Topic -5
Environmental Events

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Bioaccumulation of pollutants

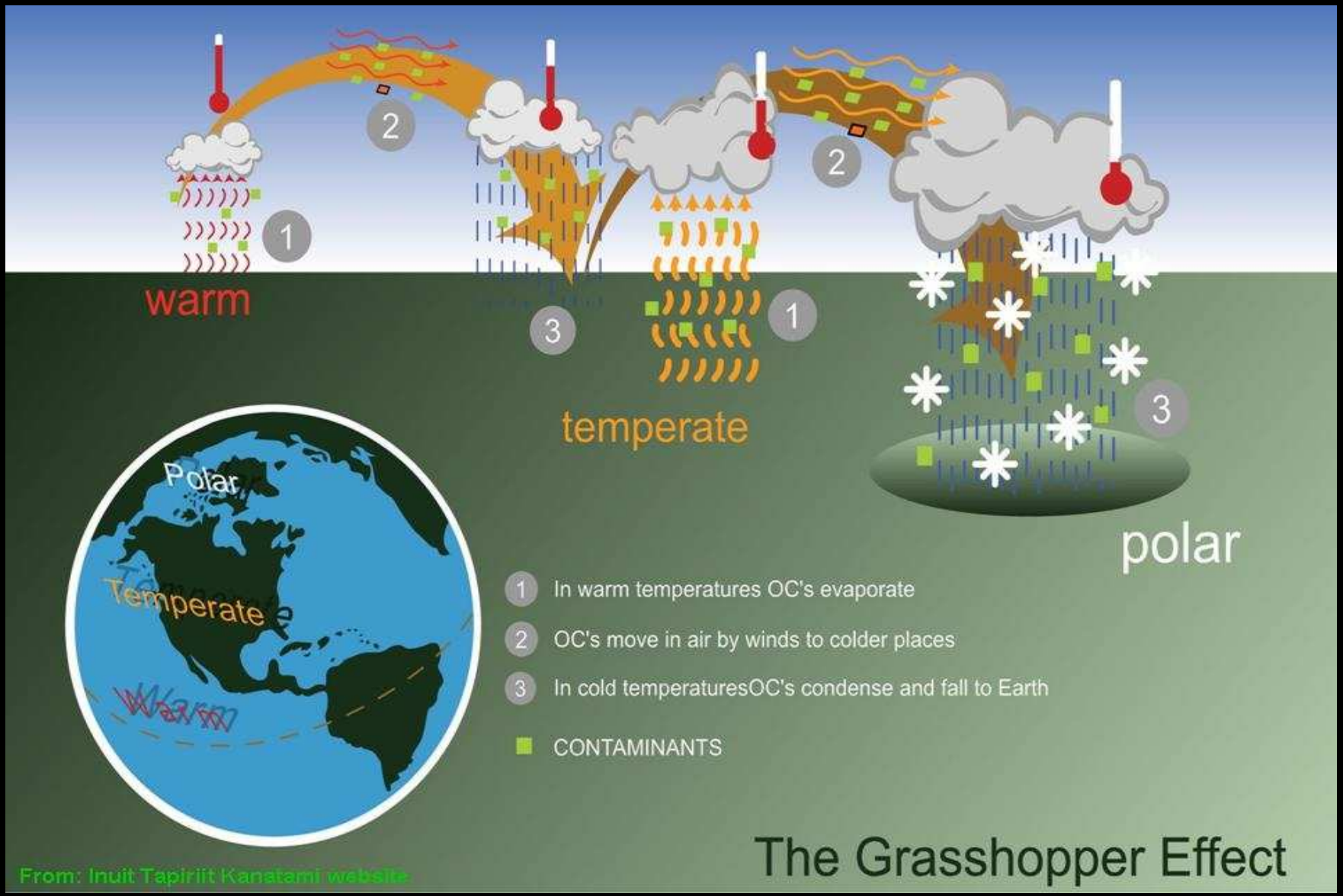
NEWSPAPER HEADLINES

"Arctic Indigenous Peoples Being Poisoned by Industry Thousands of Miles Away"

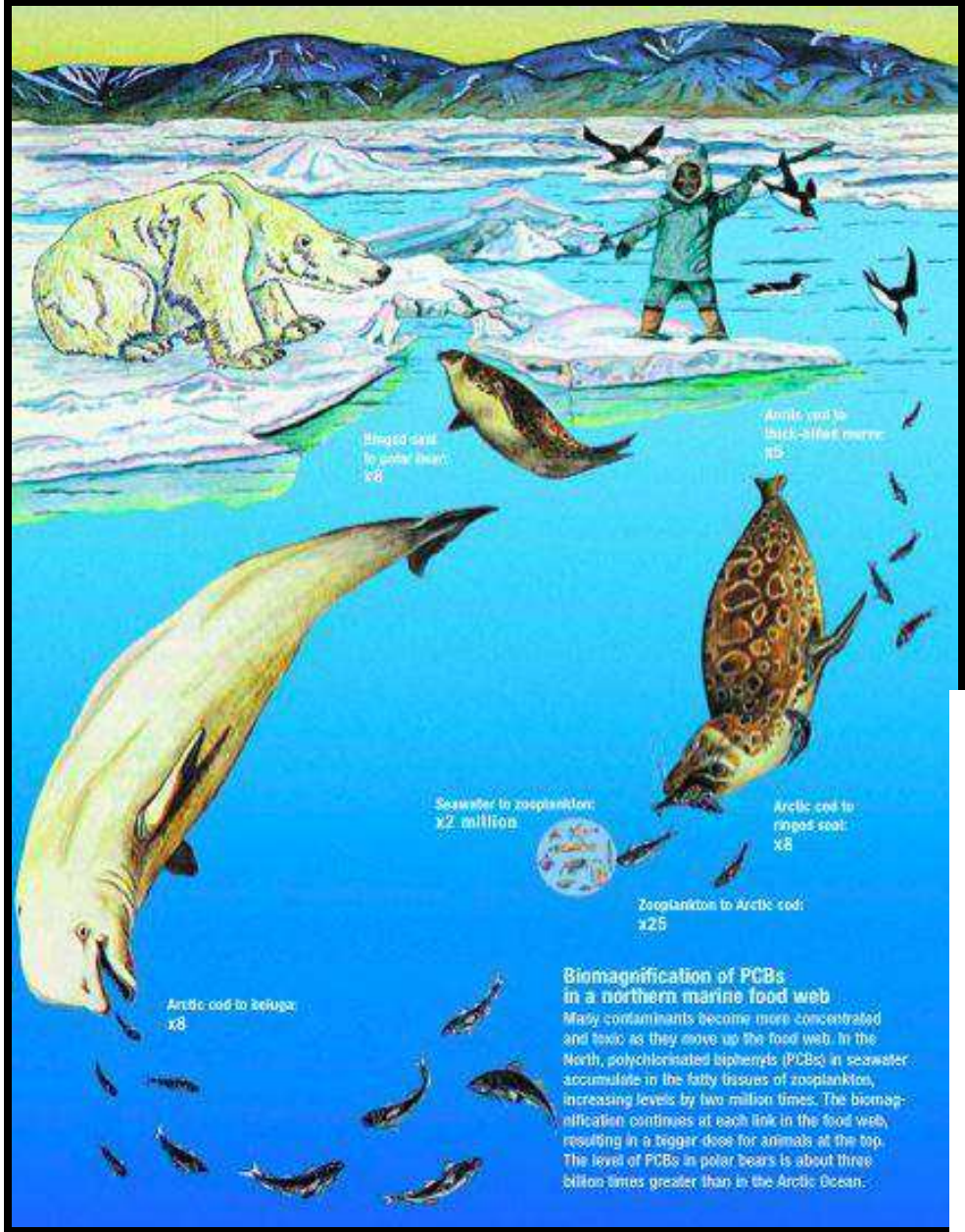
Pollution Sinks

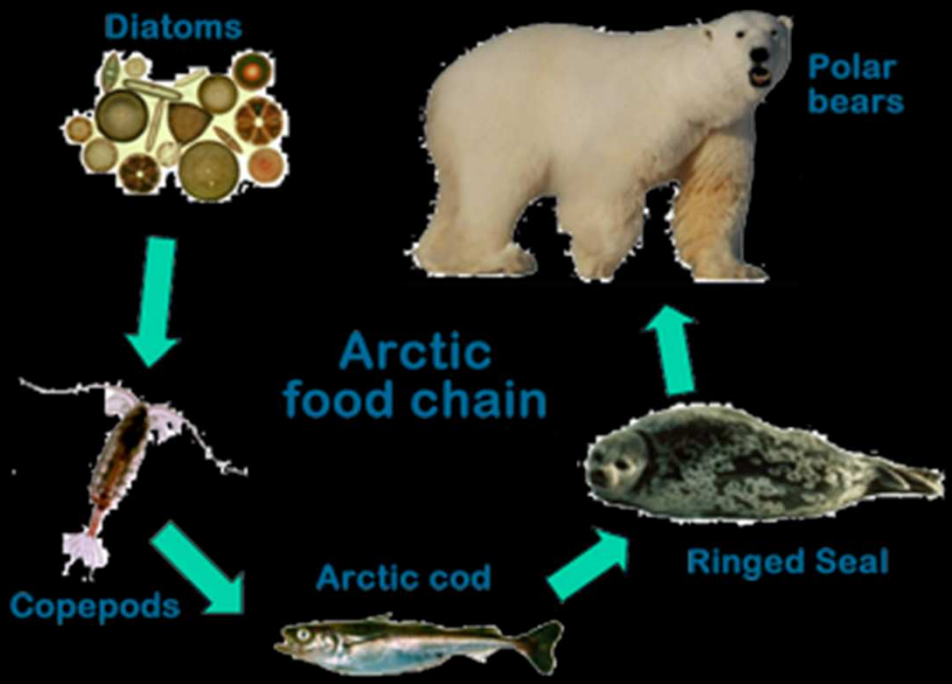
- *The pollution is the result of what scientists call the "grasshopper effect", in which transboundary pollution dispersing at the point of origin and driven by wind, re-volatilizes (or comes down to earth and oceans) thousands of miles away in the Arctic.*

