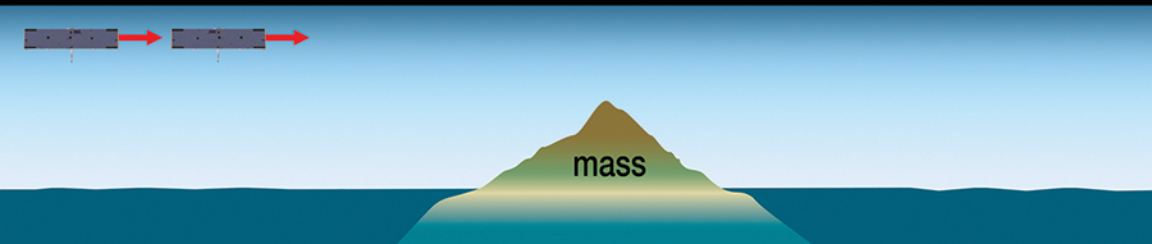
GRACE Follow-On

National Aeronautics and Space Administration

1. over ocean



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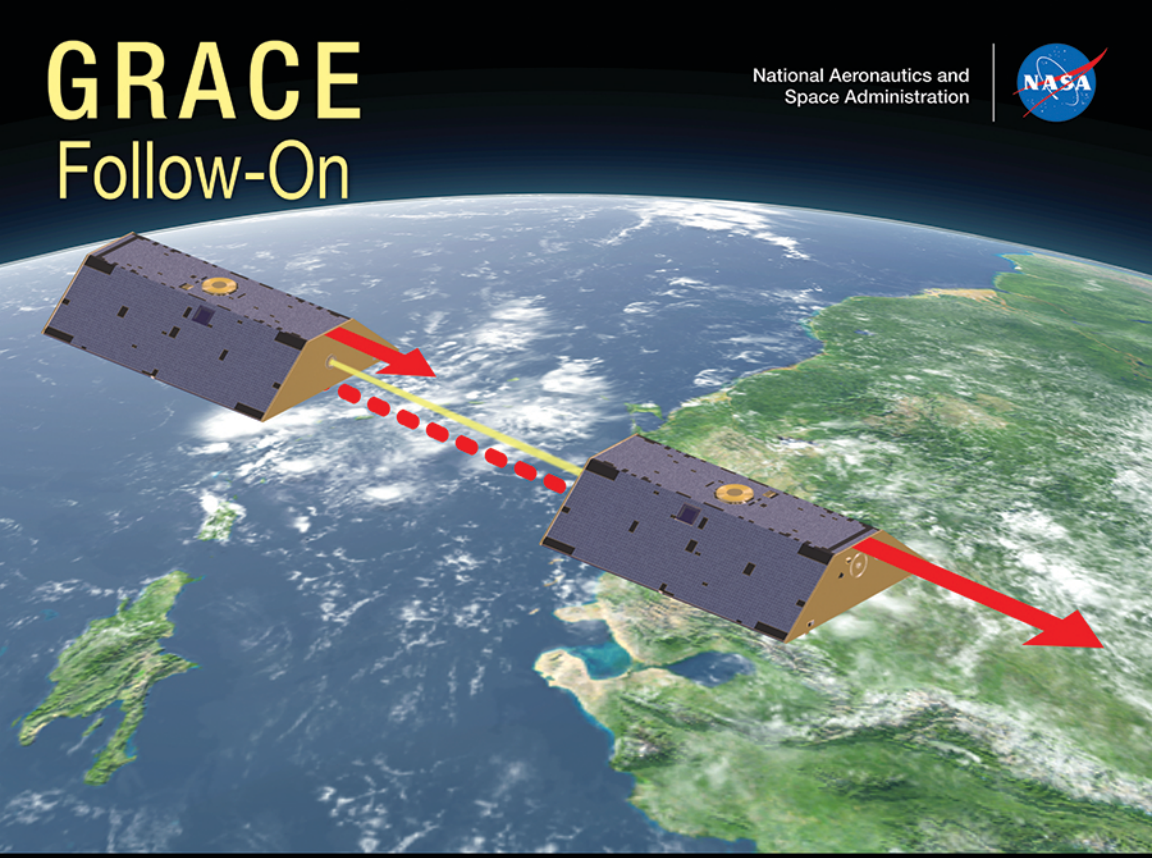
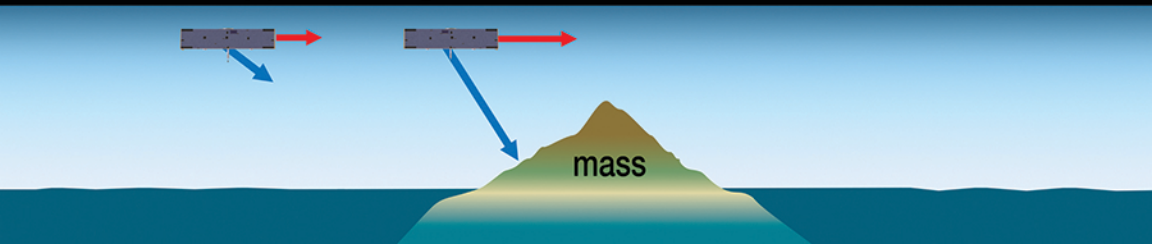


