite (ICESat).

While Grace measures water mass, ICESat will measure ice sheet elevation. It is scheduled to launch from Vandenberg Air Force Base on 19 December.

Exciting times

"The geophysical community has been waiting for ICESat for 30 years," said Nasa researcher Eric Rignot, who studies the Antarctic ice sheet.

The satellite's unique cargo - the Geoscience Laser Altimeter System (Glas) - is the first space laser altimeter used to detect ice sheet mass balance.

While changes in ice sheets strongly influence sea level and are therefore critical in assessing climate change, glaciologists do not have the precise data they need to determine whether the massive ice sheets in Greenland and Antarctica are currently growing or shrinking or how they might change as the Earth warms, according to ICESat project scientist Jay Zwally.

"We actually have better information of planet Mars than we do Earth," said Dr Zwally, referring to a laser altimeter that Nasa flew around the Red Planet a few years back.

Along with ice sheet measurements, ICESat will provide data on sea ice, vegetation and aerosol distribution. Combined with Grace, the "dynamic duo", as one researcher called them, have enormous potential for advancing climate science.

"Grace is exciting because it's the first gravity mission," Dr Watkins said, "and ICESat is the first ice sheet altimeter, and in that sense a pioneer. Together they will help us get a much better picture of the climate than we've ever had in the past."

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