TOPIC #15

OBSERVATIONS OF SHORT-TERM CLIMATIC VARIABILITY

pp 81 - 82 in Class Notes

All things are connected. Whatever befalls the earth, befalls the children of the earth.

~ Chief Seattle

To make an incontrovertible case about the role that humans play in global warming, what do scientists need?

1) a long-term temperature record, i.e., centuries

2) over a large part of the globe

3) To be able to say . . . . .

"What's the average been for several hundred years, & is this a significant departure from that?"

"And that's very difficult to do."

(James Trefil, physicist)

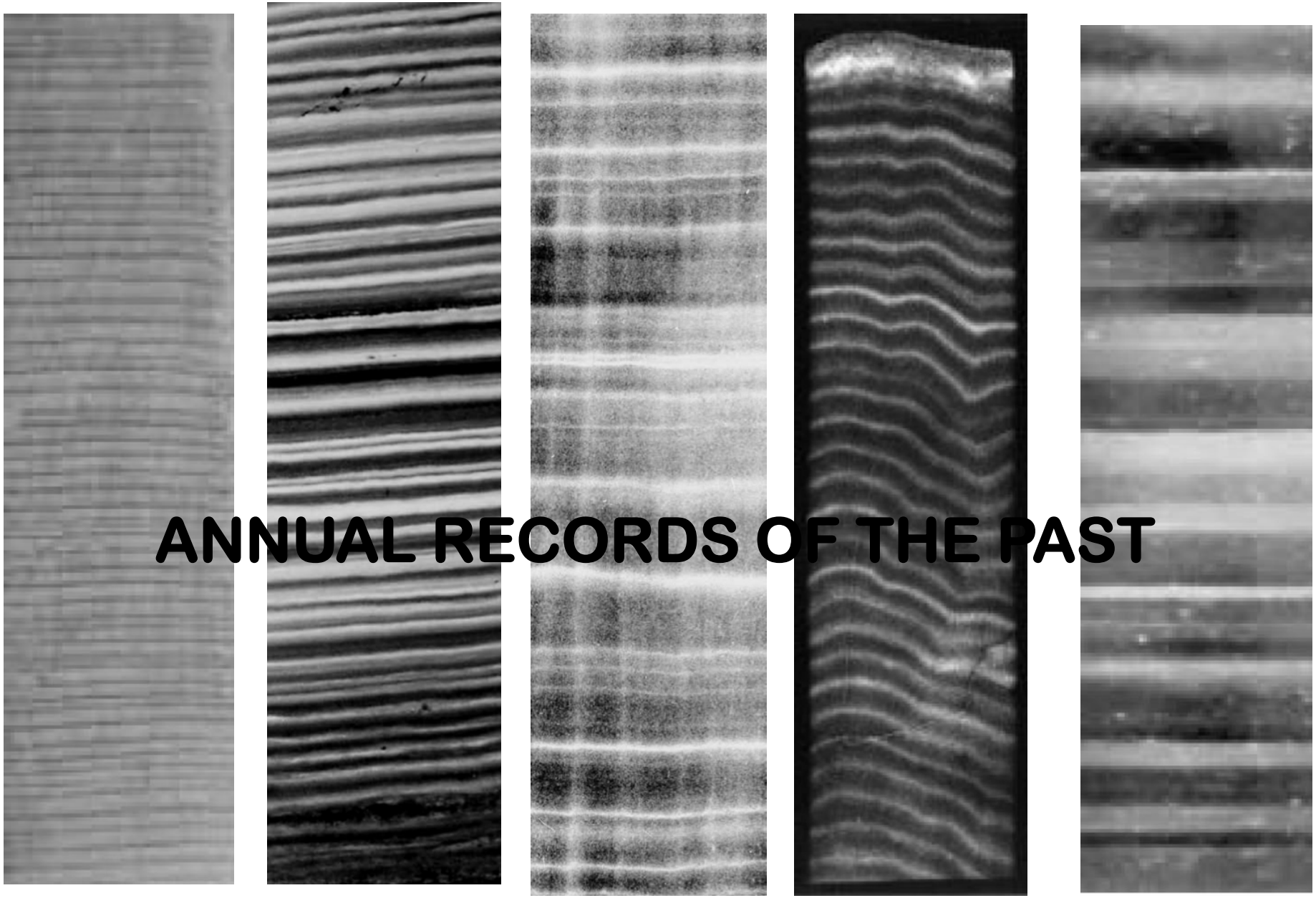
Tree rings

Lake varves (sediments)

Speleothems (from cave)

Coral (annual growth)

