Researchers measure climate variability and conflict risk in East Africa

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While a new study led by the University of Colorado Boulder shows the risk of human conflict in East Africa increases somewhat with hotter temperatures and drops a bit with higher precipitation, it concludes that socioeconomic, political and geographic factors play a much more substantial role than climate change.

According to CU-Boulder geography Professor John O'Loughlin, the new CU-Boulder study undertaken with the National Center for Atmospheric Research in Boulder is an attempt to clarify the often-contradictory debate on whether climate change is affecting armed conflicts in Africa. "We wanted to get beyond the specific idea and hype of climate wars," he said. "The idea was to bring together a team perspective to see if changes in rainfall and temperature led to more conflict in vulnerable areas of East Africa."

The research team examined extensive climate datasets from nine countries in East Africa, including the Horn of Africa, between 1990 and 2009: Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, Tanzania and Uganda. The team also used a dataset containing more than 16,000 violent conflicts in those countries during that time period, parsing out more specific information on conflict location and under what type of political, social, economic and geographic conditions each incident took place.

The study, which included changes in precipitation and temperature over continuous six-month periods from 1949 to 2009, also showed there was

no climate effect on East African conflicts during normal and drier precipitation periods or during periods of average and cooler temperatures, said O'Loughlin.

Moderate increases in temperature reduced the risk of conflict slightly after controlling for the influence of social and political conditions, but very hot temperatures increased the risk of conflict, said O'Loughlin. Unusually wet periods also reduced the risk of conflict, according to the new study.

"The relationship between climate change and conflict in East Africa is incredibly complex and varies hugely by country and time period," he said. "The simplistic arguments we hear on both sides are not accurate, especially those by pessimists who talk about 'climate wars'. Compared to social, economic and political factors, climate factors adding to conflict risk are really quite modest."

The results are being published online Oct. 22 in the *Proceedings of the National Academy of Sciences*. Co-authors on the study include CU-Boulder Research Associate Frank Witmer and graduate student Andrew Linke as well as three scientists from the National Center for Atmospheric research—Arlene Laing, Andrew Gettelman and Jimy Dudhia. The National Science Foundation funded the study.

Much of the information on the 16,359 violent events in East Africa from 1990 to 2009 came from the Armed Conflict Location and Event Dataset, or ACLED, directed by Clionadh Raleigh of Trinity College in Dublin. The database covers individual conflicts from 1997 to 2009 in Africa, parts of Asia and Haiti – more than 60,000 violent incidents to date. Raleigh started the data collection while earning her doctorate at CU in 2007 under O'Loughlin.

In addition, more than a dozen CU-Boulder undergraduates spent

thousands of hours combing online information sources like LexisNexis—a corporation that pioneered the electronic accessibility of legal and newspaper documents—in order to fill in details of individual violent conflicts by East African countries from 1990 to 1997. The student work was funded by the NSF's Research Experiences for Undergraduates program.

The CU students coded each conflict event with very specific data, including geographic location coordinates, dates, people and descriptive classifications. The event information was then aggregated into months and into 100-kilometer grid cells that serve as the units of analysis for quantitative modeling.

Each conflict grid also was coded by socioeconomic and political characteristics like ethnic leadership, distance to an international border, capital city, local population size, well-being as measured by infant mortality, the extent of political rights, presidential election activity, road network density, the health of vegetation and crop conditions.

"The effects of climate variability on conflict risk is different in different countries," O'Loughlin said. "Typically conflicts are very local and quite confined. The effects of climate on conflict in Ethiopia, for example, are different than those in Tanzania or Somalia. The idea that there is a general 'African effect' for conflict is wrong."

The researchers used a variety of complex statistical calculations to assess the role of climate in violent conflict in East Africa, including regression models and a technique to uncover nonlinear influences and decrease "noise," said O'Loughlin, also a faculty member at CU-Boulder's Institute of Behavioral Science.

One component of the methods used by the team extracts predictions of individual instances of conflict from the statistical model and

systematically compared them with the actual observations of conflict in the data, "a rigorous validity check," he said.

Catastrophic conflicts like those in the "Great Lakes region"—Rwanda, Burundi, Uganda and the eastern Democratic Republic of the Congo—since the 1990s and the war with the Lord's Resistance Army led by terrorist Joseph Kony that has been running since the late 1980s in northern Uganda and neighboring regions are marked with large red swaths on the maps.

Legacies of violence are extremely important for understanding and explaining unrest, he said. "Violence nearby and prior violence in the locality, especially for heavily populated areas, are the strongest predictors of conflict."

Ongoing work is extending the study to all of sub-Saharan Africa since 1980 with a database of 63,000 violent events. Preliminary results from the work confirm the East African climate effects of higher than normal temperatures are increasing conflict risk.

Provided by University of Colorado at Boulder