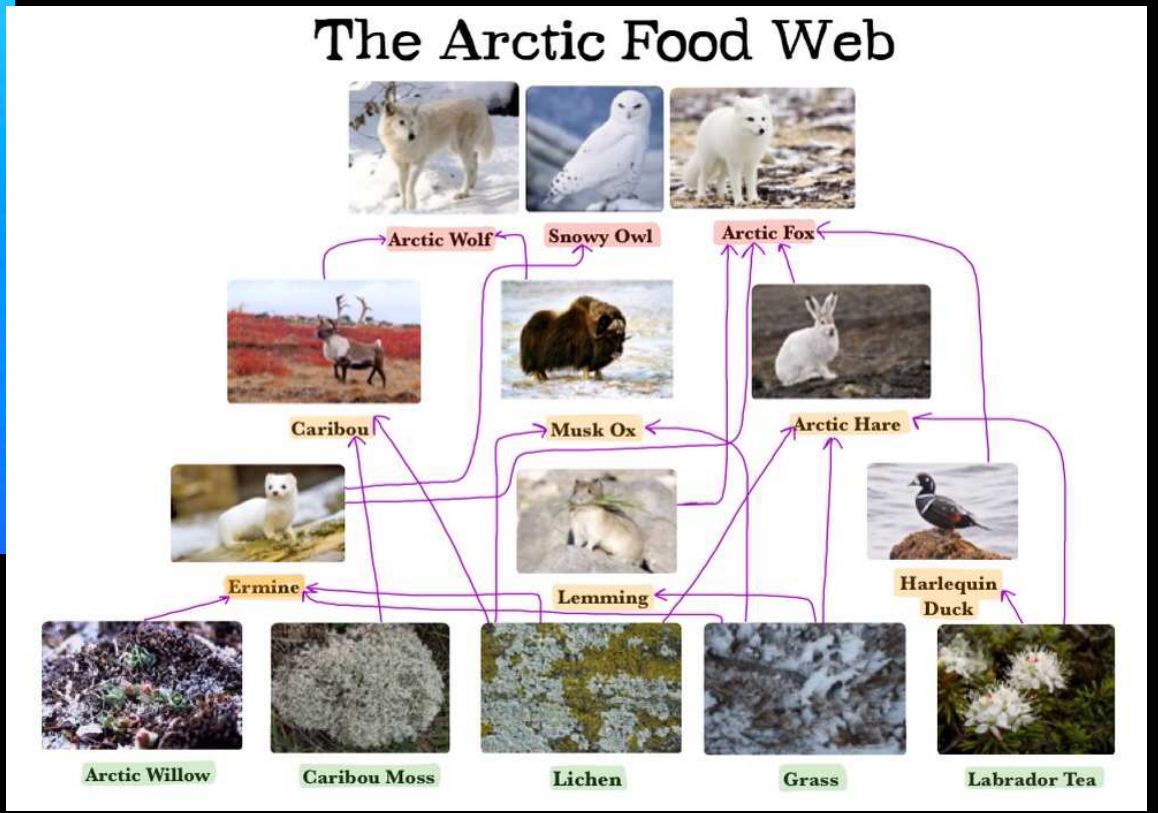
Global Distillation



Persistent organic pollutants (POPs) are among the most dangerous and are used as pesticides and also occurring as by-products from various industrial processes and from combustion.







Arctic Paradox
Inuit concern

Buoys and garbage litter a beach along the coast of Svalbard, Norway. Svalbard does not have trees and the logs that have washed up on the beach are from neighboring Russia.

Case studies: Belgium-dioxin; China;-acid rains; Britian-Sweden- Acid rains

Global Dimming

Global dimming is defined as the decrease in the amounts of solar radiation reaching the surface of the Earth.

How ??: 1950; NH>SH

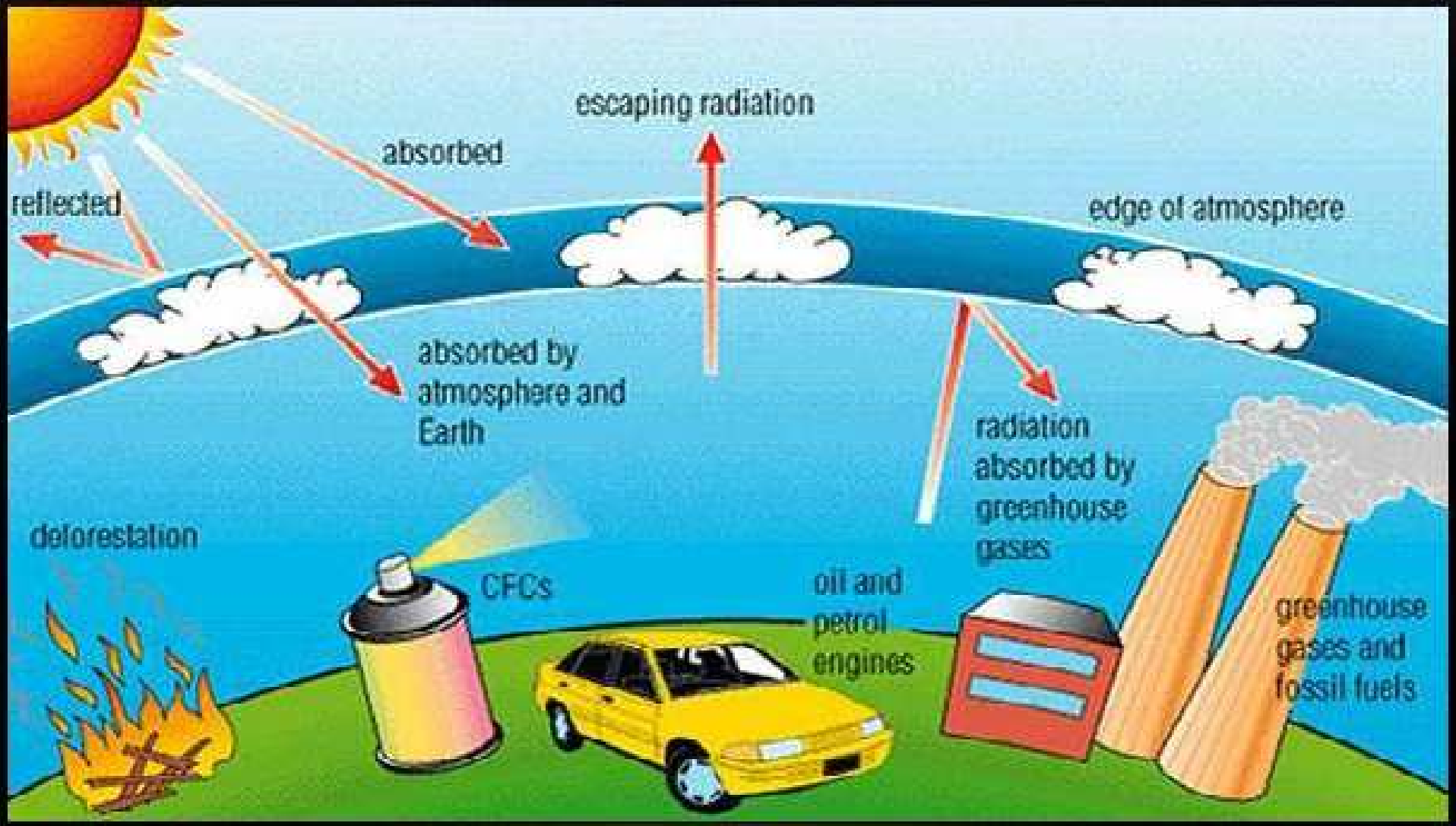
2. contrails

Causes of Global Dimming

1. Aerosols

brown clouds

SIMPLE DIAGRAM OF GLOBAL DIMMING



Both global dimming and global warming have been happening all over the world and together they have caused severe changes in the rainfall patterns

