

# Nuclear weapons and climate catastrophe

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- **The possibility of nuclear winter was first raised in 1983, at the height of the Cold War.**
- **Climate modelling was in its infancy but the models suggested that use of a 1000 nuclear warheads would lead to severe global cooling, “darkness at noon” and ozone depletion lasting for a year or more.**
- **Are these results valid and what do the latest models predict?**
- **First let’s look at the basic science:**

Nuclear Holocaust

Cities burn

Ground bursts

Massive amounts of smoke

Massive amounts of dust

Sunlight absorbed

Sunlight reflected

Very little sunlight reaches the ground

Rapid, large surface temperature drops

**"Nuclear Winter"**

## First new models run in 2007 and most recently again in 2014

Robock A, Oman L, Stenchikov GL (2007), 'Nuclear winter revisited with a modern climate model and current nuclear arsenals: still catastrophic consequences', *Journal of Geophysical Research*, vol. 112, no. D13, D13107.

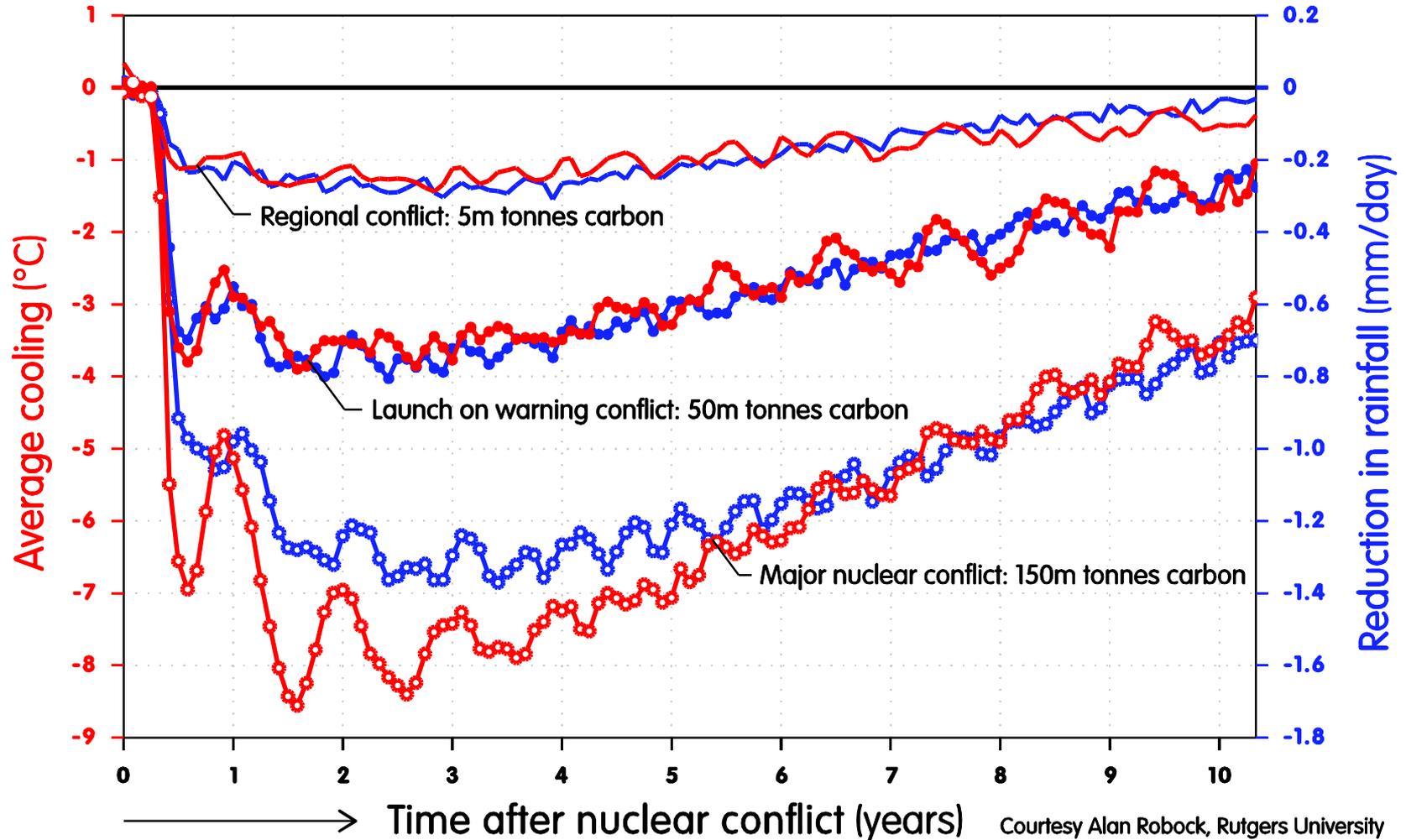
Toon OB, Turco RP, Robock A, Bardeen C, Oman L, Stenchikov GL (2007). 'Atmospheric effects and societal consequences of regional scale nuclear conflicts and acts of individual nuclear terrorism', *Atmospheric Chemistry and Physics*, vol. 7, no. 8, pp. 1973-2002.

