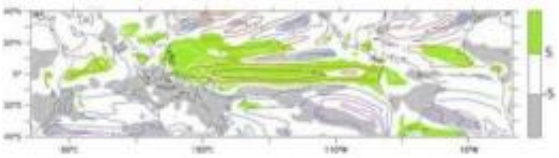
Team going after regional climate patterns of global warming

February 26 2010



This diagram shows global warming pattern formation in sea surface temperature and rainfall. Credit: Original publication: Xie, S.-P., C. Deser, G.A. Vecchi, J. Ma, H. Teng, and A.T. Wittenberg, 2010.

Climate models project that the global average temperature will rise about 1°C by the middle of the century, if we continue with business as usual and emit greenhouse gases as we have been. The global average, though, does not tell us anything about what will happen to regional climates, for example rainfall in the western United States or in paradisical islands like Hawai'i.

Analyzing global model warming projections in models used by the Intergovernmental Panel on Climate Change, a team of scientists headed by meteorologist Shang-Ping Xie at the University of Hawaii at Mānoa's International Pacific Research Center, finds that ocean temperature patterns in the tropics and subtropics will change in ways that will lead to significant changes in rainfall patterns. The study will be published in the *Journal of Climate* this month, breaking ground on such regional climate forecasts.

Scientists have mostly assumed that the surfaces of Earth's oceans will warm rather evenly in the tropics. This assumption has led to "wetter-gets-wetter" and "drier-gets-drier" regional rainfall projections. Xie's team has gathered evidence that, although ocean surface temperatures can be expected to increase mostly everywhere by the middle of the century, the increase may differ by up to 1.5°C depending upon the region.

"Compared to the mean projected rise of 1°C, such differences are fairly large and can have a pronounced impact on tropical and subtropical climate by altering atmospheric heating patterns and therefore rainfall," explains Xie. "Our results broadly indicate that regions of peak sea surface temperature will get wetter, and those relatively cool will get drier."

Two patterns stand out. First, the maximum temperature rise in the Pacific is along a broad band at the equator. Already today the equatorial Pacific sets the rhythm of a global climate oscillation as shown by the world-wide impact of El Niño. This broad band of peak temperature on the equator changes the atmospheric heating in the models. By anchoring a rainband similar to that during an El Nino, it influences climate around the world through atmospheric teleconnections.

A second ocean warming pattern with major impact on rainfall noted by Xie and his colleagues occurs in the Indian Ocean and would affect the lives of billions of people. Overlayed on Indian Ocean warming for part of the year is what scientists call the Indian Ocean Dipole that occasionally occurs today once every decade or so. Thus, the models show that warming in the western Indian Ocean is amplified, reaching 1.5°C, while the eastern Indian Ocean it is dampened to around 0.5°C.

"Should this pattern come about," Xie predicts, "it can be expected to dramatically shift rainfall over eastern Africa, India, and Southeast Asia.

Droughts could then beset Indonesia and Australia, whereas regions of India and regions of Africa bordering the Arabian Sea could get more rain than today."

Patterns of sea surface temperature warming and precipitation change in 2050 as compared with 2000. Annual mean precipitation change is shown in green/gray shade and white contours in mm/month. Precipitation tends to increase over regions with ocean warming above the tropical mean (contours of warm colors in oC), and to decrease where ocean warming is below the tropical mean (contours of cool colors).

Provided by University of Hawaii at Manoa