# Bulge in the ocean

Some giants are so big, they are practically invisible. Geophysicists have discovered one of them — a huge hump of water in the South Pacific that is imperceptible to the naked eye. Satellites aided scientists in tracking the phenomenon. Carmen Böning and her colleagues at the California Institute of Technology (Caltech) have reported a bulge in ocean waters that extended over an area the size of Australia for some months, and measured up to six centimetres in height (C. Böning *et al. Geophys. Res. Lett.* **38,** L04602; 2011). A "record" or an "unusual maximum", say the researchers.

The discovery can be attributed to the satellite programmes Gravity Field and Steady-State Ocean Circulation Explorer (GOCE) (http://go.nature.com/ZOJZup) and Gravity Recovery and Climate Experiment (GRACE) that measure the Earth's gravitational pull. These programmes have provided the most precise atlas of the Earth's gravitational field so far.

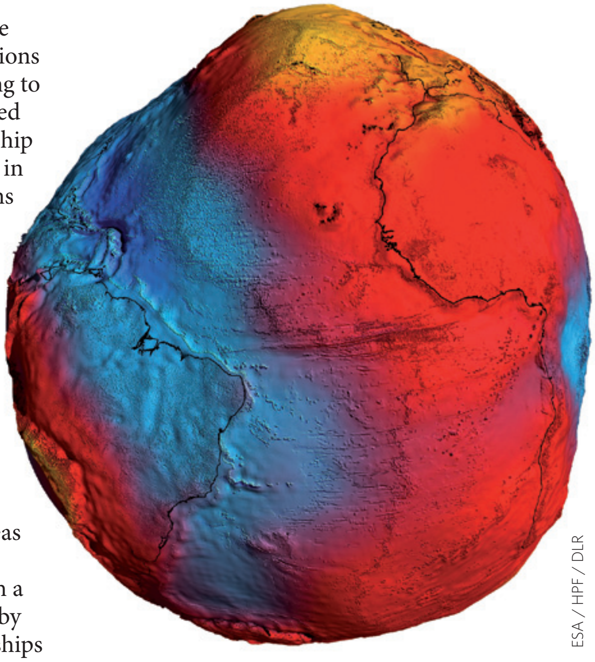
The GOCE maps show the form of the Earth if all mountains and ocean basins were levelled and the planet could be moulded like clay. The result is a potato-like shape (see image), with a surface that is deformed according to regional variations in gravitational pull. Areas with high gravity — where mass is concentrated — lead to bulges. Dents represent areas with weak pull.

GOCE makes the effect visible. The satellite's sensors detect minute variations in gravitational acceleration: according to the mission operators, the force exerted by a single snowflake on a container ship shows up. Differences in rock density in the Earth's interior cause the variations in the force of gravity: the denser the rock, the stronger the pull. But primarily, the data are intended for oceanographic measurements.

Unlike the continents, which are relatively inflexible, the shape of the ocean surface adjusts to the forces of gravity. Off the coast of India, sea level is 120 m lower than the global average at present, because of the relatively low gravitational pull in this location. Water is drawn to areas with greater pull.

The dip off India extends over such a wide area that it cannot be perceived by seafarers nor observed directly. And ships require no additional energy to travel out of the dent, because potential gravity is constant everywhere on the surface of the sea: the same amount of energy must be exerted to lift an object from the centre of the Earth to anywhere along the sea surface.

The deformability of water ensures more than its compliance with the forces of gravity. Atmospheric pressure and ocean currents also raise and lower sea level. GOCE and GRACE help detect these influences with unprecedented resolution. Their maps of gravitational pull supply a reference surface, so that deviations from that surface can be attributed to non-gravitational forces, such as ocean currents. With the GOCE data, the most precise maps of the oceans so far were unveiled.



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Thanks to the gravitational data, Carmen Böning and her colleagues discovered the big oceanic hump. Sea level was elevated in the South Pacific from October 2009 to January 2010. The researchers discovered the cause of the phenomenon in the weather map: an unusually stable high-pressure system dominated the region at the time. As a result, the wind direction persisted anticlockwise around the area of high pressure. Says Böning, "The wind was unusually strong and continued for an unusually long period of time."

The wind drove the water into the area of high pressure, through the effect of the Earth's rotation on ocean currents. In the centre of the circle, the water was trapped and the sea swelled up by six centimetres. The South Pacific Ocean bulge has been one of the most surprising discoveries based on gravitational data from GOCE and GRACE so far. ❐

### The journalist's take

In my daily survey of geoscientific publications, a paper entitled 'Record-high ocean bottom pressure in the South Pacific observed by GRACE' caught my eye: it held the promise of something special, a record. Most records are not relevant for a general audience. But extreme water pressures on the Pacific sea floor had potential.

Yet that alone would not necessarily be enough for a story. So I read the paper. It turned out to be about raised sea level, observed in a very large area over a period of months — unquestionably an unusual natural phenomenon. But could it be made accessible to the general public?

I contacted the paper's primary author, to find out the details: the exact elevation in sea level, the size of the area, the period over which it persisted, and finally, the explanation. The answers made it clear that the paper reported a special discovery.

However, I underestimated the level of interest in the story. I proposed it for the weekend, not prime time in terms of readership. I saw the story as a curiosity, rather than a significant piece of news. But in just a few hours, the text was read by nearly 300,000 people, and by far surpassed articles on politics, sports and even gossip. We should have run the piece during prime time.

In terms of journalistic criteria for a good story, the piece featured:

- A superlative: a record was set. People like to know what or who is first or last.
- A paradox: a bulge in the water is unexpected. A paradox brings together seemingly contradictory phenomena. That is stimulating.
- Scientific relevance and news quality: recent publication in a significant scientific journal.

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