Robock A, Oman L, Stenchikov GL, Toon OB, Bardeen C, Turco RP (2007), 'Climatic consequences of regional nuclear conflicts', *Atmospheric Chemistry and Physics*, vol. 7, no. 8, pp. 2003-2012.

Mills MJ, Toon OB, Lee-Taylor J, Robock A (2014), 'Multidecadal global cooling and unprecedented ozone loss following a regional nuclear conflict', *Earth's Future*, vol. 2, pp. 161-176. DOI: 10.1002/2013EF000205. **2014** study - (Community Earth System Model and Whole Atmosphere Climate Model)

## So, what are the findings?

# Climatic changes caused by nuclear conflict



2007 modelling

Courtesy Alan Robock, Rutgers University

## What's New? - 2014 findings are even more serious ...

(2014 study - Community Earth System Model with the Whole Atmosphere Community Climate Model):

- **Longer persistence time** for stratospheric black carbon than previous studies (*e*-folding time of 8.7 years compared to 4–6.5 years).
- **Global ozone losses of 20%–50%** over populated areas, levels unprecedented in human history, with the coldest average surface temperatures for 1000 years.
- **Summer UV up 30%–80%** over mid-latitudes – implications widespread damage to human health, agriculture, and terrestrial and aquatic ecosystems.
- **Killing frosts reduce growing seasons by 10–40 days** per year for 5 years.
- **Surface temperatures reduced for more than 25 years** due to thermal inertia and albedo effects in the ocean and expanded sea ice.
- The combined cooling and enhanced UV would put significant pressures on global food supplies and could trigger a **global nuclear famine**.

**What would be the consequences of a regional nuclear war using 100 15-kt (Hiroshima-size) weapons? (data from 2007 studies)**

**(0.03% of the current world arsenal)**

**Scenario: Weapons dropped on the 50 targets in each country to produce the maximum smoke.**

**20,000,000 people killed by blast, fires, radiation etc. - half of the total fatalities from all of World War II.**

**Portions of megacities attacked with nuclear devices or exposed to fallout of long-lived isotopes likely to be abandoned indefinitely.**

**5 m tonnes (Tg) of smoke injected into the upper troposphere, taking account of fuel loading, emission factors and rainout.**

**100% of arsenals leads to 150m tonnes, a decade of cooling:  
Years sub zero in key agricultural regions, Severe drought**