2. approaching mass



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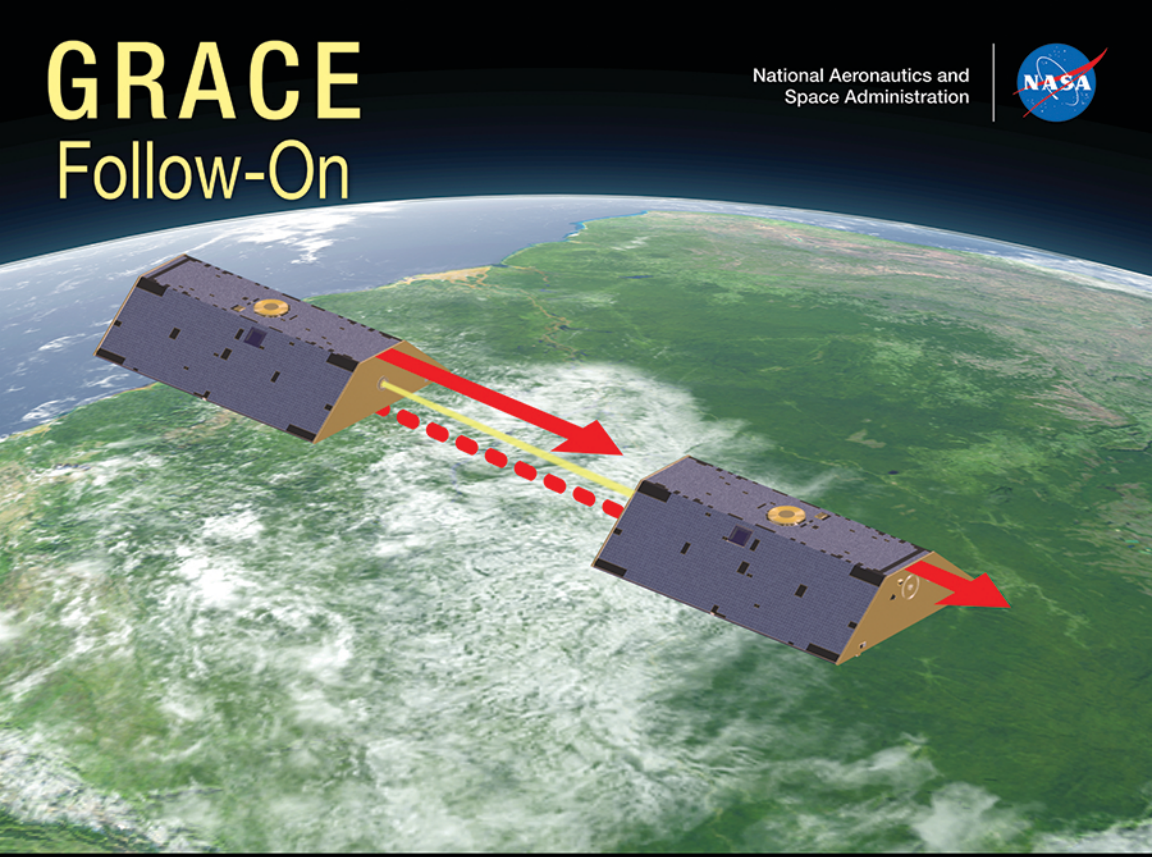
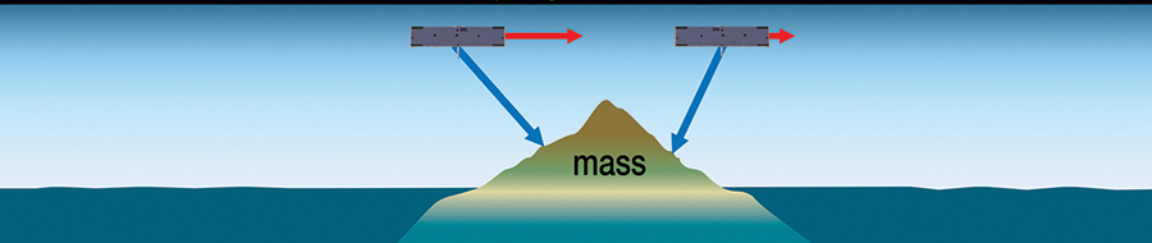