1984 Saharan drought

- *Decline in solar radiation at land surfaces documented in observational records up to 1990, by 24 stations distributed globally*

- *Global dimming has reversed since 1990. New data from 1990 to the present (mostly from the Northern Hemisphere) show that the dimming did not persist into the 1990s (Data from 300 stations available)*
- *Studies of the amount of sunlight making it through the atmosphere suggest that our air is getting cleaner*
  - *Reduced industrial emissions and the use of particulate filters*

- *'Studies published in 2005 indicate dimming replaced by brightening since 1990.*
- *New data show widespread brightening since the late 1980s*

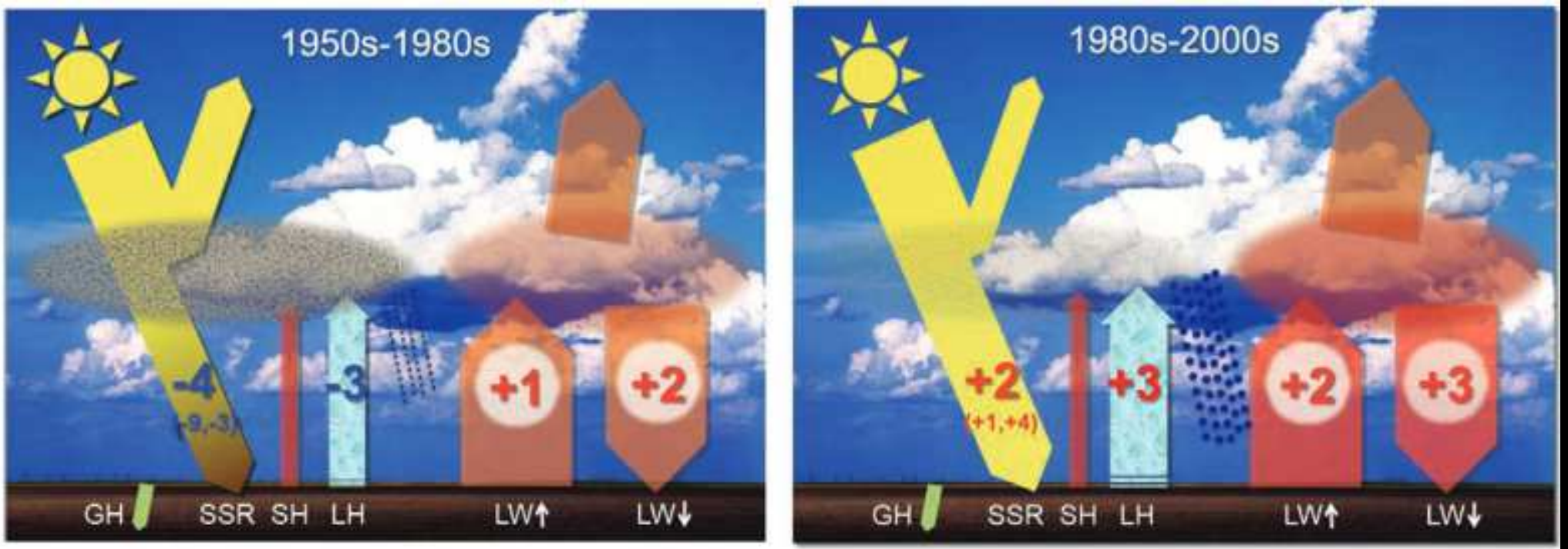
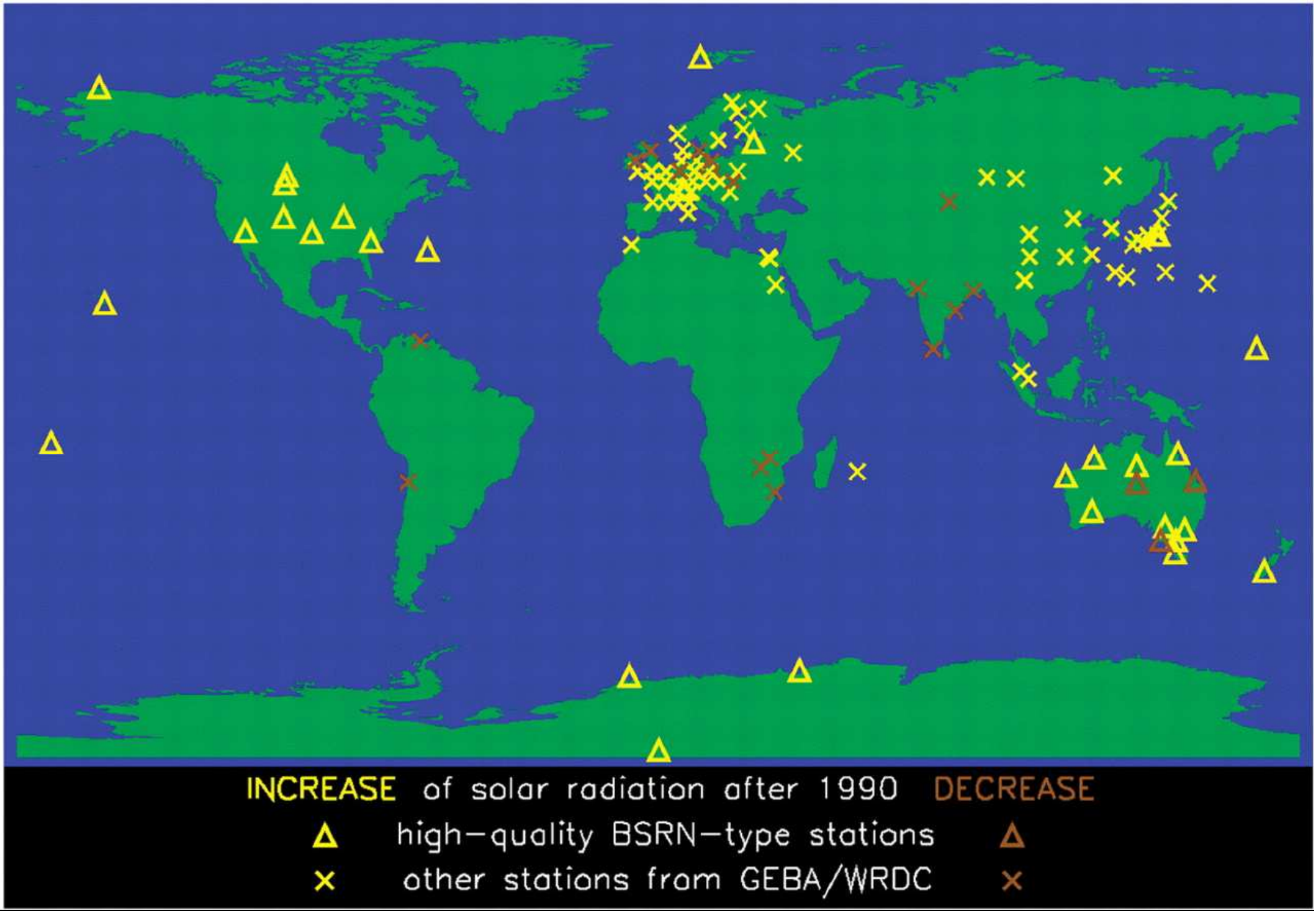


FIG. 1. Schematic representation of "dimming" and "brightening" periods over land surfaces. (left) During dimming (1950s–80s) the decline in surface solar radiation (SSR) may have outweighed increasing atmospheric downwelling thermal radiation (LW↓) from enhanced greenhouse gases and effectively counteracted global warming, causing only little increase in surface thermal emission (LW↑). The resulting reduction in radiative energy at Earth's surface may have attenuated evaporation and its energy equivalent, the latent heat flux (LH), leading to a slowdown of the water cycle. (right) With the transition from dimming to brightening (1980s–2000s), the enhanced greenhouse effect has no longer been masked, causing more rapid warming, stronger evaporation/LH, and an intensification of the water cycle. Values denote best estimates of overall changes in surface energy fluxes over both periods in W m^{-2} (ranges of literature estimates for SSR dimming/brightening in parentheses). Positive (negative) numbers, shown in red (blue), denote increasing (decreasing) magnitudes of the energy fluxes in the direction indicated by the arrows. Changes in ground heat flux (GH) and sensible heat flux (SH) are considered small compared to the above mentioned flux changes.

