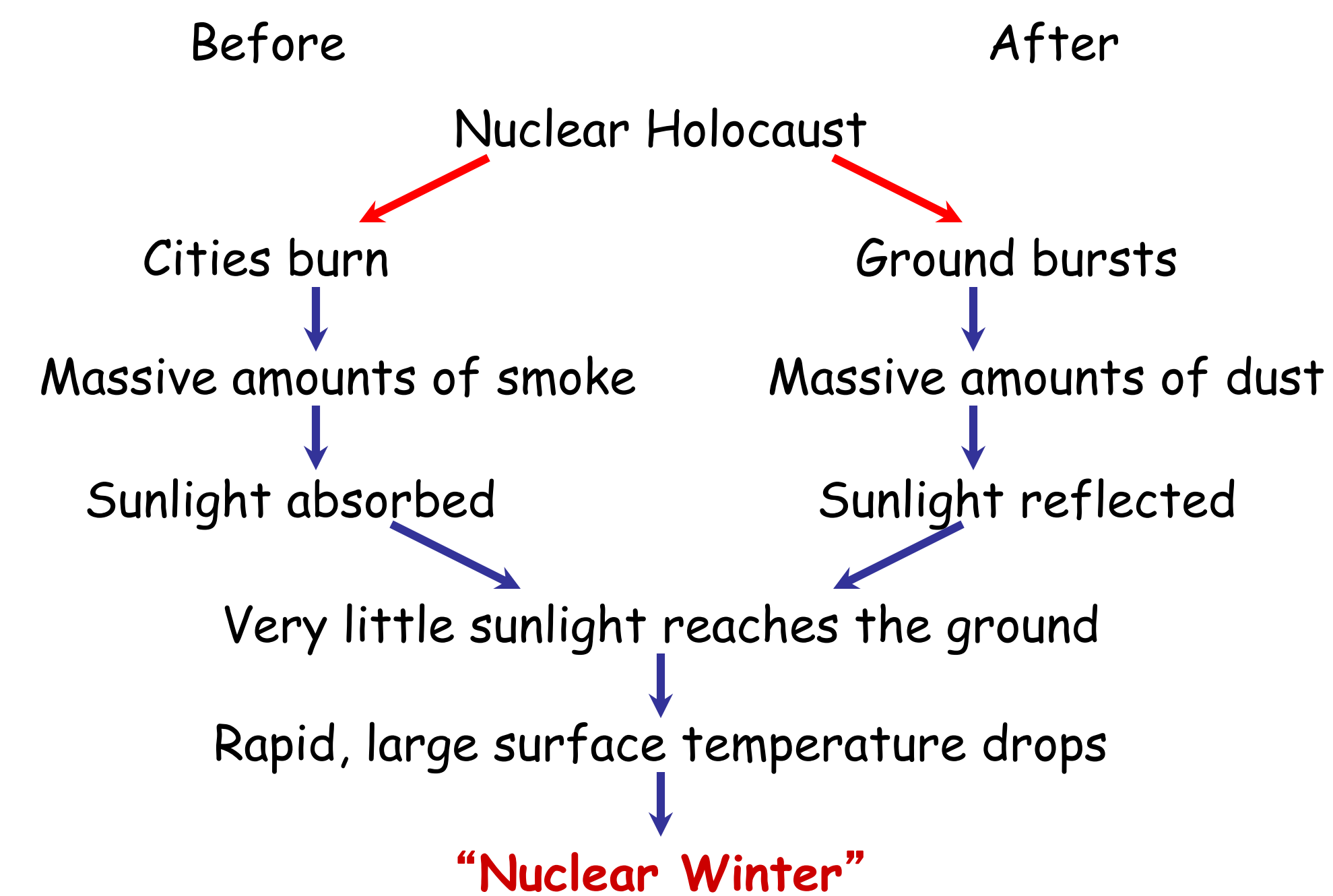


# Climatic Consequences of Nuclear Conflict: Nuclear Winter Still a Threat

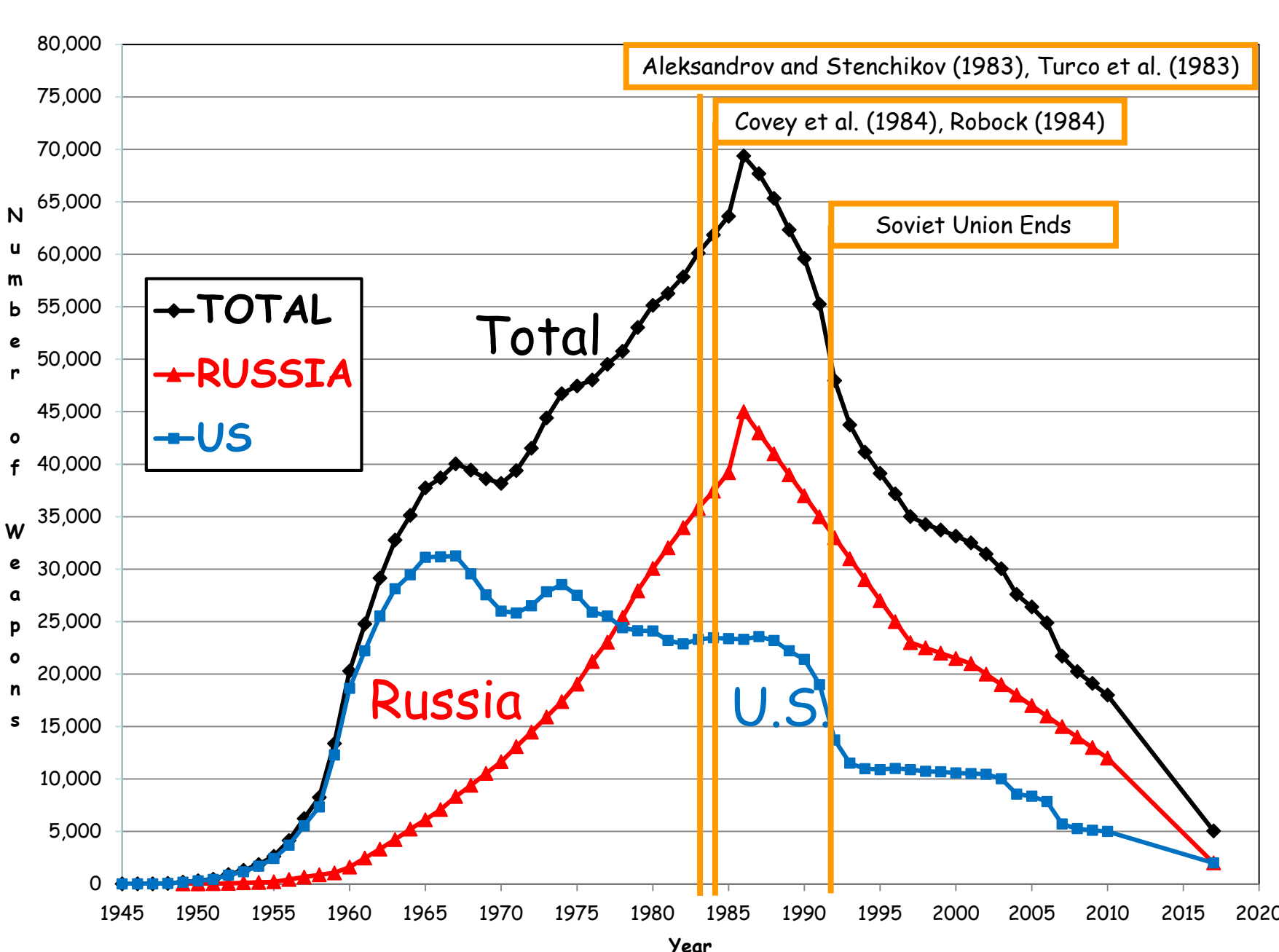
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**Abstract.** A nuclear war between Russia and the United States, using the reduced arsenals of 4000 total nuclear weapons that will result by 2017 in response to the New START treaty, could still produce nuclear winter. A nuclear war between India and Pakistan, with each country using 50 Hiroshima-sized atom bombs as airbursts on urban areas, could produce climate change unprecedented in recorded human history and global-scale ozone depletion. Furthermore, there would be massive ozone depletion with enhanced ultraviolet radiation reaching the surface. New results (<http://climate.envsci.rutgers.edu/nuclear/>) show a reduction of agricultural production in the US and China by about 20% for a decade. Using climate models, we injected different amounts of soot aerosols that would be generated by fires from regional and global nuclear wars into the upper troposphere, and examined the climatic and stratospheric chemistry responses. The soot is lofted into the stratosphere, and the effects of regional and global nuclear war would last for more than a decade, much longer than previously thought. The continued environmental threat of the use of even a small number of nuclear weapons must be considered in nuclear policy deliberations in Russia, the U.S., and the rest of the world.



