



FFI Norwegian Defence
Research Establishment

Nuclear weapons, their effects and recent developments

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Nuclear weapons, their effects and recent developments

1. Types of nuclear weapons
2. Nuclear weapons worldwide – status
3. Some current trends
4. New developments in Russia
– Putin's 2018 speech
5. Effects of the use of nuclear weapons



Hiroshima 1945

What is a nuclear weapon?

- A nuclear warhead plus a means of delivery
- Contains a fission charge and possibly a fusion charge



Categorization of nuclear weapons

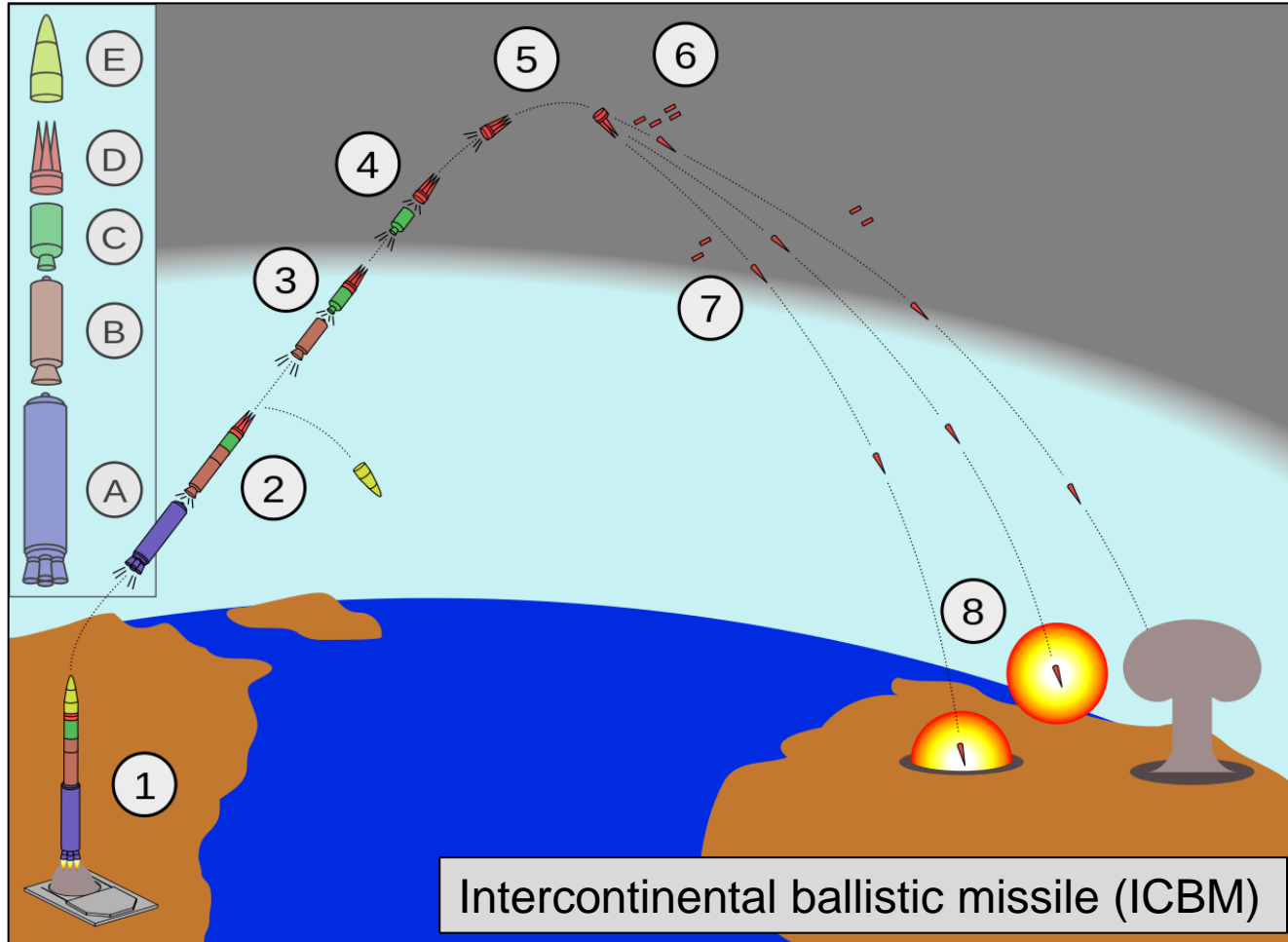
- Commonly, but not very clearly, divided into
 - Strategic weapons: the big picture, deterrence, ...
 - Non-strategic weapons: tactical weapons, theatre weapons, battlefield weapons, ...
- Traditionally, strategic weapons have (very) high yield
- Missiles are commonly categorized according to their range:

(this terminology is not uniquely defined)