Observed tendencies in surface solar radiation

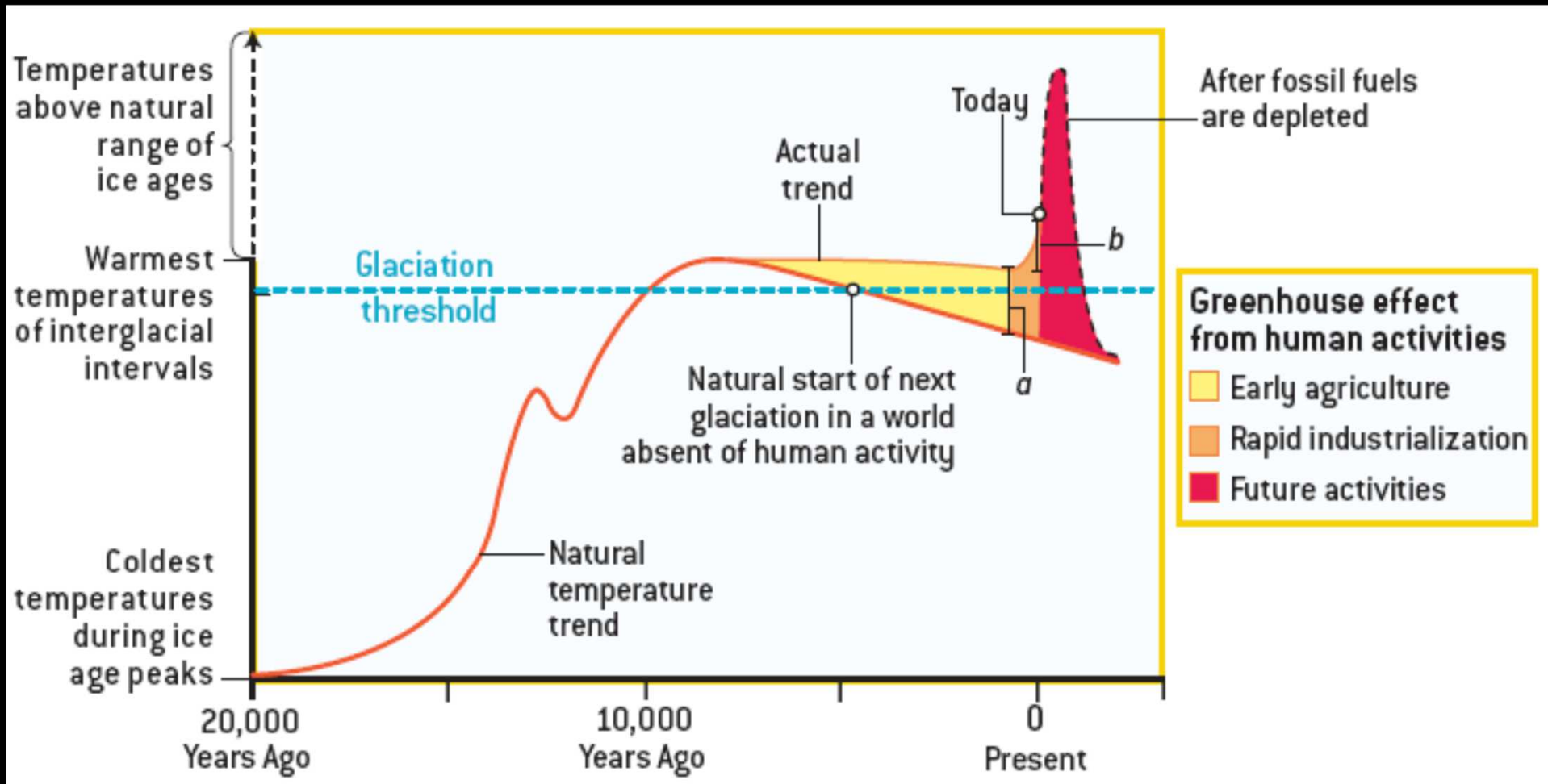
	1950s-1980s	1980s-2000	after 2000
USA	-6	5	8
Europe	-3	2	3
China/Mongolia	-7	3	-4
Japan	-5	8	0
India	-3	-8	-10

FIG. 2. Changes in surface solar radiation observed in regions with good station coverage during three periods. (left column) The 1950s–1980s show predominant declines ("dimming"), (middle column) the 1980s–2000 indicate partial recoveries ("brightening") at many locations, except India, and (right column) recent developments after 2000 show mixed tendencies. Numbers denote typical literature estimates for the specified region and period in W m^{-2} per decade. Based on various sources as referenced in Wild (2009).



Wild *et al. Science* 308, 847-850 (2005)

Global Dimming and Global Warming

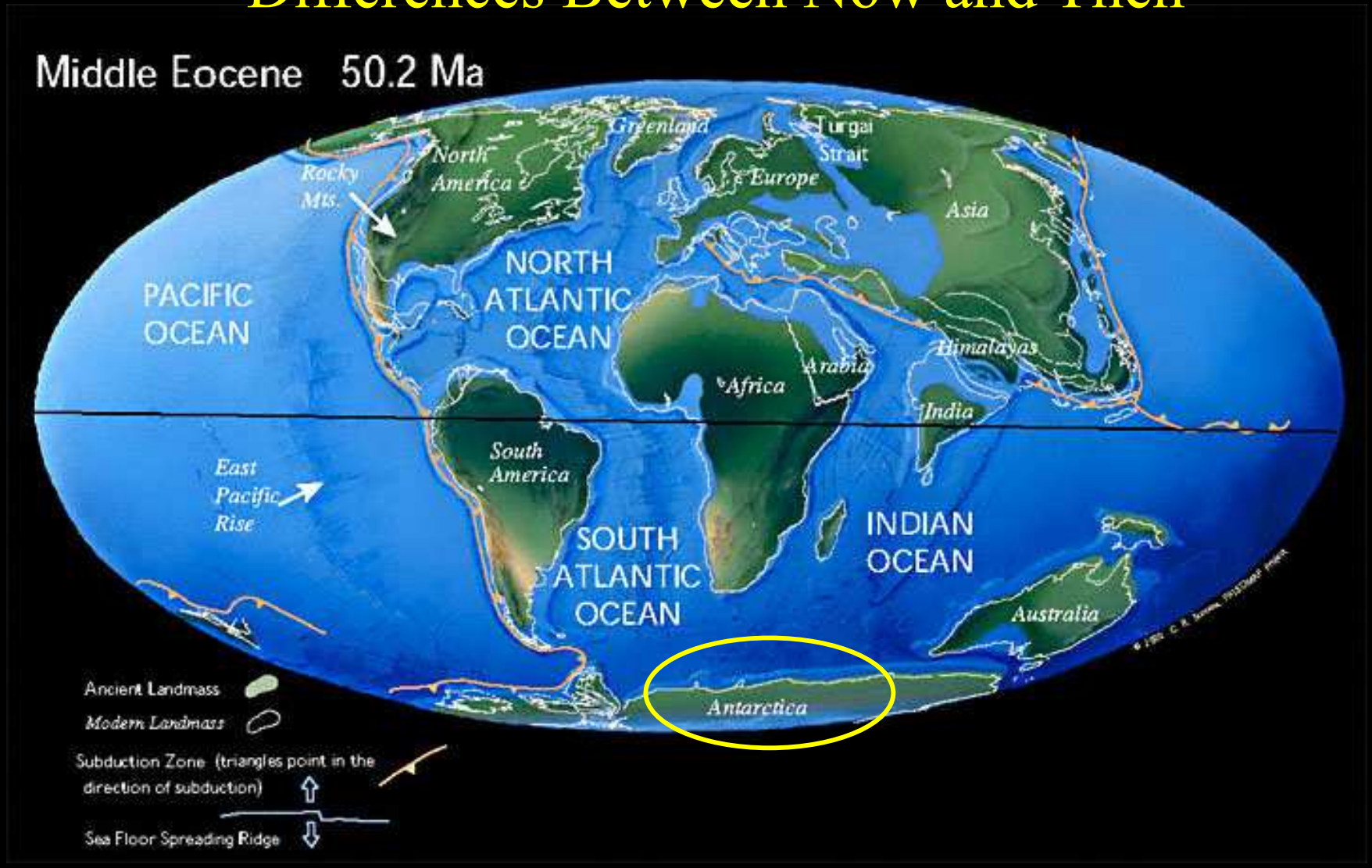


GREENHOUSE EFFECT from human activities has warded off a glaciation that otherwise would have begun about 5,000 years ago. Early human agricultural activities produced enough greenhouse gases to offset most of the natural cooling trend during preindustrial times (*yellow*), warming the planet by an average of almost 0.8 degree Celsius. That early warming effect (*a*) rivals the 0.6 degree Celsius (*b*) warming measured in the past century of rapid industrialization (*orange*). Once most fossil fuels are depleted and the temperature rise caused by greenhouse gases peaks, the earth will cool toward the next glaciation—now thousands of years overdue.

AZOLLA EVENT

The Eocene

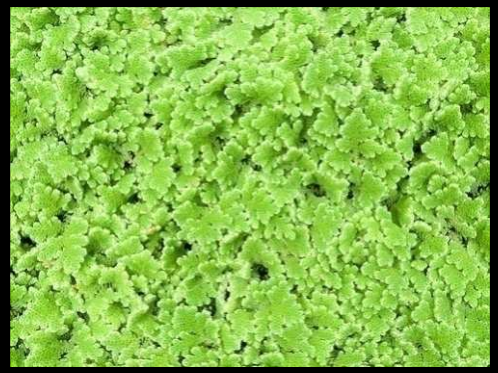
Differences Between Now and Then



But, why so warm ?

