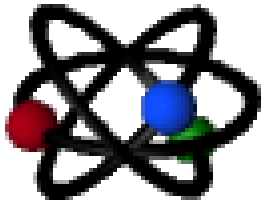
Weapons of Mass Destruction and Global Climate Change



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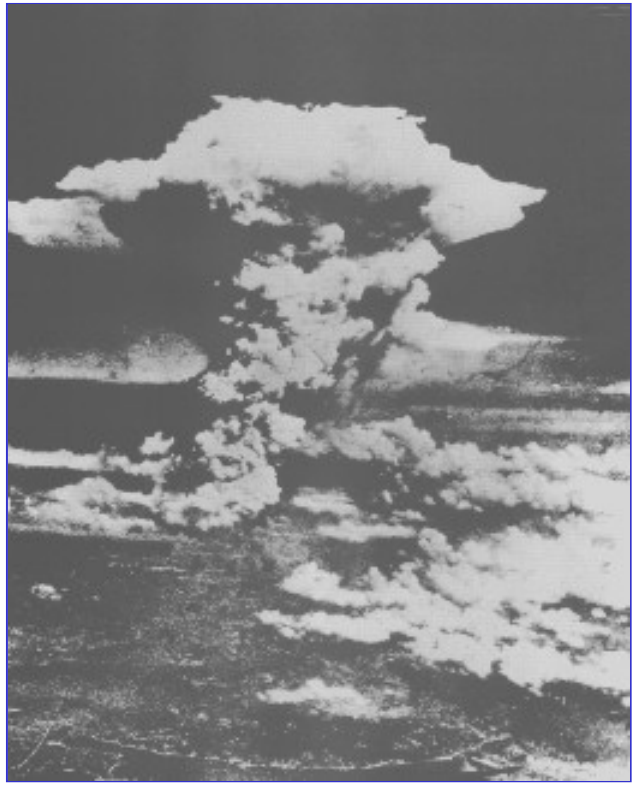
Talk Outline

- Hiroshima and Nagasaki
- Nuclear Weapons Proliferation
- Nuclear Weapons Effects
- Regional Nuclear Conflicts
- Nuclear “Autumn”?
- Conclusions

http://www.comeclean.org.uk

Hiroshima and Nagasaki

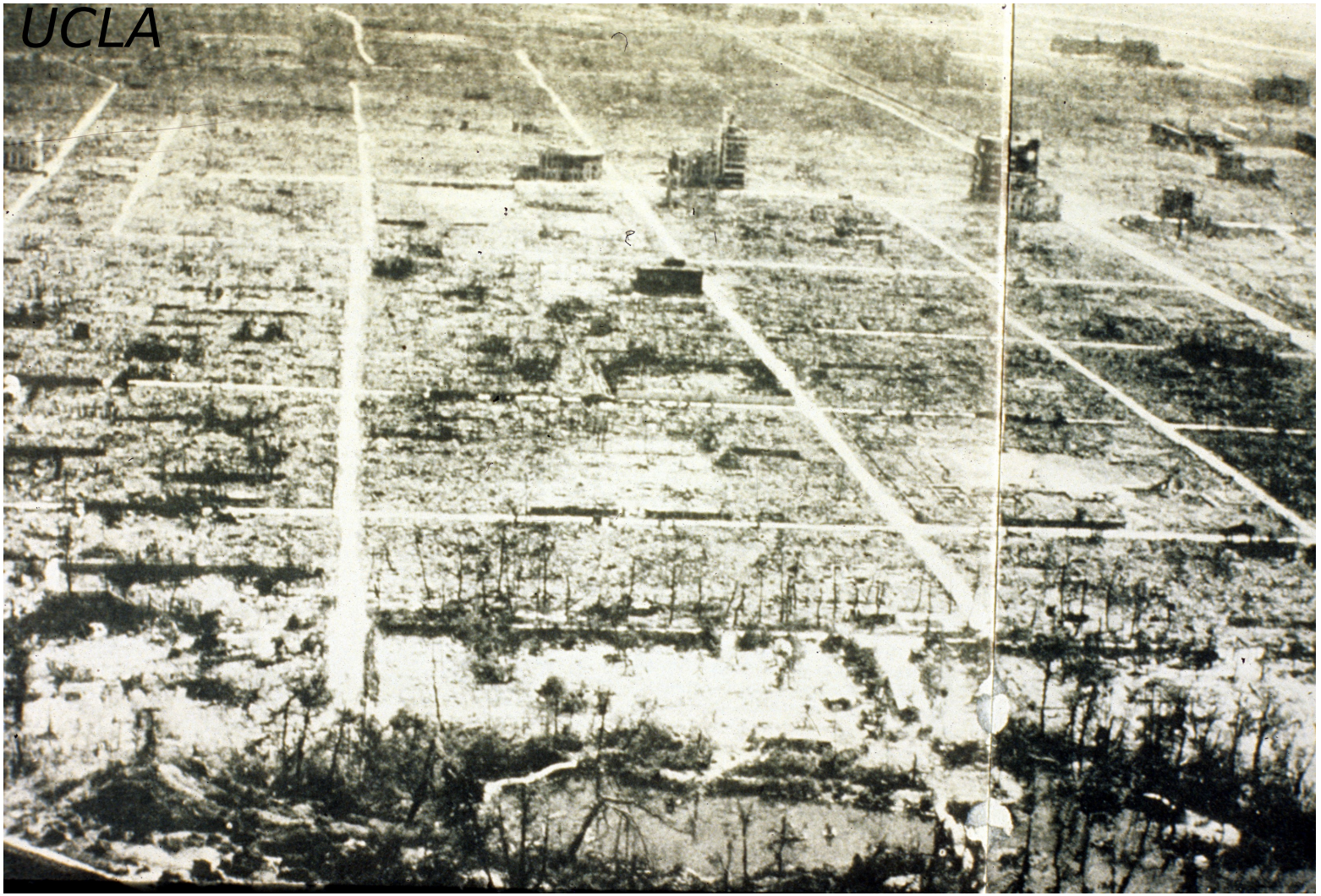
- Approximately 15 kilotons of equivalent TNT were dropped by the U.S. on each city during World War II
- This is “small” by today’s standards - modern warheads are ~100 kTons
- 13 square kilometers were burned in Hiroshima