Ice Core

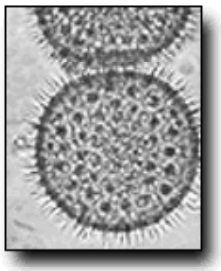


ANNUAL RECORDS OF THE PAST

"PROXY" DATA or NATURAL ARCHIVES of CLIMATE

Corals

Ice cores



Pollen

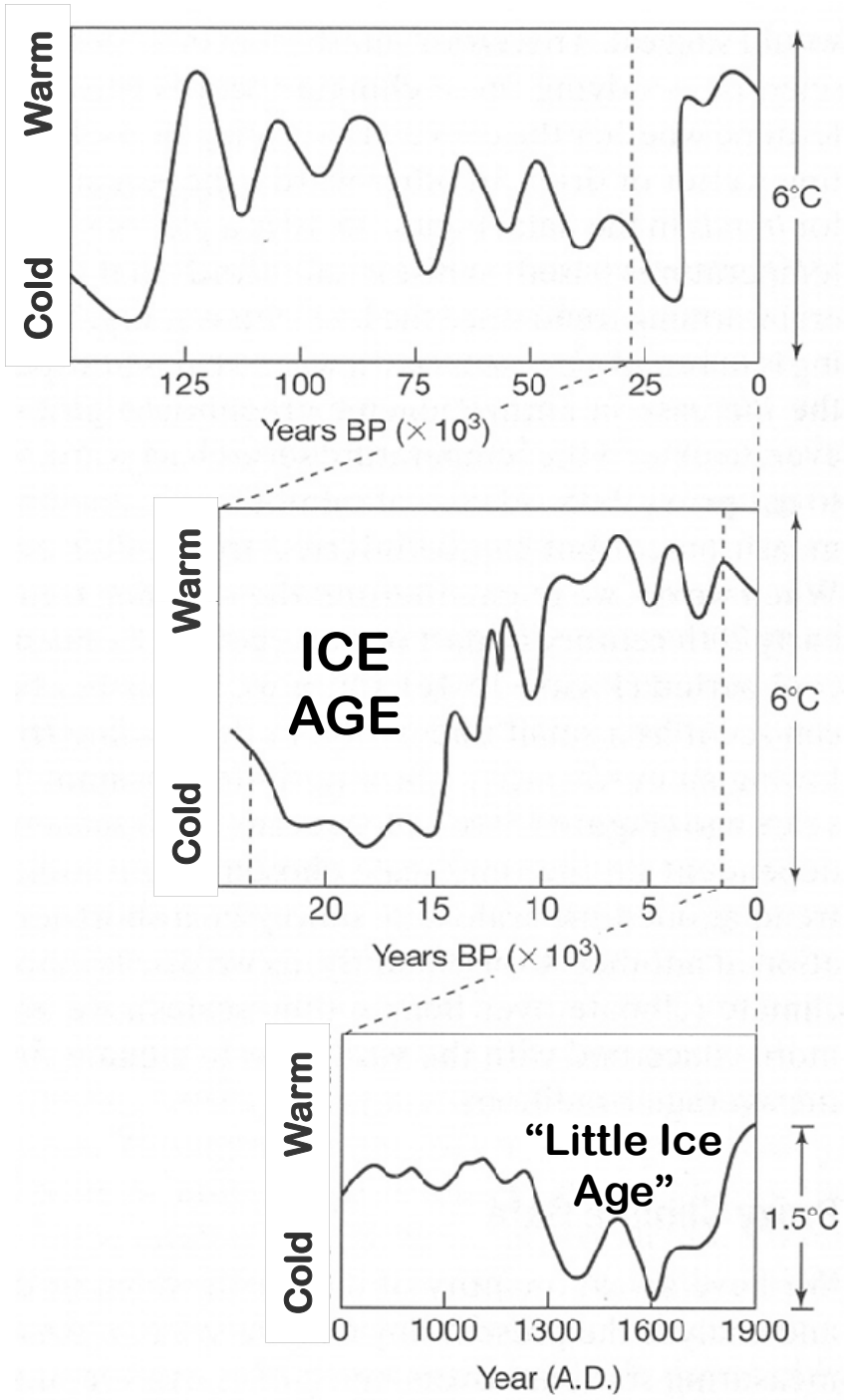
Lake, bog & ocean sediments

WHAT NATURAL ARCHIVES REVEAL:

Over different "Telescoping" Time Scales Of Variability about:

Mean Global Temperature Change

Since The Last Glacial Maximum
(Years BP = "years before present")