So, why did it get cold ?

AZOLLA..



Pest

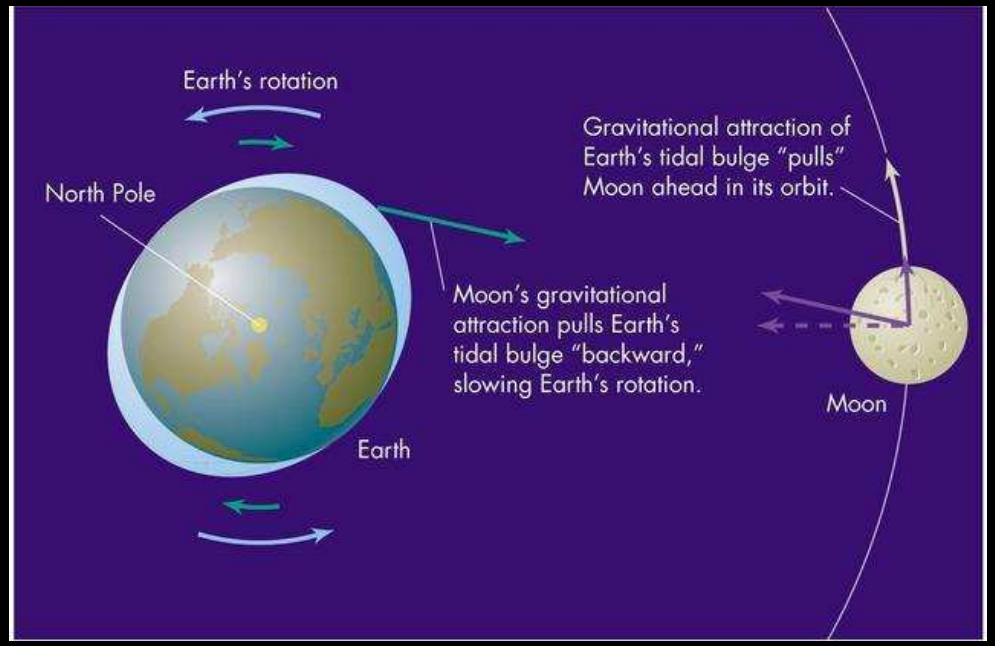
IMPACT

CHANGE IN EARTH'S ROTATION DUE TO CONSTRUCTION OF DAMS

- *Days are shorter in past....!!!!*
- *Atomic Clocks show that a modern day is longer by about 1.7 milli sec than a century ago*
- *Many reasons and many theories like.....*
  - *due to gravitational interactions with the Moon,*
  - *construction of sky scrapers, construction of dams....etc*

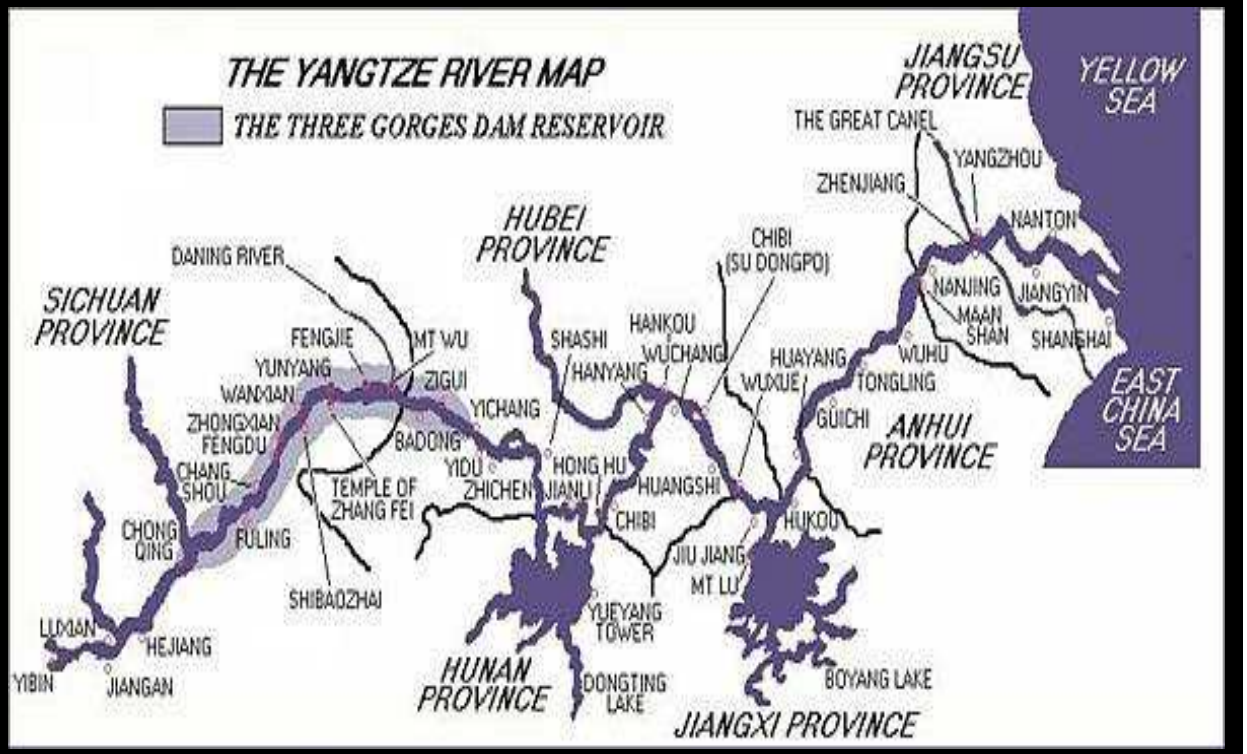
THE MYTH

The filling of the reservoir behind Three Gorges Dam in China changed the rotation of the Earth



China's Monster
"THE THREE GORGES DAM"

- *30°44'18" North, 111°16'27" East.*
- *Biggest, most expensive dam*
- *Crosses the Yangtze River in Hubei province, China.*
- *Height : 185 m.*
- *Goals :*
  - *Flood control*
  - *Power Generation*
  - *Tourism*



Features of the dam

One of the few man made objects that can be seen clearly from space. Dam is build in the middle of an earthquake zone!!

Project used 27.2 million cubic meters of concrete (mainly for the dam wall), 463,000 tonnes of steel (enough to build 63 Eiffel Towers) , Moved about 102.6 million cubic meters of Earth. Conc dam wall is 181m above rock basis.

The reservoir created by the dam is about 660 km in length and 1.12 km in width , The total surface area of the reservoir is 1045 km^2, and it will flood a total area of 632 km^2, of land.

The reservoir contain about 39.3 cu km of water. That water weigh more than 39 trillion kilograms (42 billion tons)

MASS SHIFT CHANGES ROTATION!!!!!!

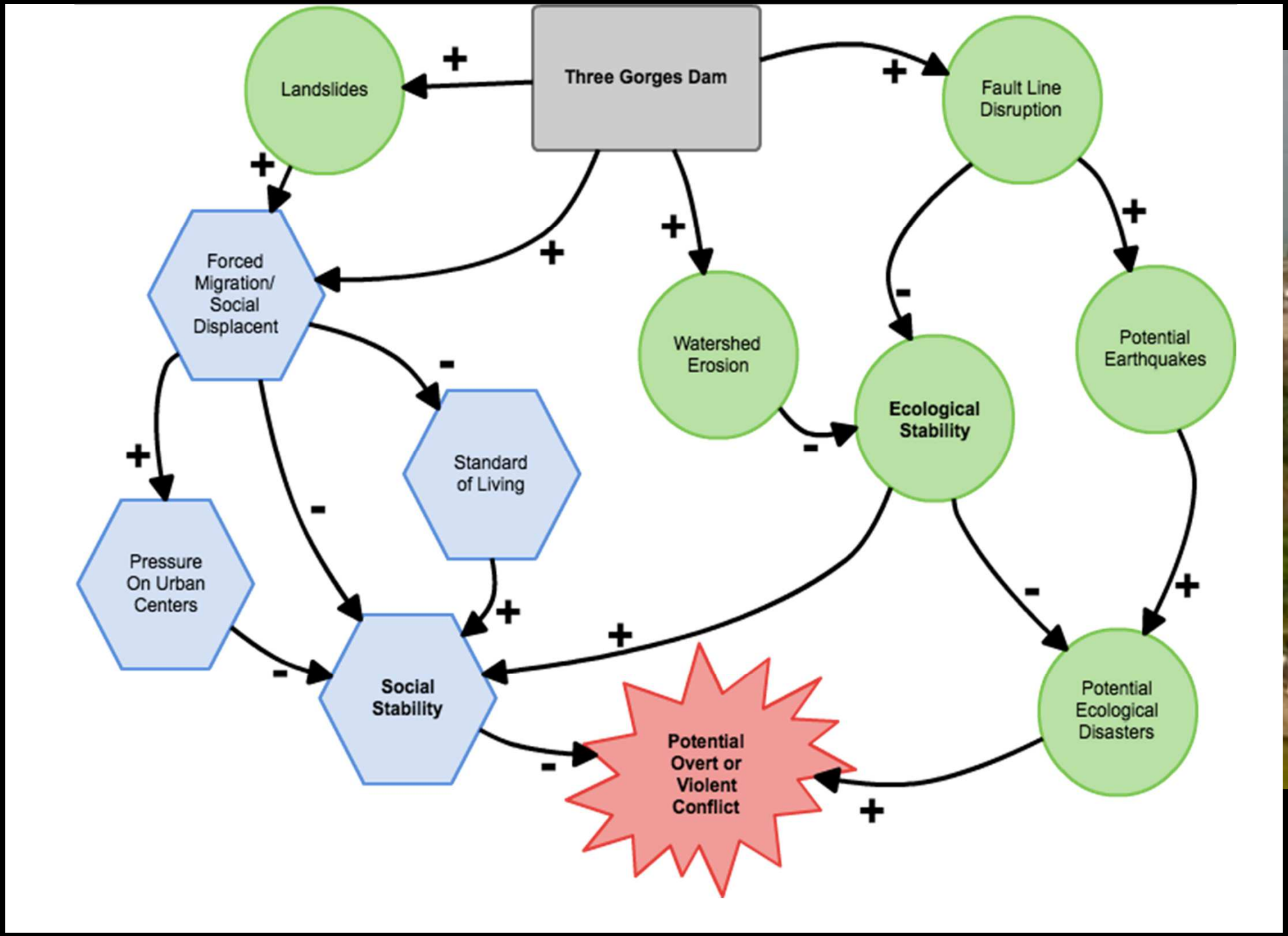
Thus by shifting a significant mass of water, the dam will literally SLOW THE ROTATION OF THE EARTH. *This is because (a shift in mass) raising about 39 trillion kilograms of water, 175 meters above sea level will increase the Earth's moment of inertia and thus slow its rotation. However, the effect would extremely small.*

