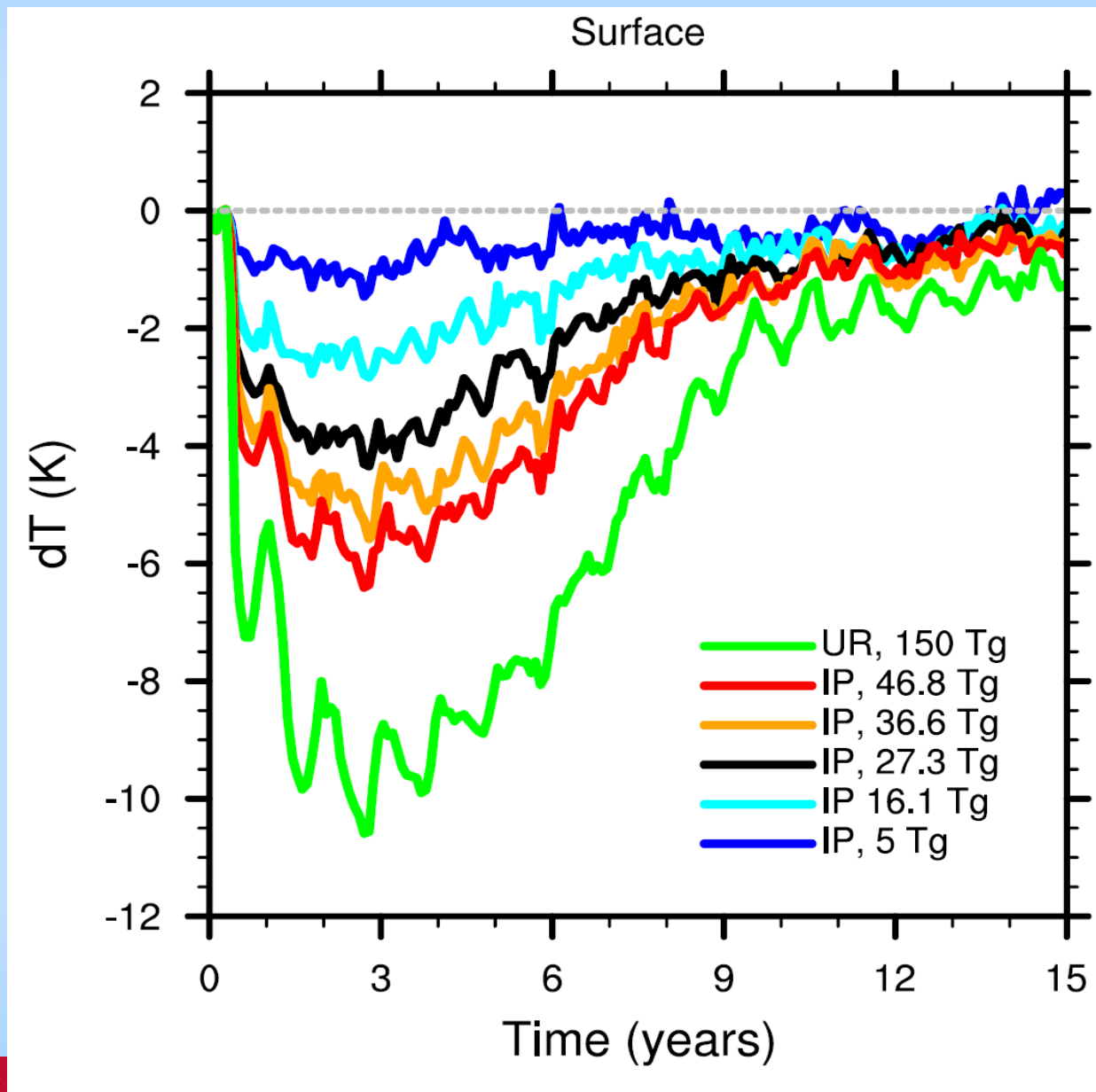


WACCM4 global average surface temperature changes for different soot amounts



HOW NUCLEAR WAR WOULD AFFECT AGRICULTURE

- Darkness
 - Cold
 - Slower growth
 - Shortened frost-free growing season
 - Increased time for crop maturation
 - Cold spells during growing season that could kill crops
 - Less rainfall
-
- Toxic chemicals in the atmosphere and soil
 - Highly engineered genetic stocks
 - Lack of fuel for machinery
 - Lack of water supplies
 - Lack of pesticides (but not of pests)
 - Lack of distribution system
 - Enhanced UV (later)

nature food

Article | [Open Access](#) | [Published: 15 August 2022](#)

Global food insecurity and famine from reduced crop, marine fishery and livestock production due to climate disruption from nuclear war soot injection

[Lili Xia](#) , [Alan Robock](#), [Kim Scherrer](#), [Cheryl S. Harrison](#), [Benjamin Leon Bodirsky](#), [Isabelle Weindl](#), [Jonas Jägermeyr](#), [Charles G. Bardeen](#), [Owen B. Toon](#) & [Ryan Heneghan](#)