Subcategory	Acronym	Range
Close range ballistic missile	CRBM	Less than 300 km
Short-range ballistic missile	SRBM	300–1000 km
Medium-range ballistic missile	MRBM	1000–3000 km
Intermediate-range ballistic missile	IRBM	3000–5500 km
Long-range ballistic missile	LRBM	
Intercontinental ballistic missile	ICBM	Greater than 5500 km

Ballistic missiles

– Multiple Independently targetable Re-entry Vehicles (MIRV)



A-C: Stages for propulsion

D: Post-Boost Vehicle (“bus”) with re-entry vehicles (RVs)

E: Protective shroud



W48 nuclear artillery shell (non-strategic)



Mk17 nuclear bomb (strategic)



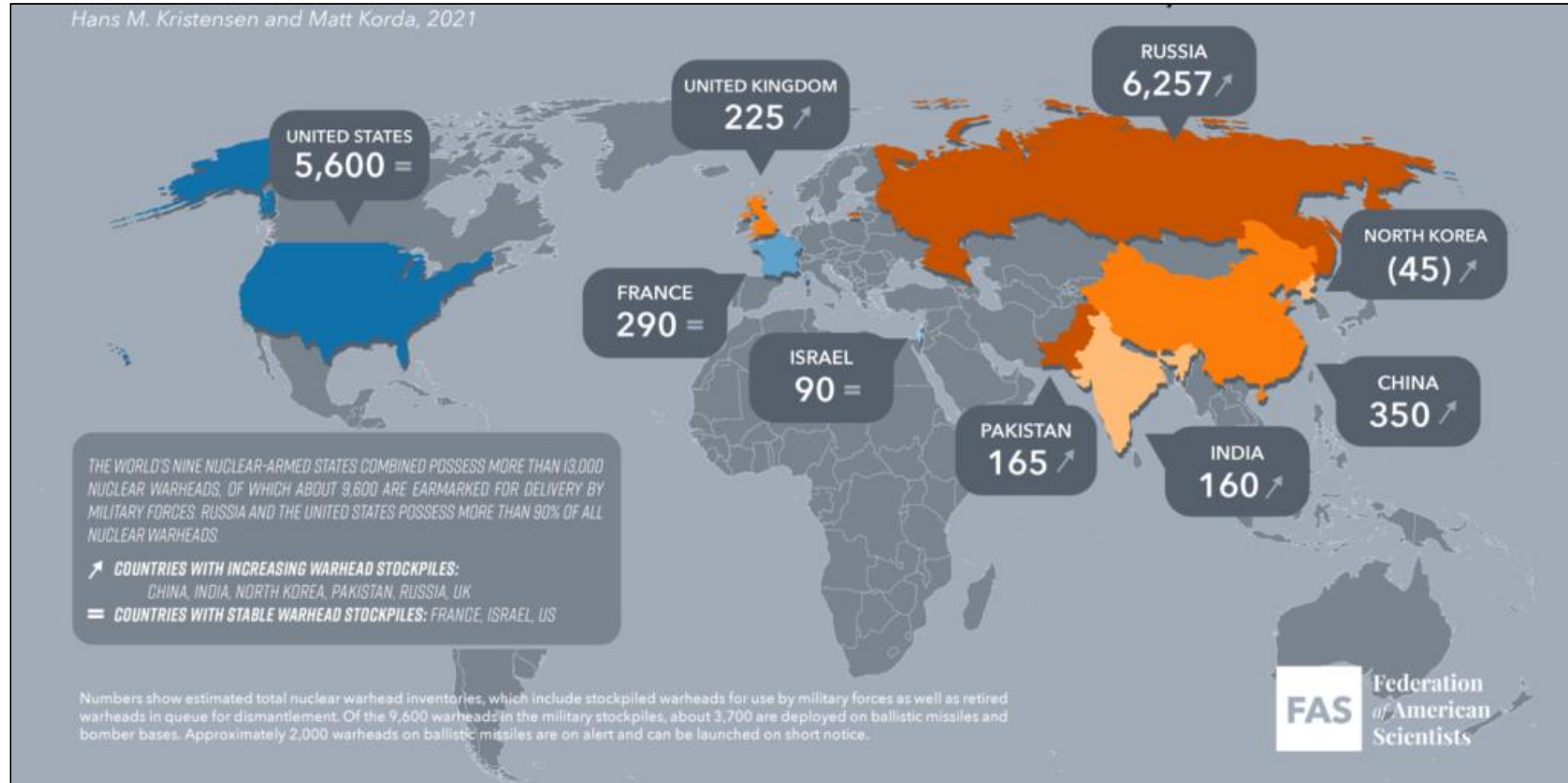
Mk17 THERMONUCLEAR WEAPON

The Mark 17 was the largest nuclear bomb deployed by the United States. It was one of the first thermonuclear weapons stockpiled. When the bomb shape was test-dropped, the plane would soar upwards a couple hundred feet. The pilots said it was as if the bomb had released the plane.