As per NASA scientists, the shift of such mass would increase the length of a day only by 0.006 microseconds,

Since longer the distance of mass to its axis of rotation, longer would be its MOI there by slower it would spin.

This would make Earth very slightly more round in the middle and shift pole position by 2 centimeters

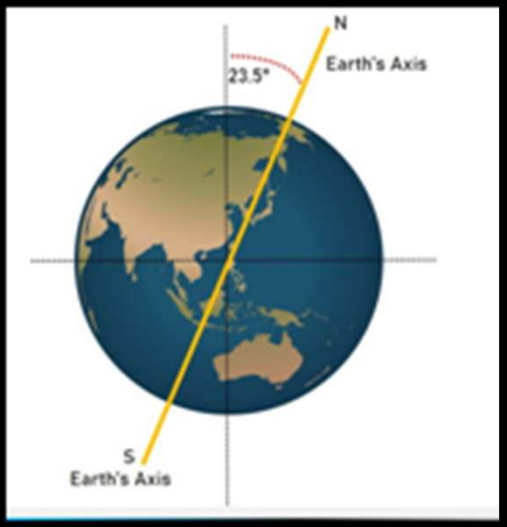
China's Three Gorges Dam: An Environmental Catastrophe?



How Groundwater Extraction Has Shifted the Earth's Axis?

Excessive extraction of groundwater for drinking and irrigation has shifted the Earth's axis of rotation.

Humans pumped out around **2,150 gigatons** of groundwater between 1993 and 2010 and this has led the planet's axis to drift at the rate of 4.36 cm per year towards the east.



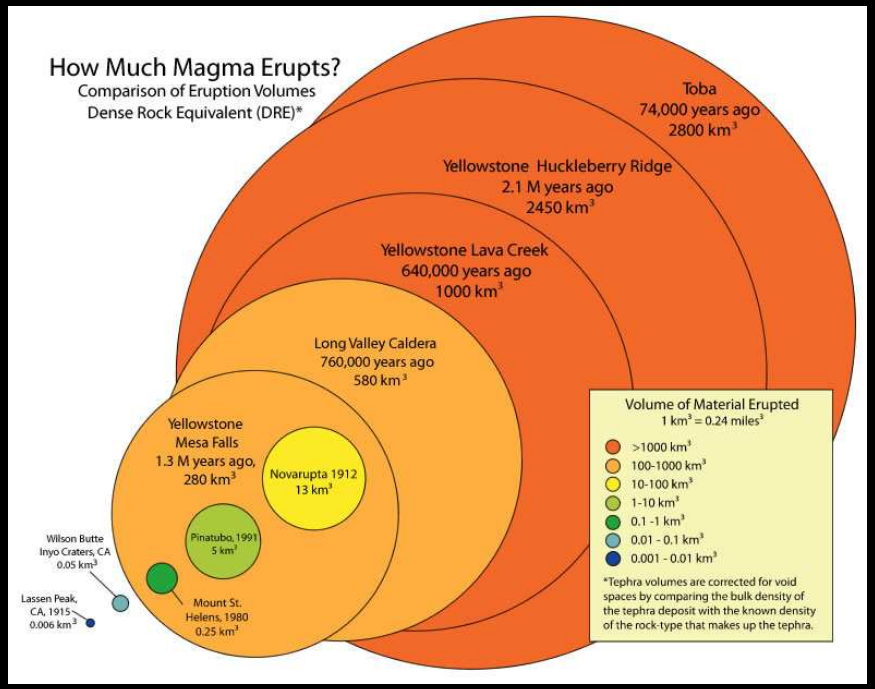
Polar Motion

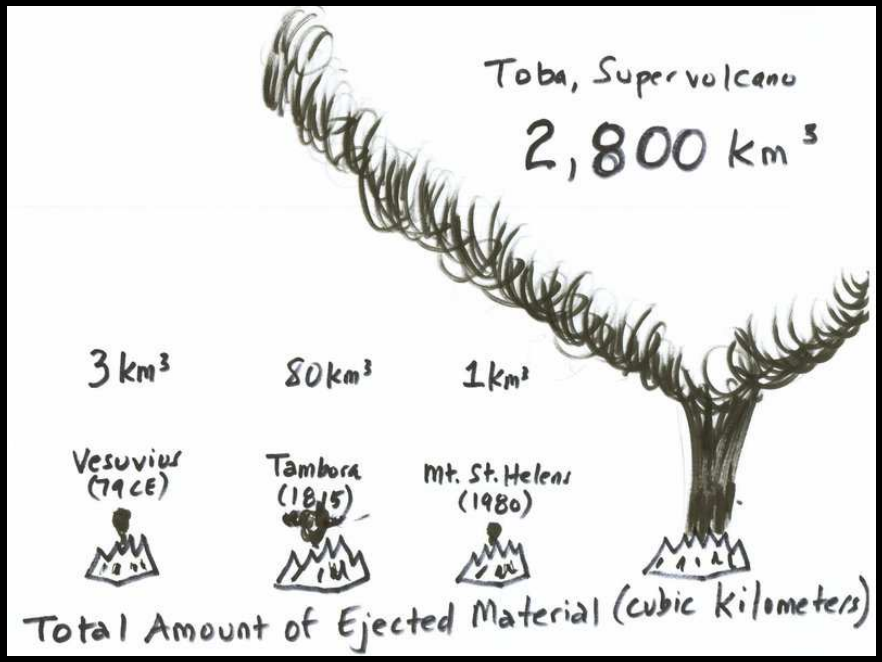
Redistribution of groundwater as the largest contributor to the drift of the rotational pole.

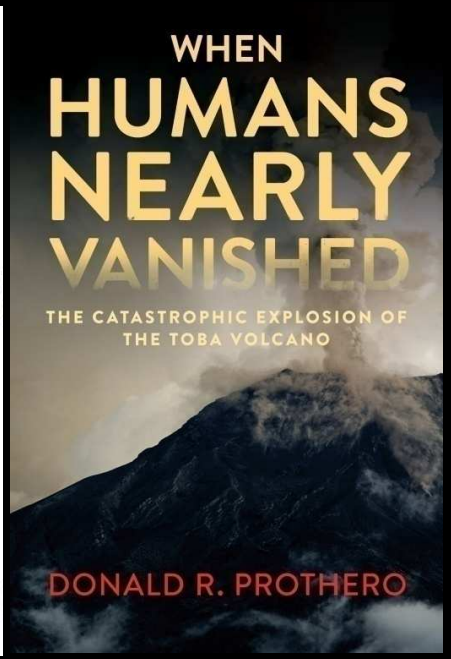
Groundwater extraction from North America and northwestern India, both located at the Earth's midlatitudes

Groundwater extraction raised global sea levels by 6.24mm between 1993 and 2010.

