The Role of Meteorology in Nuclear Disarmament

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MeteorologInnentag, Wien 5./6. Juni 2025

This presentation will also be available on the first author's web site
https://homepage.univie.ac.at/petra.seibert/

BOKU
Institut für Meteorologie und Klimatologie

Aug 6 & 9, 2025: 80 years bombing of Hiroshima and Nagasaki

The Doomsday Clock 2025

Closer than ever

"Blindly continuing on the current path is a form of madness."

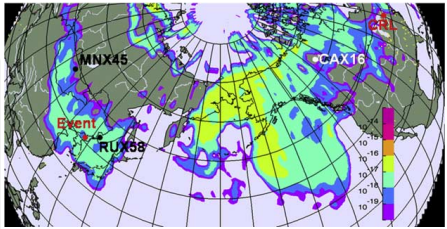
https://thebulletin.org/doomsday-clock/

- nuclear war
- climate change
- biohazards
- disruptive technologies
- ...

Overview

Where atmospheric science is needed

- Consequences of nuclear explosions – atmospheric transport and deposition of radioactivity
- Verification – backtracking of atmospheric emissions
- Nuclear winter – impact of soot
- etc.



2006 DPRK nuclear test, field of regard for Yellowknife, Saey et al., GRL 2007, doi:10.1029/2007GL030611

Relevant treaty regimes and UN acitivities

- (Nuclear Non-Proliferation Treaty **NPT**)
- Comprehensive Nuclear-Test-Ban Treaty **CTBT**
- Treaty on the Prohibition of Nuclear Weapons **TPNW**
- (Fissile Material Cut-Off Treaty **FMCT**)
- UN-mandated studies on the effects of nuclear war

Photo credit (TPNW 3MSP, UN New York): ICAN

1. Comprehensive Nuclear-Test-Ban Treaty (CTBT)

CTBTO
PREPARATORY COMMISSION

- Prohibits all nuclear explosions (weapon tests or ‘peaceful use’)
- Opened for signature 1996, 187 states have already signed, 178 ratified
- Not yet in force – USA, RF, CN, IN, PK, IL, DPRK, EG, IR still have to ratify
- Provisional Technical Secretariate (PTS) in Vienna (at VIC), ≈200 staff
- Has built ≈90 % of the verification system
- Technical Working Group B, meets 2× a year in Vienna, mix of scientists and diplomats, to guide PTS

Photo credit: CTBTO

CTBT International Monitoring System & International Data Centre

IMS with 336 stations:

- Seismic
- Infrasound
- Hydroacoustic (ocean)
- 80 Radionuclide stations
  - 80 particulate (12 / 24 h sampling)
  - ⊃ 40 radioxenon (12 h sampling)
- All data transmitted in real time

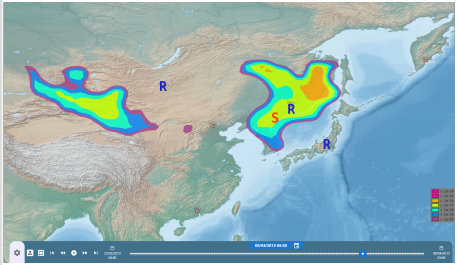
International Data Centre (IDC) in Vienna

- field of regards
- potential source regions

CTBTO and Atmospheric science

Atmospheric transport modelling

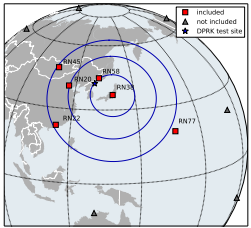
- IDC does daily backward calculations with FLEXPART, ECMWF and NCEP input (source–receptor sensitivities) for all RN samples
- for special events, WMO RMSCs will do that as well
- several National Data Centres also perform ATM
- is used for simple ‘possible source region’ as well as inverse modelling
- RN stations also have meteo data, some go into WMO GTS
- similar methods might be used for future FMCT to track Pu separation through Kr emissions



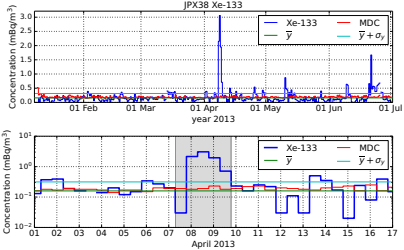
Infrasound propagation modelling

uses ECMWF data for stratospheric winds and temperature

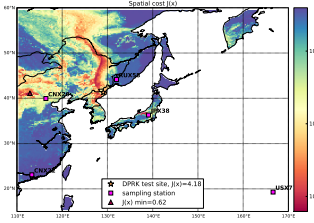
Analysis of the 2013 DPRK nuclear test (Seibert/Hofman/Tipka)