**Theory of nuclear winter.** The smoke from burning targets and dust from ground bursts would block out the Sun, making it cold, dark, and dry at Earth's surface.



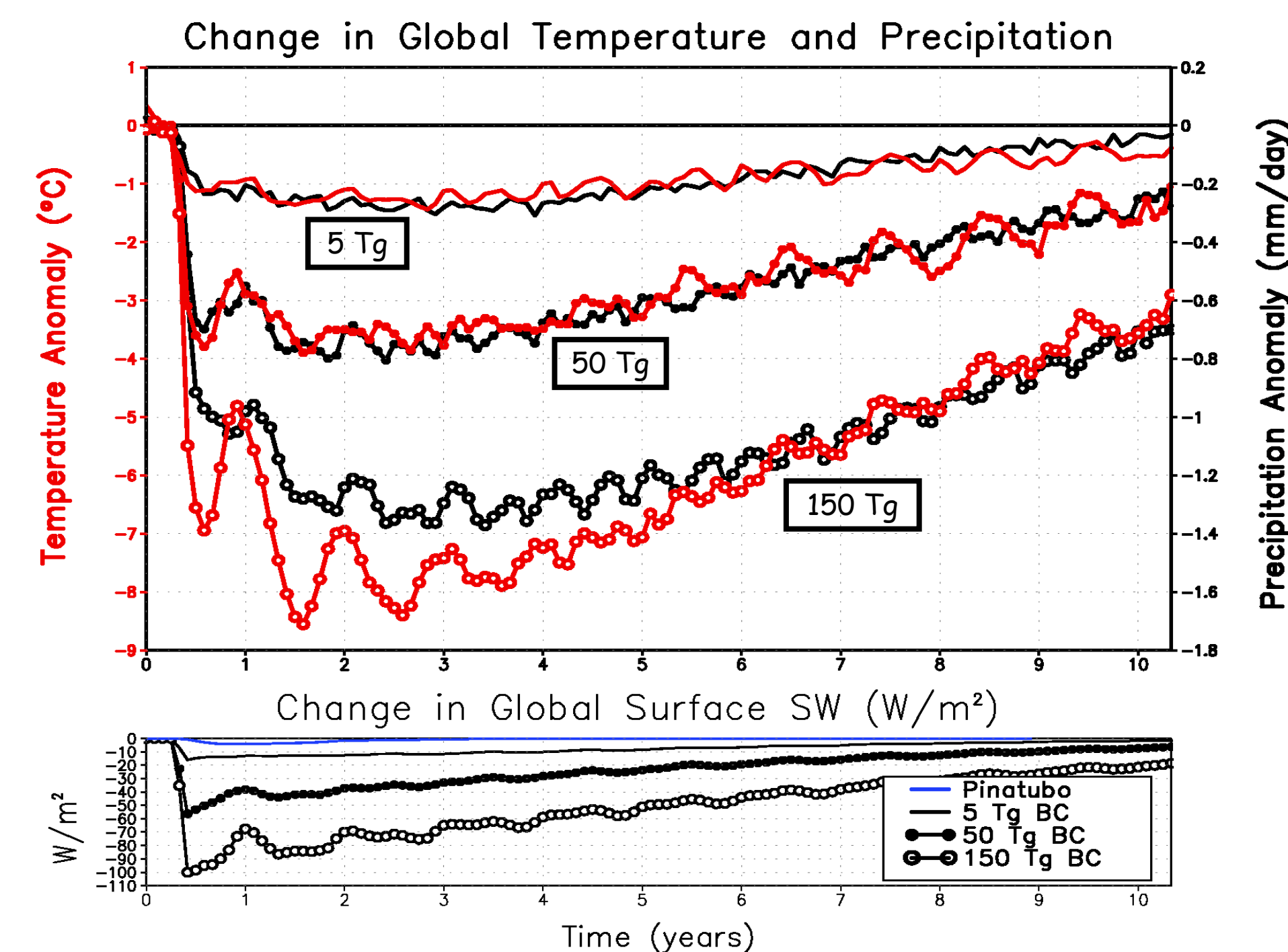
Aleksandrov, V. V., and G. L. Stenchikov, 1983: On the modeling of the climatic consequences of the nuclear war. *Proc. Applied Math. Computing Centre, USSR Academy of Sciences, Moscow*, 21 pp.