Toba catastrophe theory

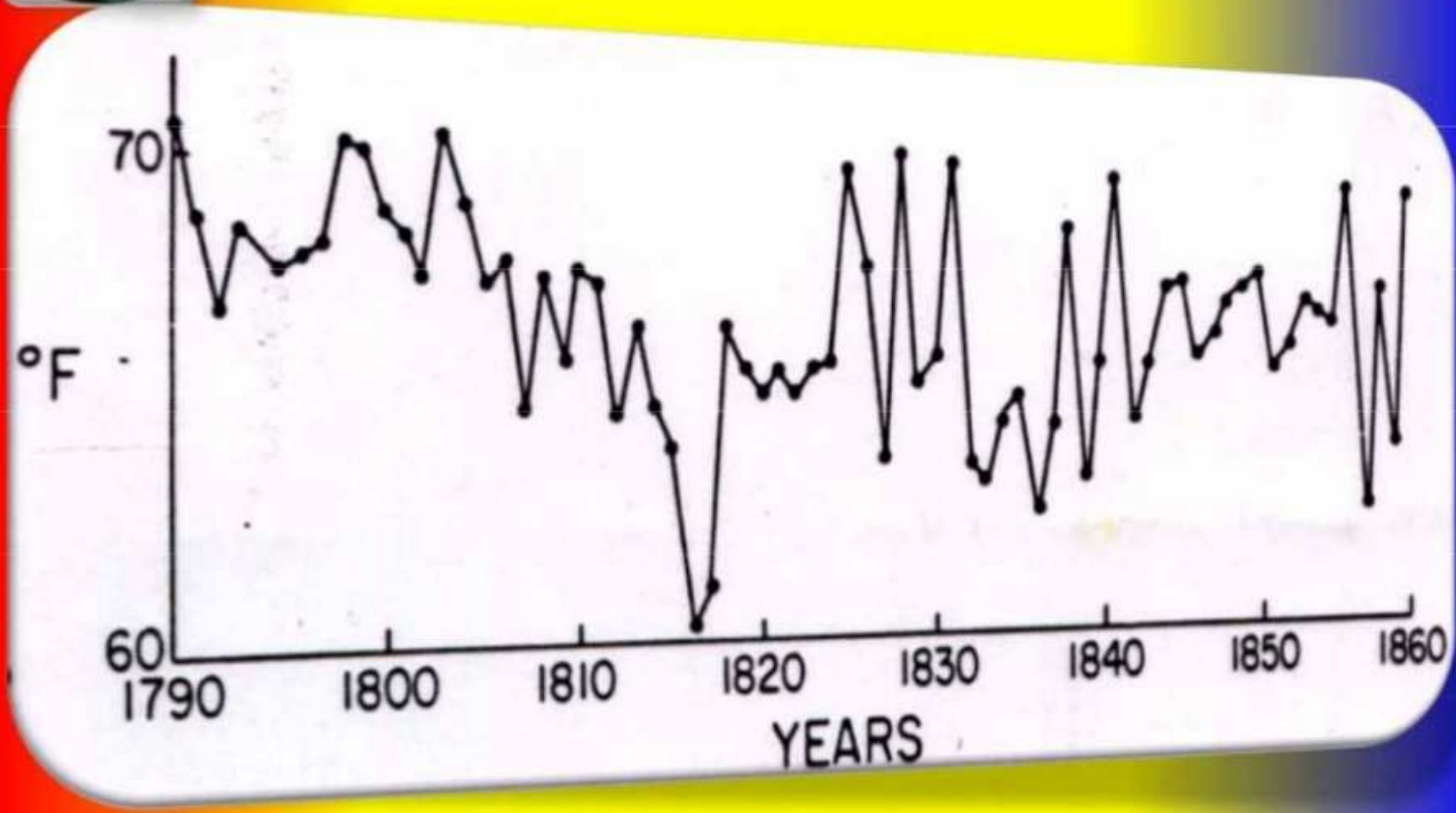






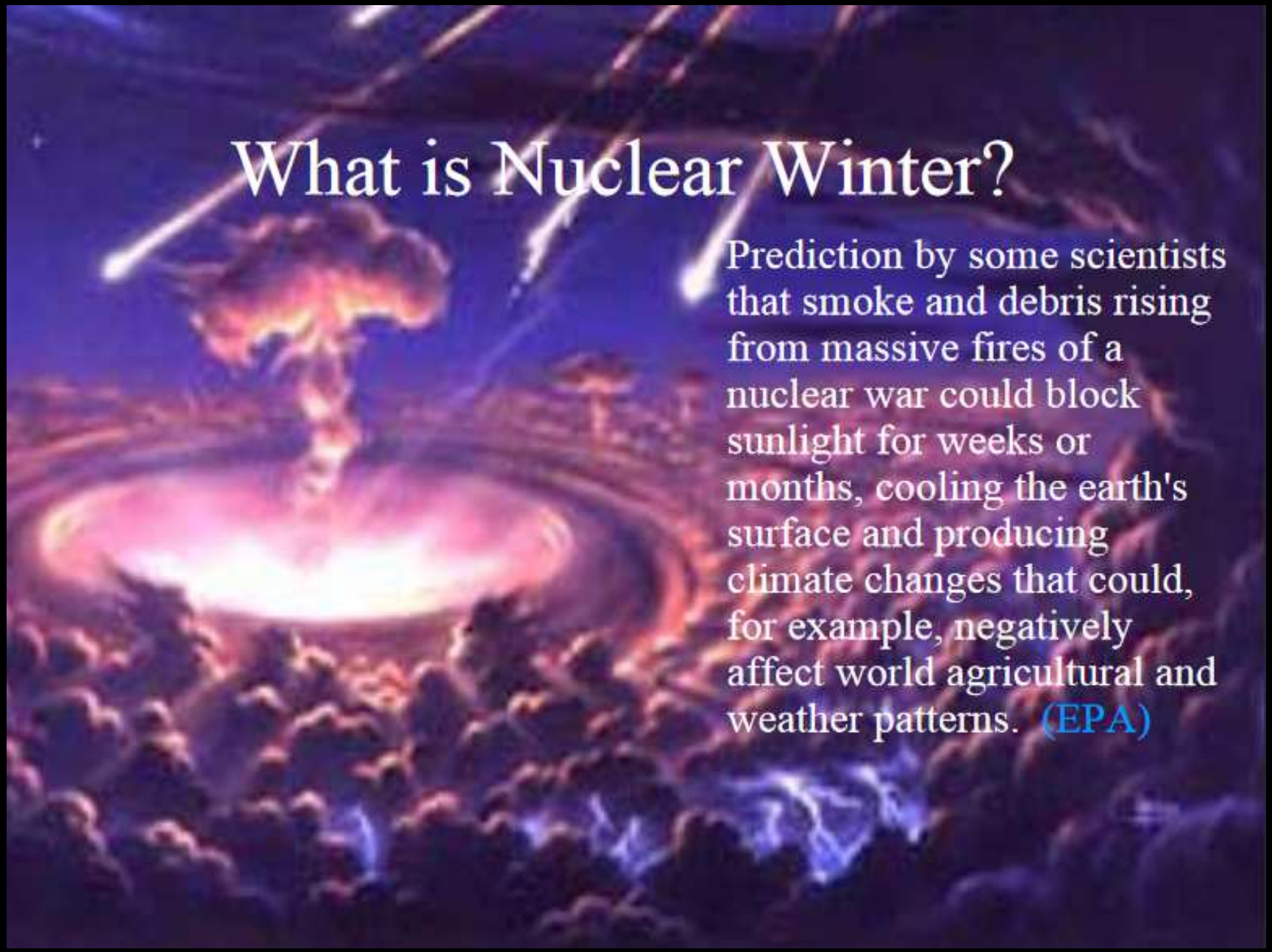
Napoleon's defeat at Waterloo caused in part by Indonesian volcanic eruption

Global Surface Temperature Reconstruction



Mean Annual temperature at New Haven, CT 1790-1983

From Stommel and Stommel, 1979, Scientific American 240, 176-186.



