NewsRelease

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Observations of 1998 El Niño Provide Powerful Climate Test

NASA satellite observations of the 1998 El Niño—the strongest ever recorded—show never before seen changes in cloud structures that provide a challenging test for even the world's best climate models.

Scientists from NASA Langley Research Center in Virginia and Stony Brook University in New York found substantial differences in cloud heights across the tropical Pacific Ocean during the 1997-1998 El Niño that contrast to other strong El Niño events. This unique cloud-climate interaction may impact how the Earth responds to climate changes and will help test the accuracy of climate predictions.

"The 1998 El Niño was so strong that it evenly distributed warm water across all of the Pacific Ocean," said Bruce Wielicki, the Clouds and the Earth's Radiant Energy System (CERES) principal investigator at NASA Langley in Hampton, Va. "This lack of a temperature difference collapsed the atmospheric circulation known as the Walker cell—marking the first time we've seen it wiped out in the satellite record of the planetary radiation balance."

The normal Walker circulation consists of air rising over Indonesia in the western Pacific Ocean and sinking off the West Coast of South America. Trade winds blowing east to west fuel this circulation and drag ocean surface waters with them. A weaker Walker circulation normally occurs during El Niño years. As the trade winds subside, warm waters in the western and central tropical Pacific Ocean spread east into colder waters, lessening the difference in east and west sea surface temperatures.

But the 1998 El Niño was so strong there was no temperature gradient—a contrast to even the strong 1983 El Niño where it, and the Walker circulation, was severely lessened but still existed. The ensuing collapse of the Walker cell during the 1998 event allowed for rising air over the eastern tropical Pacific Ocean.

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The collapse caused lower clouds in the west and higher clouds in the east over the tropical Pacific during the 1998 El Niño as compared to normal years. Scientists reported this result in the December 15 issue of the Geophysical Research Letters. The finding is significant because cloud height affects how much clouds warm and cool the Earth, potentially impacting the radiation budget—the amount of incoming and outgoing energy.

Researchers determined this finding using observations from NASA's Earth Radiation Budget Experiment (ERBE) and two NASA Langley instruments—CERES on the Tropical Rainfall Measuring Mission satellite (TRMM) and the Stratospheric Aerosol and Gas Experiment (SAGE) II.

This discovery about the 1998 El Niño also gives scientists a powerful new way to test climate predictions.

"The big uncertainty in climate model projections hinges directly on cloud-climate interactions," said Robert Cess, a professor and researcher at Stony Brook University's Marine Sciences Research Center. "These changes in cloud structure are so substantial that it could serve as an extremely useful test in climate models."

If climate models are to portray realistic cloud structures, then they should also produce the same changes in clouds captured by NASA satellite observations.

"One of the better models does not replicate these changes, and my guess is that very few models, if any, could," said Cess, adding that the next step is to continue comparing other climate models against satellite observations.

Images associated with this release are available at:
http://asd-www.larc.nasa.gov/ceres/ASDceres.html

Additional information is available about CERES and SAGE II on the Internet at:
http://www-sage2.larc.nasa.gov/
http://visibleearth.nasa.gov/Sensors/Terra/CERES.html

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Caption: Arrows in the first image show how the normal Walker cell circulates air over a steep temperature gradient in the Pacific Ocean between warm western and cold eastern waters in January 1997. By March 1998, the lack of an east-west sea surface temperature difference has collapsed the Walker circulation cell. As shown in the second image, the collapse produced lower clouds (fewer thunderstorms) in the west and higher clouds (more thunderstorms) in the east during the 1998 El Niño as compared to normal years. (Images courtesy of NASA SVS).