<https://www.nature.com/articles/s43016-022-00573-0>

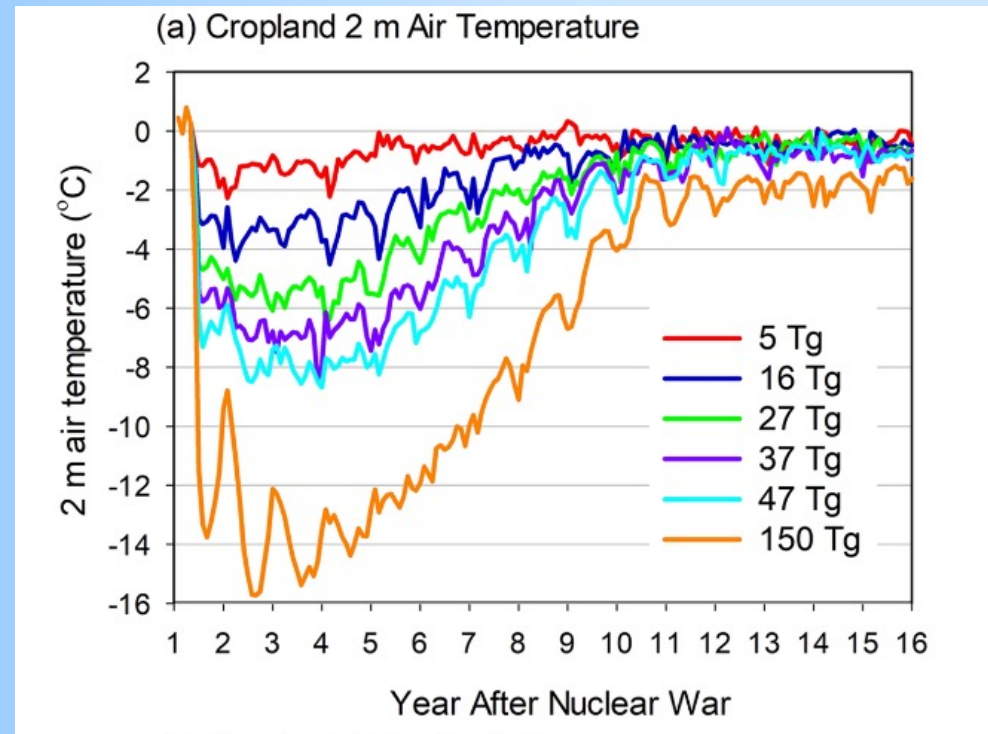
Food Calculations

We used the Community Land Model version 5 crop model in the Community Earth System Model version 2 to simulate maize, rice, soybeans, wheat, and grasses, and the Bioeconomic Marine Trophic Size-spectrum model to simulate marine fisheries.

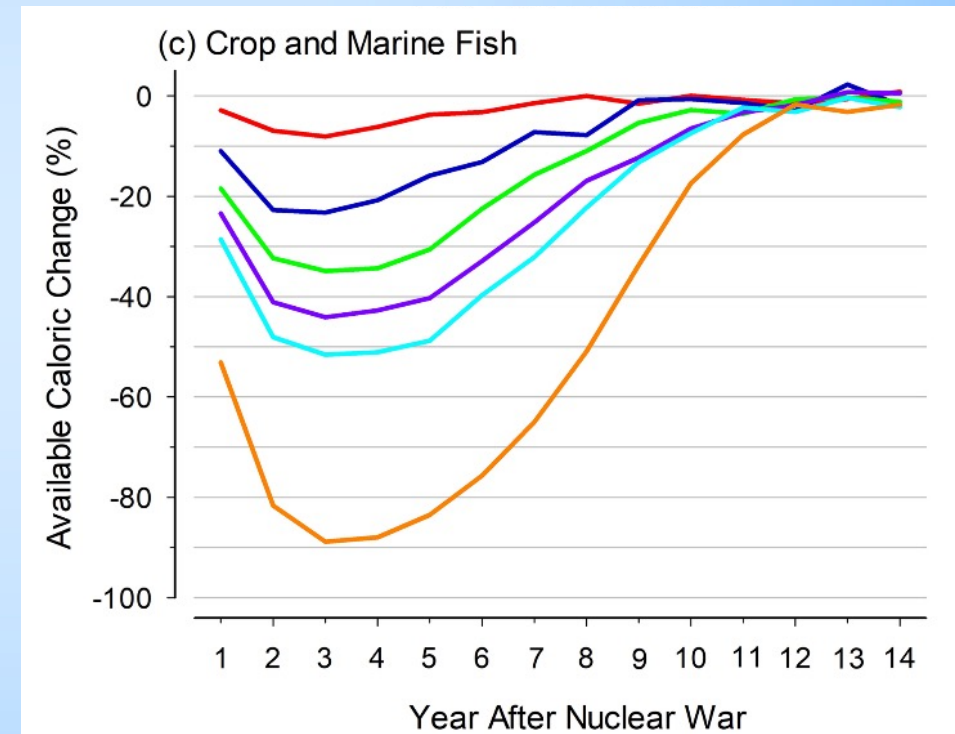
For cattle and sheep, on average half are fed by pasture, and half are fed by crops and processed products. We used data for each animal and each country in our calculations.

We used Food and Agricultural Organization data for the calorie content of each food, and for the national import, export, and consumption of all the different foods.