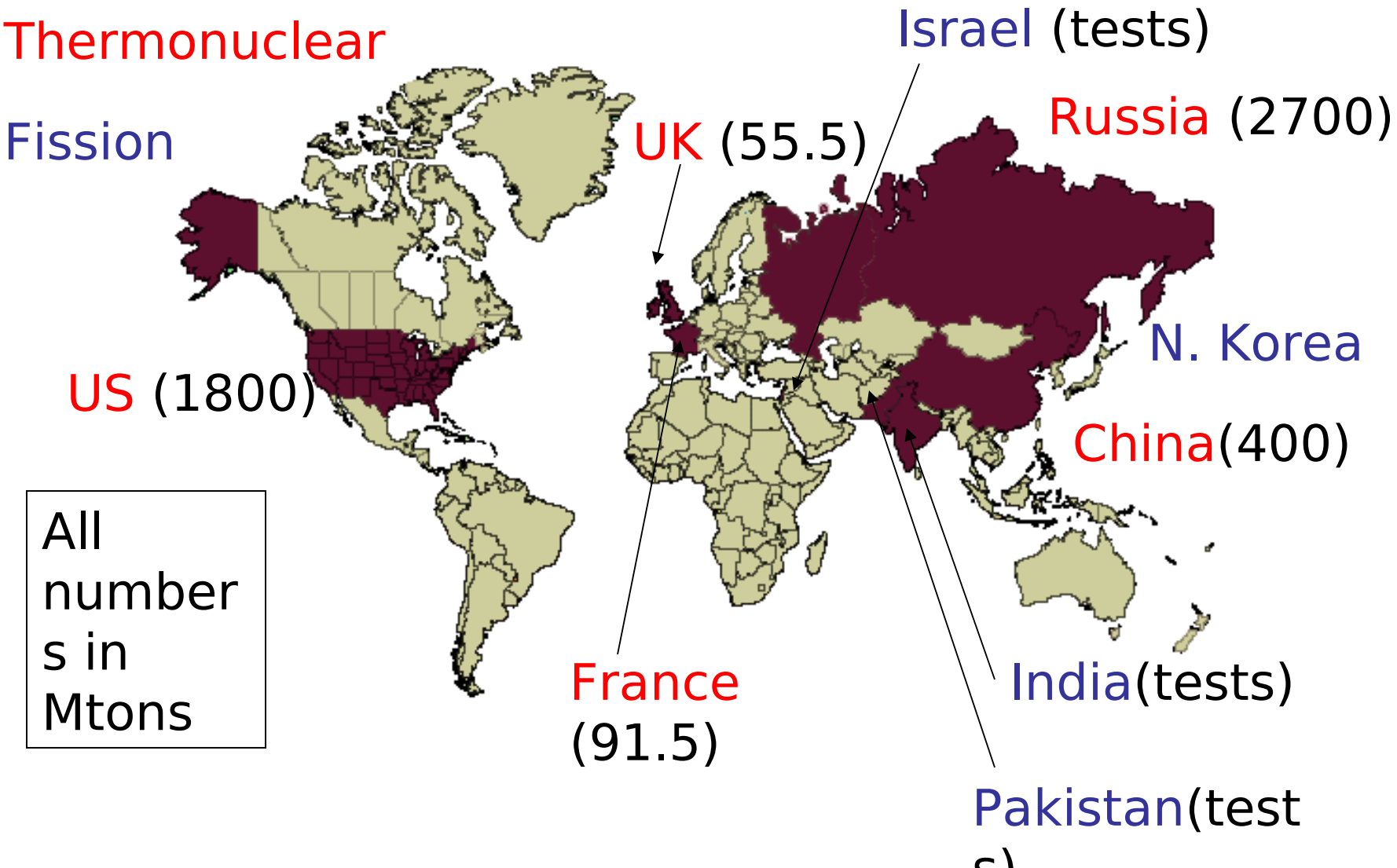
Ground level view of Hiroshima cloud

Hiroshima after the bomb

August 6, 1945 – *Courtesy of Richard Turco, UCLA*



Who has nuclear weapons?



Who can make nuclear weapons?

- Brazil (200)
- Argentina (1100)
- North Korea (10-20)
- South Korea (4400)
- Pakistan (100+)
- India (1000+)
- Up to 45 countries have the potential or are already nuclear states

Assumes Hiroshima-sized atomic weapon

Other players...

