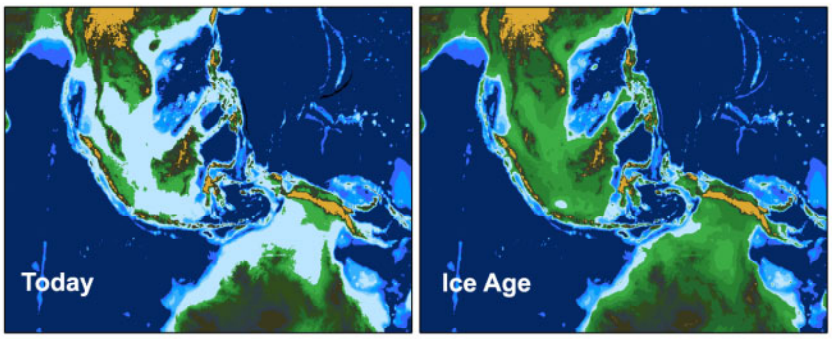
INTERNATIONAL PACIFIC RESEARCH CENTER

IN THE SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY AT THE UNIVERSITY OF HAWAI'I at MĀNOA

Press Release **May 19, 2013**

Sea level influenced tropical climate during the last ice age

Scientists look at past climates to learn about climate change and the ability to simulate it with computer models. One region that has received a great deal of attention is the Indo-Pacific warm pool, the vast pool of warm water stretching along the equator from Africa to the western Pacific Ocean.



The exposed Sunda Shelf during the last ice age greatly influenced tropical climate. Left, the shelf is shown for today as the light-blue submerged areas between Java, Sumatra, Borneo, and Thailand, and on the right for the last Ice Age as the exposed green areas.

In a new study, Pedro DiNezio of the International Pacific Research Center, University of Hawaii at Manoa, and Jessica Tierney of Woods Hole Oceanographic Institution investigated preserved geological clues (called "proxies") of rainfall patterns during the last ice age when the planet was dramatically colder than today. They compared these patterns with computer model simulations in order to find a physical explanation for the patterns inferred from the proxies.

Their study, which appears in the May 19, online edition of *Nature Geoscience*, not only reveals unique patterns of increased and decreased rainfall over the Indo-Pacific warm pool, but also shows that they were caused by the effect of lowered sea level on the configuration of the Indonesian archipelago.

"For our research," explains lead-author Pedro DiNezio at the International Pacific Research Center, "we compared the climate of the ice age with our recent warmer climate. We analyzed about 100 proxy records of rainfall and salinity stretching from the tropical western Pacific to the western Indian Ocean and eastern Africa. Rainfall and salinity signals recorded in geological sediments can tell us much about past changes in atmospheric circulation over land and the ocean respectively."

"Our comparisons show that, as many scientists expected, much of the Indo-Pacific warm pool was drier during this glacial period than today. But, counter to some theories, several regions, such as the western Pacific and the western Indian Ocean, especially eastern Africa, were wetter," adds co-author Jessica Tierney from Woods Hole Oceanographic Institute.

In the second step, the scientists matched these rainfall and salinity signals of those two time periods with simulations from 12 state-of-the-art climate models that are used to also predict future climate change. For this matching they applied a method of categorical data comparison called the 'Cohen's kappa' statistic. Though widely used in the medical field, this method has not yet been used to match geological climate signals with climate model simulations.

"We were taken aback that only one model out of the 12 is consistent with the proxy-inferred patterns of the rainfall changes. This model, though, agrees well with both the rainfall and salinity indicators – two entirely independent sets of proxy data covering distinct areas of the tropics," says DiNezio.

The model reveals that the dry climate during the glacial period stems from greatly reduced convection over a region of the warm pool called the Sunda Shelf. Today the shelf is submerged beneath the Gulf of Thailand, but was above sea level during the glacial period, when sea level was about 120 m lower.

"The exposure of the Sunda Shelf greatly weakens convection over the warm pool, with far-reaching impacts on the large-scale circulation and on rainfall patterns from Africa to the western Pacific and northern Australia," explains DiNezio.

The main weakness of the other models, according to the authors, is their limited ability to simulate convection, the vertical air motions that pump humid air into the atmosphere. Differences in the way each model simulates convection may explain why the results for the glacial period are so different.

"Our research resolves a decades-old question of what the response of tropical climate was to glaciation," concludes DiNezio. "The study, moreover, presents a fine benchmark for assessing the ability of climate models to simulate the response of tropical convection to altered land masses and global temperatures."

###

Citation:

Pedro DiNezio and Jessica Tierney: The effect of sea level on glacial Indo-Pacific climate. *Nature Geoscience*, May 19 online publication at http://dx.doi.org/10.1038/NGEO1823.

Funding:

Funding for this work was provided by NSF (grant AGS 1204011) and by JAMSTEC, NASA, and NOAA, which sponsor research at the International Pacific Research Center, University of Hawaii at Manoa.

Author Contacts:

Dr. Pedro DiNezio, SOEST Young Investigator: International Pacific Research Center, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa, Honolulu, Hawaii 96822; phone: (804) 674-4150; email: pdn@hawaii.edu.

Dr. Jessica E. Tierney, Assistant Scientist Woods Hole Oceanographic Institution, 360 Woods Hole Rd. MS #22 Woods Hole, MA 02543; phone: (508) 289-3775; email: tierney@whoi.edu

International Pacific Research Center Media Contact: Gisela E. Speidel, International Pacific Research Center, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa, Honolulu, Hawaii 96822: phone (808) 956-9252; email: gspeidel@hawaii.edu.