Covey, C., S. Thompson, and S. H. Schneider, 1984: Global atmospheric effects of massive smoke injections from a nuclear war: Results from general circulation model simulations. *Nature*, **308**, 21-25, 1984.

Robock, A., 1984: Snow and ice feedbacks prolong effects of nuclear winter. *Nature*, **310**, 667-670.

Turco, R. P., O. B. Toon, T. P. Ackerman, J. B. Pollack, and C. Sagan, 1983: Nuclear winter: Global consequences of multiple nuclear explosions. *Science*, **222**, 1283-1292.

**Debate and discussion about the original nuclear winter results helped to end the nuclear arms race and the cold war.** As Mikhail Gorbachev said in 2000, “Models made by Russian and American scientists showed that a nuclear war would result in a nuclear winter that would be extremely destructive to all life on Earth; the knowledge of that was a great stimulus to us, to people of honor and morality, to act in that situation.”



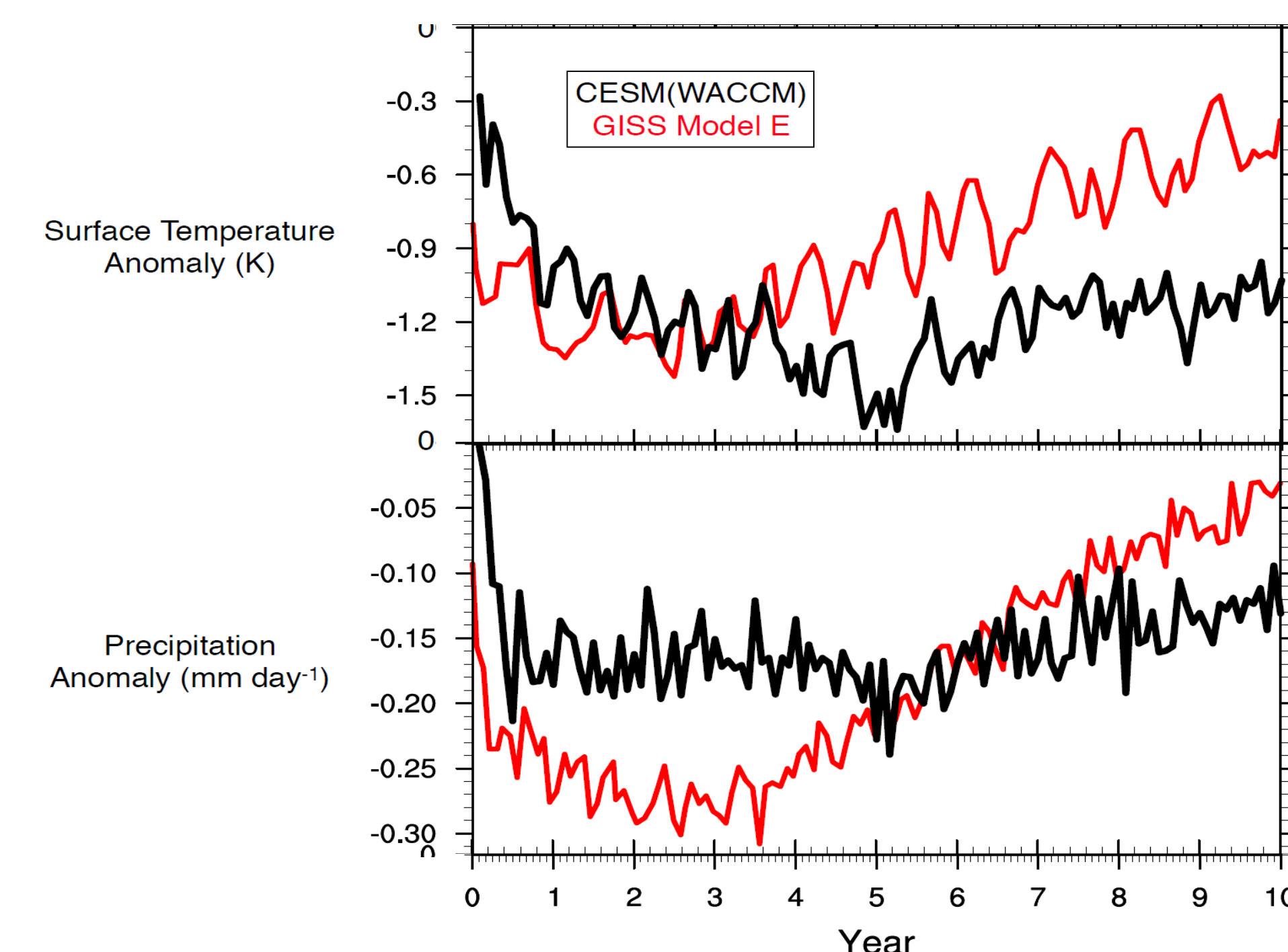
**Temperature and precipitation changes from different amounts of smoke injection into the upper troposphere** (Robock et al., 2007a, 2007b; Toon et al., 2008).