May want weapons

- ~~Iraq~~
- Iran
- Libya
- Algeria
- Syria
- Chechnya (old USSR?)

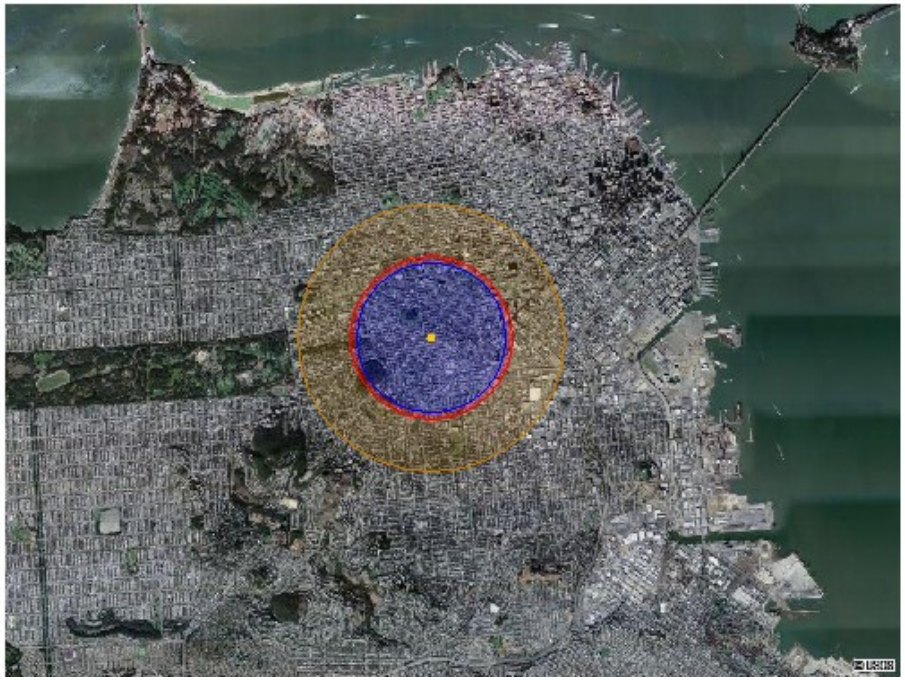
Renounced weapons

- Belarus
- Ukraine
- Kazakhstan
- South Africa

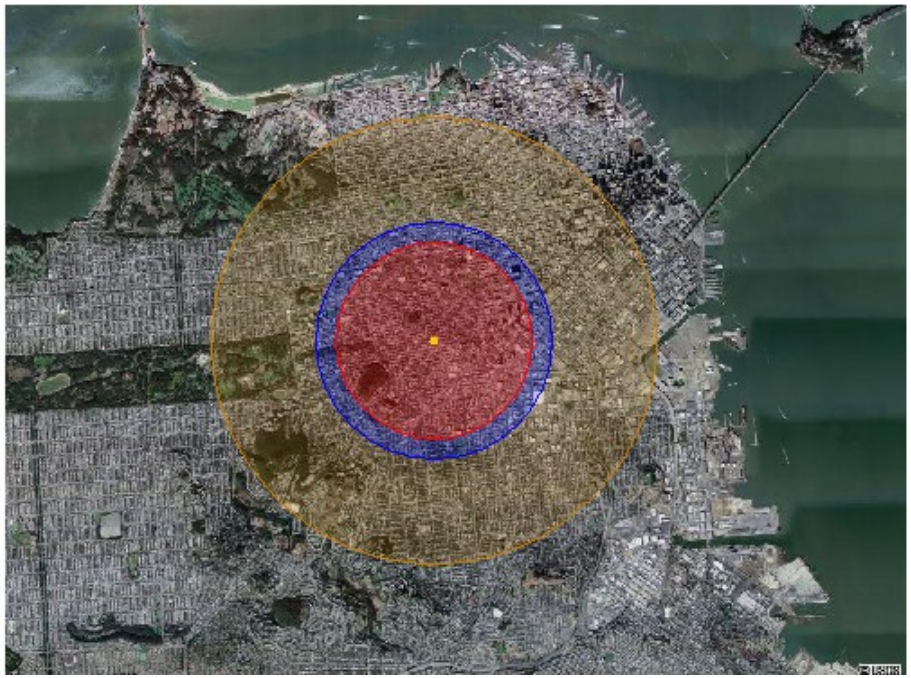
Physical Effects of Nuclear Weapons

Google "Nuclear Weapons Effects Calculator" – provided by the Federation of American Scientists

