Fine-scale climate model projections predict malaria at local levels

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(Medical Xpress)—Fine-scale climate model projections suggest the possibility that population centers in cool, highland regions of East Africa could be more vulnerable to malaria than previously thought, while population centers in hot, lowland areas could be less vulnerable, according to a team of researchers. The team applied a statistical technique to conventional, coarse-scale climate models to better predict malaria dynamics at local levels.

"People might have an interest in predictions for global malaria trends and even more so for regional patterns, but they probably care most about what's going to happen in their own town or village," said Matthew Thomas, professor and Huck Scholar in Ecological Entomology, Penn State. "We found that malaria predictions using global climate model simulation results don't necessarily tell you what's going to happen at a specific location. What is likely to happen in one location can be very different from another location just 50 miles down the road. To really understand the impact of climate change on malaria dynamics we need to adopt a higher-resolution approach."

According to Krijn Paaijmans, assistant research professor, Barcelona Centre for International Health Research, the ability of mosquitoes to transmit malaria is strongly influenced by environmental temperature.

"Malaria mosquitoes are ectothermic organisms, which means that their body temperature matches the temperature of their direct surroundings," Paaijmans said.

The scientists examined how changes in temperature due to future climate warming might impact the potential for mosquitoes to transmit malaria. The researchers compared malaria transmission at four sites in Kenya that differed in their baseline environmental characteristics—two sites were cool upland locations, a third site was a warm lower-altitude site and a fourth site was a hot savannah-like environment.

The team used a statistical technique to "downscale" projections from conventional global climate models—specifically, projections from atmosphere-ocean global climate models (AOGCMs), which evaluate temperature on coarse spatial and temporal scales—to generate high-resolution, daily temperature data.

"Statistical downscaling takes historically observed relationships between the large-scale atmospheric state and a local climate response, and applies them to global climate model projections," said Robert Crane, professor of geography, Penn State. "We applied the downscaling methodology to the climate model projections."

The team's goal was to predict malaria transmission potential within the four locations. They used a simple mathematical model that describes the influence of temperature on the ability of adult mosquitoes to transmit malaria parasites to compare the predictions they obtained in the four locations with the predictions from the coarse-scale model simulations.

"Fine-scale predictions of malaria risk will be better tailored to the needs of local communities and can improve local adaptation and mitigation strategies," Paaijmans said.

The results appear in the June 19 issue of *Climatic Change*.

The team found that the conventional approach of using coarse-scale climate models yielded different predictions for future changes in malaria transmission potential in the four locations than when they applied the downscaling methodology.

"Using the raw coarse-scale model simulation results sometimes overestimated and sometimes underestimated the effects of climate change for particular locations compared with our downscaled model results," Thomas said.

Specifically, the team's downscaled model results predicted large increases in future malaria transmission potential in the cool upland sites, but reduced transmission in the hot savannah-like site. The results also predicted an increase in transmission potential in the warm lower-altitude site, but the increase was less pronounced when using the downscaling methodology than when using the conventional models. According to the researchers, the warm lower-altitude site is characterized by relatively consistent, year-round transmission, so even modest increases in transmission potential may translate into measurable changes in disease risk.

"This is one of the first studies to attempt to explore how climate change might impact conditions at the local level," said Michael Mann, Distinguished Professor of Meteorology, Penn State. "The results suggest the possibility that population centers in cool highland regions could be more vulnerable than previously thought, while other equally large lowland areas might be less vulnerable. But this would have to be confirmed with more detailed modeling assessments that take into account the full suite of environmental and socio-economic factors that ultimately determine risk of malaria."

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