

Nuclear weapons: Why reducing the risk of nuclear war should be a key concern of our generation

The consequences of nuclear war would be devastating. Much more should – and can – be done to reduce the risk that humanity will ever fight such a war.

by Max Roser
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The shockwave and heat that the detonation of a single nuclear weapon creates can end the lives of millions of people immediately.

But even larger is the devastation that would follow a nuclear war.

The first reason for this is nuclear fallout. Radioactive dust from the detonating bombs rises up into the atmosphere and spreads out over large areas of the world from where it falls down and causes deadly levels of radiation.

The second reason is less widely known. But this consequence – ‘nuclear winter’ and the worldwide famine that would follow – is now believed to be the most serious consequence of nuclear war.

Cities that are attacked by nuclear missiles burn at such an intensity that they create their own wind system, a firestorm: hot air above the burning city ascends and is replaced by air that rushes in from all directions. The storm-force winds fan the flames and create immense heat.

From this firestorm large columns of smoke and soot rise up above the burning cities and travel all the way up to the stratosphere. There it spreads around the planet and blocks the sun’s light. At that great height – far above the clouds – it cannot be rained out, meaning that it will remain there for years, darkening the sky and thereby drying and chilling the planet.

The nuclear winter that would follow a large-scale nuclear war is expected to lead to temperature declines of 20 or even 30 degrees Celsius (60–86° F) in many of the world’s agricultural regions – including much of Eurasia and North America. Nuclear winter would cause a ‘nuclear famine’. The world’s food production would fail and billions of people would starve.¹

These consequences – nuclear fallout and nuclear winter leading to famine – mean that the destruction caused by nuclear weapons is not contained to the battlefield. It would not just harm the attacked country. Nuclear war would devastate all countries, including the attacker.

The possibility of global devastation is what makes the prospect of nuclear war so very terrifying. And it is also why nuclear weapons are so unattractive for warfare. A weapon that can lead to self-destruction is not a weapon that can be used strategically.

US President Reagan put it in clear words at the height of the Cold War: ‘A nuclear war cannot be won and must never be fought. The only value in our two nations possessing nuclear weapons is to make sure they will never be used. But then would it not be better to do away with them entirely?’²

Nuclear stockpiles have been reduced, but the risk remains high

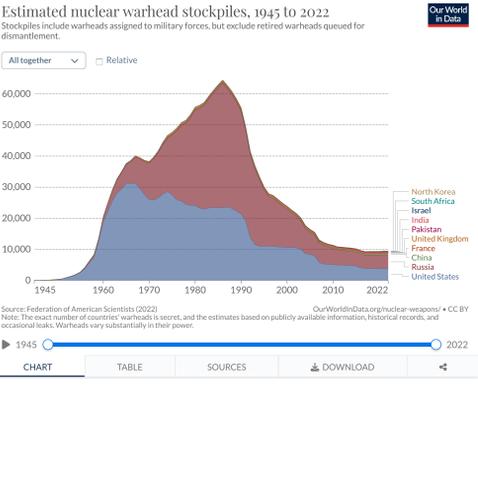
40 years after Reagan’s words, the Cold War is over and nuclear stockpiles have been reduced considerably, as the chart shows.

The world has learned that nuclear armament is not the one-way street that it was once believed to be. Disarmament is possible.

But the chart also shows that there are still almost ten thousand nuclear weapons distributed among nine countries on our planet, at least.³ Each of these weapons can cause enormous destruction; many are much larger than the ones that the US dropped on Hiroshima and Nagasaki.⁴

Collectively these weapons are immensely destructive. The nuclear winter scenario outlined above would kill billions of people—*billions*—in the years that follow a large-scale nuclear war, even if it was fought ‘only’ with today’s reduced stockpiles.⁵

It is unclear whether humanity as a species could possibly survive a full-scale nuclear war with the current stockpiles.⁶ A nuclear war might well be humanity’s final war.