- 15 kTons by automobile



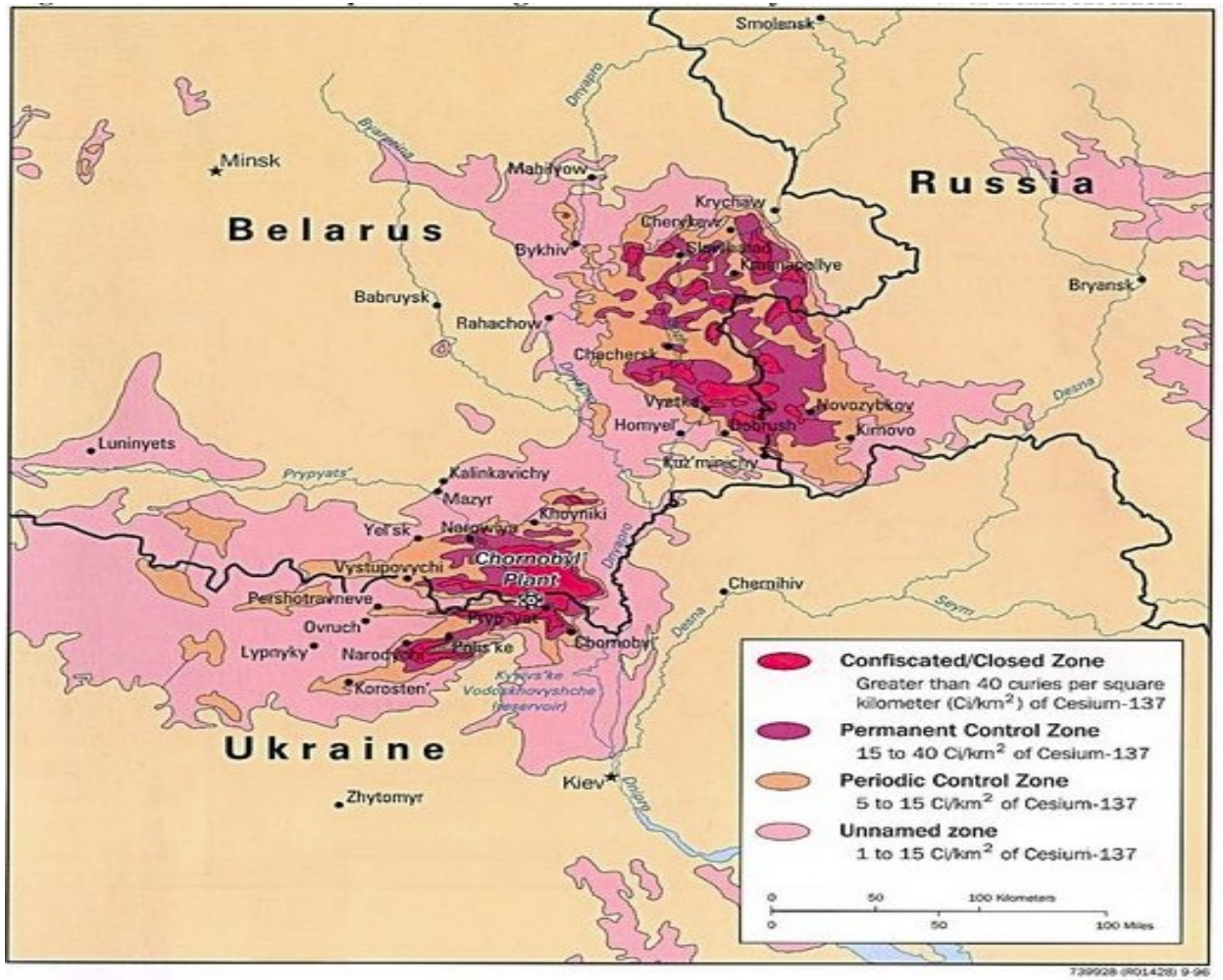
- 15 kTons by airplane



Physical Effects of Nuclear Weapons

- Thermal (Red circle)
  - Intense heat from the explosion will likely cause widespread fires within this region.
- Pressure Blast Wave
  - Blue circle: Most homes are completely destroyed and stronger commercial buildings will be severely damaged due to the high pressure blast wave in this region.
  - Yellow Circle: Moderate damage to buildings causing some risk to people due to flying debris is caused by the blast wave in this region

Abandoned area from Cherynobyl accident



- This wasn't even a bomb!
- *From Toon et al. 2006*

Regional Nuclear Conflicts

- Based on work presented at AGU 2006 by Toon, Robock, Turco, Fromm, Jensen et al.
- Imagine a scenario where two nuclear powers start a regional war – e.g. India and Pakistan
- Each country sends about 50 Hiroshima-sized nukes at the others' largest cities
- At least 5 million people die immediately -- as many fatalities as once projected for a full scale "strategic" war between the superpowers
- The deaths per kTon are 100 times

Regional Nuclear Conflicts

- Up to 5 million tons of soot loft into the atmosphere from the resulting firestorms
- Soot spreads around the world, darkening the skies and lowering the temperature by 1.25^0 for up to a decade, disrupting food supplies and the ozone layer
- Although not as dramatic as the original Nuclear Winter predicted by an all-out war between super-powers, this type of regional war would still have significant

