

Press Release

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Tropical Atlantic Sees Weaker Trade Winds and More Rainfall

Earth's global temperature has been rising gradually over the last decades, but the warming has not been the same everywhere. Scientists are therefore trying to pin down how the warming has affected regional climates because that is what really matters to people, and to adaptation and mitigation strategies. Their efforts, however, had hit a roadblock because the necessary observations of winds over the oceans were biased.

Developing a new method to remove the bias, Hiroki Tokinaga and Shang-Ping Xie at the International Pacific Research Center, University of Hawaii at Manoa, found that their corrected observations show the trade winds in the tropical Atlantic have weakened and the pattern of ocean surface temperature has changed. As a result, the equatorial Amazon and the Guinea Coast are seeing more rainfall and the Sahel less. The findings are published online in the February 6, 2011, issue of *Nature Geoscience*.

The raw observations of winds over the ocean suggest that the winds have grown stronger during the last 60 years. The trend is, however, largely due to a change in the placement of the anemometers, the instruments measuring wind speed. Ships are the main source of wind data over the ocean, and ships have increased in height and so has the anemometer placement. Tokinaga and Xie corrected this wind bias using wind-wave heights. The tropical Atlantic has three major ship routes along which ships provide meteorological data. Applying their new correction technique to observations along these routes from 1950 to 2009 together with other observations, they found the trade winds in the tropical Atlantic had weakened significantly during this period.

Although ocean surface temperature in the tropical Atlantic has risen, the pattern has changed and with it the climate. The cold tongue of water that stretches out from the eastern tropical Atlantic coast has warmed more than the western part of the basin. At the same time, the weakened trade winds have resulted in less upwelling of cold water and nutrients in the eastern tropical Atlantic. These latter changes could impact marine life.

Accompanying these changes in wind and ocean temperature is a very significant increase in rainfall, not only over the ocean but also over adjacent land areas such as the equatorial coastal regions of the Amazon and the Guinea Coast. For example, the August rainfall at Ibadan, one of the largest cities in Nigeria, has increased by 79 mm/month from 1950 to 1998, which is a whopping 93% increase over the long-term average for 1900–1949. The study also suggests that the year-to-year variations of ocean temperature and rainfall have weakened during recent decades, implying fewer extreme events.



Image 1. Wind waves depend on wind speed, and have long been logged by ship crews. A new ocean wind data corrected with wind-wave heights suggests a slow down of the southeast trade winds in the equatorial Atlantic. Image courtesy of Ship DAVID STARR JORDAN, NOAA Photo Library.

Tokinaga and Xie reason that the pattern of ocean warming and trade-wind changes are caused by the asymmetric reduction in surface solar radiation due to man-produced aerosols, the reduction affecting the Northern more than the Southern Hemisphere. If aerosol emissions decrease over the next decades, the tropical Atlantic climate may experience yet another shift as greenhouse gas forcing increases. Such a shift in the patterns of climate change (i.e., precipitation and sea level) will have important impacts on the socio-economics of regions surrounding the tropical Atlantic. For example, “If the year-to-year variability is to recover in the future, the resulting increase in climate extremes would add burdens to an ecosystem and to a society already stressed by global warming,” said Tokinaga.

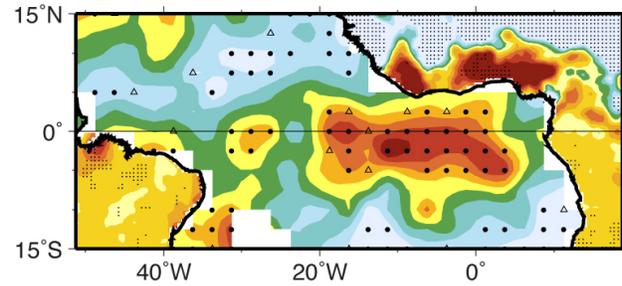


Figure 1. Sixty-year changes in the August marine-cloudiness and land-rainfall over the tropical Atlantic. Yellow to dark red indicates more cloudiness or rainfall; light blue to grey, less cloudiness or rainfall. Over land, dark red = 40 mm/month more rain, and grey = 40 mm/month less rain. Note the significant increase in rainfall on the Guinea Coast.

Historical observations of accurate winds are gravely lacking over the World’s oceans. This new robust and physically consistent set of observations by the IPRC team is valuable for improving computer models and evaluating model projections of climate change under further global warming.

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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.