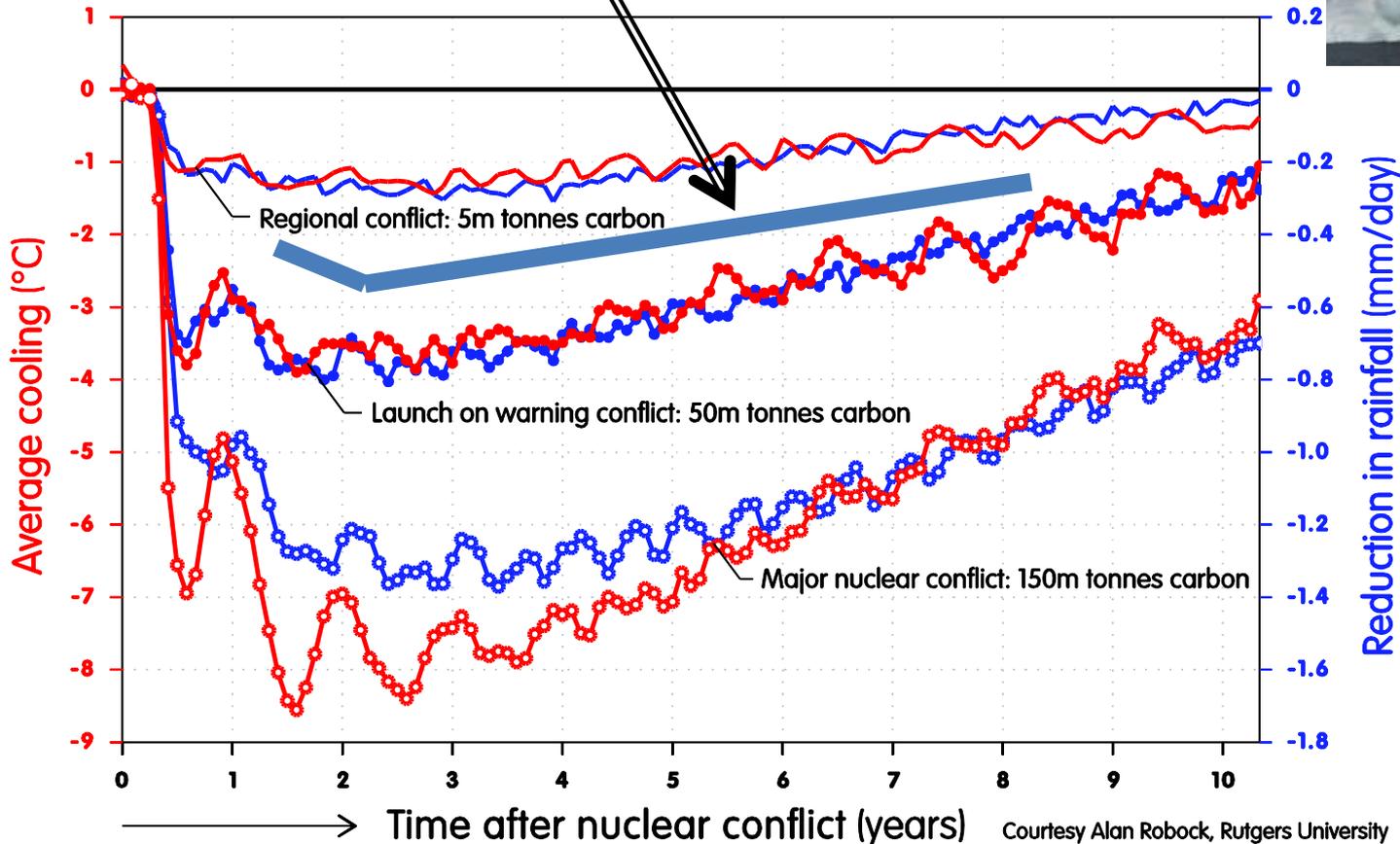
# 1 Trident submarine

- Destructive power: 40 x 100 kT (i.e. 4 million tonnes TNT)
- Blast area equivalent to 160 x Hiroshima
- 10 – 32 m tonnes of carbon injection
- More severe than the “Regional” scenarios
- Less than 1% of current arsenals



# Impact of Trident?

## Climatic changes caused by nuclear conflict



Courtesy Alan Robock, Rutgers University

# Nuclear Winter Analogies

## Smoke and dust transport, Surface temperature effects

- Volcanic eruptions – a whole series up to 1816 (Tambora) preceded by La Soufriere (1812), Awu (1812), Philippines (1813), Japan (1814) which led to the ‘Year without a Summer’.
- Deaths in 1816: 100,000 in Ireland, 200,000 in Europe, refugee farmers from Wales, a yellow haze - this from “only” 1 C cooling
- Martian and Saharan dust storms
- Asteroid impact → dinosaur extinction
- Forest fires

## Fires: World War II firestorms

- Dresden, Hamburg, Darmstadt, Tokyo (“conventional” fire-bombing)
- Hiroshima, Nagasaki (nuclear bombs)