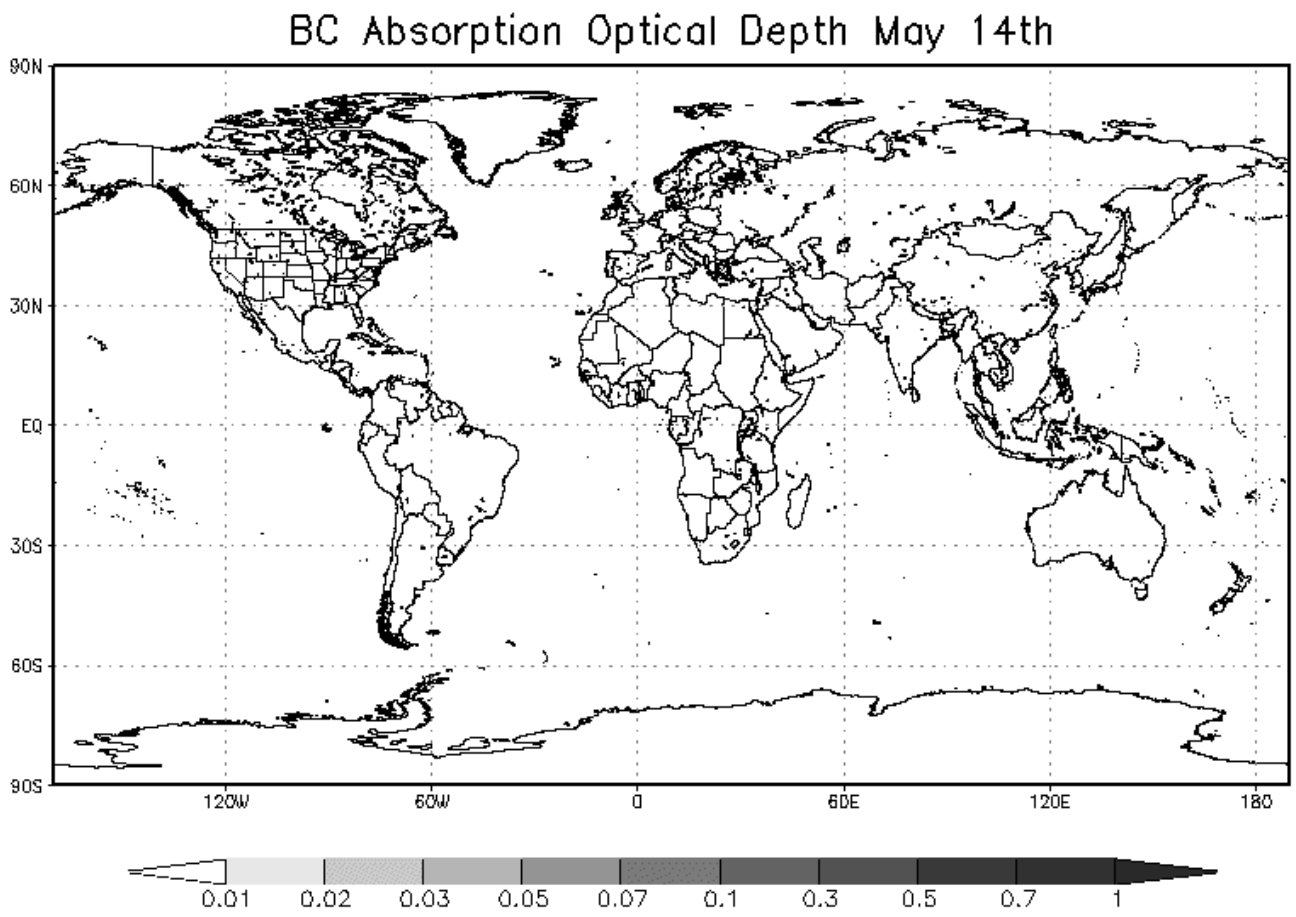
Combustible material in cities

- Bangalore, India inner city
- Nashville, TN suburb

From Turco et al. 2006

- Each image is 1 square km = 1/13 of area destroyed in Hiroshima
- Each person in a mega-city contributes about 11 tons of