What could produce **5 Tg of smoke**? A nuclear war between India and Pakistan using “only” 100 small nuclear weapons, much less than 1% of the current world arsenal. **This would produce devastating agricultural impacts.**

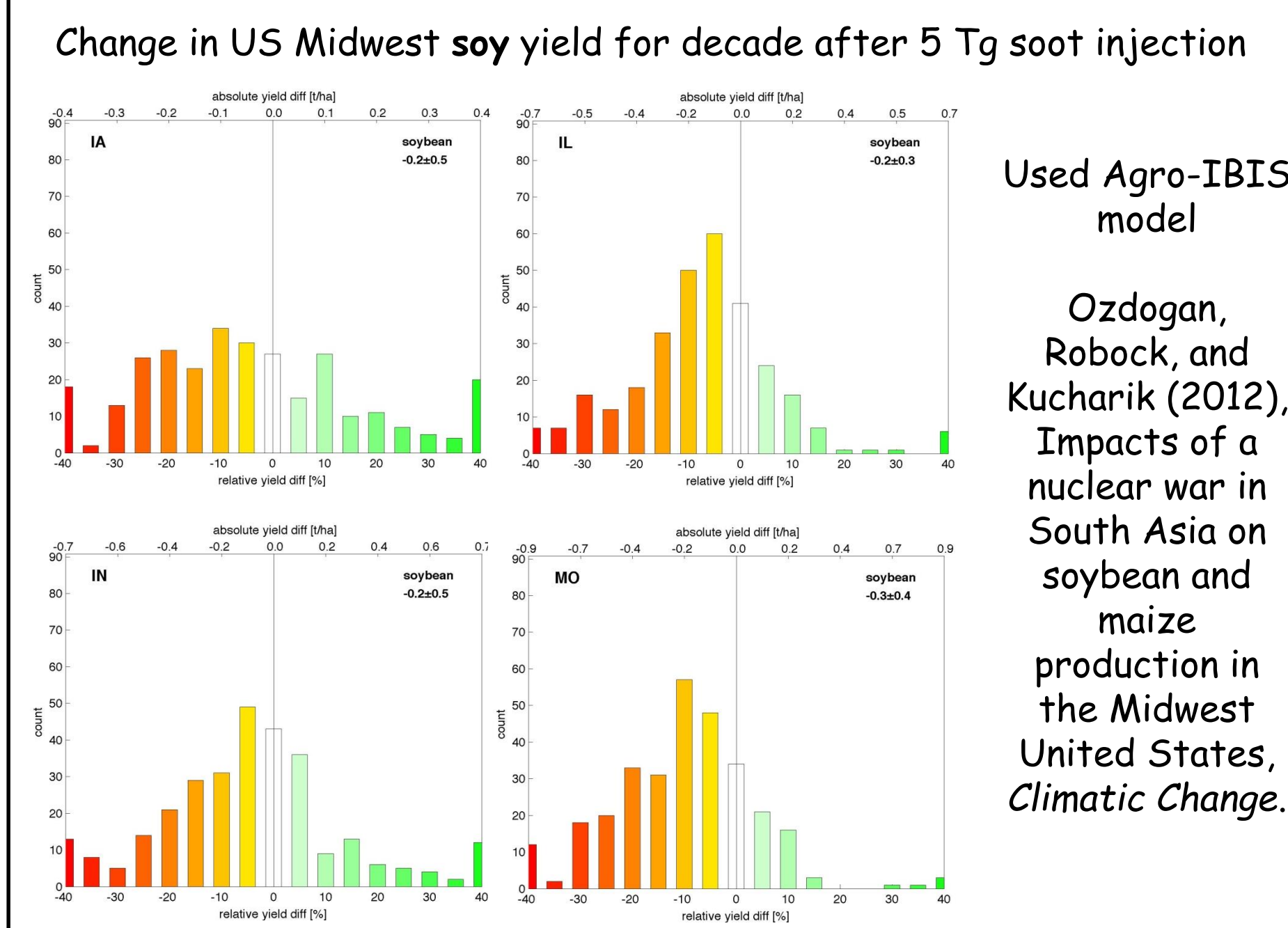
What could produce **150 Tg of smoke**?