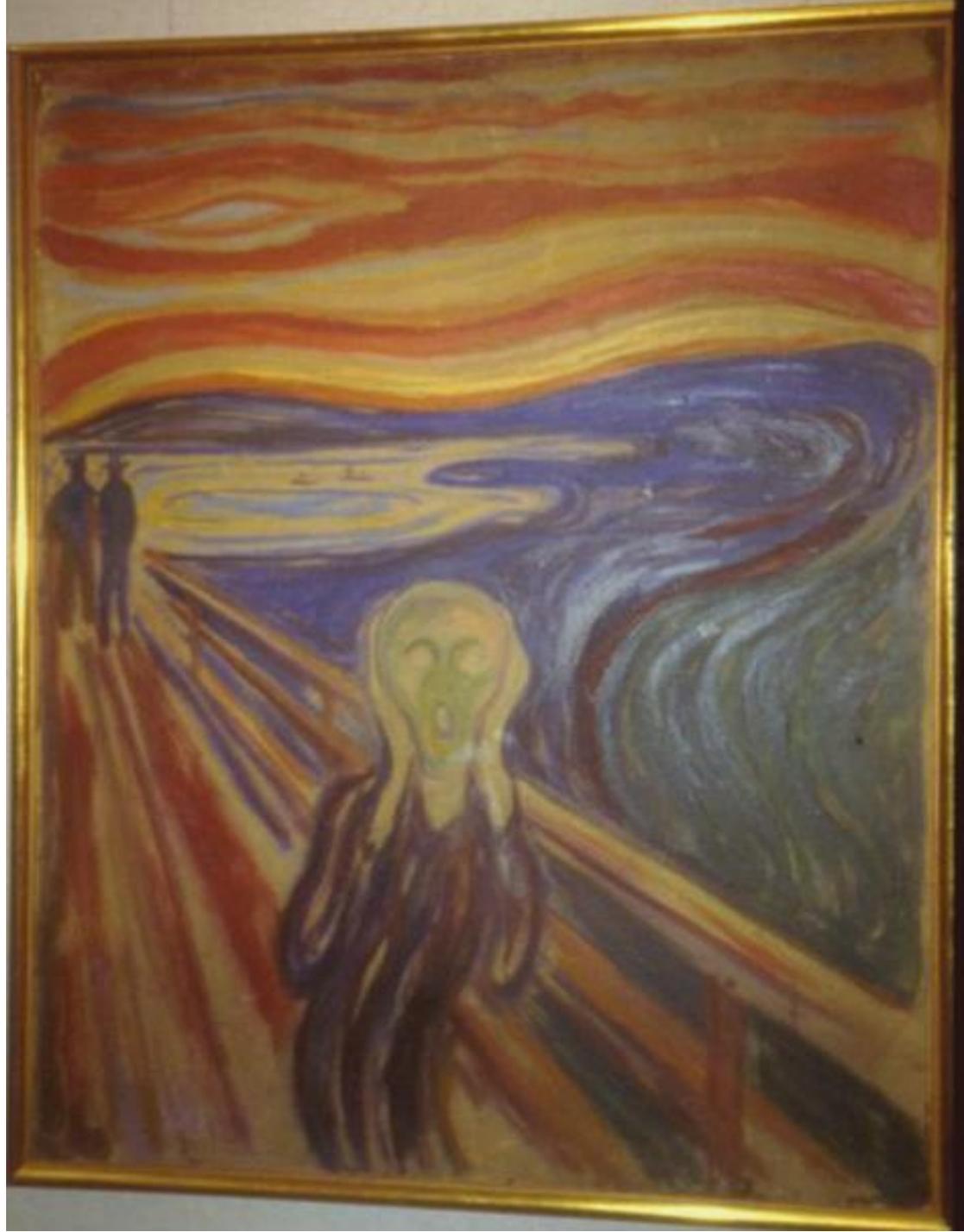
# Evidence in Art

“The Scream”

Edvard Munch

Painted in 1893  
depicting brilliant  
sunsets following the  
1883 Krakatoa  
eruption.

Many of Turner’s  
paintings show  
sunsets inspired from  
1816, also inspired  
Mary Shelley’s  
Frankenstein and  
Byron’s “Darkness”.



# Nuclear weapons and Paris

- Substantial arsenals of nuclear weapons pose a very substantial risk of massive, rapid, climate impact
- Risks of accidental war or serious conflict are very real with many nuclear near misses so far. One every 3 years on average
- Hacking presents a new, very real risk – for example of warning systems, to fire code authorisations, to early warning systems, to fire control systems.
- Former US commander of nuclear forces calling for all (1800) US & Russian weapons to be taken off rapid response status to avoid this risk
- How lucky do you feel for another 70 years of nuclear weapons deployment and proliferation?