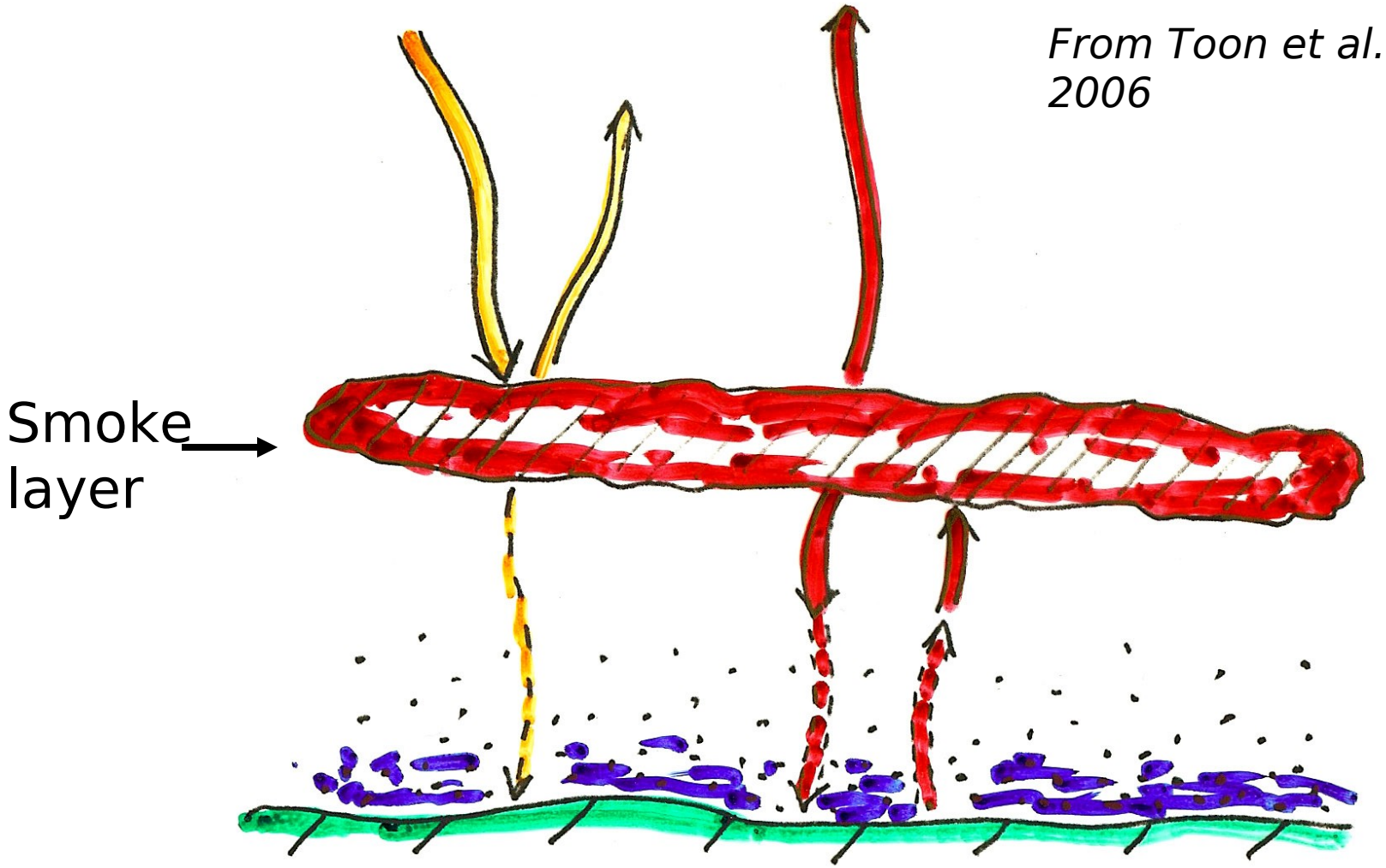
Soot spreading around the world



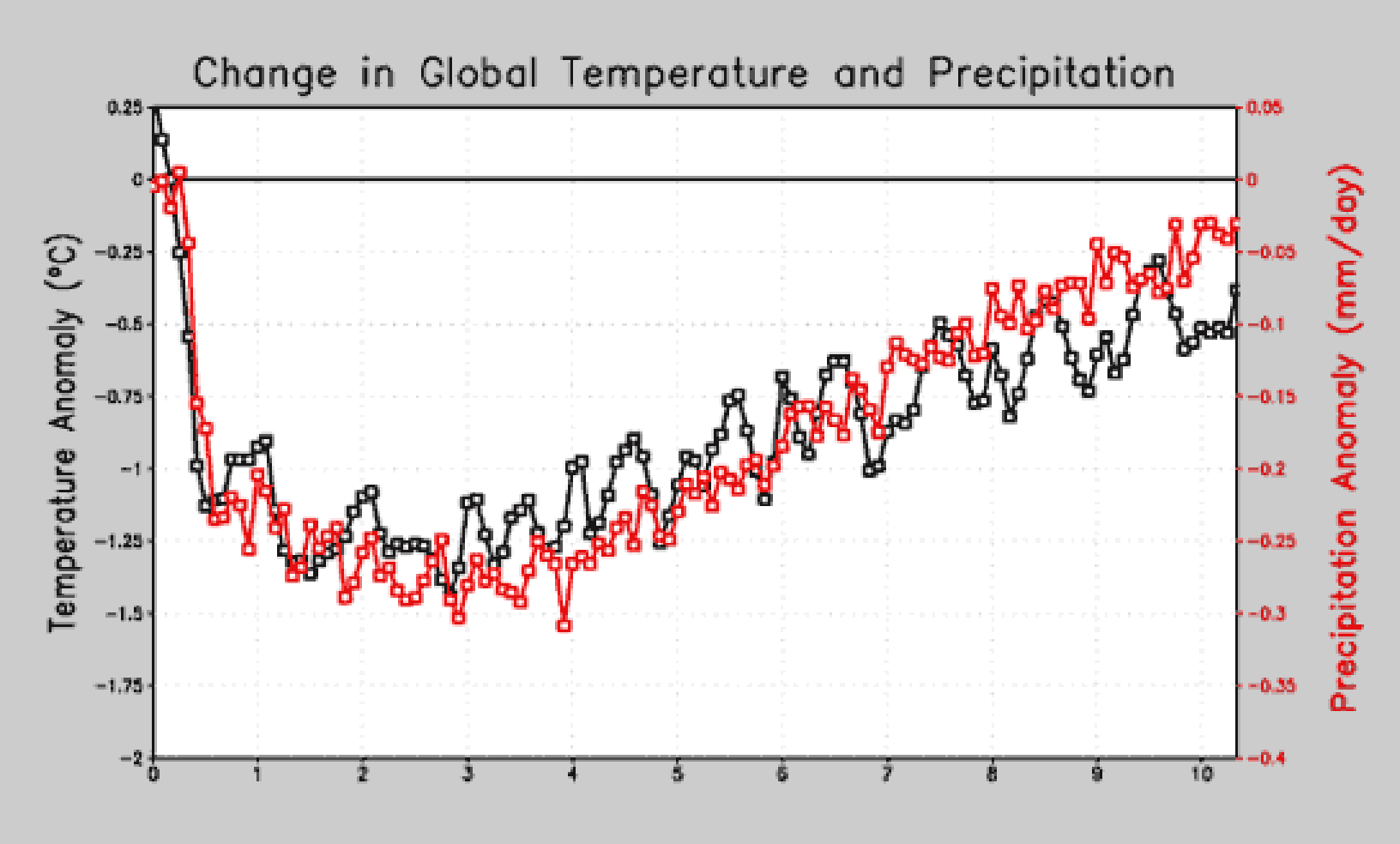
- From models by Alan Robock, Rutgers Universi ty

