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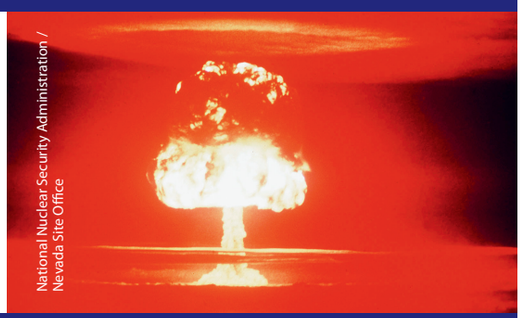
INFORMATION NOTE NO. 2

CLIMATE EFFECTS OF NUCLEAR WAR AND IMPLICATIONS FOR GLOBAL FOOD PRODUCTION



National Nuclear Security Administration / Nevada Site Office

SUMMARY

Recent environmental research using previously unavailable climate modeling techniques indicates that even a limited regional nuclear war could cause global climate cooling that would cut food production for many years and put one billion people at risk of starvation worldwide. This research also estimates that a large-scale nuclear war would create ice-age conditions likely to eliminate most of the human race.

IMPACT OF NUCLEAR WEAPONS USE ON CLIMATE AND AGRICULTURE

A "limited" nuclear war involving only 100 Hiroshima-sized bombs (i.e. of 13 kilotons each), which is less than 0.5 percent of the world's nuclear weapons, could disrupt the global climate. More than 5 million tonnes of soot from fires in urban and industrial areas targeted by these weapons could be lofted into the upper atmosphere[1] and cause global temperatures to fall by an average of 1.3°C for several years, shortening the growing season in many areas.[2] The drop in temperatures would be much more severe inland, especially in the interior of North America and Eurasia. The cooler temperatures would result in a major decline in precipitation, as less water evaporates from the oceans to fall back as rain and snow. In addition, there would be a large reduction in ozone levels in the upper atmosphere, allowing increased levels of harmful ultraviolet (UV) light to reach the earth's surface.[3] The cooler weather, shorter growing seasons and decline in precipitation would have severe effects on agriculture. For example, it is estimated that soybean and corn production in the Midwestern United States and rice production in China

1 Toon, Owen B., Richard P. Turco, Alan Robock, Charles Bardeen, Luke Oman, and Georgiy L. Stenchikov, "Atmospheric effects and societal consequences of regional scale nuclear conflicts and acts of individual nuclear terrorism", *Atm. Chem. Phys.*, 2007, Vol. 7, 1973-2002.

2 Robock, Alan, Luke Oman, Georgiy L. Stenchikov, Owen B. Toon, Charles Bardeen, and Richard P. Turco, "Climatic consequences of regional nuclear conflicts", *Atm. Chem. Phys.*, 2007, Vol. 7, 2003-2012.

3 Mills, Michael J., Owen B. Toon, Richard P. Turco, Douglas E. Kinnison, and Rolando R. Garcia, "Massive global ozone loss predicted following regional nuclear conflict", *Proc. National Acad. Sci.*, 2008, 105, pp. 5307–5312.

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Even the limited use of nuclear weapons could cause major disruptions to food production and severe food shortages

would be 20 percent lower in the years immediately following the event, and 10 percent lower even after a decade.[4,5]

More than one billion people around the world might face starvation as a result of a limited, regional nuclear war.[6] The world is ill-prepared to deal with a decline in food production. World food reserves cover only 60 to 70 days of consumption. In addition, there are currently some 870 million malnourished people in the world, who do not receive the minimum of 1,800 calories per day that are required to maintain body mass and perform the physical labour necessary to gather or grow food. A reduction in food intake of as little as 10 percent for a full decade would put this entire group at risk. The estimated 10 to 20 percent drop in corn and maize production could easily translate into a much larger decline in access to food because hoarding and panic are likely to drive up market prices, thereby making food unaffordable for many people. Furthermore, more than 300 million people in the world are well-nourished today but live in countries that are highly dependent on food imports. They too would be at risk if food-exporting countries halted exports to feed their own people.

4 Özdoğan, Mutlu, Alan Robock, and Christopher Kucharik, "Impacts of a nuclear war in South Asia on soybean and maize production in the Midwest United States", *Climatic Change*, 2013, 116, pp. 373-387, doi:10.1007/s10584-012-0518-1.

5 Xia, Lili, and Alan Robock, "Impacts of a nuclear war in South Asia on rice production in mainland China", *Climatic Change*, 2013, 116, 357-372, doi:10.1007/s10584-012-0475-8.

6 Helfand, Ira, *Nuclear Famine: A Billion People At Risk*, Physicians for the Prevention of Nuclear War and Physicians for Social Responsibility, 2012, Somerville, MA, International Press, 19 pp.

The consequences of a large-scale nuclear war would be even more catastrophic. A war waged using the weapons to which Russia and the United States will remain entitled in 2018, when the 2010 New START Treaty will have been fully implemented, could send 150 million tonnes of soot into the upper atmosphere. Temperatures would fall by an average of 8°C worldwide for several years. In the interior of North America and Eurasia, temperatures would drop by 20 to 30°C, to levels lower than those that prevailed 18,000 years ago at the peak of the last ice age. Agriculture would stop, ecosystems would collapse and most of the human race would starve.

BACKGROUND INFORMATION ON THE RESEARCH CITED

The above predictions of the effects of nuclear war are made possible by new supercomputers and climate models that for the first time have allowed calculations covering the entire depth of the atmosphere. By allowing researchers to simulate the lofting of smoke into the stratosphere and the subsequent behaviour of this smoke for periods as long as several decades, it has been possible for the first time to portray the long-term effects of nuclear war. This is also the first time that the impacts on ozone chemistry have been modelled in detail.

There have been no studies challenging these findings, which are based on the above scenario of a "limited" nuclear war. It is not possible to predict precisely how any future use of nuclear weapons may play out. What is clear, however, is that this is not a worst-case scenario. In fact, there are many conservative assumptions built into it:

It was assumed that only 100 Hiroshima-sized bombs would be used; however, the countries involved in the simulations are estimated to hold around 200 nuclear weapons, of which many are up to three times larger than the Hiroshima bomb.

It was assumed that 5 million tonnes of soot would be deposited in the upper atmosphere; in fact, 100 Hiroshima bombs might generate as many as 6.5 million tonnes of soot.

The agricultural studies cited in footnotes 5 and 6 do not consider the impact of increased UV light, even though this may further reduce food output.

All reference material available at http://climate.envsci.rutgers.edu/nuclear/

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