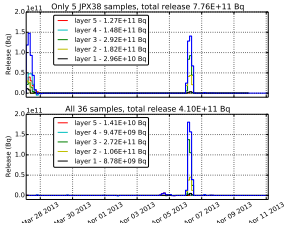
Stations used



Radioxenon measured at JPX39 in Japan



Cost function in colour

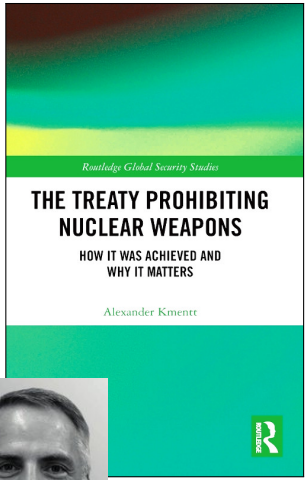


reconstructed source

2. Treaty on the Prohibition of Nuclear Weapons (TPNW)

Key points

- New treaty: negotiated 2017,
  - frustration with lack of nuclear disarmament
  - concern about humanitarian consequences of NW use
- Comprehensive prohibition of any activity related to nuclear weapons
- Victim assistance and environmental remediation
- Entry into force 2021
- 1st MSP and Vienna Action Plan 2022
- currently 94 signatures, with 73 ratification (including AT, IE, MT)
- Nuclear armed states and their allies have remained outside
- Strong NGO and science connection



Amb. Alexander Kmentt (BMEIA)

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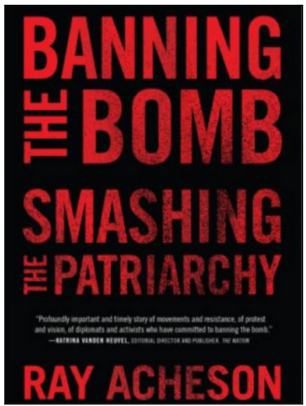
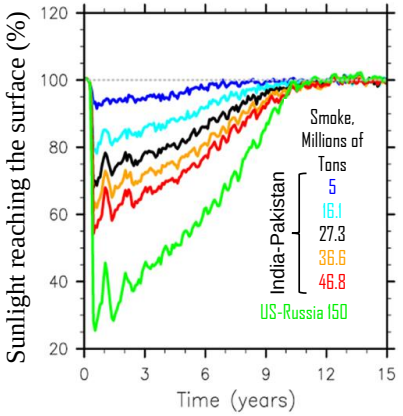
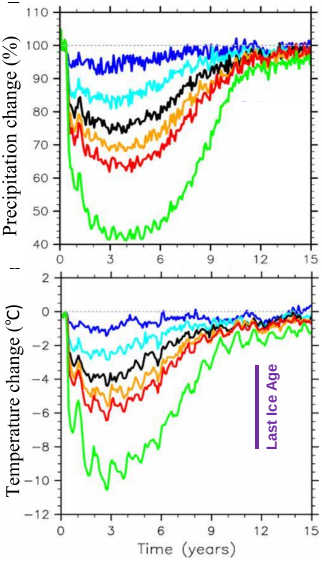


Nuclear winter – dark, cold, dry



Toon et al., *Rapidly expanding nuclear arsenals in Pakistan and India portend regional and global catastrophe*, Science Advances, (2019).

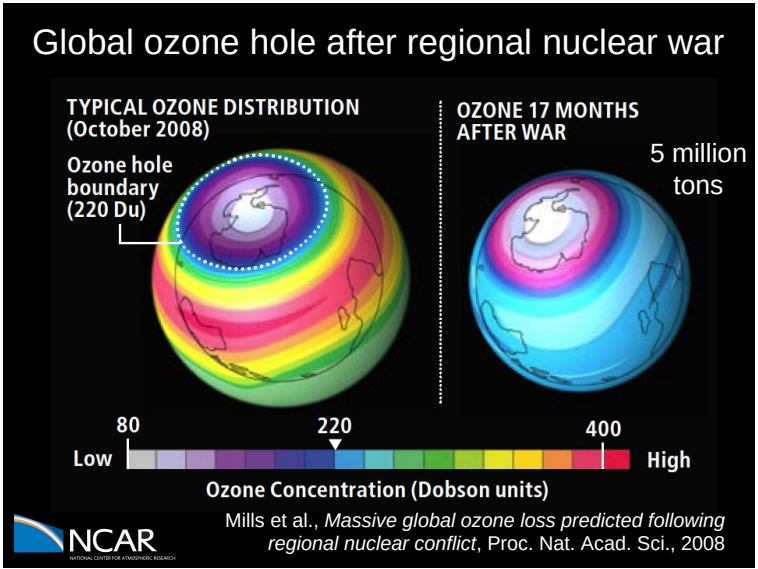


Soot [5-150 Mt] from nuclear-induced fires reaching the stratosphere ⇒ severe reductions in