- standard nuclear winter scenario of 30 years ago
- entire current arsenal if targeted the same way
- only 4000 weapons (2017 global arsenals of New START treaty)

**This would produce nuclear winter, with no agriculture for years and global starvation.**

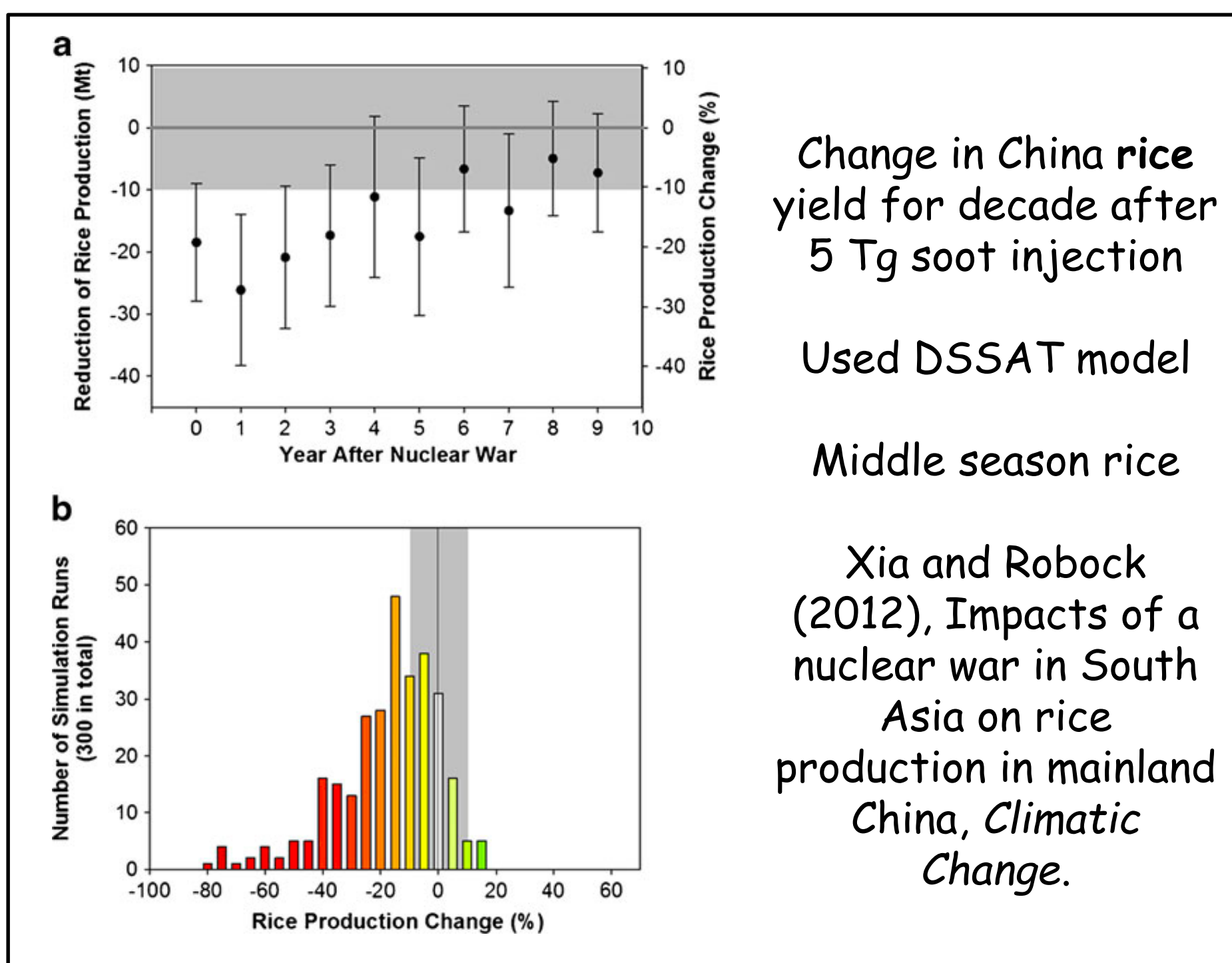


Recent simulations with a more complete climate model (WACCM) at NCAR got even longer-lasting results for the 5 Tg case, so the impacts above right might be even longer lasting.



Used Agro-IBIS model

Ozdoğan, Robock, and Kucharik (2012), Impacts of a nuclear war in South Asia on soybean and maize production in the Midwest United States, *Climatic Change*.



Change in China rice yield for decade after 5 Tg soot injection

Used DSSAT model

Middle season rice

Xia and Robock (2012), Impacts of a nuclear war in South Asia on rice production in mainland China, *Climatic Change*.

## What's New?

A nuclear war between new nuclear states, using much less than 1% of the current nuclear arsenal, would produce climate change unprecedented in human history.

Nuclear winter theory was correct.

The current global nuclear arsenal can still produce nuclear winter.

The effects of regional or global nuclear war would last for more than a decade. (This new result was only possible because now we can use atmospheric GCMs that include the entire troposphere, stratosphere and mesosphere, coupled to a complete ocean GCM.)