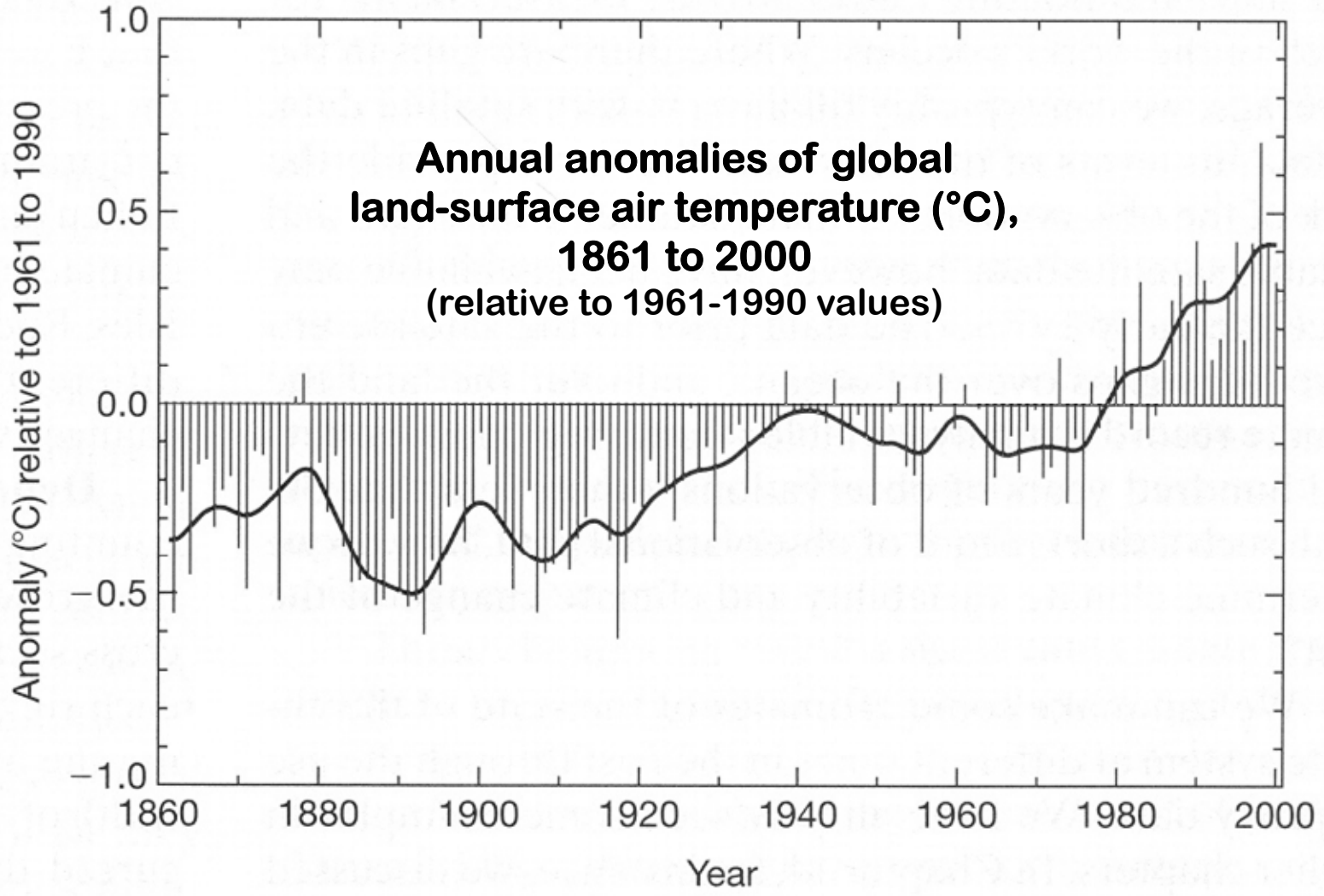


Generalized oxygen isotope curve from deep-sea sediments

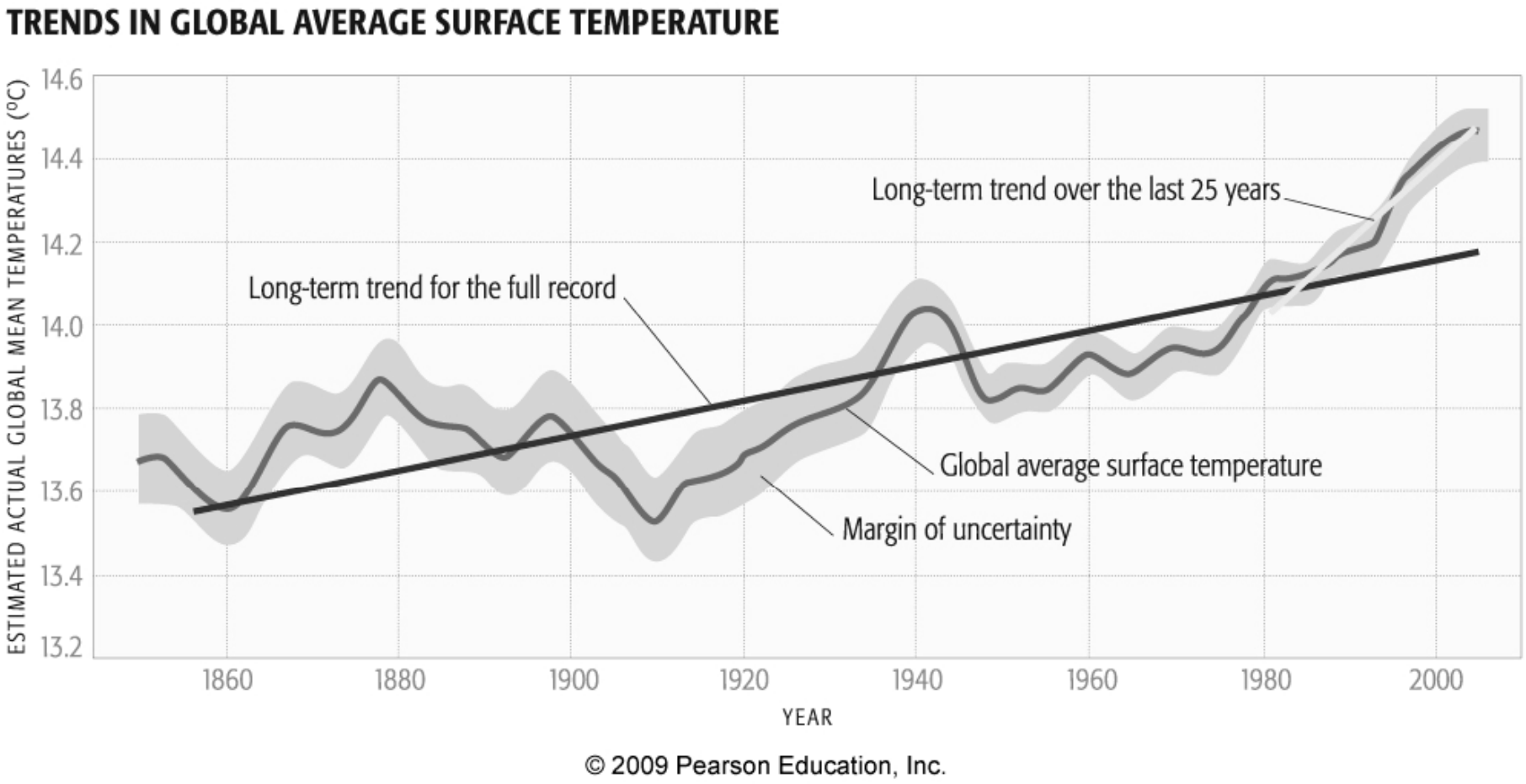
Generalized estimates from pollen data & alpine glaciers (mid-latitudes of eastern N. America & Europe)

General estimates from historical documents (emphasis on the North Atlantic region)

The most recent 150 years:



How is the Earth's GLOBAL Mean Temperature Changing?