3. flying over mass



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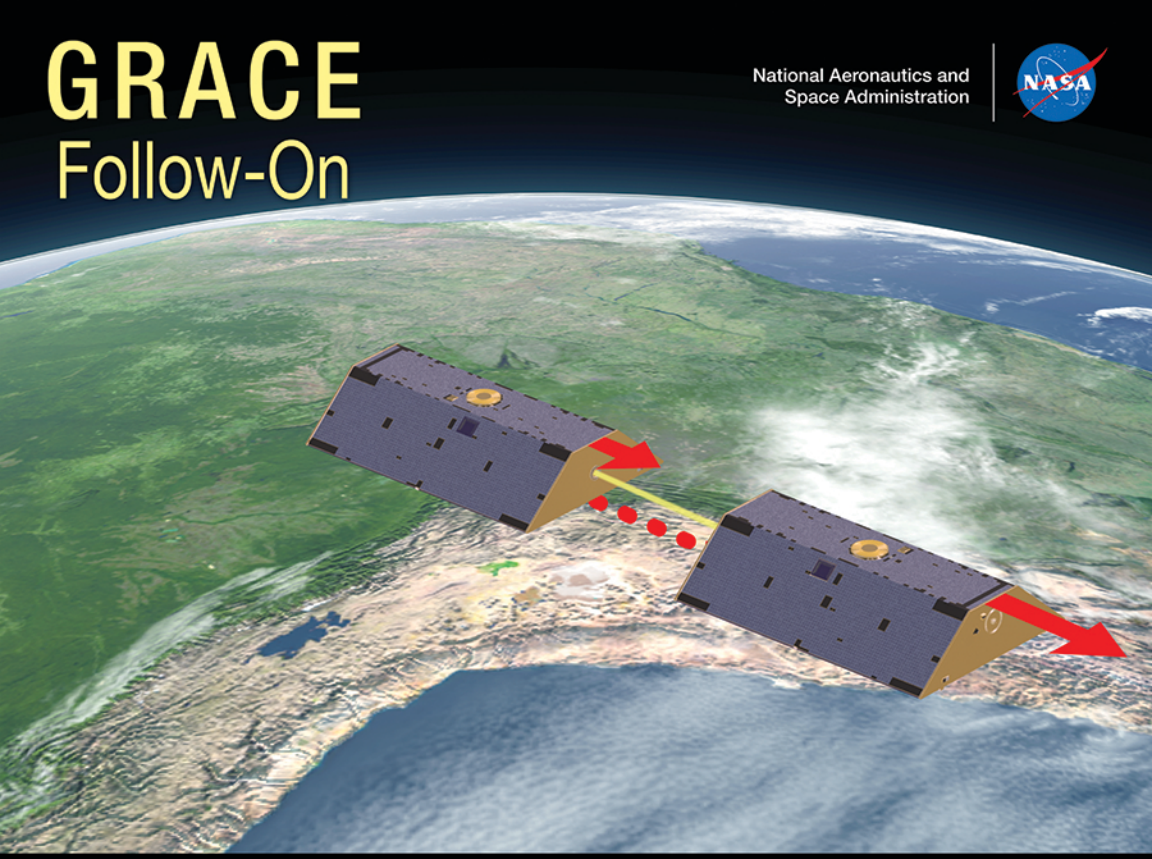
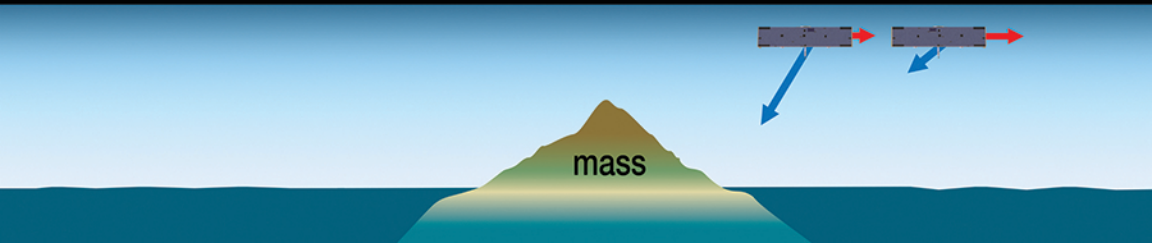
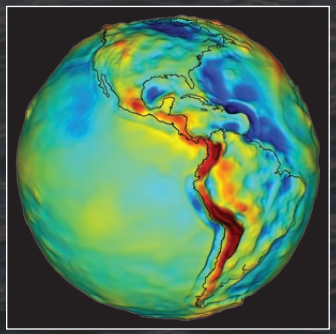
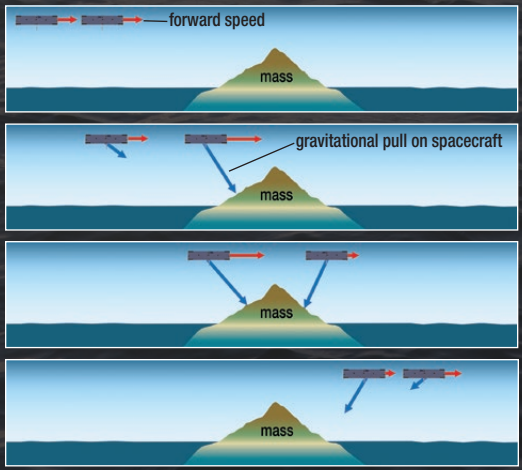