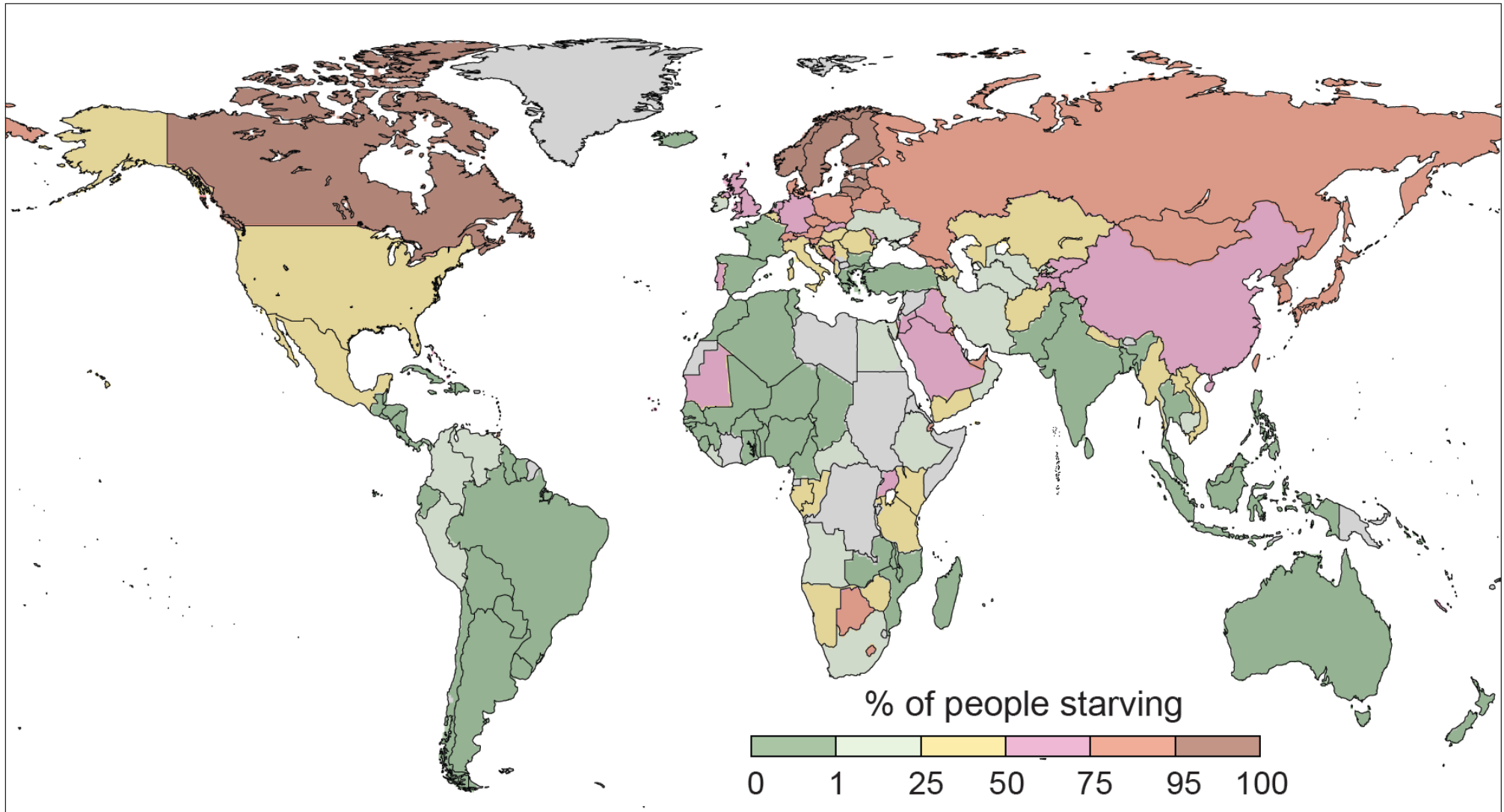
Cropland temperature



Available calories



Proportion of population that would starve to death Partial Livestock Case, 37 Tg, 50% livestock feed to human consumption, no trade



Proportion of population that would starve to death
Partial Livestock Case, 150 Tg, 50% livestock feed to human consumption, no trade



Combatants	Number of weapons	Yield	Smoke	Number of direct fatalities	Number of people without food at the end of Year 2
India - Pakistan	250	15 kt	16 Tg	52,000,000	926,000,000
	250	100 kt	37 Tg	127,000,000	2,081,000,000
Russia-U.S.-NATO	4400	100 kt	150 Tg	360,000,000	5,341,000,000

A war between India and Pakistan could kill 1 to 2 billion people.

A Russia-U.S.-NATO war could kill most of Earth's population.

Not yet considered in these calculations:

Effects of ultraviolet radiation

Effects of ozone changes

More complex economic responses, including:

- Some international trade

- Food distribution within countries

- Agricultural adaptations, including different crops

Nuclear Winter Analogs

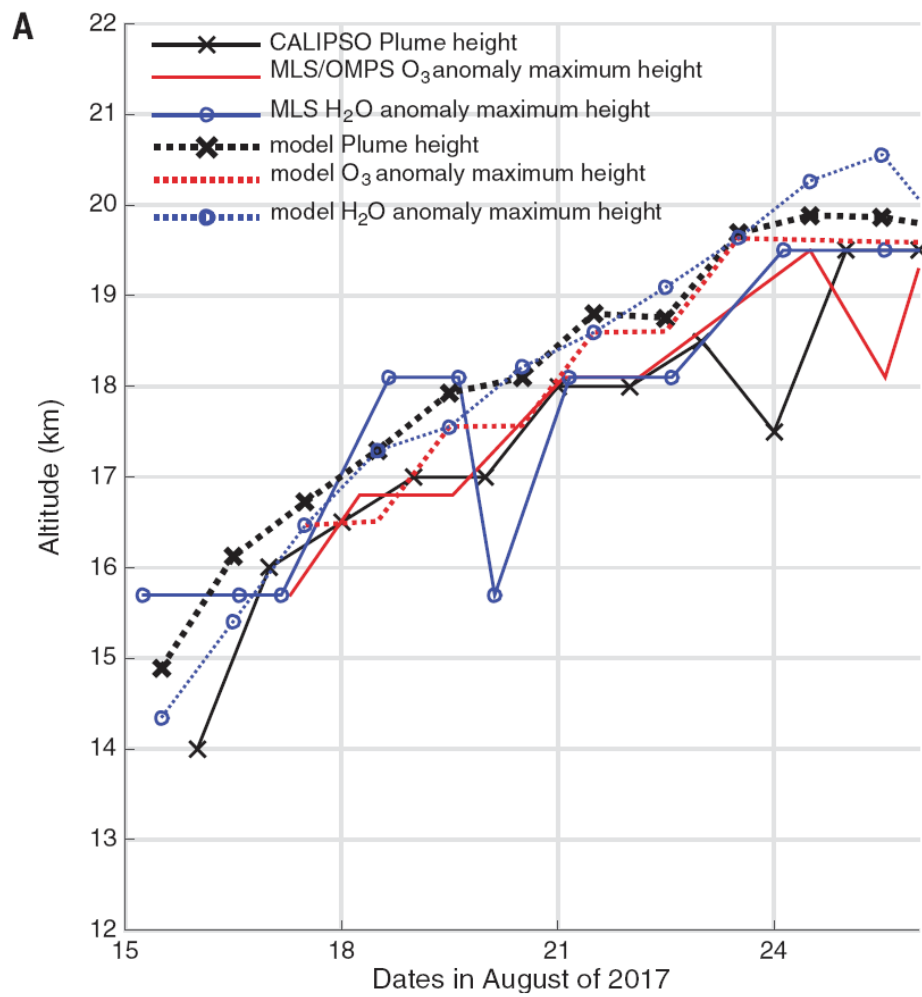
- Seasonal cycle
- Diurnal cycle (day and night)
- Firestorm: 1906 San Francisco earthquake
- Fires: World War II firestorms
 - Dresden, Hamburg, Darmstadt, Tokyo (“conventional” bombs)
 - Hiroshima, Nagasaki (nuclear bombs)
- Smoke and dust transport, Surface temperature effects
 - Martian dust storms
 - Asteroid impact → dinosaur extinction
 - Forest fires
 - Saharan dust
 - Volcanic eruptions

Black carbon lofts wildfire smoke high into the stratosphere to form a persistent plume

Pengfei Yu^{1,2,3*}, Owen B. Toon^{4,5}, Charles G. Bardeen⁶, Yunqian Zhu⁵, Karen H. Rosenlof², Robert W. Portmann², Troy D. Thornberry^{1,2}, Ru-Shan Gao², Sean M. Davis², Eric T. Wolf^{5,7}, Joost de Gouw^{1,8}, David A. Peterson⁹, Michael D. Fromm¹⁰, Alan Robock¹¹

Yu *et al.*, *Science* **365**, 587–590 (2019) 9 August 2019

In 2017, western Canadian wildfires injected smoke into the stratosphere that was detectable by satellites for more than 8 months. The smoke plume rose from 12 to 23 kilometers within 2 months owing to solar heating of black carbon, extending the lifetime and latitudinal spread. Comparisons of model simulations to the rate of observed lofting indicate that 2% of the smoke mass was black carbon. The observed smoke lifetime in the stratosphere was 40% shorter than calculated with a standard model that does not consider photochemical loss of organic carbon. Photochemistry is represented by using an empirical ozone-organics reaction probability that matches the observed smoke decay. The observed rapid plume rise, latitudinal spread, and photochemical reactions provide new insights into potential global climate impacts from nuclear war.



Rapid ascent in first 10 days, observed and modeled.

Fig. 3. Observed and modeled smoke transport in August 2017.
 (A) Maximum altitude of observed plume height by CALIOP in the region of interest in black lines with cross symbols; maximum altitude of observed significant O₃ negative anomaly (more negative than -0.3 ppmv) by MLS and OMPS in the region of interest (30° to 70°N, 80°W to 20°E) in red solid line; maximum altitude of observed water vapor positive

Yu *et al.*, *Science* **365**, 587-590 (2019) 9 August 2019

Tambora in 1815, together with an eruption from an unidentified volcano in 1809, produced the "Year Without a Summer" (1816)