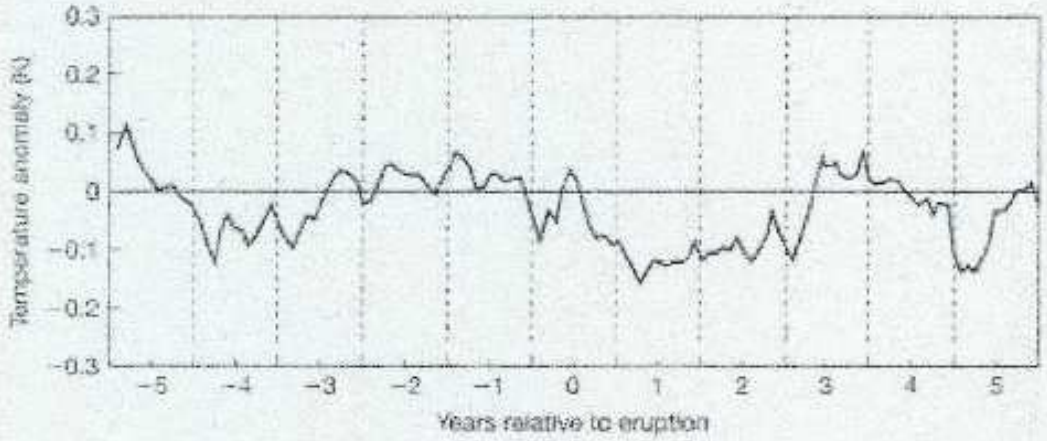
Carl Sagan and others conducted additional studies and found that soot from cities and dust from the explosions themselves were also climatically significant and could cool the surface of the earth

Nuclear winter theory is supported by observational evidence from natural catastrophic events

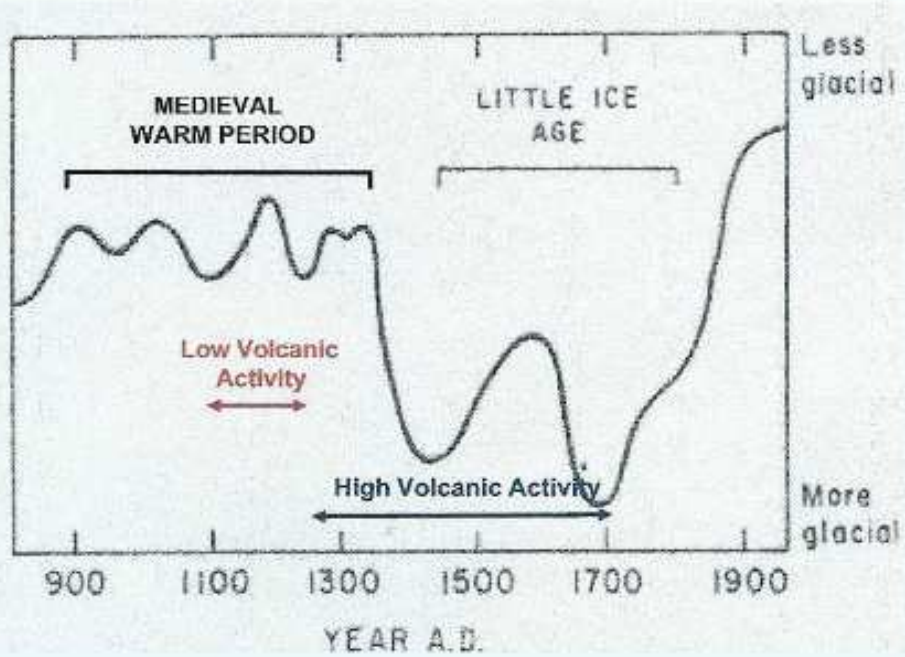
>130 active volcanoes in Indonesia,
Krakatau eruptions: 535 AD, 1883 AD, 200X

Considerable impact on global temperatures was recorded for both volcano events!

Effects on global temperature



Average Impact of Krakatau (1883), Santa Maria (1902), Katmai(1919), Agung (1963),El Cichon(1982), on temperatures recorded by the GISP2 ice core.



Nuclear winter is the term for a theory describing the climatic effects of nuclear war. Smoke from the fires started by nuclear weapons, especially the black, sooty smoke from cities and industrial facilities, would be heated by the Sun, lofted into the upper stratosphere, and spread globally , lasting for years.

The resulting cool, dark, dry conditions at Earth's surface would prevent crop growth for at least one growing season, resulting in mass starvation over most of the world.

In addition, there would be massive ozone depletion, allowing enhanced ultraviolet radiation. More people could die in the noncombatant countries than in those where the bombs were dropped, because of these indirect effects. Nuclear proliferation is now expanding the threat.

A nuclear war between India and Pakistan could produce so much smoke that it would produce global environmental change unprecedented in recorded human history.

Although the number of nuclear weapons in the world has fallen from 70,000 at its peak in the 1980s to less than 10,000 currently deployed, a nuclear war between the United States and Russia could still produce nuclear winter. This theory cannot be tested in the real world. However, analogs can inform us about parts of the theory.

Clim Change, 2010 1 418–427 – Alan Robock

Access : http://climate.envsci.rutgers.edu/pdf/WiresClimateChangeNW.pdf

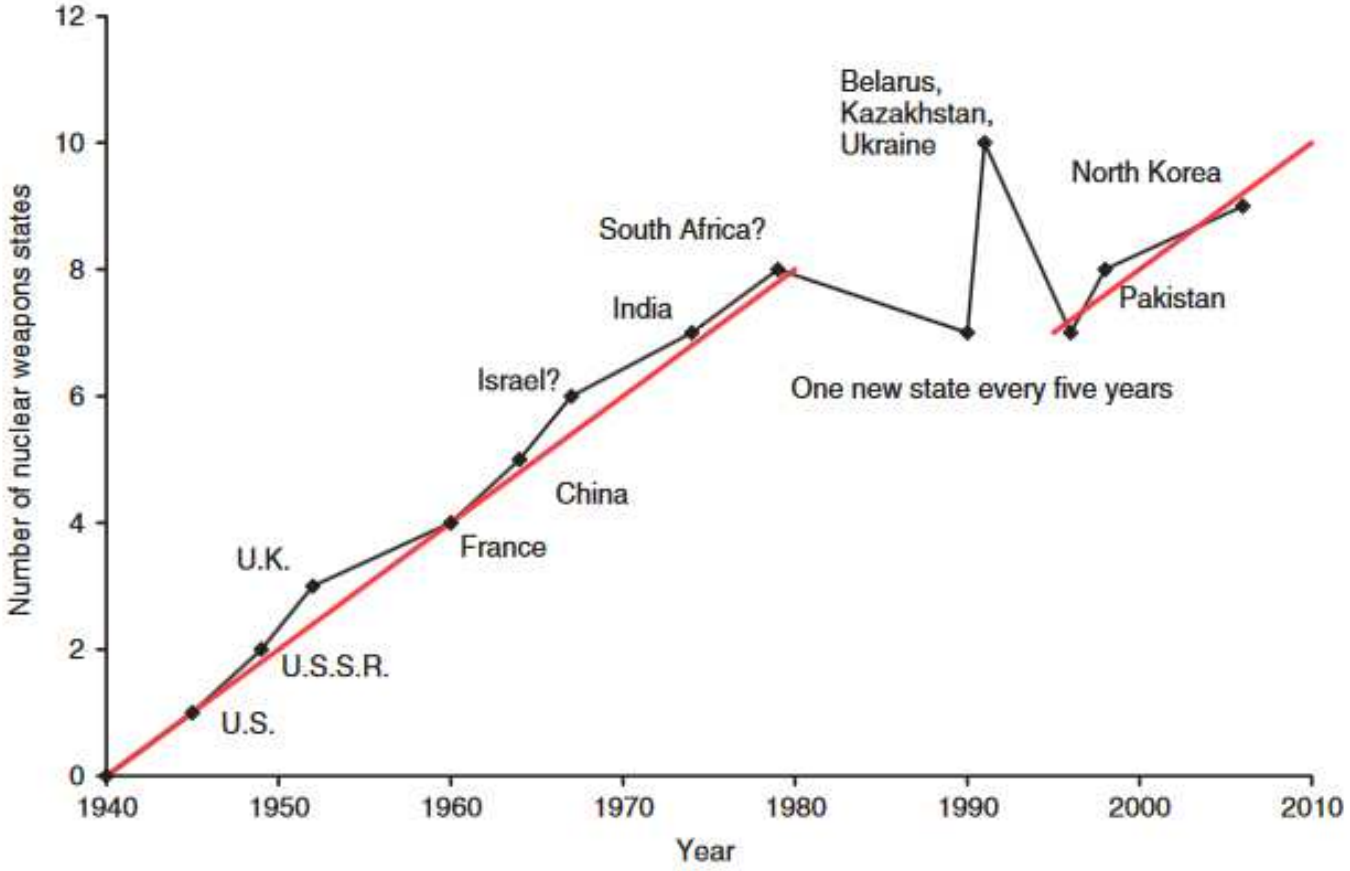


FIGURE 3 | New nuclear states have steadily appeared since the invention of nuclear weapons. In this graph the date of the first test, or the date when weapons were obtained, is noted. Israel and South Africa did not test weapons so their dates to obtain weapons are uncertain. South Africa abandoned its arsenal in the 1990s. Ukraine, Belarus, and Kazakhstan also abandoned the weapons they inherited after they left the Soviet Union. The red lines show growth in the number of nuclear weapons states at the rate of one new state each 5 years. Although the growth halted during the 1980s and 1990s, just after nuclear winter research was published and the Cold War ended, the recent resumption of growth is of great concern. (Modified from Ref 28, used by permission).

POLICY IMPLICATIONS/WAR PROTECTION

- INF
- START

https://www.youtube.com/watch?v=USDCATD89oY

https://www.youtube.com/watch?v=2Pp-W1Va5gE

https://www.aljazeera.com/indepth/features/project-force-world-survive-nuclear-winter-200622132211696.html

https://www.ethz.ch/content/dam/ethz/special-interest/usys/iac/iac-dam/documents/edu/courses/radiation_and_climate_change/WildBAMS.pdf

https://www.scientificamerican.com/article/chinas-three-gorges-dam-disaster/