The B-36 bomber, and the B-52, with modified bomb-bay doors, were the only planes capable of carrying the Mk17. The Mk17 used a series of special parachutes to help improve its accuracy and to slow its descent. This allowed the delivery aircraft time to escape the effects of the blast.

*Type: Strategic • Yield: Megaton range • Carrier: B-36, B-52
Options: Airburst • Length: 24.8 ft. • Diameter: 61.4 in. • Weight:
41,400 lb. • Stockpiled: 1953-1957*

Estimated global nuclear warhead inventories 2021

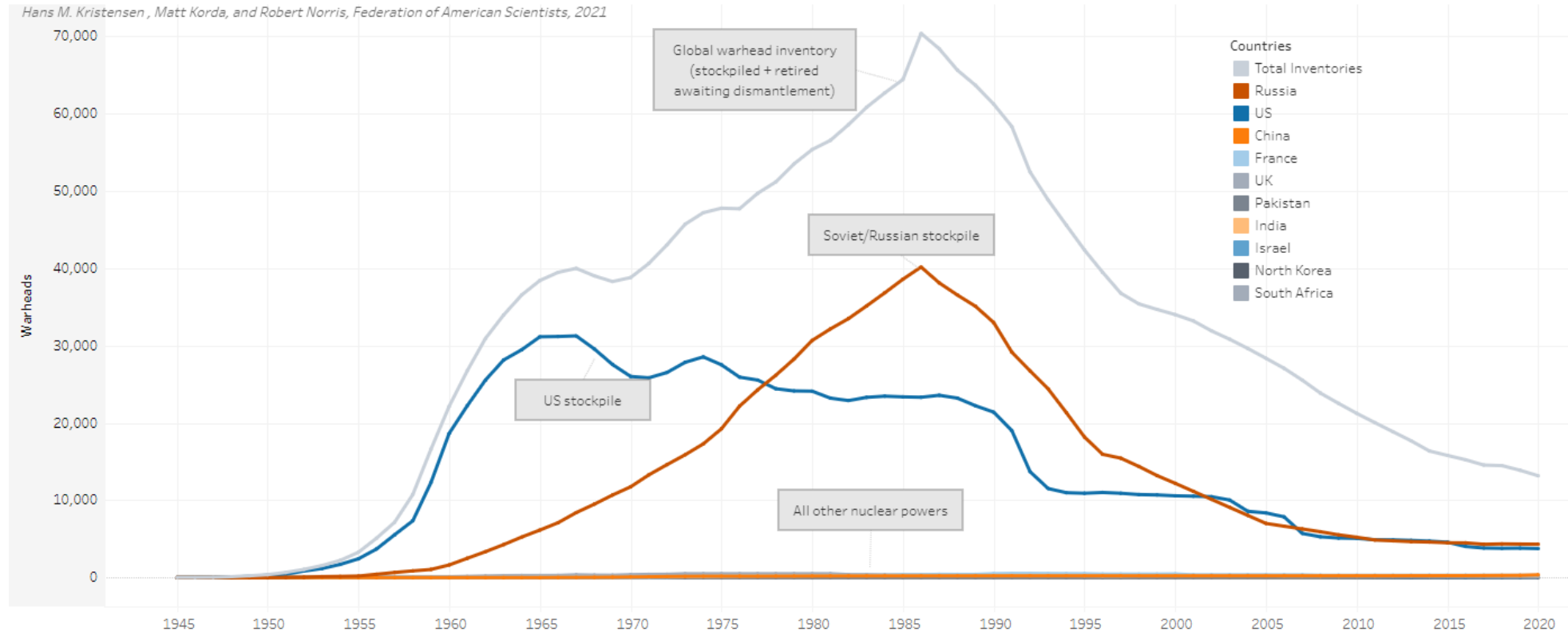


Who has nuclear weapons? Status as of October 2021

State	Number of nuclear warheads		
	Deployed	Inactive	Total
USA	1750	3850	5600
Russia	1600	4657	6257
United Kingdom	120	105	215
France	280	10	290
China		350	350
India		160	160
Pakistan		165	165
Israel		90	90
North Korea		45	45
Total	3750	9430	13200