Close Calls: Instances that threatened to push the ‘balance of terror’ out of balance and into war

The ‘balance of terror’ is the idea that all involved political leaders are so scared of nuclear war that they never launch a nuclear attack.

If this is achievable at all, it can only be achieved if all nuclear powers keep their weapons in check. This is because the balance is vulnerable to accidents: a nuclear bomb that detonates accidentally – or even just a false alarm, with no weapons even involved – can trigger nuclear retaliation because several countries keep their nuclear weapons on ‘launch on warning’; in response to a warning, their leaders can decide within minutes whether they want to launch a retaliatory strike.

For the balance of terror to be a balance, all parties need to be in control at all times. This however is not the case.

In the timeline, you can read through some of the close calls during the past decades.

The risk of nuclear war might well be low – because neither side would want to fight such a war that would have such awful consequences for everyone on the planet. But there is a risk that the kinds of technical errors and accidents listed here could lead accidentally to the use of nuclear weapons, as a nuclear power can incorrectly come to believe that they are under attack.

This is why false alarms, errors, and close calls are so crucial to monitor: they are the incidents that can push the ‘balance of terror’ out of balance and into war.

Accidents and errors are of course not the only possible path that could lead to the use of nuclear weapons. There is the risk of a terribly irresponsible person leading a country possessing nuclear weapons. There is the risk of nuclear terrorism, possibly after a terrorist organization steals weapons. There is the possibility that hackers can take control of the nuclear chain of command. And there is the possibility that several of these factors play a role at the same time.

A timeline of nuclear weapons ‘close calls’⁷

Below this post, you find additional lists of close calls, where you find much more information on each of these incidents.

A timeline of ‘close calls’ with nuclear weapons

Close calls are incidents during which nuclear powers came close to using their nuclear weapons, either accidentally or deliberately.

There is no complete list of close calls: Firstly because it is always a question of where one draws the line for what should be considered a close call. Second, only a few close calls are publicly known. Most publicly known close calls are events in the history of the US military, as the US has declassified several relevant events. Much less is known about close calls in Soviet and Russian history and all other countries that have nuclear weapons. The list of close calls below should therefore be considered to be only a (likely small) fraction of the total list of close calls.

The list below is largely based on Toby Ord – ‘The Precipice’: several descriptions are direct quotes. He in turn largely relies on the US Department of Defense.