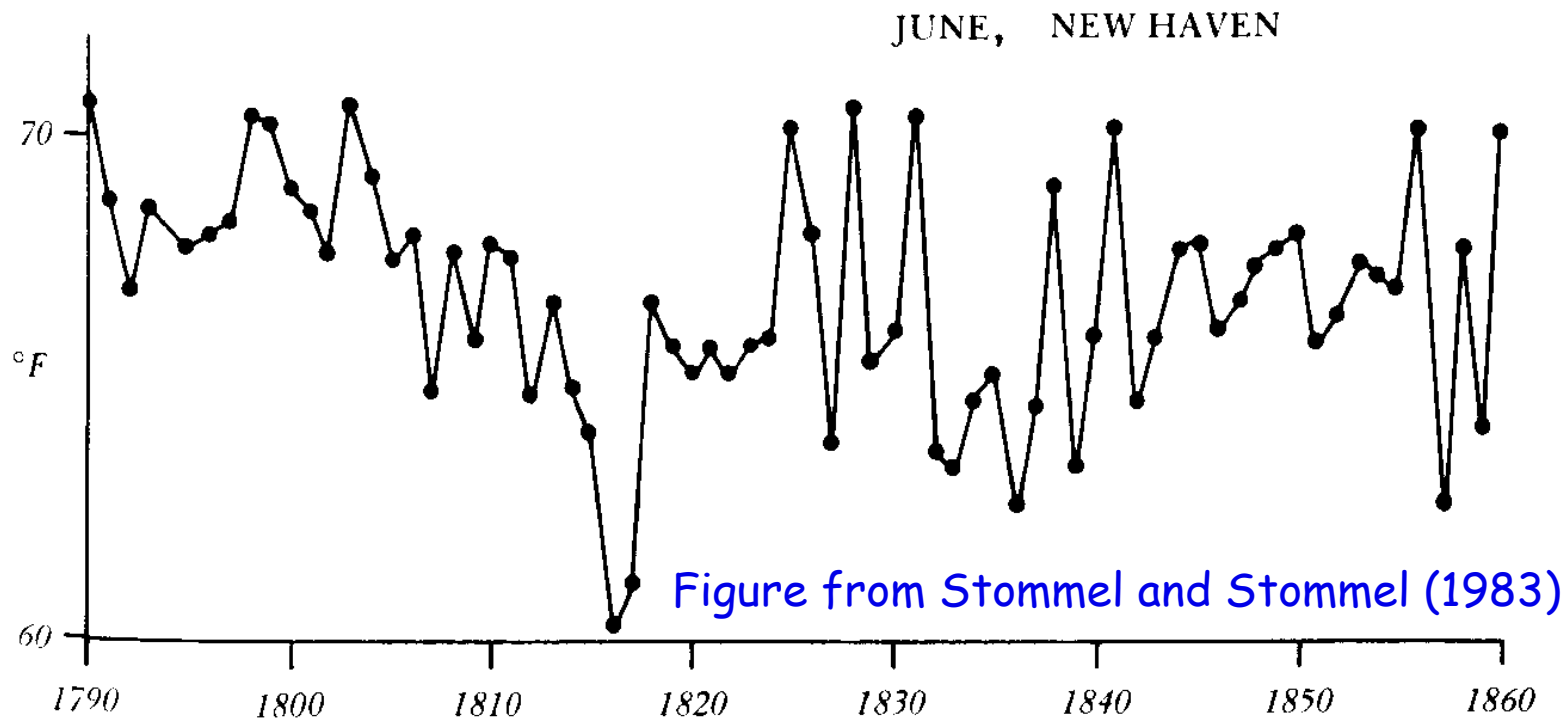
Image © 2017 TerraMetrics
Image © 2017 CNES / Airbus
Image © 2017 DigitalGlobe
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Goewoe Pranggawaoe

Google Earth Alan Robock
al Sciences

lat -8.245260° lon 117.958554° elev 2662 m eye alt 27.03 km

Mean June temperatures at New Haven, Connecticut, for some early years.