4. leaving mass





[*Left*] Earth's gravity field is lumpy. Gravity is slightly stronger over places with more mass than over places with less mass. Warm colors (red, orange, yellow) represent areas with stronger gravity. Cool colors (green, blue) represent areas with weaker gravity. Image credit: University of Texas Center for Space Research and NASA



Sensing Gravity from Space

Gravity is an attraction between two objects and its strength varies depending on how much mass those objects have and how far apart they are. For example, the tug of gravity is weaker for a person on the moon than on Earth, because Earth is more massive. Our senses perceive gravity as constant on Earth, but it actually varies slightly from location to location; it also changes over time as mass shifts (e.g., due to currents in the ocean, land water storage, exchanges between glaciers and the ocean, or land shifts caused by earthquakes).

The Gravity Recovery And Climate Experiment Follow-On (GRACE-FO) mission will map variations in Earth's gravitational field. GRACE-FO is a successor to the original GRACE mission, which began orbiting Earth on March 17, 2002. Unlike other missions, the GRACE satellites together form the "instrument": Two identical spacecraft, orbiting Earth at about 220 km (137 mi) apart, will constantly send signals to each other to measure and track how the distance between them changes as gravity pulls on each satellite. For the first time ever, GRACE-FO will use a laser, in addition to the current microwave instrument.

When the GRACE satellites encounter a change in the distribution of Earth's mass—such as a mountain range or large mass of underground water—the distance between the two satellites changes. The satellites record this change in separation to within a small fraction of the width of a human hair. By accurately tracking how the satellites' separations change over each orbit and over time, scientists can calculate how gravity is changing regionally on Earth.

The simplified example above illustrates the movements of the satellites as they pass southward from the Caribbean Sea across Colombia and Peru (i.e., a denser landmass) to the Pacific Ocean. The two satellites begin over the ocean (Panel 1), but when the leading spacecraft encounters land, the land's higher gravity pulls it away from the trailing spacecraft, which is still over water (Panel 2). Once the second satellite encounters the land, it too is pulled toward the mass and consequently toward the leading spacecraft (Panel 3). When the lead spacecraft moves back over water, it is pulled back slightly by the land, while the trailing spacecraft continues over the land. Once both spacecraft are back over water, the trailing spacecraft is slowed by the land (Panel 4) before returning to its original distance trailing the leading spacecraft.

GRACE-FO is scheduled to launch no earlier than December 2017 to continue these valuable measurements. GRACE-FO is a partnership between NASA and the German Research Centre for Geosciences (GFZ).