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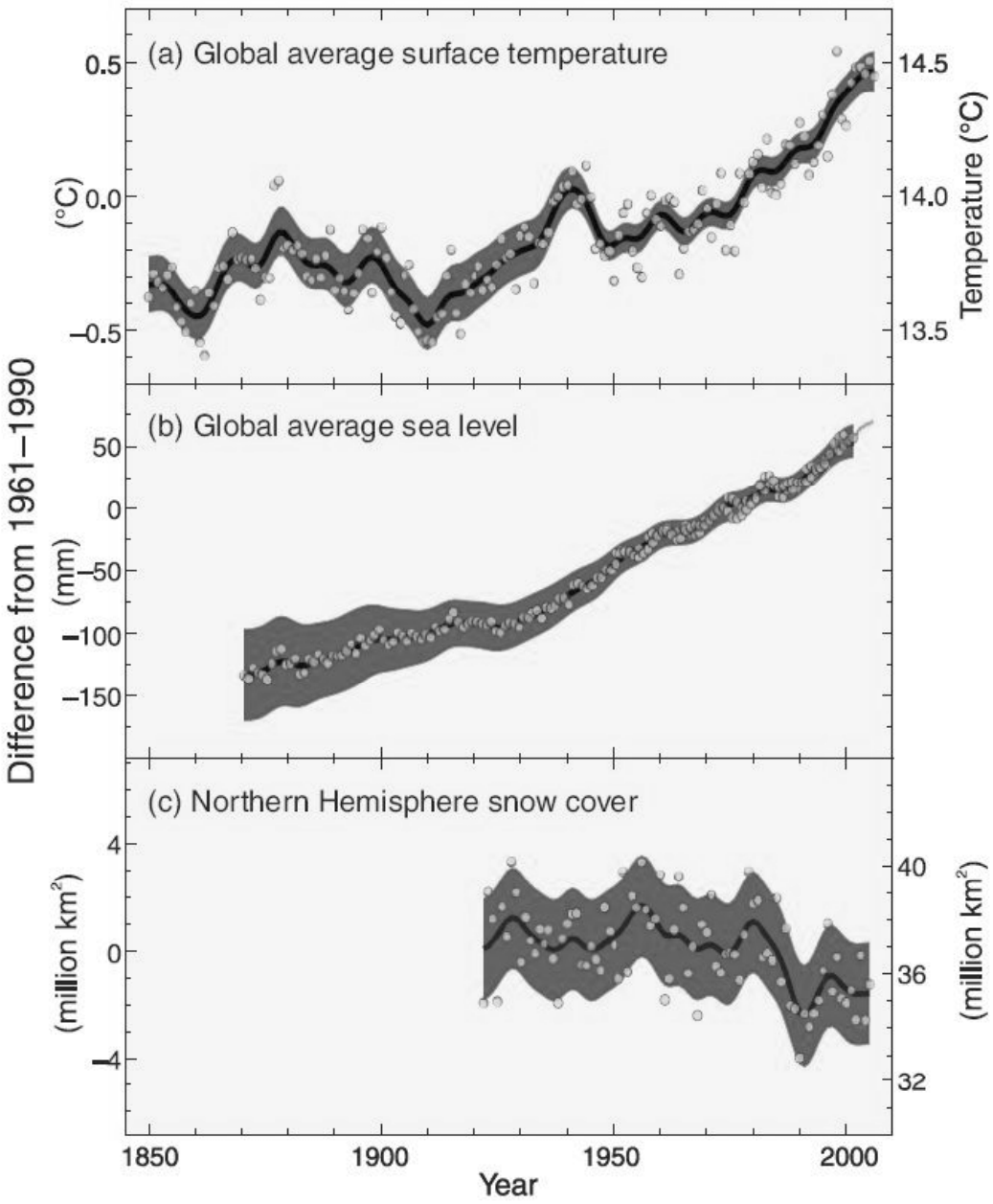
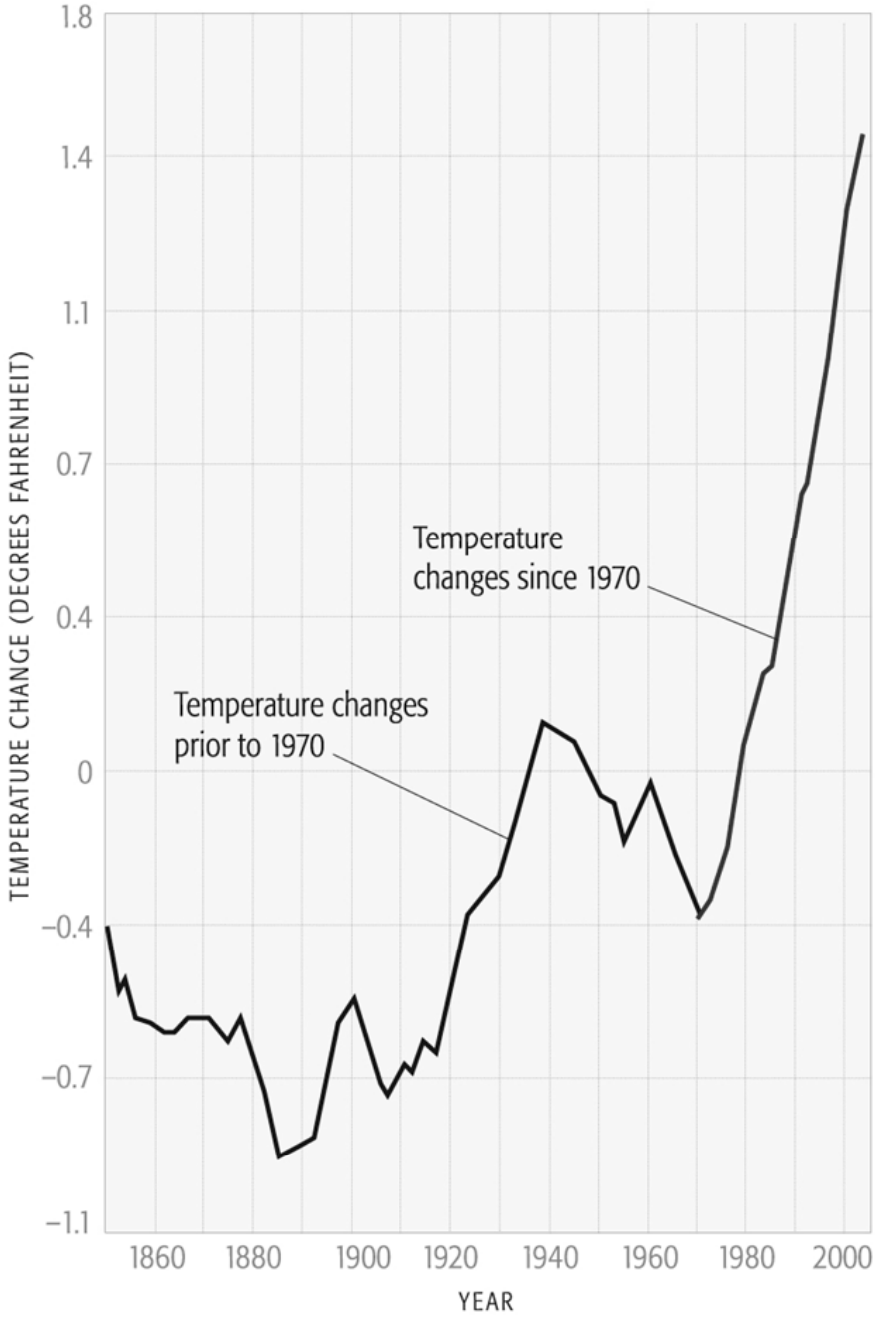
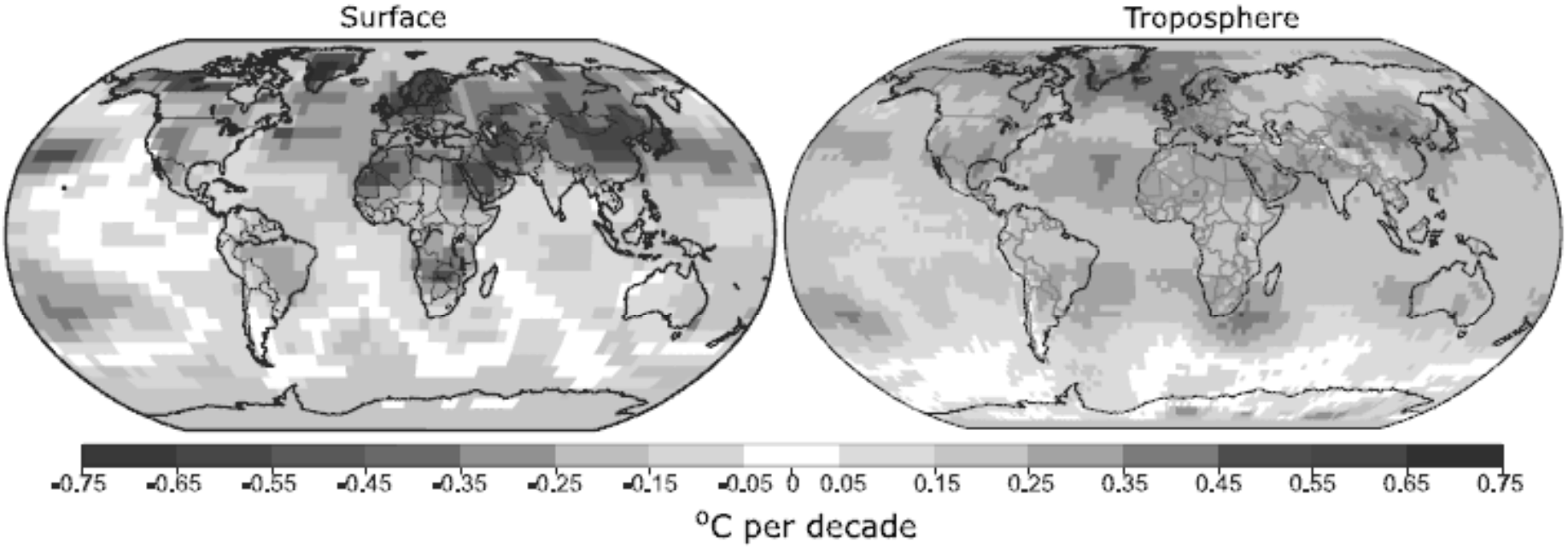
Changes in temperature, sea level and Northern Hemisphere snow cover



