News Front Page
Africa
Americas
Asia-Pacific
Europe
Middle East
South Asia
UK
Business
Health
Science/Nature
Technology
Entertainment
Have Your Say
Country Profiles
In Depth
Programmes
RELATED SITES
BBC SPORT
BBC WEATHER
BBC ON THIS DAY

Last Updated: Thursday, 24 July, 2003, 16:49 GMT 17:49 UK

E-mail this to a friend Printable version

'Potato' Earth's deep secrets

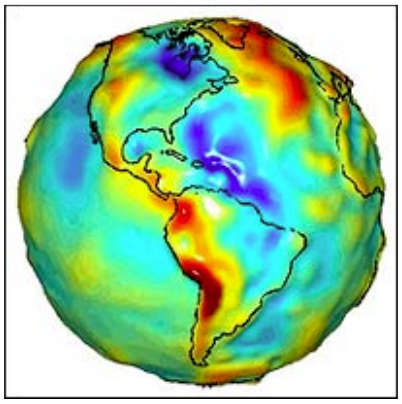
By Jonathan Amos
BBC News Online science staff

It is a map the like of which you have probably never seen before.

The sweep of colours shows minute variations in the Earth's gravitational field.

If you were to fly over the red areas, you would be tugged ever so slightly downwards; the blues mark regions where the planet's attraction is much weaker.

These gravity anomalies, as they are known, are imperceptible to the human senses, and so the scientists have wrapped the data on to a sphere and exaggerated the highs and lows.



Gravity highs are marked red; gravity lows are blue

OPEN Enlarge Image

This gives us a stunning visual representation of the subject under study.

VIDEO Click here to see the spinning gravity model

It might look a bit odd - but don't be fooled by this "virtual potato". The map and the others that will follow it are going to give extraordinary new insights into how the oceans move and influence the climate.

Understanding precisely how greenhouse warming could change our planet will depend on these bumps and pimples.

Sharp focus

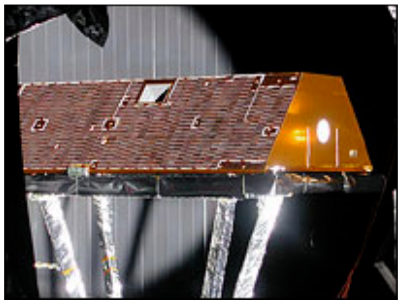
The map has been produced by the US-German Gravity Recovery and Climate Experiment (Grace) mission.

This model is the first full science product to come out of the mission which gathers its data from two spacecraft orbiting more than 450 kilometres above the Earth.

Earth's equatorial 'obesity'
11 Dec 02 | Science/Nature
Earth 'getting fatter'
02 Aug 02 | Science/Nature
Earth loses weight
01 May 00 | Science/Nature

RELATED INTERNET LINKS:
Grace
The BBC is not responsible for the content of external internet sites

Whales' recovery 'vastly overestimated'
'Potato' Earth's deep secrets
Museum planned for prehistoric art
Infertility 'could be wiped out'


One of the wedge-shaped twins in preparation prior to launch

The Grace twins, which were launched last year, are still being tested but already their gravity map easily surpasses the detail of any other previously obtained.

"I'd say this model is an order of magnitude more accurate than any of the previous ones built from satellite data," said Dr Byron Tapley, the principal investigator on the mission.

"In just 30 days, we collected enough information from Grace to improve what we'd done in 30 years by other methods by about a factor of 10. It's a dramatic improvement in what we know about the Earth and there is more to come," the University of Texas, US, researcher told BBC News Online.

The Grace satellites obtain their data by executing a carefully calibrated pursuit in orbit.

Mass movement

As one spacecraft lurches and drags through the Earth's uneven gravity field, the second follows 220 km behind, measuring changes in their separation to the nearest micron (a thousandth of a millimetre).

It is the size of those changes detected by the twins that describes the nature and scale of the gravity anomalies over which they pass.

GRACE GRAVITY MAP

"It's a dramatic improvement in what we know about the Earth and there is more to come"

OPEN Enlarge Map

Obvious hotspots are discernible, such as the Himalayas where mass continues to increase - and with it gravitational attraction - as rock is piled into the region by plate tectonic movements in the Earth.

But it is in the fine detail that Grace excels, particularly with the oceans which are a constant shifting mass.

"The ocean's surface, while appearing flat, is actually covered with hills and valleys caused by currents, winds and tides, and also by variations in Earth's gravity field," said the US space agency's Dr Lee-Lueng Fu.

"Scientists want to separate out these gravitational effects, so they can improve the accuracy of satellite altimeters like Jason and Topex/Poseidon, which measure sea surface height, ocean heat storage and global ocean circulation.

"This will give us a better understanding of ocean circulation and how it affects climate."

Deep down

The first model produced from the Grace data is a static map - a snapshot of the Earth's gravity profile. But of course this profile is changing with the movements in the solid Earth, the oceans and the mass of the atmosphere on top of them.

So Grace, every 30 days, will send down new map data that will give a time-variable view of the gravity profile.

They will permit researchers to monitor changes - such as the major event in 1998 when satellites detected a sudden reversal in the shrinking of the Earth's girth that has been going on since the last Ice Age.

The probable cause was a surge in polar ice melting which, along with shifts in ocean circulation, sent a huge movement of water towards the equator.

"It's looking pretty certain that a lot of what was happening was due to something going on in the deep ocean," said Dr Chris Hughes, from the UK's Proudman Oceanographic Laboratory.

If it happens again, Grace will be able to provide more definitive answers.

"Grace allows us to see the parts of the ocean that are hardest to observe by any other method," said Dr Hughes, who will be using Grace to study deep circulation patterns.

"This is the only satellite technology that can actually see through the surface of the ocean; everything else gives you a measure of what's going on in the top metres.

"But with this, you actually see straight to the bottom."

All images courtesy of Nasa/DLR/UTCSR/GFZ

E-mail this to a friend Printable version

LINKS TO MORE SCIENCE/NATURE STORIES

Select Go

E-mail services | **Desktop ticker** | **News on mobiles/PDAs**

Back to top ^^

News Front Page | **Africa** | **Americas** | **Asia-Pacific** | **Europe** | **Middle East** | **South Asia**
UK | **Business** | **Entertainment** | **Science/Nature** | **Technology** | **Health**
Have Your Say | Country Profiles | In Depth | Programmes

BBCi Homepage >> | BBC Sport >> | BBC Weather >> | BBC World Service >>

Help | Feedback | News sources | Privacy | About the BBC