Changes in Earth's shape tied to climate

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Researchers at The University of Texas at Austin have found that significant changes in the shape of the Earth in the past 28 years may be linked to climate events such as the El Niño weather pattern.
The Earth's shape changes because the climate events shift where the mass of water is stored: in oceans, continents and the atmosphere.

Dr. Minkang Cheng and Dr. Byron D. Tapley of the university's Center for Space Research used nearly 30 years of NASA satellite laser ranging (SLR) data to examine how much the Earth flattens at the poles and widens at the equator.

Cheng, a research scientist, and Tapley, the director of the center, looked at events like El Niño-Southern Oscillation and Pacific Decadal Oscillation that affect the amount of water moving in the oceans, atmosphere and continents around the world.

The scientists found that two large variations of increases in the Earth bulging at the equator were connected to the strong El Niño-Southern Oscillation events from 1986-1991 and 1996-2002.

Although El Niño is normally associated with warming of surface waters in the eastern Pacific Ocean, it also causes changes in weather patterns and the way the ocean circulates.

During an El Niño, heavy rains associated with the warmer waters move into the central Pacific Ocean and typically cause drought in Australia, and floods in Peru. That is, there's more water in Peru, less water in

Australia.

Similar to El Niño, but lasting 20 to 30 years instead of months, the Pacific Decadal Oscillation is a long-term temperature fluctuation in the Pacific Ocean. The oscillation also brings changes in the location of the cold and warm water masses that also alter the path of the jet stream, which moves storms around the world.

These changes redistribute water mass among the oceans, and water vapor in the atmosphere, and in soil on the continents, resulting in slight but detectable changes of the Earth's gravity field.

Cheng and Tapley found that the variations in mass, which caused the change in the gravity field, were predominantly over the continents, with a smaller contribution due to changes over the ocean.

The Texas scientists also found that another change in mass may have started in late 2002, which coincides with the moderate El Niño that developed at that time. But the cause of a variation in the Earth's shape over a 21-year period between 1978 and 2001, however, still remains a mystery.

"The main idea, however, is that the Earth's large scale transport of mass is related to the long-term global climate changes," Cheng said.

Cheng and Tapley used the NASA SLR data, which measured the distance from ground stations to satellites by using satellite lasers that are accurate within a millimeter. The SLR data reflected mass changes as water was redistributed around the world and resulted in the changes of Earth's gravity field. The NASA Satellite Laser Ranging Mission studies the Earth's mass and gravity changes.

The long-term history of these range measurements makes it possible for

scientists to see how the large-scale mass was redistributed around the world, and the long-period and secular changes in the melting of glaciers and polar ice sheets and the associated sea level change.

The laser range data have also been used to detect the motion of global tectonic plates on which land masses rest, the deformation of the Earth's crusts near plate boundaries, and the orientation and rate of spin of the Earth.

The scientists' paper on the study was published in the September 2004 issue of the Journal of Geophysical Research-Solid Earth.

Source: University of Texas at Austin

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