NORTHERN HEMISPHERE CONTINENTAL TEMPERATURE TRENDS



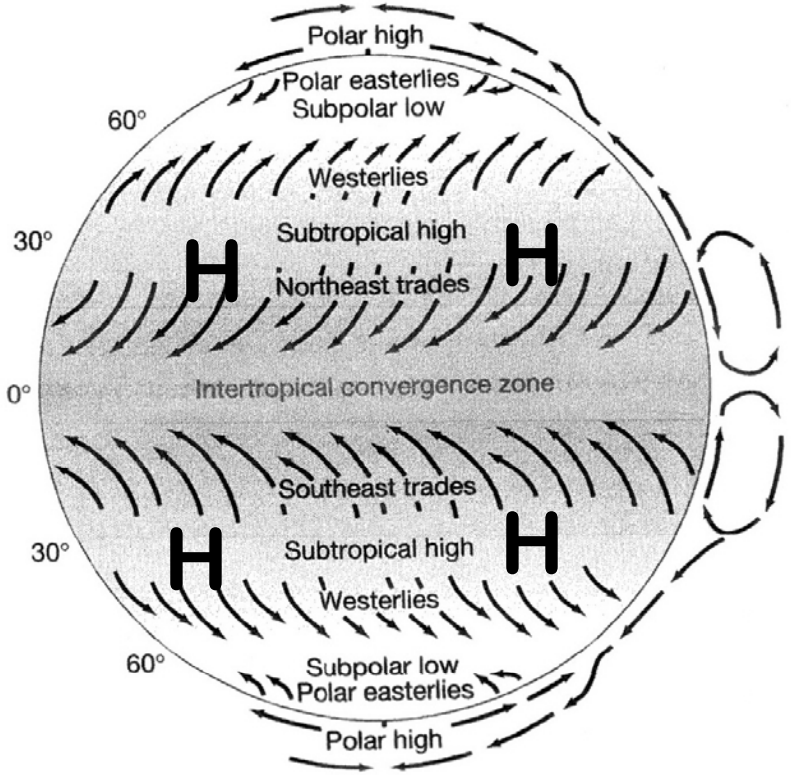


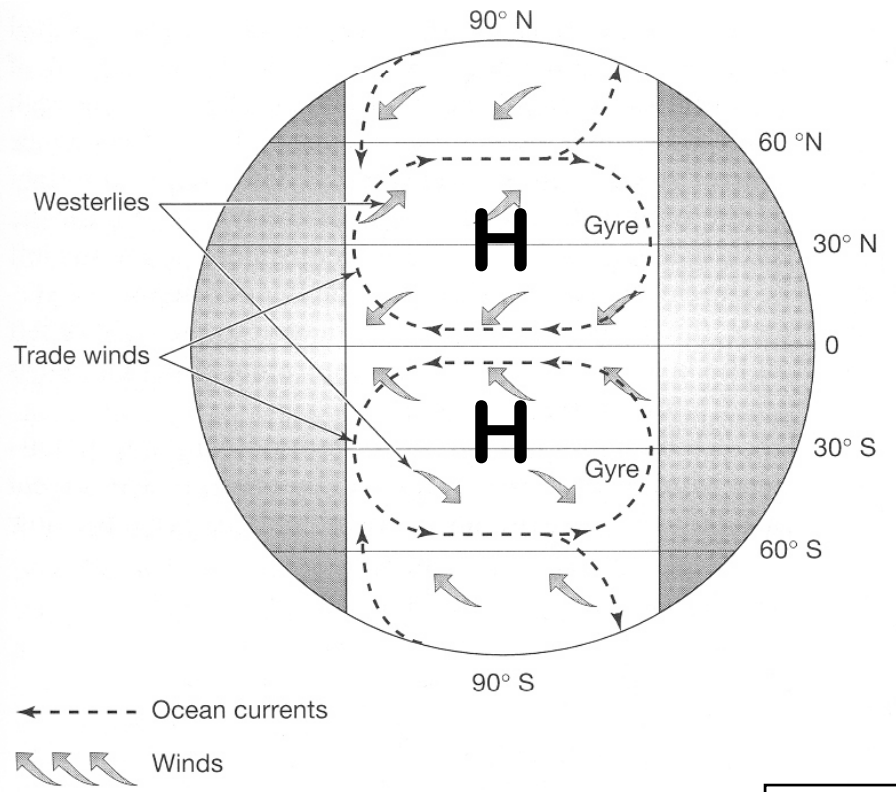
Patterns of linear global temperature trends from 1979 to 2005 estimated at the surface (left), and for the troposphere (right) from the surface to about 10 km altitude, from satellite records.

Grey areas indicate incomplete data.

Note the more spatially uniform warming in the satellite tropospheric record while the surface temperature changes more clearly relate to land and ocean.