- 1957:** A nuclear bomb accidentally fell out of a bomber over New Mexico. The flight crew was alerted, but there was no nuclear explosion.
- 1958:** A B-47 bomber accidentally dropped a nuclear bomb over South Carolina. It landed in someone’s garden, destroying their house. Fortunately, its atomic warhead was still in the plane.
- 1961:** Over North Carolina a B-52 bomber broke up and two nuclear bombs fell to the ground. Defense Secretary Robert McNamara said that a single switch prevented a nuclear explosion.
- 1961:** A B-52 carrying two nuclear bombs crashed in California. Neither bomb detonated.
- 1962:** The Cuban Missile Crisis is considered the closest the Cold War came to escalating into a full-scale nuclear war. A particular close call involved a Soviet submarine which got attacked by the US navy close to Cuba. The Soviet submarine had not been in contact with Moscow for several days and did not know whether war had broken out. The captain had made the decision to launch a nuclear torpedo, but in an ensuing argument Vasily Arkhipov eventually persuaded the others to not launch the nuclear weapon. If the submarine had launched the nuclear weapon, nuclear war would have been likely. Arkhipov is often credited as “the man who saved the world”.
- 1965:** Near Japan a fighter jet carrying a nuclear bomb fell off the side of a US aircraft carrier. The bomb was never recovered.
- 1966:** Above Spain a B-52 bomber crashed into a refueling plane in mid-air. Four nuclear weapons fell out and two of the bombs suffered conventional explosions. There was substantial radiation, and 1,400 tons of contaminated soil needed to be taken back to the US.
- 1968:** A B-52 bomber carrying four hydrogen bombs caught fire and crashed into the ice of Greenland. Luckily, this did not set off a nuclear reaction. Had it done so, all signals would have suggested – incorrectly – that this was a Soviet nuclear strike, which would have likely triggered nuclear retaliation.
- 1979:** A large number of incoming missiles – a full-scale Soviet first strike – appeared on the screens at four US command centers. In response intercontinental ballistic missiles (ICBMs) with nuclear warheads were put on high alert and nuclear bombers were prepared for take-off. Before any counter attack was launched it was realized to be a false alarm. The screens had been showing a realistic simulation of a Soviet attack from a military exercise that had mistakenly been sent to the live computer system.
- 1980:** In Arkansas a 9-megaton warhead was propelled about 100 meters away in an explosion. Fortunately, its safety features kept it intact.
- 1983:** The Soviet early-warning system showed five ICBMs launching from the US. Stanislav Petrov, the officer on duty, reported it to his commanders as a false alarm. Petrov reasoned that it is unlikely that the US would launch a first strike with just five missiles and noted that the missiles’ vapor trails could be identified. He was right. The false alarm turned out to be caused by sunlight glinting off clouds, which looked to the Soviet satellite system like the flashes of launching rockets.
- 1995:** Russian radar detected the launch of a missile aimed at Russia. The warning was quickly escalated all the way up the chain of command, leading President Yeltsin to open the Russian nuclear briefcase and consider whether to authorize nuclear retaliation. It turned out to be a false alarm, caused by the launch of a Norwegian scientific rocket to study the northern lights. Russia had been notified, but word hadn’t reached the radar operators.
- 2007:** Six nuclear-armed cruise missiles were mistakenly loaded onto a B-52 bomber in North Dakota. For 36 hours no one in the US Air Force realized that six live nuclear weapons were missing. US General Halgeir commented: “I have been in the nuclear business since 1966 and am not aware of any incident more disturbing.”

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How to reduce the risk of nuclear war?

An escalating conflict between nuclear powers – but also an accident, a hacker, a terrorist, or an irresponsible leader – could lead to the detonation of nuclear weapons.

Those risks only go to zero if all nuclear weapons are removed from the world. I believe this is what humanity should work towards, but it is exceedingly hard to achieve, at least in the short term. It is therefore important to see that there are additional ways that can reduce the chance of the world suffering the horrors of nuclear war.⁸

A more peaceful world: Many world regions in which our ancestors fought merciless wars over countless generations are extraordinarily peaceful in our times. The rise of democracy, international trade, diplomacy, and a cultural attitude shift against the glorification of war are some of the drivers credited for this development.⁹

Making the world a more peaceful place will reduce the risk of nuclear confrontation. Efforts that reduce the chance of any war reduce the chance of nuclear war.

Nuclear treaties: Several non-proliferation treaties have been key in achieving the large reduction of nuclear stockpiles. However, key treaties – like the Intermediate-Range Nuclear Forces (INF) Treaty between the US and Russia – have been suspended and additional agreements could be reached.

The UN Treaty on the Prohibition of Nuclear Weapons, which became effective in 2021, is a recent development in this direction.

Smaller nuclear stockpiles: Reducing the stockpiles further is seen as an important and achievable goal by experts.

It is considered achievable because smaller stockpiles would still provide the deterrence benefits from nuclear weapons. And it is important as it reduces the risk of accidents and the chance that a possible nuclear war would end civilization.

Better monitoring, better control: The risk can be further reduced by efforts to better control nuclear weapons – so that close calls occur less frequently. Similarly better monitoring systems would reduce the chance of false alarms.

Taking nuclear weapons off ‘hair-trigger alert’ would reduce the risk that any accident that does occur can rapidly spiral out of control. And a well-resourced International Atomic Energy Agency can verify that the agreement in the treaties are met.