Hans M. Kristensen and Matt Korda, FAS.org

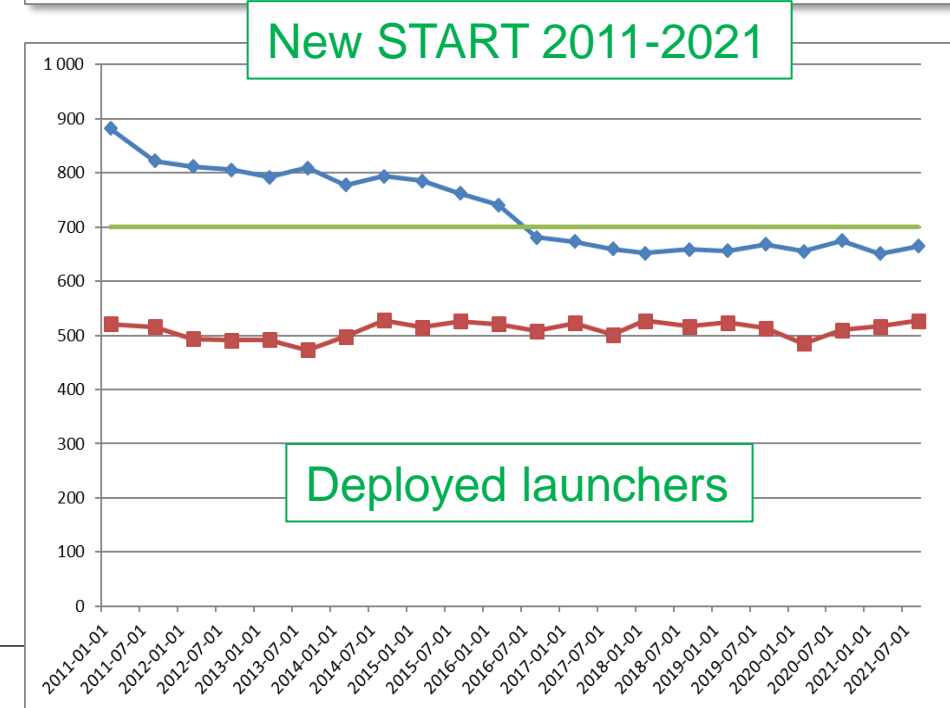
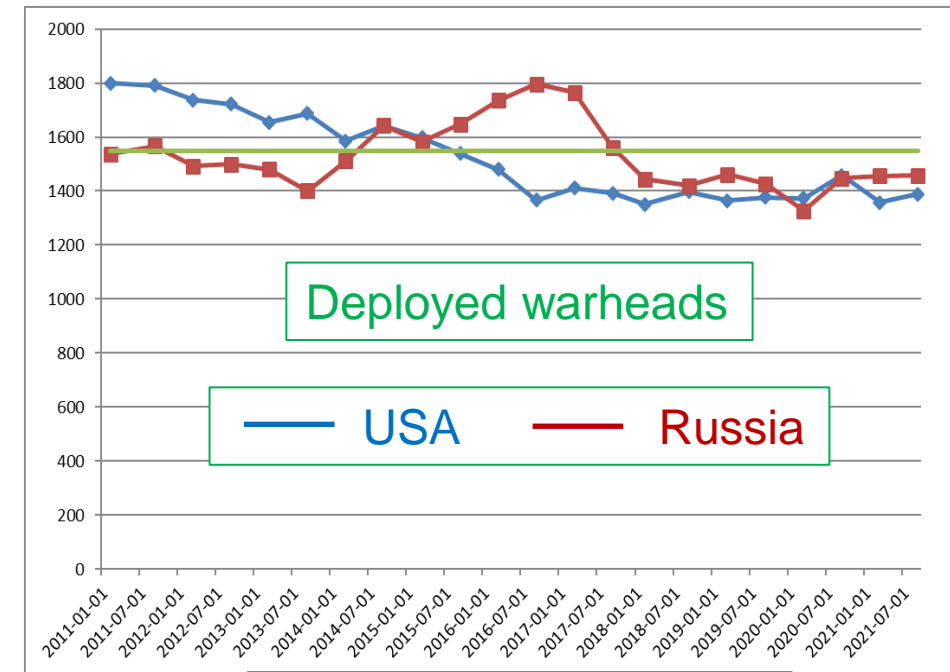
Estimated global nuclear warhead inventories 1945-2021



- More than 125 000 warheads produced since 1945
- Peak of 70 300 stockpiled warheads in 1986

General trends in recent years

- USA and Russia have reduced their stockpiles of strategic nuclear weapons in accordance with New START
 - New START extended till 2026
 - Many retired weapons have been dismantled
 - Non-strategic weapons supposedly placed in central storage, but they are easy to hide
- Numeric increases in several states
- As weapons get more precise, their yield may be lowered
 - Possibly lowering the threshold for actually using them
- No possessor states seem inclined to eliminate their nuclear weapons
 - Instead they are modernizing their arsenals



President Putin's new weapons 1 March 2018

Heavy emphasis on modern, sophisticated nuclear weapons

- Essential to reduce vulnerability to missile defence systems
- Five future strategic nuclear weapon systems presented

1. Sarmat (RS-28, SS-29)

- Heavy ICBM to replace SS-18 'Satan'
 - Often referred to as "Son of Satan"
- Under development since around 2005, may be deployed in 2022
- Long range (18 000 km) with heavy payload
- Up to 10 manoeuvrable RVs
- Maybe carrying Avangard