REVIEW:
Atmosphere & Ocean Circulation





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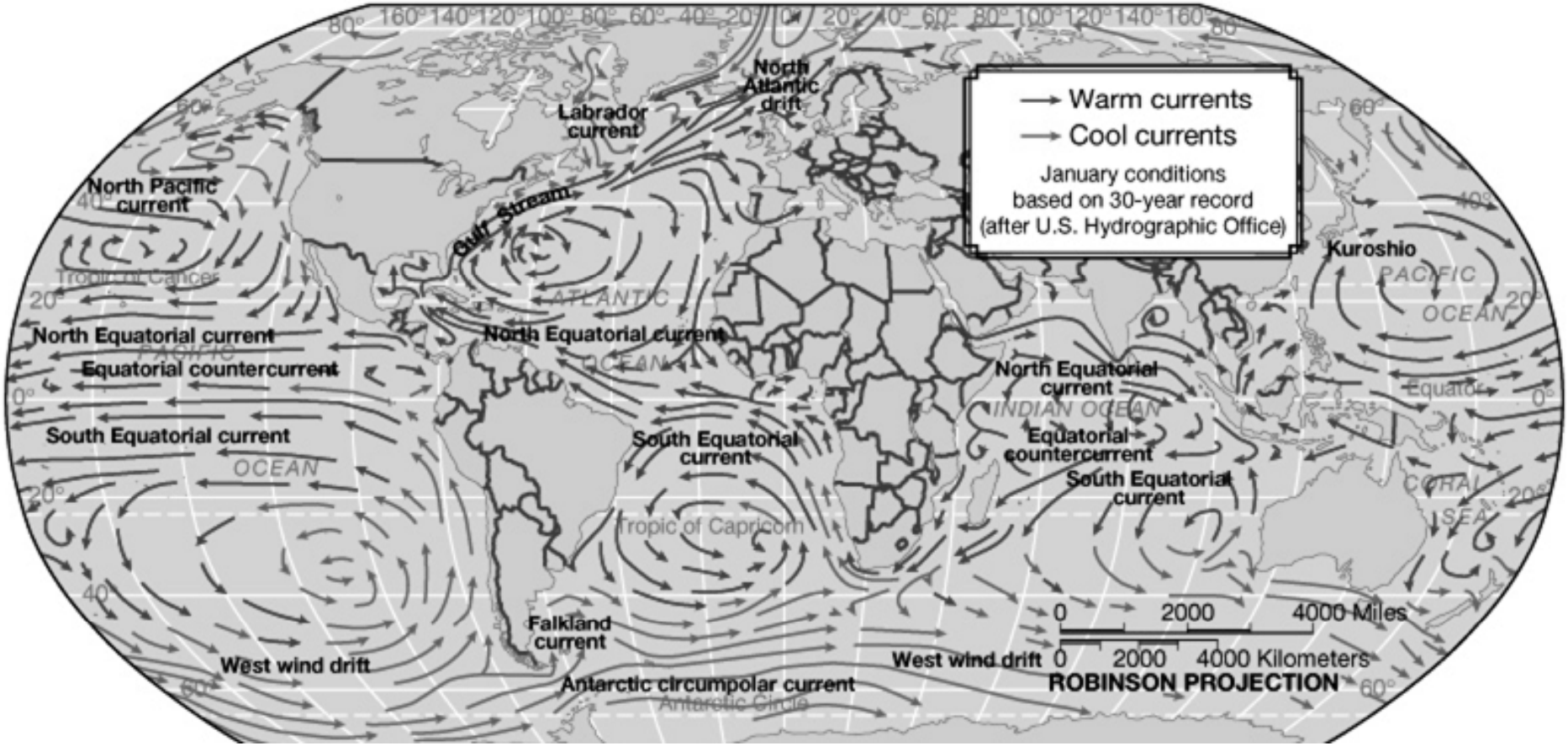