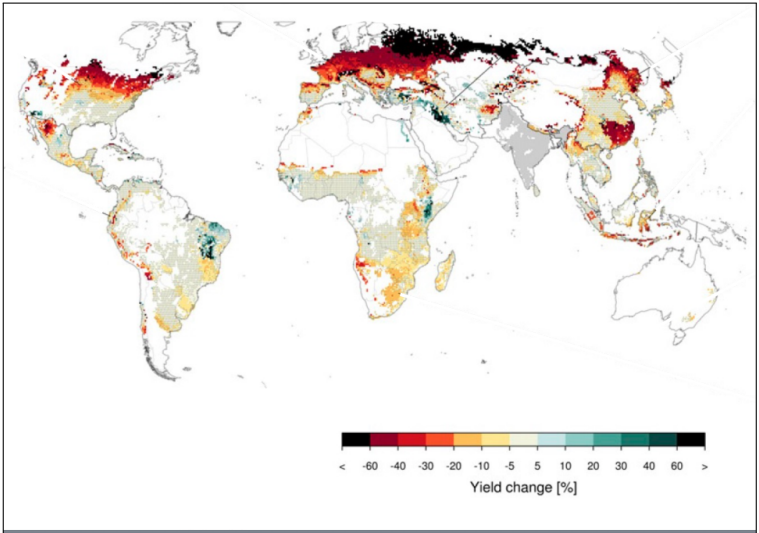
- solar radiation ⇒
- Temperature ⇒
- Precipitation

- over 5–10 years

also ozone is affected



… and agricultural production



Jägermeyr et al., (2020) *PNAS*

⟸ 'Small' regional (IN-PK) nuclear war: 5 Mt soot scenario

- 11 % reduction global production (2× historical fluctuation)
- 3.7 billion people suffer a staple crop reduction of more than 10%
- 600 million people suffer a staple crop reduction of more than 30%

Global nuclear war: 50-150 Mt:

- global catastrophe
  2-5 billions lives threatened by hunger

Science and the implementation of the TPNW

Scientific Advisory Group SAG

- 1MSP instituted Scientific Advisory Group
- 15 members nominated by States, monthly meetings since March 2023
- tasked i.a. with setting up a scientific network to support the implementation of the treaty

(Pilot) Scientific Network

- Organised by SAG, mandated by states
- Ca 25 members from across the globe, various disciplines
- To support work of the SAG and to assist states in implementing the treaty

Activities in Austria

- First meeting of small group (BOKU, Univie, Geosphere)
- KIRAS project proposal (see below)
- Wide, transdisciplinary meeting planned
- Collaboration with ICAN Austria

In Austria: KIRAS project **FALLAUT** (submitted)

FALLAUT- Fallanalyse der Auswirkungen grenznaher Kernwaffeneinsätze auf die Resilienz wesentlicher Versorgungsinfrastrukturen

Case analysis of the effects of nuclear weapons use near borders on the resilience of major supply infrastructures

- Potential consequences of a hypothetical use of nuclear weapons over the NATO base in Aviano (Italy)
- Source term derivation
- FLEXPART calculation of transport, dispersion and deposition
- Radiological model to estimate doses
- Estimatation of the humanitarian consequences in Austria
- Consequences for critical infrastructures such as food supply or health services
- Potential effects on supply chains
- Partners: BOKU University – Institute of Safety and Risk Research, Geosphere Austria, University of Vienna – Dept of Meteo & Geophysics, AIT, and more

3. UN-mandated studies on the effects of nuclear war

UN General Assembly 2024: Panel & report (initiative of Ireland and others)

- Panel of 21 members appointed by UN Secretary General (soon):
- to examine the physical, effects and societal consequences of a nuclear war,
- on a local, regional and planetary scale
- in the days, weeks, years after nuclear war
- collaborate with the scientific community, UN organisations, NGOs etc.

- [to assess and report about]:
  1. climatic effects
  2. environmental effects
  3. radiological effects
  4. impacts on public health
  5. impacts on global socioeconomic systems
  6. impacts on agriculture
  7. impacts on ecosystems.

World Health Assembly (WHO) Resolution May 2025

• ... to update the World Health Organization reports “Effects of nuclear war on health and health services” (1983 and 1987) and the report “Health and environmental effects of nuclear weapons” (1993) and in this regard, collect and analyse existing related studies;
• to present report in 2029

Outlook

Closer than ever

“The world depends on immediate action.
It is 89 seconds to midnight.”

https://thebulletin.org/doomsday-clock/