

Press Release

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Increased greenhouse gases and aerosols have similar effects on rainfall

Although greenhouse gases and aerosols have very distinct properties, their effects on spatial patterns of rainfall change are surprisingly similar, according to new research from the University of Hawaii at Manoa's International Pacific Research Center (IPRC) and Scripps Institution of Oceanography. The study is published in the September 1 online issue of *Nature Geoscience*.

Manmade climate change comes mostly from the radiative forcing of greenhouse gases and air pollutants or aerosols. While greenhouse gases are well-mixed in the atmosphere and tend to be evenly distributed around the globe, aerosols vary greatly in local concentration and tend to be found near emission sources such as industrial centers in Asia and North America. Moreover, aerosols tend to cool and greenhouse gases to warm the atmosphere.

Aerosols affect climate in two ways: one is fast and perturbs the physics and behavior of clouds in minutes to days; the other effect takes years and is mediated by interactions with the ocean and atmosphere. The fast effects of aerosols on clouds have been studied intensely, but their long-term ocean-mediated effect has received little attention.

A team of scientists at the IPRC and Scripps has now provided important new insights based on results from experiments with three state-of-the-art climate models. Even though aerosols and greenhouse gases are concentrated in vastly different regions of the earth, all three models revealed similar regional effects on rainfall over the ocean.

"This came as a big surprise to us," reflected lead-author Shang-Ping Xie, a professor of climate science and first Roger Revelle Chair in Environmental Science at Scripps. "It took a while for the result to sink in. The result means that it is hard to tell apart the greenhouse and aerosol effects."

The scientists noted that both aerosol-induced and greenhouse-gas-induced changes in rainfall appear to be mediated by the spatial patterns of sea surface temperature.

"Although much of the aerosol research has focused on microphysical processes, over the ocean the climate response to aerosols appears to be insensitive to details of the micro-processes in clouds," Xie said. "The climate changes induced by greenhouse gases and by aerosols share a common set of ocean-atmospheric feedback structures, explaining the spatial resemblance between the two types of response."

"Innovative model experiments are now needed," says coauthor Baoqiang Xiang, postdoctoral fellow at the IPRC. We want to probe the ocean-atmosphere interaction mechanisms that mediate these rainfall patterns and to determine what forms the foundation. This will allow us to develop more reliable regional climate projections."



Human activities have increased atmospheric concentrations of greenhouse gases and aerosols, which are causing considerable climate change. Image credit: Ozone.com.

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The International Pacific Research Center (IPRC) of the School of Ocean and Earth Science and Technology (SOEST) at the University of Hawaii at Manoa, is a climate research center founded to gain greater understanding of the climate system and the nature and causes of climate variation in the Asia-Pacific region and how global climate changes may affect the region. Established under the "U.S.-Japan Common Agenda for Cooperation in Global Perspective" in October 1997, the IPRC is a collaborative effort between agencies in Japan and the United States.