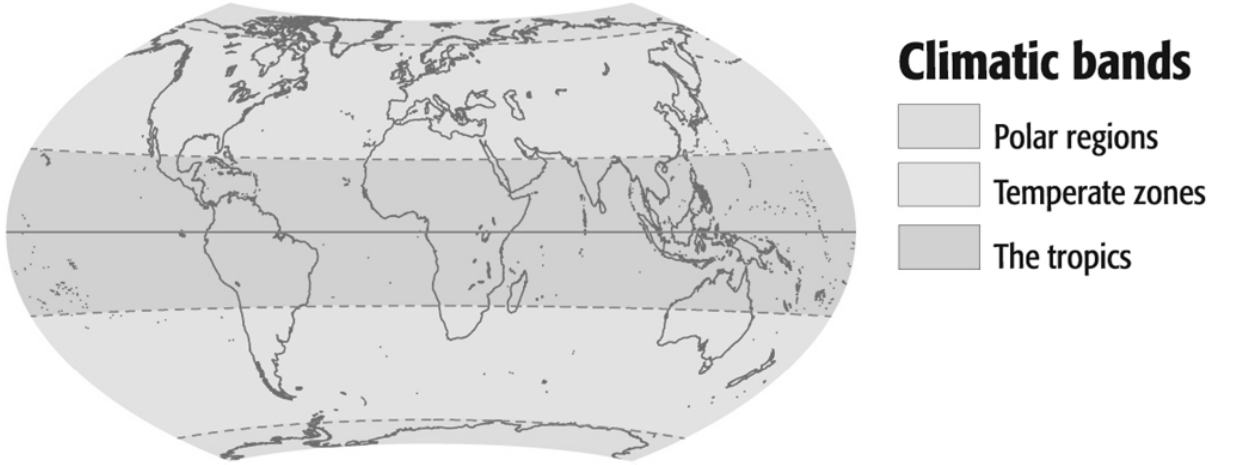
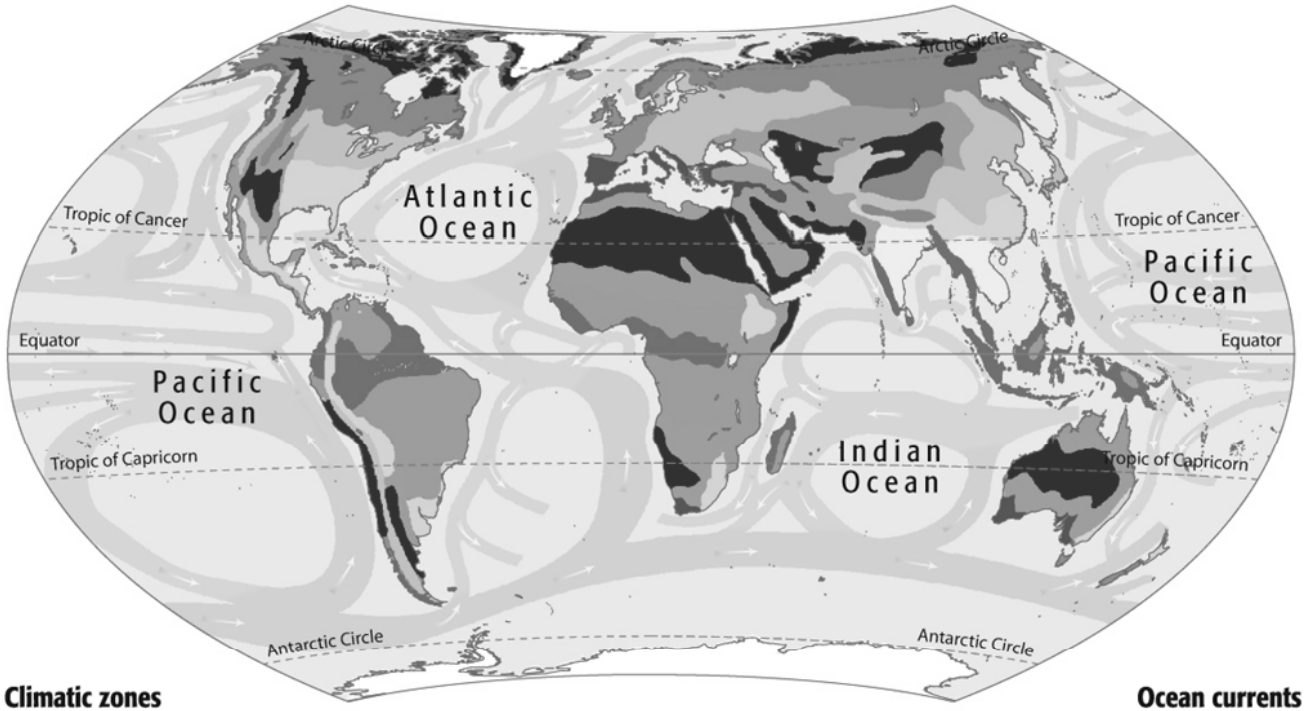
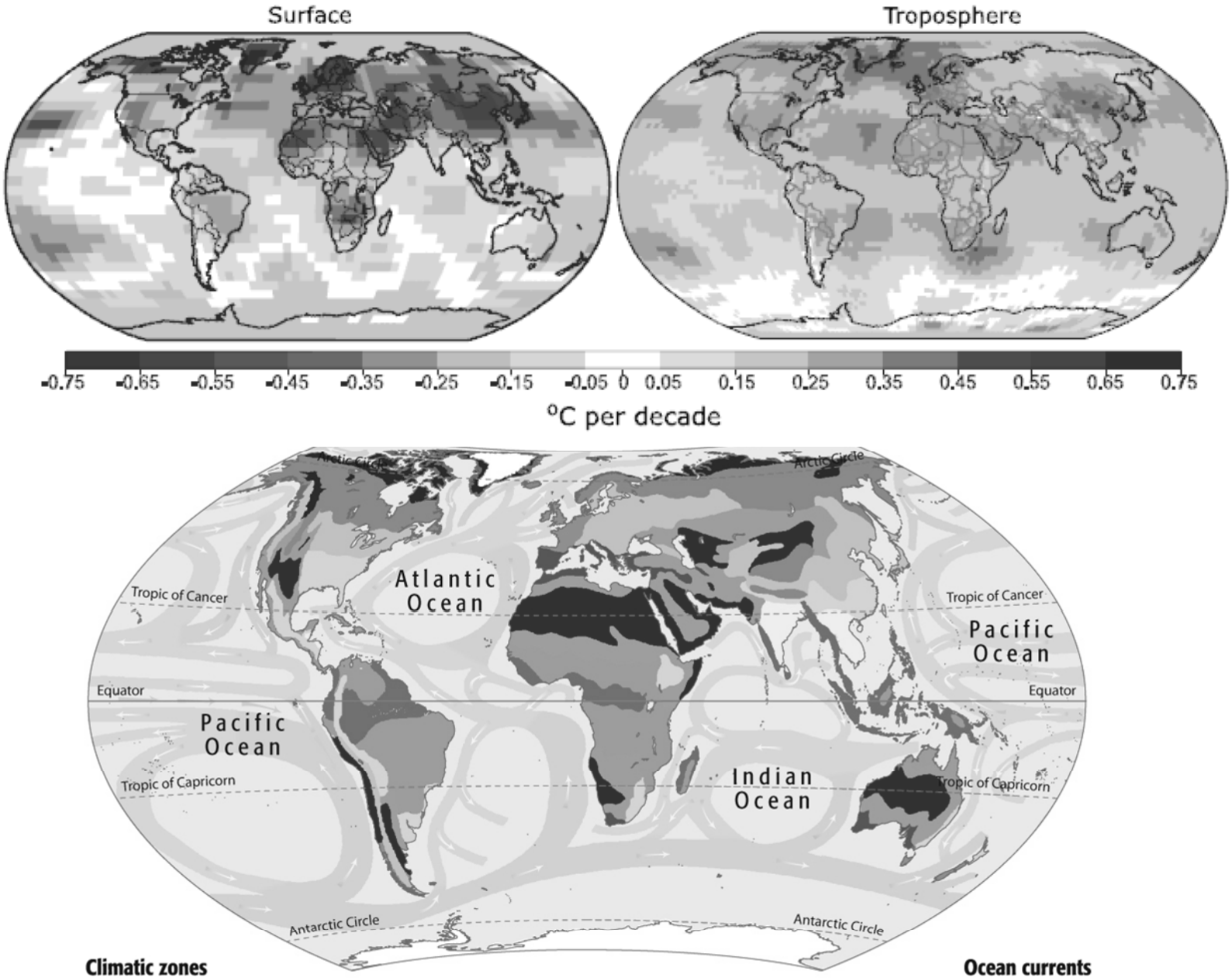