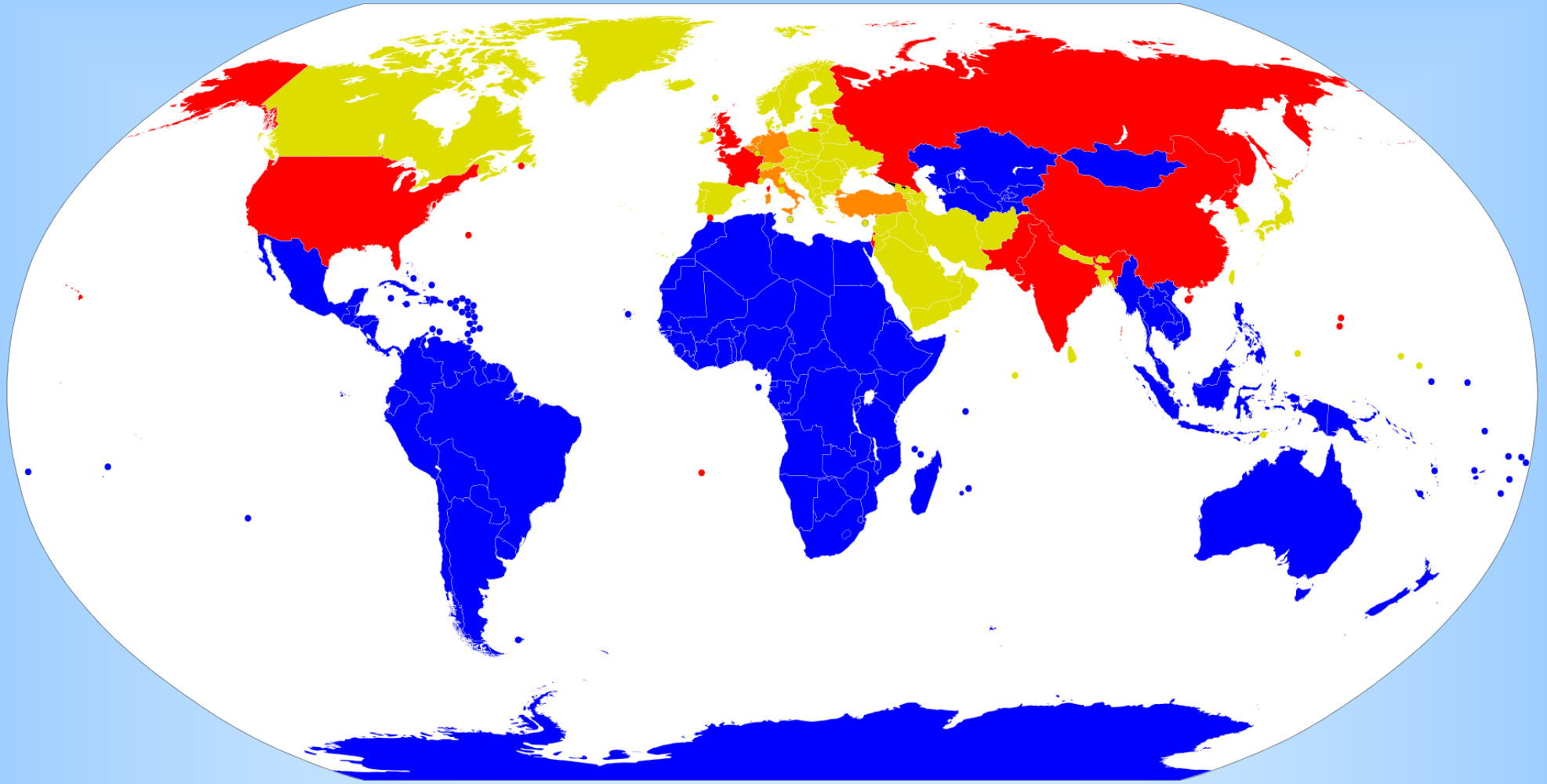






Gillen D'Arcy Wood, *Tambora: The Eruption That Changed the World* (2014): "For three years following Tambora's explosion, to be alive, almost anywhere in the world, meant to be hungry."

Conclusions

The current nuclear arsenal can produce nuclear winter.

Nuclear winter could kill most of humanity. In a US-NATO-Russia nuclear war, more people could die in India or China than in the US or Russia, even if no bombs were dropped there.



-  Nuclear-weapon-free zones by international treaty, including territories that belong to a Nuclear Weapons State that has agreed the territory is subject to a zone
-  Nuclear weapons states and territories belonging to them that are not in any NWFZ
-  Nuclear sharing (US nuclear arsenal stationed there for host country use in wartime)
-  None of the above (but party to the Non Proliferation Treaty (NPT))

Bulletin of the Atomic Scientists

IT IS 5 MINUTES TO MIDNIGHT



Feature

Self-assured destruction: The climate impacts of nuclear war

Alan Robock and Owen Brian Toon

Bulletin of the Atomic Scientists

68(5) 66–74

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DOI: 10.1177/0096340212459127

<http://thebulletin.sagepub.com>



<http://climate.envsci.rutgers.edu/pdf/RobockToonSAD.pdf>



Mexico hosted the **Second Conference on the Humanitarian Impact of Nuclear Weapons** in Nayarit, February, 2014, attended by 146 nations, the United Nations, Red Cross, Red Crescent, and civil society.



First week of Ban negotiations at UN, March 27-31, 2017

The New York Times

<https://nyti.ms/2uRgH4p>

AMERICAS

A Treaty Is Reached to Ban Nuclear Arms. Now Comes the Hard Part.

By RICK GLADSTONE JULY 7, 2017



R-12 ROCKET (SS-4)

Middle range ballistic rocket belonging to the Strategic Rocket Troops

Length: 22.1 m

Diameter: 1.65 m

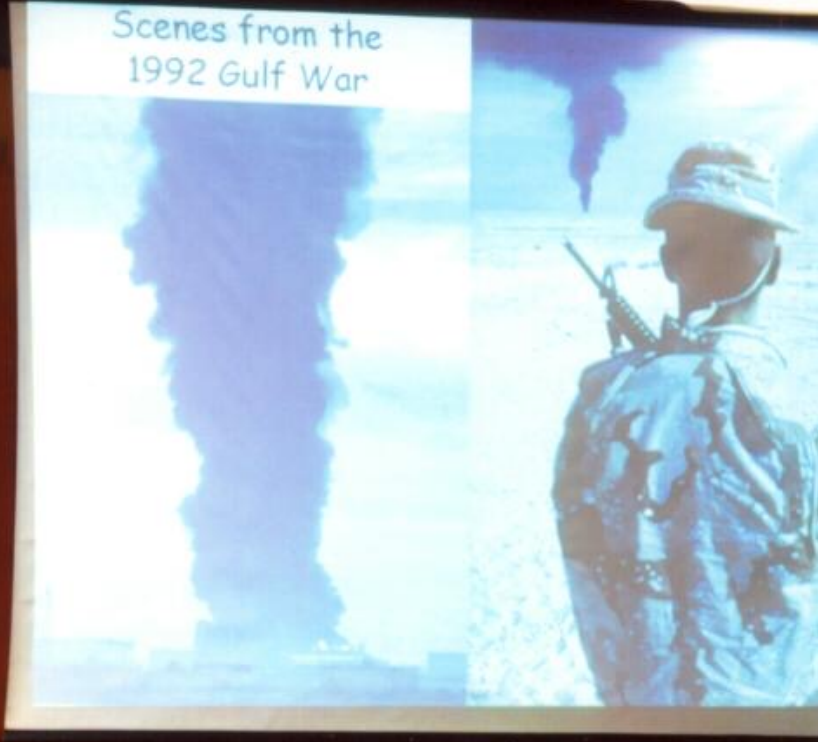
Weight: 27 200 Kg

Range: 700 to 2100 Km

Power of nuclear load: 1 megaton (77 times more powerful than the bomb which devastated Hiroshima).

Three regiments arrived in Cuba with a total of 36 operational rockets with 36 nuclear heads. These were positioned at three ports: Bahia Honda, Mariel and Casilda at the Pinar del Rio province.

The exhibit is a replica donated by the Soviet Government during the early years of the Revolution.



*By a debutant
Sept. 10 de 2010*



**De: Comandante en Jefe
Fidel Castro Ruz**

Para: Alan Robock



RUTGERS

Alan Robock
Department of Environmental Sciences

Fidel Castro Ruz

Reflexiones
Sept. 23, 2010



“While the United States and Russia each committed to reducing their operative nuclear arsenals down to some 2,000 weapons in April 2010 in Prague, the only way to prevent a global climate catastrophe from taking place would be by eliminating nuclear weapons.”

