Regional nuclear conflict would create near-global ozone hole, says CU-Boulder study

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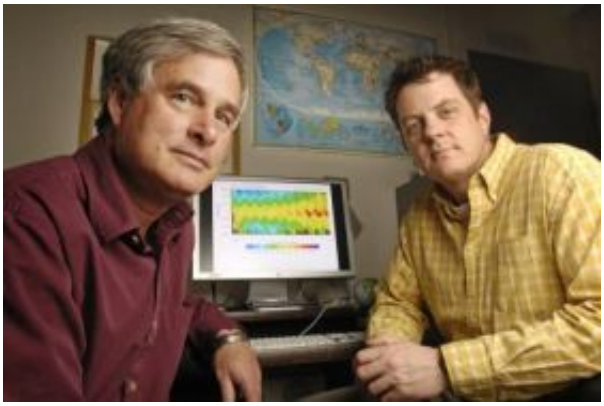

A new computer modeling study led by CU-Boulder scientists Brian Toon, left, and Michael Mills, right, indicates a limited nuclear weapons exchange in the Middle East would create a near-global ozone hole, impacting human and ecosystem health for a decade or more. Image courtesy Glenn Asakawa, University of Colorado

A limited nuclear weapons exchange between Pakistan and India using their current arsenals could create a near-global ozone hole, triggering human health problems and wreaking environmental havoc for at least a decade, according to a study led by the University of Colorado at Boulder.

The computer-modeling study showed a nuclear war between the two countries involving 50 Hiroshima-sized nuclear devices on each side would cause massive urban fires and loft as much as 5 million metric

tons of soot about 50 miles into the stratosphere, said CU-Boulder Research Associate Michael Mills, chief study author. The soot would absorb enough solar radiation to heat surrounding gases, setting in motion a series of chemical reactions that would break down the stratospheric ozone layer protecting Earth from harmful ultraviolet radiation, said Mills.

“We would see a dramatic drop in ozone levels that would persist for many years,” said Mills of CU-Boulder’s Laboratory for Atmospheric and Space Physics. “At mid- latitudes the ozone decrease would be up to 40 percent, which could have huge effects on human health and on terrestrial, aquatic and marine ecosystems.”

A paper on the subject, titled “Massive Global Ozone Loss Predicted Following A Regional Nuclear Conflict,” appeared the week of April 7 in the *Proceedings of the National Academy of Sciences*. Co-authors on the study include CU-Boulder Professor Brian Toon, UCLA Professor Richard Turco and National Center for Atmospheric Research scientists Douglas Kinnison and Rolando Garcia.

According to the computer simulations, fires ignited in large cities by nuclear explosions would send several million metric tons of soot into the upper stratosphere, which would be heated by massive smoke injections. Higher temperatures would accelerate catalytic reaction cycles in the stratosphere, particularly reactions of nitrogen oxide gases known collectively as NOx that destroy ozone, Mills said.

In addition to ozone losses of 25 percent to 40 percent at mid-latitudes, the models show a 50 percent to 70 percent ozone loss at northern high latitudes, said Mills. “The models show this magnitude of ozone loss would persist for five years, and we would see substantial losses continuing for at least another five years,” he said.

The ozone losses predicted in the study are much larger than losses estimated in previous “nuclear winter” and “ultraviolet spring” scenario calculations following nuclear conflicts, said Toon, chair of CU-Boulder’s oceanic and atmospheric sciences department. A 1985 National Research Council Report predicted a global nuclear exchange involving thousands of megatons of explosions, rather than the 1.5 megatons assumed in the PNAS study, would deplete only 17 percent of the Northern Hemisphere’s stratospheric ozone, which would recover by half in three years.

“The missing piece back then was that the models at the time could not account for the rise of the smoke plume and consequent heating of the stratosphere,” said Toon. “The big surprise is that this study demonstrates that a small-scale, regional nuclear conflict is capable of triggering ozone losses even larger than losses that were predicted following a full-scale nuclear war.”

Human health ailments like cataracts and skin cancer, as well as damage to plants, animals and ecosystems at mid-latitudes would likely rise sharply as ozone levels decreased and allowed more harmful UV light to reach Earth, according to the *PNAS* study. “By adopting the Montreal Protocol in 1987, society demonstrated it was unwilling to tolerate a small percentage of ozone loss because of serious health risks,” said Toon. “But ozone loss from a limited nuclear exchange would be more than an order of magnitude larger than ozone loss from the release of gases like CFCs.”

UV radiation has been shown to be particularly damaging to inhabitants of aquatic ecosystems, including amphibians, shrimp, fish and phytoplankton, said Mills. “Most organisms can do little to avoid UV exposure, so one of the big unanswered questions is how the biota would respond to these big UV increases triggered by a nuclear exchange.”

The team used a cluster of computer processors at LASP to run three separate 10-year simulations -- each more than 300 hours long -- linking the urban fire nuclear scenario to climate and atmospheric chemistry processes. The team coupled NCAR's Whole Atmosphere Community Climate Model 3 with the Community Aerosol and Radiation Model for Atmospheres developed by CU-Boulder and NASA Ames.

Two 2006 studies led by Toon and involving UCLA and Rutgers University showed that such a small-scale regional nuclear war could produce as many fatalities as all of World War II and disrupt global climate for a decade or more. Of the eight nations known to possess nuclear weapons, even those with the smallest nuclear arsenals, like Pakistan and India, are believed to have 50 or more Hiroshima-sized weapons.

In addition, about 40 countries possess enough plutonium, uranium or a combination of both to construct substantial nuclear arsenals, said Toon. A nuclear exchange involving 100 15-kiloton, Hiroshima-type weapons is only 0.03 percent of the total explosive power of the world's nuclear arsenal, he said.

"We hope other research groups repeat our calculations and undertake their own scientific studies on this issue," said Toon. "The world has become a far more dangerous place when the actions of two countries on the other side of the world could have such a drastic impact on the planet." The study was funded by CU-Boulder.

Source: University of Colorado at Boulder

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