President Putin's new weapons 1 March 2018

2. Avangard

- Hypersonic glide vehicle launched as an RV from an ICBM
- Scramjet engine
- Highly manoeuvrable at high speeds
- Supposedly flew 6000 km at up to Mach 27 during a test
- Became operational December 2019 on two SS-19 M4 ICBMs
- Expected to be carried on Sarmat when possible



President Putin's new weapons 1 March 2018

3. Kinzhal (Kh-47M2)

- ALBM launched at high altitude from supersonic MiG-31K (Foxhound)
- Range supposedly up to 2000 km
- Development began 2010
- Operational in 2017
- Highly manoeuvrable during final approach
- Hypersonic up to about Mach 10
- Made for both strategic and tactical missions
- Nuclear warhead estimated to 5-50 kt



President Putin's new weapons 1 March 2018

4. Poseidon (Status-6)

- Unmanned underwater vehicle, about 20 m long, high speed, maybe diving to 1000 m
- Powered by a nuclear reactor and may carry a very large nuclear charge (2 Mt?)
- Can reach coasts anywhere in the world with nuclear propulsion
- Tested at sea since 2018, scheduled for delivery by 2027
- Will be launched from special purpose submarines
 - *Belgorod* – longest submarine in the world (184 m) – maybe carrying six Poseidon torpedoes



President Putin's new weapons 1 March 2018

5. Burevestnik (9M730, SSC-X-9 Skyfall)

- Nuclear-powered cruise missile
- May carry a nuclear warhead
- May stay airborne for a long time
- Essentially unlimited range
- Has failed a number of tests
- Similar to US “Project Pluto” in the 1960s
 - US reactor much more powerful
 - Project cancelled because of severe environmental effects