A lecture by a professor, or a feature film?









The 2022 Future of Life Award

The winners are announced

6th August 2022

For reducing the risk of nuclear war by developing and popularizing the science of nuclear winter

We bestow the 2022 Future of Life Award upon...

JEANNIE PETERSON



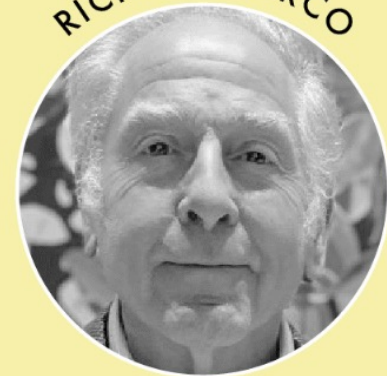
PAUL CRUTZEN



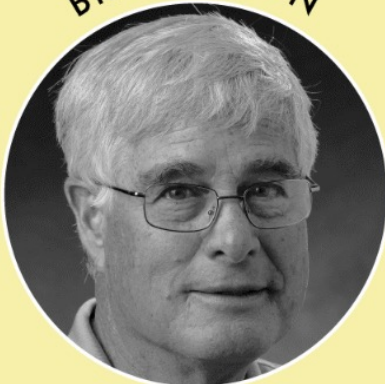
JOHN BIRKS



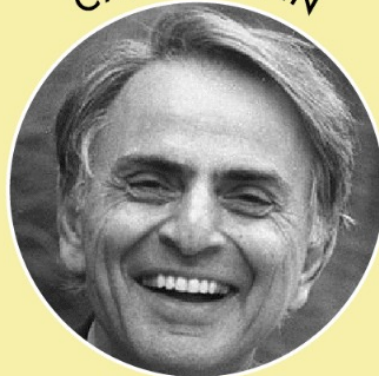
RICHARD TURCO



BRIAN TOON



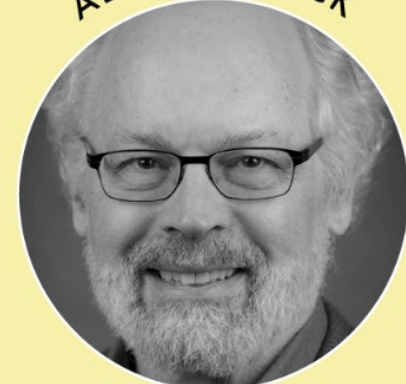
CARL SAGAN



GEORGIY STENCHIKOV



ALAN ROBOCK



Nobel Peace Prizes for Advocating Nuclear Disarmament (from <https://www.nobelprize.org/prizes/lists/all-nobel-peace-prizes>)

Year	Nobel Laureates
1959	Philip Noel-Baker "He engaged in intense efforts to prevent nuclear war between the United States and the Soviet Union."
1962	Linus Pauling "He spoke and wrote against the nuclear arms race, and he was a driving force in the Pugwash movement. ... He was one of the prime movers who urged the nuclear powers the USA, the Soviet Union and Great Britain to conclude a nuclear test ban treaty."
1982	Alva Myrdal "She worked actively to persuade the superpowers to disarm. The nuclear race was a major concern, and she fought for nuclear weapons-free zones in Europe." and Alfonso García Robles "played a key part in the laborious efforts to make Latin America a nuclear-free zone. ... He was lauded as 'Mr. Disarmament.'"
1985	International Physicians for the Prevention of Nuclear War "IPPNW held annual congresses to tell the world about the consequences of nuclear war. Extensive nuclear explosions could prevent sunlight from reaching the earth. The resulting drop in temperature would cause a 'nuclear winter.' The organization recommended a nuclear test ban and demanded that the great powers should refrain from first use in conflict situations."
1995	Joseph Rotblat and Pugwash Conferences on Science and World Affairs "for their efforts to diminish the part played by nuclear arms in international politics and, in the longer run, to eliminate such arms"
2005	International Atomic Energy Agency (IAEA) and Mohamed ElBaradei "for their efforts to prevent nuclear energy from being used for military purposes and to ensure that nuclear energy for peaceful purposes is used in the safest possible way"
2017	International Campaign to Abolish Nuclear Weapons (ICAN) "for its work to draw attention to the catastrophic humanitarian consequences of any use of nuclear weapons and for its ground-breaking efforts to achieve a treaty-based prohibition of such weapons"

Nobel Peace Prizes for Advocating Nuclear Disarmament (from <https://www.nobelprize.org/prizes/lists/all-nobel-peace-prizes>)

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"For the greatest benefit to mankind"
Alfred Nobel



The Norwegian Nobel Committee has decided to award the

2017 NOBEL PEACE PRIZE

to:



International Campaign to Abolish Nuclear Weapons (ICAN)

"for its work to draw attention to the catastrophic humanitarian consequences of any use of nuclear weapons and for its ground-breaking efforts to achieve a treaty-based prohibition of such weapons."

 Nobelprize.org

Illustrations: Niklas Elmehed, Nobel Prize Medal: © The Nobel Foundation, Photo: Thomas Widerberg.