Better public understanding, global relations, and culture: Finally I also believe that it will help to see clearly that billions of us share the same goal. None of us wants to live through a nuclear war, none of us wants to die in one. As Reagan said, a nuclear war cannot be won and it would be better to do away with these weapons entirely.

A generation ago a broad and highly visible societal movement pursued the goal of nuclear disarmament. These efforts were to a good extent successful. But since then, this goal has unfortunately lost much of the attention it once received – and this is despite the fact that things have not fundamentally changed: the world still possesses weapons that could kill billions.¹⁰ I wish it was a more prominent concern in our generation so that more young people would set themselves the goal to make the world safe from nuclear weapons.

Below this post you find resources on where you can get engaged or donate, to help reduce the danger from nuclear weapons.

Conclusion

I believe some dangers are exaggerated – for example, I believe that the fear of terrorist attacks is often wildly out of proportion with the actual risk. But when it comes to nuclear weapons I believe the opposite is true. There are many today who hardly give nuclear conflict a thought and I think this is a big mistake.

For eight decades people have been producing nuclear weapons. Several countries have dedicated vast sums of money to their construction. And now we live in a world in which these weapons endanger our entire civilization and our future.

These destructive weapons are perhaps the clearest example that technology and innovation are not only forces for good, they can also enable catastrophic destruction.

Without the Second World War and the Cold War, the world might have never developed these weapons and we might find the idea that anyone could possibly build such weapons unimaginable. But this is not the world we live in. We live in a world with weapons of enormous destructiveness and we have to see the risks that they pose to all of us and find ways to reduce them.

I hope that there are many in the world today who take on the challenge to make the world more peaceful and to reduce the risk from nuclear weapons. The goal has to be that humanity never ends up using this most destructive technology that we ever developed.

Resources to continue reading and finding ways to reduce the risk of nuclear weapons:

- Hiroshima: John Hersey’s report for the New Yorker about the bombing of Hiroshima, published in August 1946.
- ‘80,000 Hours’ profile on Nuclear Security: an article focusing on the question of how to choose a career that makes the world safer from nuclear weapons.
- The ‘Future of Life Institute’ on Nuclear Weapons: this page includes an extensive list of additional references – including videos, research papers, and many organisations that are dedicated to reducing the risk from nuclear weapons.

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Additional lists of close calls with nuclear weapons:

- Future of Life Institute – [Accidental nuclear war: A timeline of close calls](#).
- Alan F. Phillips, M.D. – [20 Mishaps That Might Have Started Accidental Nuclear War](#), published on Nuclear Files
- Josh Harkinson (2014) – [That Time We Almost Nuked North Carolina](#)
- Union of Concerned Scientists (2015) – [Close Calls with Nuclear Weapons](#)
- Chatham House Report (2014) – [Too Close for Comfort: Cases of Near Nuclear Use and Options for Policy](#) authored by Patricia Lewis, Heather Williams, Benoit Pelopidas, and Sasan Aghlani
- Wikipedia – [List of Nuclear Close Calls](#)