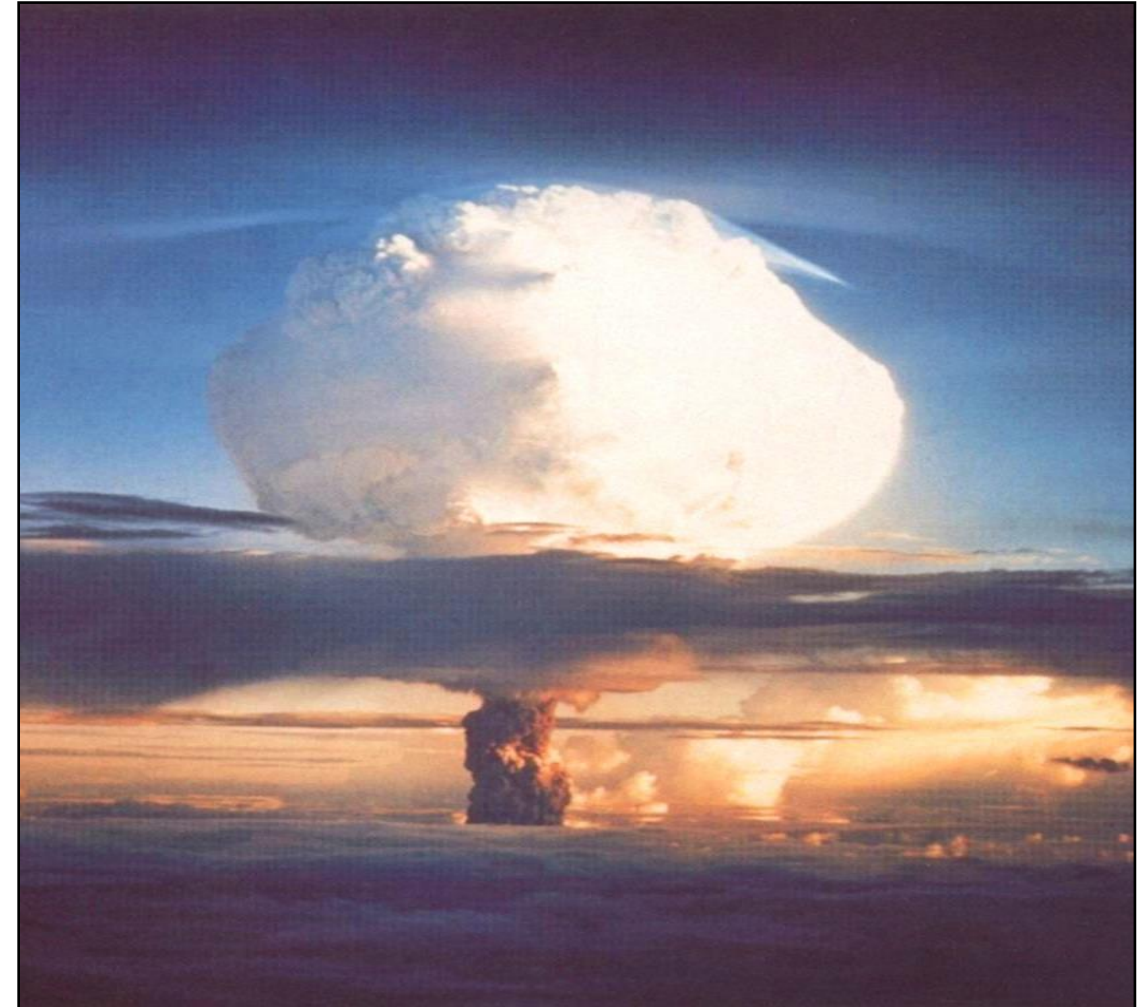
Improvised nuclear devices

- Could a terrorist organisation go nuclear?
- Conventional explosives are simple and effective
- However:
 - Much information is generally available
 - Relevant software exists
 - High precision is not required
 - A specific yield is not required
 - Health and safety may be a minor issue
- Access to weapons grade uranium or plutonium may be the biggest obstacle
 - **Safeguards are crucially important!**



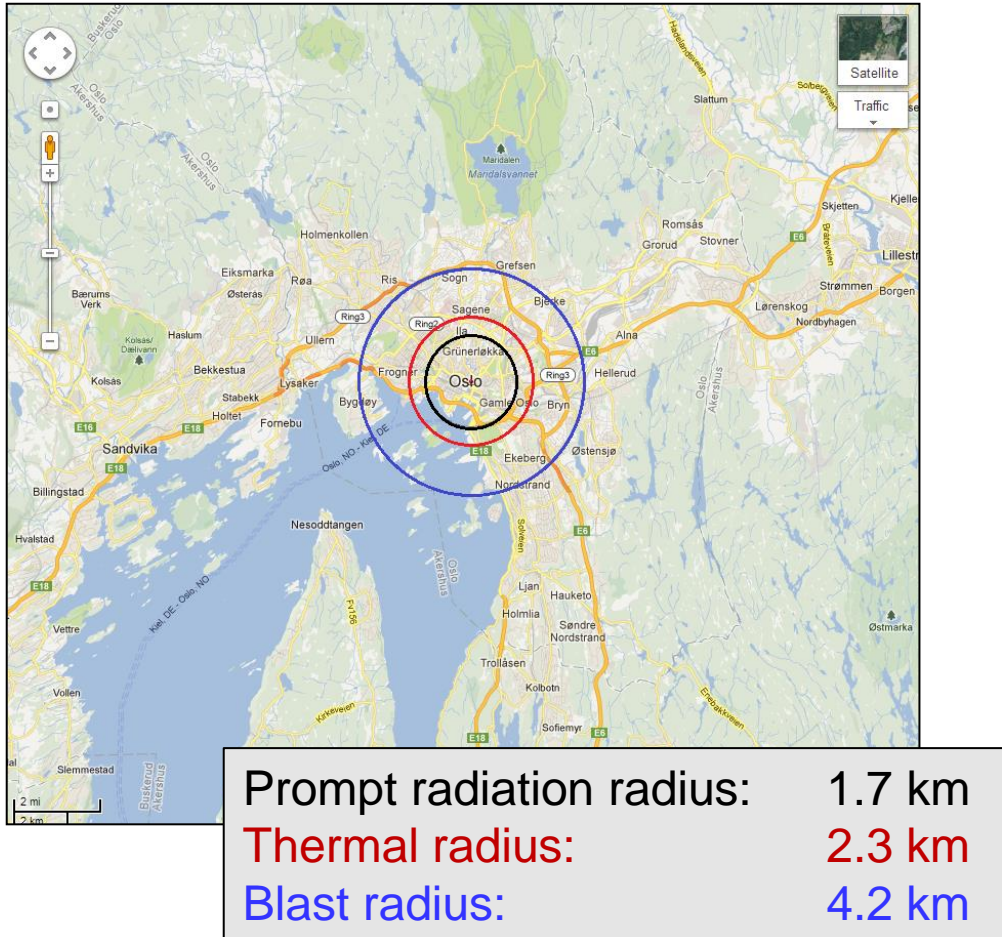
Effects of nuclear explosions

- 85 % **heat** and **pressure**
- 15 % **ionising radiation**
 - Fallout
- **Electromagnetic pulse**
 - Crashes and destroys electronic equipment in a large area
- Flash: Blindness (minutes, hours)
- Fireball
 - Plasma/gas
 - Temperature of millions of degrees
 - Grows into a mushroom cloud