- 0.1 means 90% of sunlight gets through

Anti-greenhouse effect



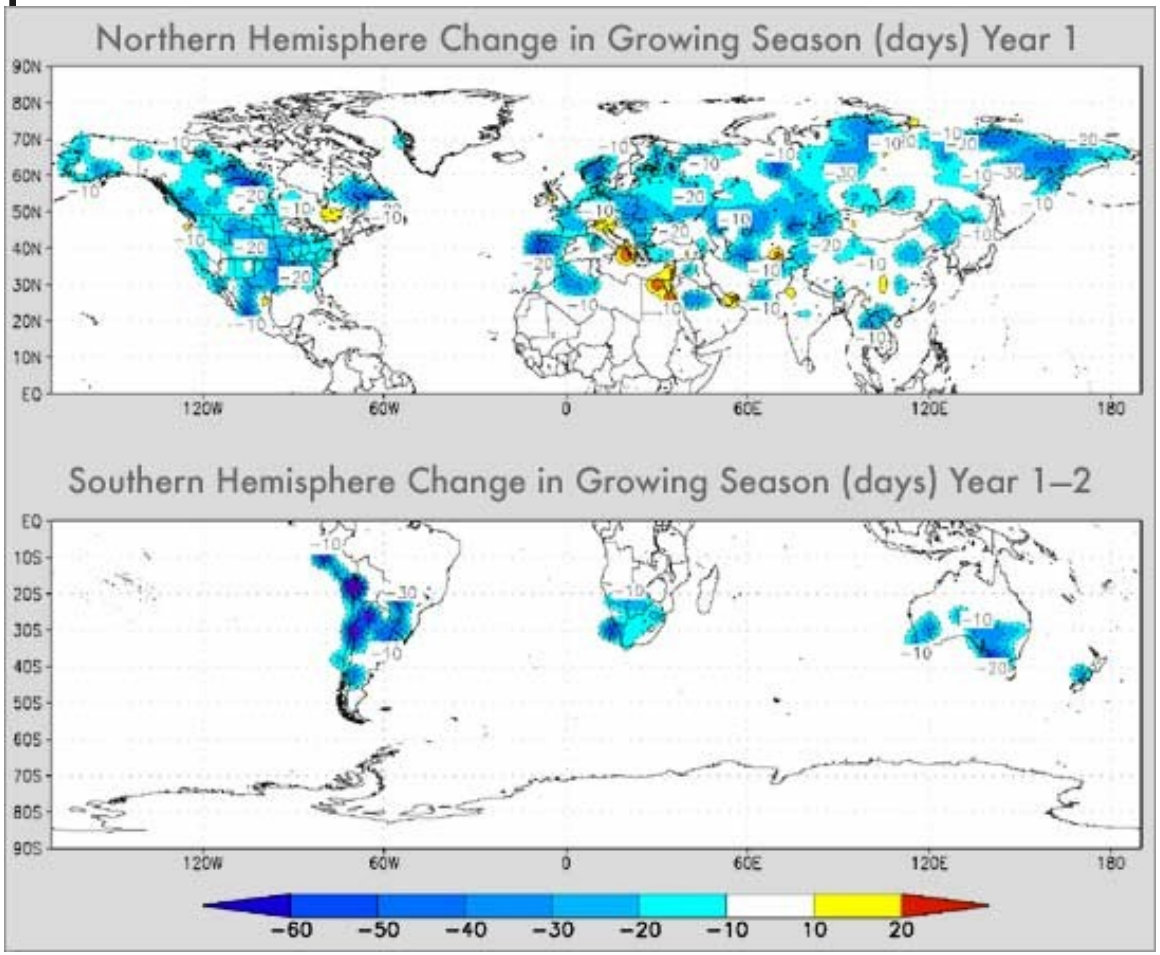
Global cooling



Time in years

From Robock et al. 2006

Mass starvation



- Lower temperatures → less evaporation from oceans → less rainfall → drought → food supply disruption all over the world

From Robock et al. 2006

Conclusions

- Nuclear weapons capabilities continue to spread throughout the world, despite existing non-proliferation treaties
- Even a “small” regional nuclear war can have catastrophic consequences that affect the entire globe
- Nuclear proliferation must be stopped and access to nuclear materials must be controlled and

Additional Resources

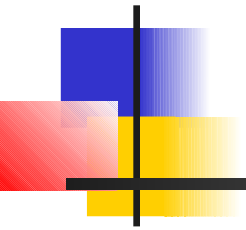
- Carnegie Endowment for International Peace http://www.ceip.org/
- Federation of American Scientists http://www.fas.org
- The Why Files: Cold Cuts http://whyfiles.org/shorties/222nuclear/
- Science News: Sudden Chill http://sciencenews.org/articles/20070203/bob8.asp
- A. Robock, L. Oman, G. L. Stenchikov, O. B. Toon, C. Bardeen, and R. P. Turco “Climatic consequences of regional nuclear conflicts” *Atmospheric Chemistry and Physics Discussions* 6 (Nov. 22, 2006):11817-11843. Available at: http://www.copernicus.org/EGU/acp/acpd/6/11817/acpd-6-11817.pdf