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Endnotes

1. ‘Nuclear Winter’ scene: see
 - Jägermeyr, Jonas, Alan Robock, Joshua Elliott, Christoph Müller, Lili Xia, Nikolay Khabarov, Christian Ferrelth, et al. (2020) – [A Regional Nuclear Conflict Would Compromise Global Food Security](#), Proceedings of the National Academy of Sciences 117, no. 13 (31 March 2020): 7071–81.
 - Robock, A. L., Oman, and G. L. Stenchikov (2007) – [Nuclear winter revisited with a modern climate model and current nuclear arsenals: Still catastrophic consequences](#), J. Geophys. Res., 112, D13107, doi:10.1029/2006JD008235.
 - Alan Robock & Owen Brian Toon (2012) – [Self-assured destruction: The climate impacts of nuclear war](#), In Bulletin of the Atomic Scientists, 68, 66–74.
 - Alan Robock & Owen Brian Toon (2016) – [Let’s End the Peril of a Nuclear Winter](#), In the New York Times, Feb. 11, 2016.
2. Some additional points:
 - The risk of nuclear winter (initially termed ‘nuclear twilight’) was only discovered in the early 1980s, more than 3 decades after the bombs were first used.
 - The main mechanism by which a nuclear winter is expected to cause a decline in global food production is by reducing the growing season, the days in a row without frost. See Robock, Oman, and Stenchikov (2007).
 - Robock estimates that the smoke and soot would rise as high as 40 kilometers (25 miles) into the atmosphere. See Robock and Toon (2016).
 - Before the nuclear famine kills people from hunger, many will die from hypothermia.
 - In addition to the impact on the climate, the ozone layer is expected to get depleted in such a scenario. This would allow more harmful ultraviolet radiation to reach our surface, harming plant and animal life.
 - In general there is only relatively little scientific work that focuses on nuclear winter and additional good research could be useful to provide a better understanding. Due to the lack of research there remains uncertainty about how devastating a nuclear winter would be. In particular, there is disagreement on how likely it is that all of humanity would die in a nuclear winter.
 - The paper by Jägermeyr et al (2020) shows that among the countries with the largest food production losses would be the US and Russia, those countries that have the largest stockpiles of nuclear weapons.
3. For anyone who interested in the impact of nuclear winter on food production and famine, Ord (2020) cites the following:
 - Cropper, W. P., and Harwell, M. A. (1986) – [‘Food Availability after Nuclear War’](#), in M. A. Harwell and T. C. Hutchinson (eds.), The Environmental Consequences of Nuclear War (SCOPE 28), vol. 2: Ecological, Agricultural, and Human Effects, John Wiley and Sons.
 - Helfand, I. (2013) – [Nuclear Warfare and Risk? Physicians for Social Responsibility](#).
 - Xia, L., Robock, A., Mills, M., Stenke, A., and Helfand, I. (2015) – [Decadal Reduction of Chinese Agriculture after a Regional Nuclear War](#), Earth’s Future, 3(2), 37–48.
4. Reagan in his State of the Union address in 1984, quoted in the New York Times: Reagan and Reaganism (1984) – [Reagan reassures Russians on war](#), In the New York Times January 26, 1984.
5. The largest bomb that was ever detonated is the ‘Tsar Bomba’ built by the USSR and detonated in October 1961. Its yield was about 50 megatons of TNT. That’s 50,000 kilotons of TNT or about 3,333-times the yield of the bomb in Hiroshima.
6. The scenario in Robock, Oman, and Stenchikov (2007) is based on the nuclear stockpiles after the large reduction that was achieved after the end of the Cold War. It shows that the world still retains enough weapons to cause “a large, long-lasting, and unprecedented global climate change”, as the authors put it. Since the publication of this study, the stockpiles have been reduced further, as the chart shows, but not very strongly so.
7. For a recent discussion of this question see Ord (2020) – ‘The Precipice’.
8. This list is largely based on Toby Ord’s 2020 book [The Precipice](#). His list can be found in Chapter 4 and Appendix C of his book.
 - Ord in turn relies mostly on a document from the US Department of Defense from 1981: [Narrative Summaries of Accidents Involving US Nuclear Weapons \(1950–1980\)](#).
 - This list is mostly based on the [‘80,000 Hours’ profile on Nuclear Security](#) and Toby Ord (2020) – ‘The Precipice’.
 - For big overviews of this literature see the forthcoming book Christopher Blattman (2022) – [Why We Fight: The Roots of War and the Paths to Peace](#) and Steven Pinker (2011) – [The Better Angels of our Nature for a big overview](#)
 - Lawrence S. Wittner – [Confronting the Bomb: A Short History of the World Nuclear Disarmament Movement](#), Stanford University Press.
9. One indication for the declining interest in the last generation: Mentions of ‘nuclear war’ in books and newspapers peaked in 1985 and declined strongly since then (see [Google Ngram for ‘nuclear war’](#)).

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