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Earth's weight watched monthly

Picture of gravity will reveal where the water goes.
10 December 2002

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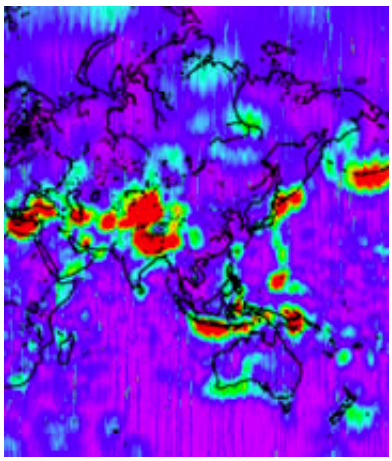

Mountain ranges and deep-sea trenches shift the satellites' orbits slightly.
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A satellite double-act has produced the most accurate map yet of the Earth's gravitational field, researchers announced on Saturday.

Monthly updates of this image will reveal previously invisible changes in ocean currents, groundwater reserves, ice sheets and river basins. The information should help us to monitor the planet's water and gain a better understanding of its climate.

The Gravity Recovery and Climate Experiment (GRACE), launched in March, is a pair of car-sized satellites flying about 220 kilometres apart. Onboard sensors measure the distance between the pair to within a hundredth of a millimetre - about the width of a red blood cell.

Anything with mass has a gravitational field, so mountain ranges and deep-sea trenches filled with billions of tonnes of water shift the satellites' orbits slightly. The change in the gap between the two spacecraft corresponds to a measurement of gravity below them.

"We'll be able to measure any process involving the redistribution of mass on a monthly scale," John Wahr, a GRACE scientist at the University of Colorado, Boulder, told the American Geophysical Union's fall meeting in San

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Francisco. The project is a partnership between the German Aerospace Centre and NASA.

GRACE's first map of the Earth's gravitational field reveals places where previous measurements have failed, says project leader Byron Tapley, of the University of Texas, Austin. These include inaccessible area such as the Himalayas, the Amazon and the poles.

But GRACE's trump card is its ability to measure the changes in gravity caused by the movements of water.

The satellites can detect changes in groundwater and river basins, which are crucial for farmers and environmental scientists. GRACE should be able to measure a 4-millimetre change in water height across the 32 million square kilometres of the Mississippi river basin, says Wahr.

Gravity maps will also aid oceanographers. Tracking temperature changes or measuring sea level from satellites is the only way to monitor the large-scale ocean currents that control the climate. But water's density, and therefore its height, changes with temperature and salinity, blurring many measurements, says oceanographer James Morison at the University of Washington in Seattle.

"GRACE is wonderful because it will basically weigh the water and allow us to overcome that," he says.