## Policy Implications of the Use of Nuclear Weapons

1. A nuclear war cannot be won. Even a “first strike” would be suicide. It is not MAD any more but SAD – Self-Assured Destruction, even for a very small number of weapons.
2. Even a “limited” nuclear war could cause severe effects, if targeted at cities and industrial areas, and it is doubtful that a nuclear war could ever be limited.
3. “Star Wars” (Strategic Defense Initiative, now the Missile Defense Agency) is not the answer, since it still does not work after 30 years of work. Even if it worked according to specifications, it would let in too many weapons, such as on cruise missiles.
4. Indirect effects of nuclear winter are greater than direct effects. There would be many innocent victims in non-combatant nations.
5. Only nuclear disarmament will prevent the possibility of a nuclear environmental catastrophe. Continuing American and Russian reductions set an example for others, maintain the nuclear deterrence of each, and dramatically lowering the chances of nuclear winter.

**Acknowledgments.** This work is supported by NSF Grant AGS-1157525. I thank Brian Toon (University of Colorado), Lili Xia (Rutgers University), Mutlu Özdoğan and Christopher Kucharik (University of Wisconsin), and Michael Mills (National Center for Atmospheric Research) for collaboration on this work.

**Further Reading** (All available at <http://climate.envsci.rutgers.edu/nuclear/>)

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