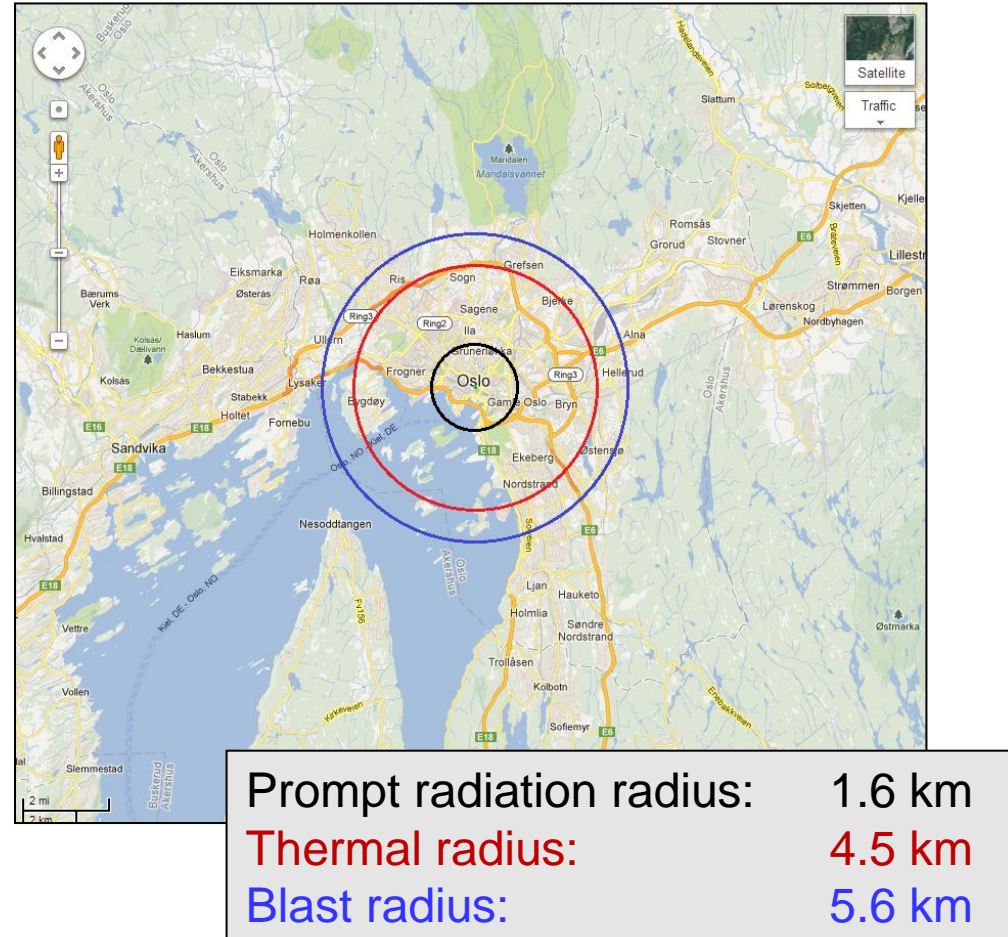


Example: 20 kt nuclear explosion in Oslo

Surface detonation

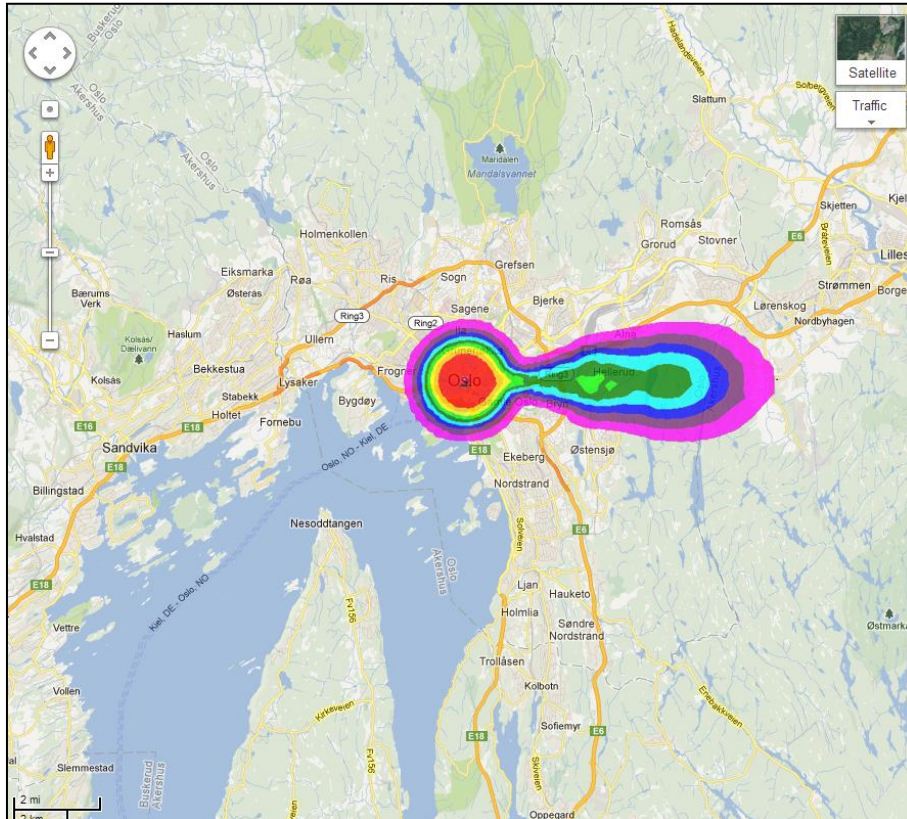


Detonation 600 m above ground

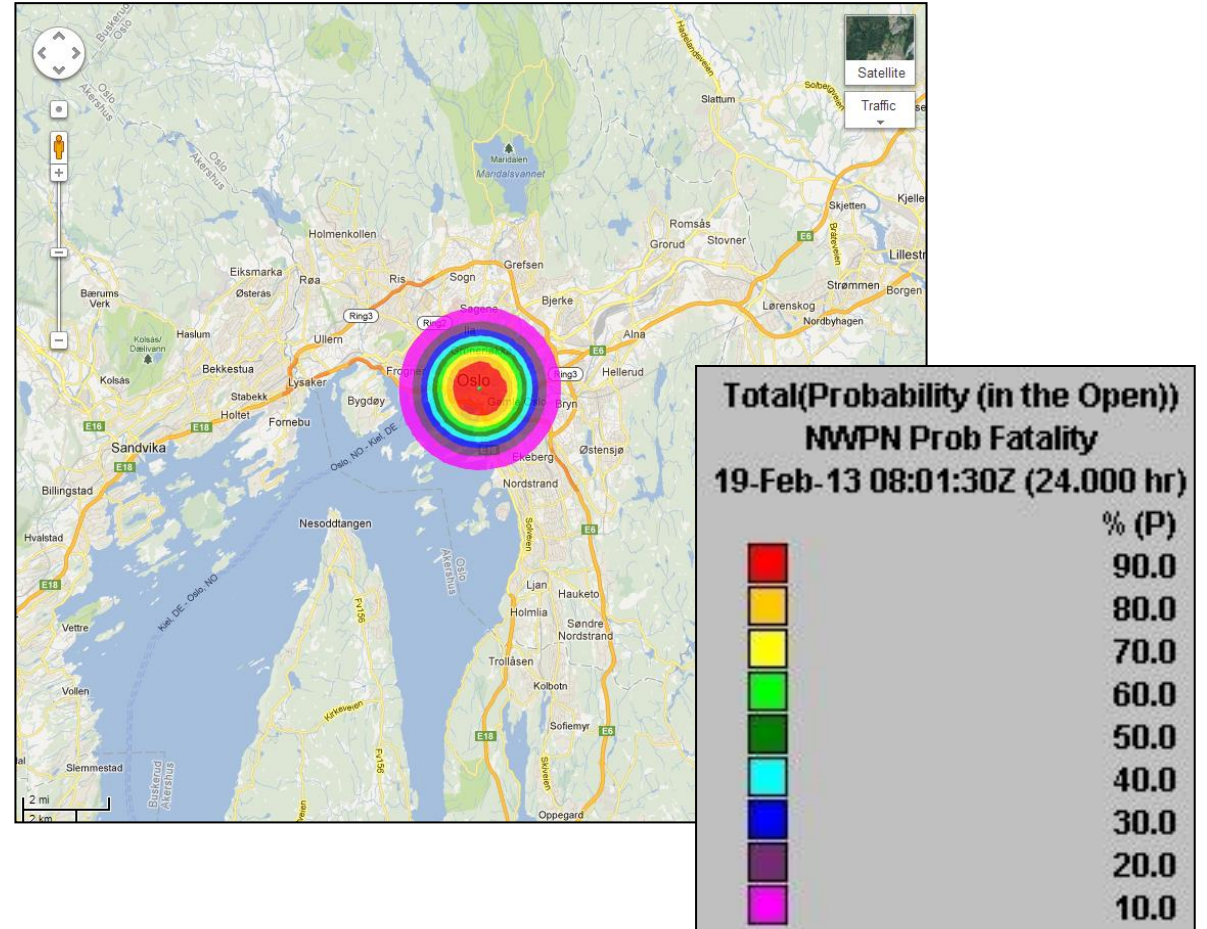


Fatality rates after a 20 kt nuclear explosion

Surface detonation



Detonation 600 m above ground



1 Mt nuclear explosion 2000 m above ground



Final remarks

- Fewer nuclear weapons, but more nuclear weapon possessors today than during the cold war
- The vision of a world free of nuclear weapons is challenged by weapons modernization programs in the nuclear weapon states
 - More precise, low-yield nuclear weapons may lower the threshold for “going nuclear”
 - Facilitating “escalate to de-escalate”?
- Russia is developing several new weapon systems
 - All seem made to avoid missile defence systems
- The political posture of a state may change quickly, but it takes time to change its nuclear posture
- Often difficult to distinguish between nuclear-armed and conventionally armed weapons
- Both physical and humanitarian effects of nuclear weapons are devastating





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