Additional Resources

- Owen B. Toon, Richard P. Turco, Alan Robock, Charles Bardeen, Luke Oman, Georgiy L. Stenchikov "Atmospheric Effects And Societal Consequences Of Regional Scale Nuclear Conflicts And Acts Of Individual Nuclear Terrorism" *Atmospheric Chemistry and Physics Discussions* 6 (Nov. 22, 2006): Available from: http://www.copernicus.org/EGU/acp/acpd/6/11745/acpd-6-11745.pdf

- Nuclear weapons effects calculator from the Federation of American Scientists: http://www.fas.org/main/content.jsp?formAction=297&contentId=367

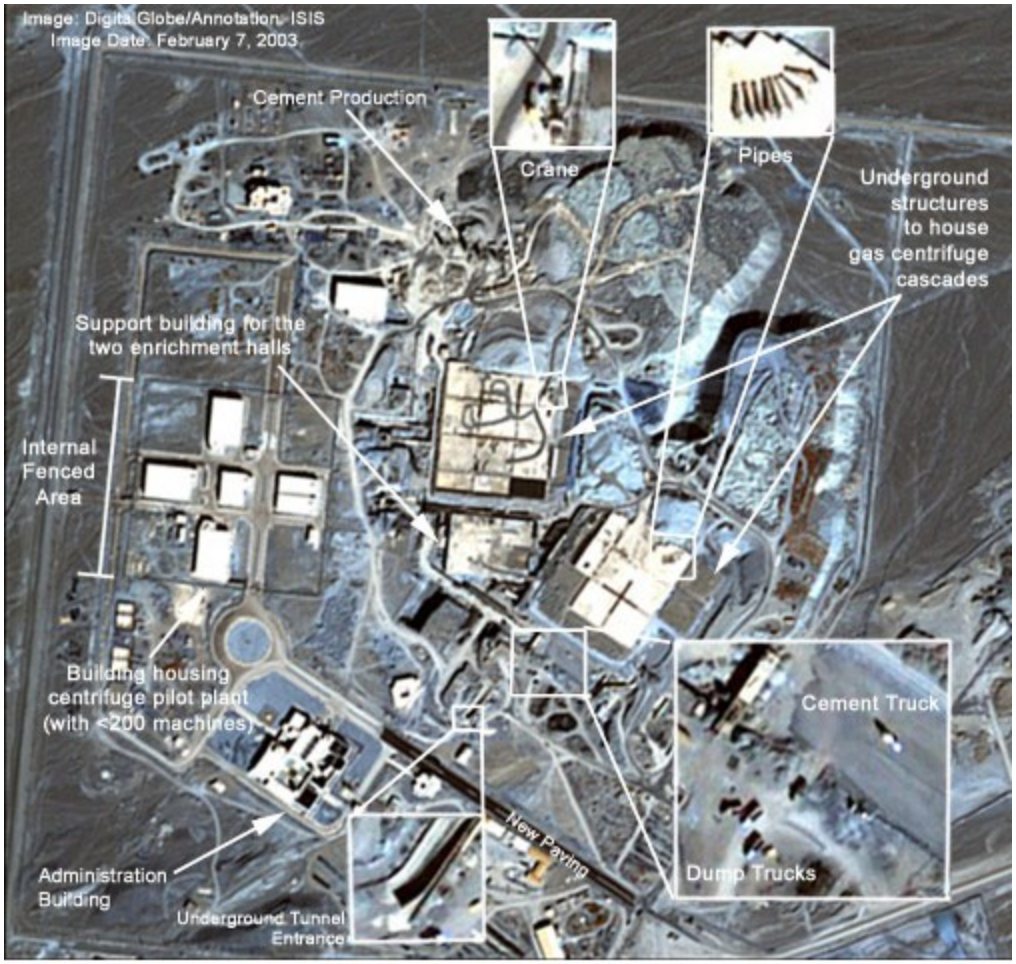
Backup Slides



Enriching Uranium in Iran

- As of 2003, Iran was developing an extensive, underground enrichment facility for Uranium
- Most of the centrifuges (up to 50,000) are underground, in order to withstand aerial attack – only 1-2% would be needed to make sufficient quantities of highly enriched U for a weapons program
- Iran's stated goal for this facility is production of sufficient low-enriched U to generate 6000 MW electricity through power plants

2003 Image of Natanz, Iran



NATANZ, IRAN

INSTITUTE FOR SCIENCE AND INTERNATIONAL SECURITY

IMAGE CREDIT: DIGITALGLOBE
DATE OF IMAGE: 7 FEBRUARY 2003

North Korean Nuclear Test

- On October 10, 2006 North Korea reported its first underground nuclear test, indicated by a small (~4th magnitude) earthquake
- Estimates are that this blast measured only ~0.5 kilotons – very small compared to other first weapons tests
- Likelihood is that it was a “fizzle” or even a conventional weapons blast – only time will tell if radio-isotopes emerge.

Are we in danger from N Korea?

- In order to threaten the US, North Korea must have:
  - Working nuclear warhead (uncertain)
  - Working long range delivery system – yet Taepodong-2 missile test failed in July – and if it worked, could only hit Alaska
  - Working electronics triggering for bomb (no evidence yet)
  - Intent to actually bomb another country

(no clear evidence but entirely possible)