Beatrice Fihn
Executive Director of ICAN
Nobel Peace Prize Lecture
December 10, 2017

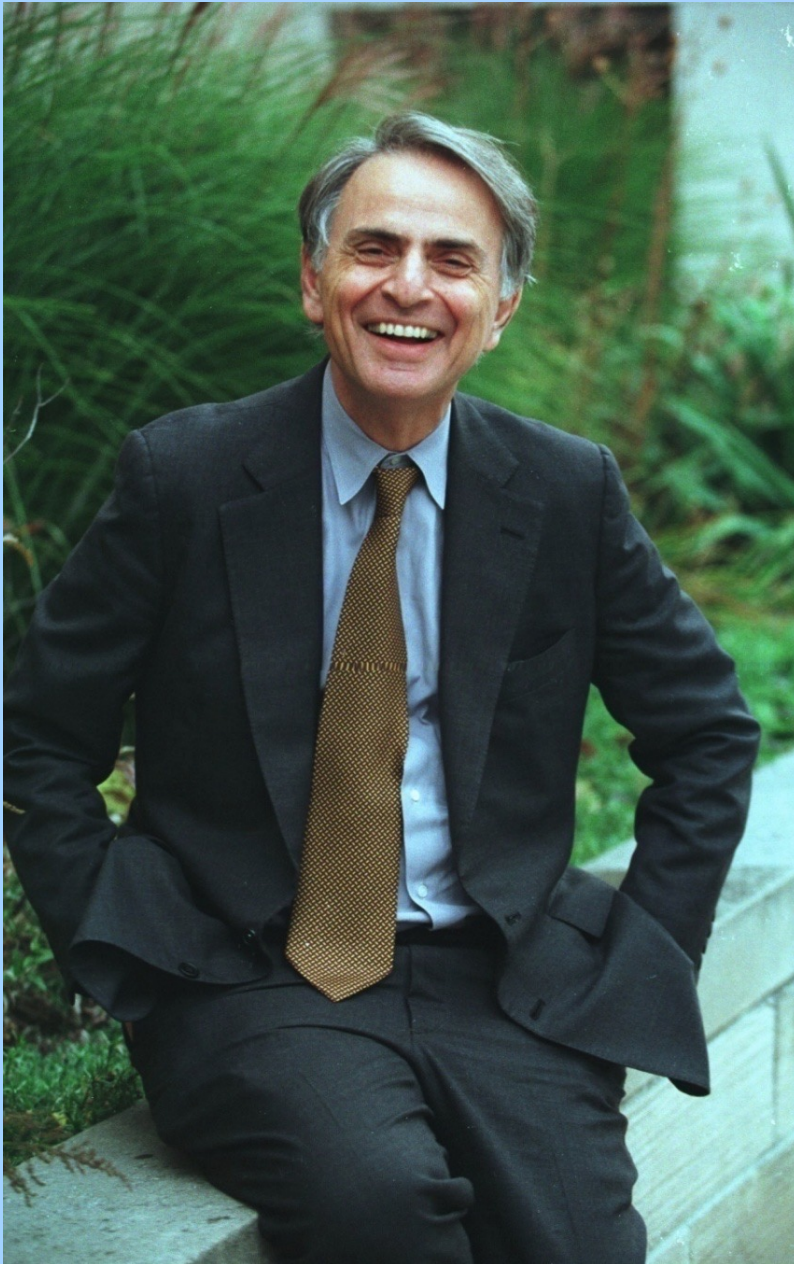
The story of nuclear weapons will have an ending, and it is up to us what that ending will be.

Will it be the end of nuclear weapons, or will it be the end of us? One of these things will happen.

The only rational course of action is to cease living under the conditions where our mutual destruction is only one impulsive tantrum away.

"Every gun that is made, every warship launched, every rocket fired signifies, in the final sense, a theft from those who hunger and are not fed, those who are cold and are not clothed. This world in arms is not spending money alone. It is spending the sweat of its laborers, the genius of its scientists, the hopes of its children."

President Dwight D. Eisenhower, April 16, 1953



"For myself, I would far rather have a world in which the climatic catastrophe cannot happen, independent of the vicissitudes of leaders, institution, and machines. This seems to me elementary planetary hygiene, as well as elementary patriotism."

-Carl Sagan

"Elementary planetary hygiene" demands that we eliminate nuclear weapons faster than the current pace.



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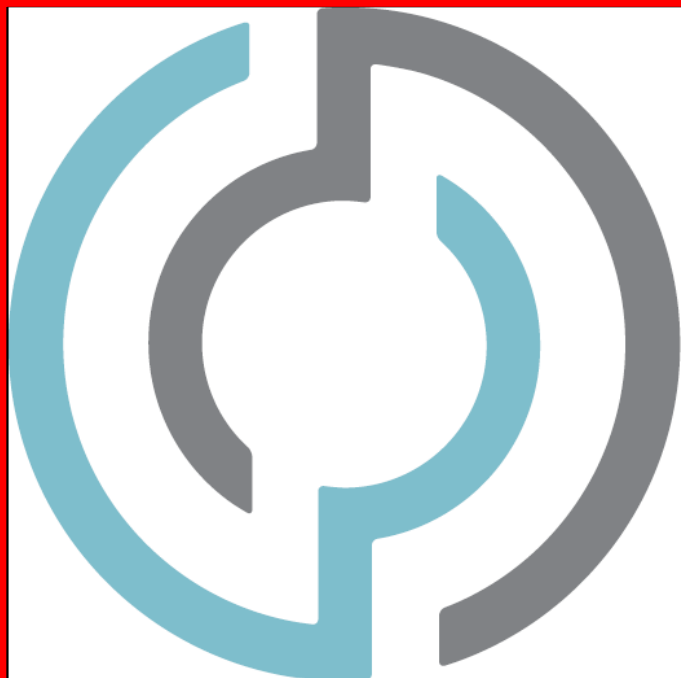
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<http://climate.envsci.rutgers.edu/nuclear/>