# A nuclear ban treaty could help

- Following discussions of the serious humanitarian issues in Oslo, Nayarit, Vienna and New York (NPT).
- 120 nations now support action – with or without the nuclear armed states
- Discussions and motions right now at UN in New York.
- Over half of world covered by “Nuclear-Free” zones
- Possible Middle East zone?? (blocked at NPT in 2015)
- Something to be raised in Paris?

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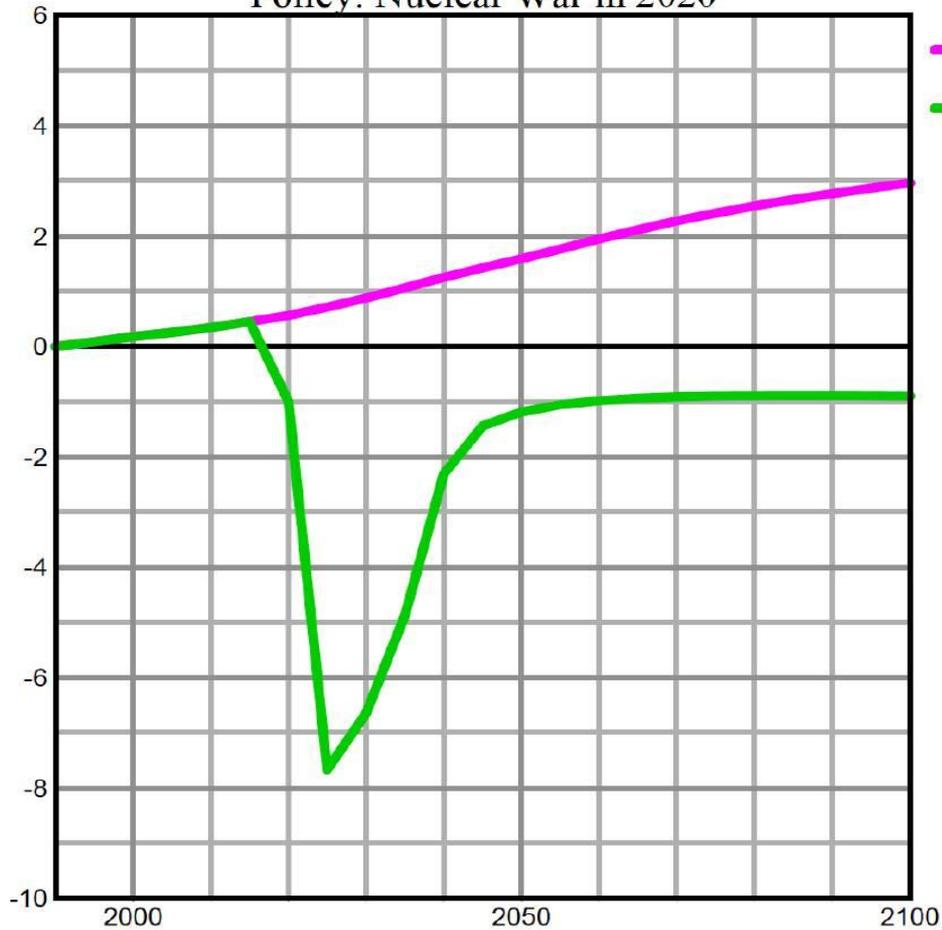
# A “modest proposal” for Paris...

- Following the satirical 1729 Jonathan Swift solution for Irish famine, & lack of political agreement ...
- A very ‘efficient’ means of quickly tackling global warming and over population – finally, a use for WMD!
- The plan must be implemented before nuclear weapons are banned
- Even with emissions of CO<sub>2</sub> from fires, the global CO<sub>2</sub> concentration would peak at about 400 ppm and would reduce, avoiding dangerous levels.

Taken from Alan Robock

[http://www.huffingtonpost.com/alan-robock/a-modest-proposal\\_15\\_b\\_8059256.html](http://www.huffingtonpost.com/alan-robock/a-modest-proposal_15_b_8059256.html)

Reference: SRES A1B-A1M (Illustrative Scenario)  
Policy: Nuclear War in 2020



BAU

Modest proposal

Problem solved...?

**Figure 1.** Global average surface air temperature change (K) with respect to 1990 for a business-as-usual scenario (A1B) in pink, and for a nuclear winter scenario, with a cloud blocking the Sun from the smoke generated by fires in targeted cities and industrial areas, and a halt to all anthropogenic greenhouse gas emissions following the nuclear holocaust, in green.