Warm currents
Cool currents
January conditions
based on 30-year record
(after U.S. Hydrographic Office)
North Atlantic drift
Labrador current
North Pacific current
Gulf Stream
Kuroshio
North Equatorial current
Equatorial countercurrent
South Equatorial current
North Equatorial current
South Equatorial current
North Equatorial current
Equatorial countercurrent
South Equatorial current
Falkland current
West wind drift
Antarctic circumpolar current
West wind drift
0 2000 4000 Miles
0 2000 4000 Kilometers
ROBINSON PROJECTION
Tropic of Cancer
Tropic of Capricorn
Equator
Antarctic Circle
PACIFIC OCEAN
ATLANTIC OCEAN
INDIAN OCEAN
CORAL SEA







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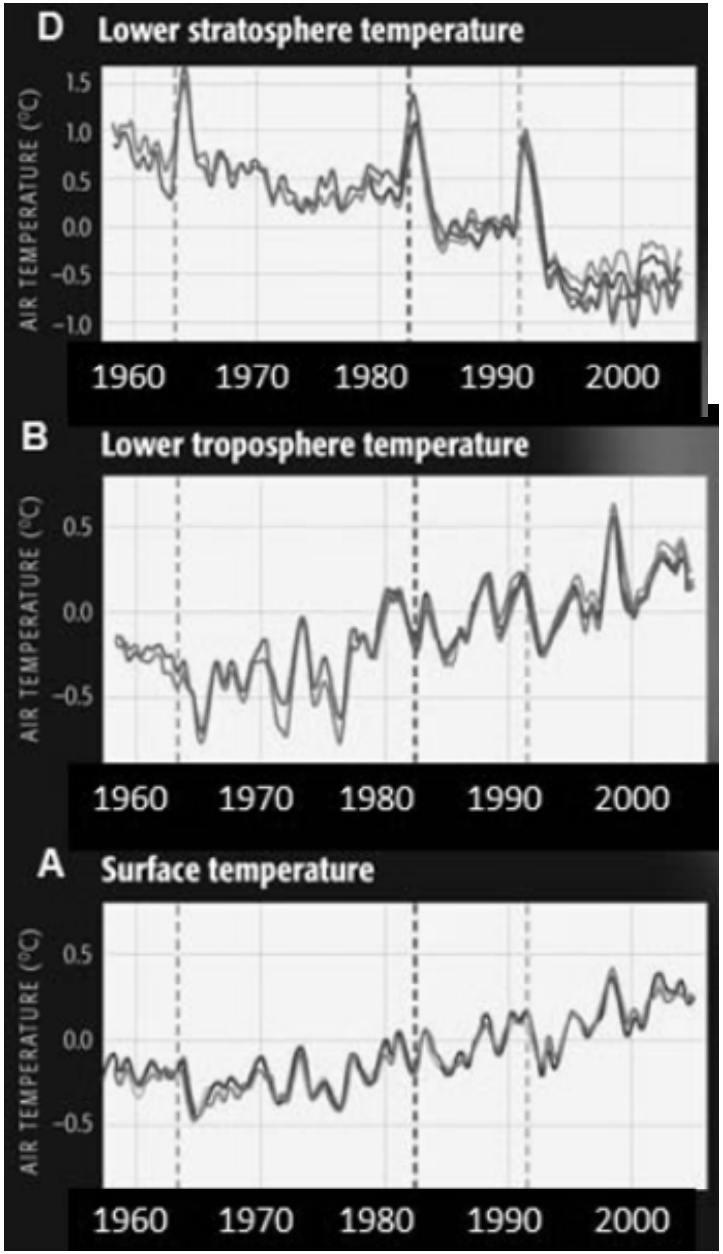
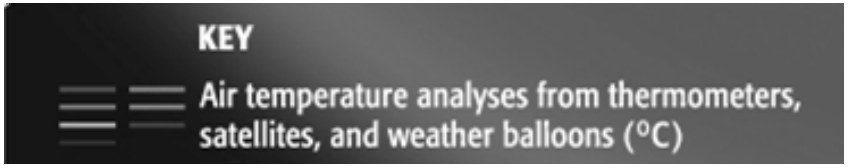


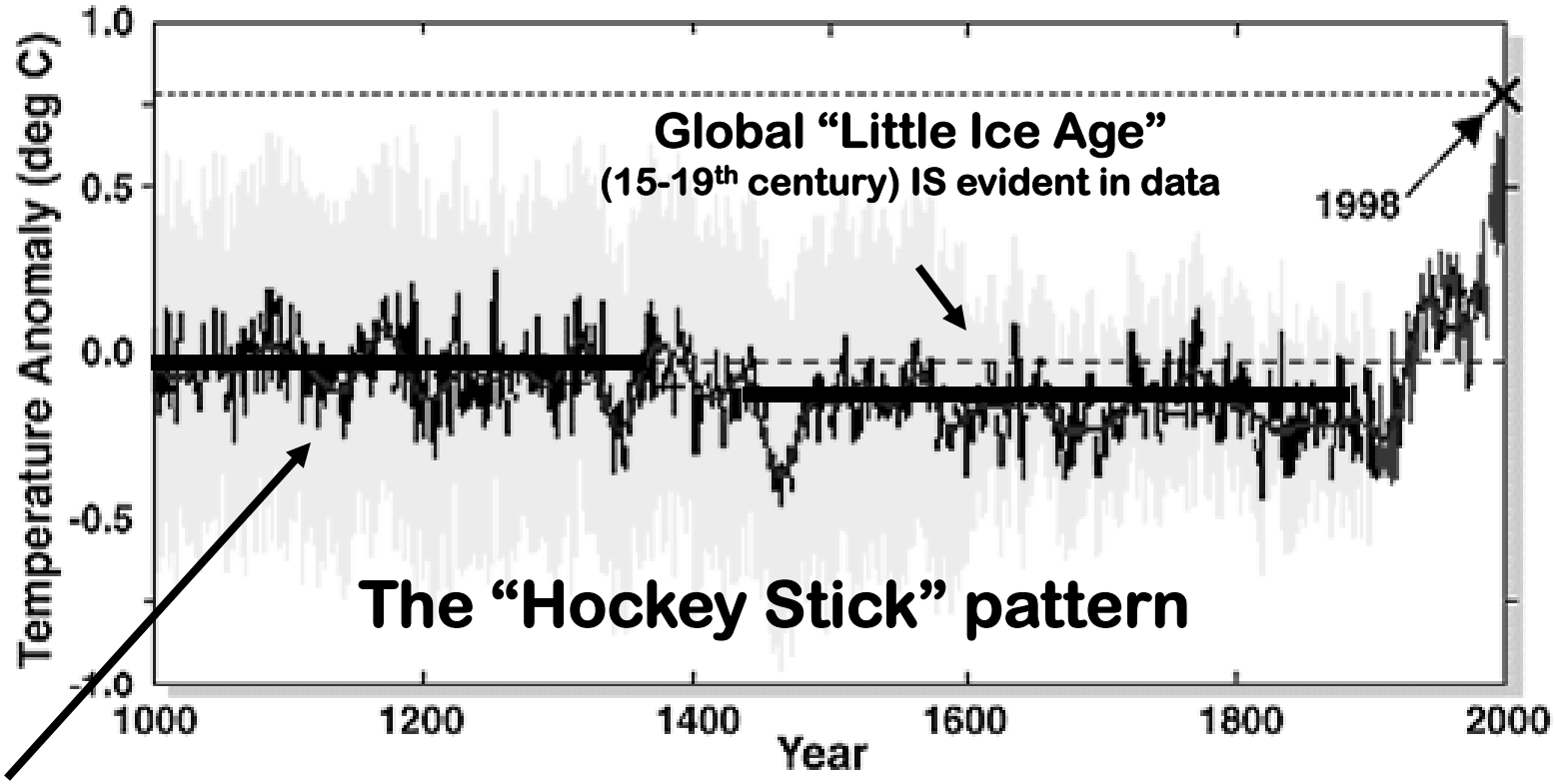
BUT! As the surface & the TROPOSPHERE warm . . . The STRATOSPHERE is COOLING!

Why?



KEY GRAPH! **Temperature change over the last 1000 years from multi-proxy records: shows there is NO period of global or hemispheric temperatures warmer than the 20th century**

1902 -80 global mean

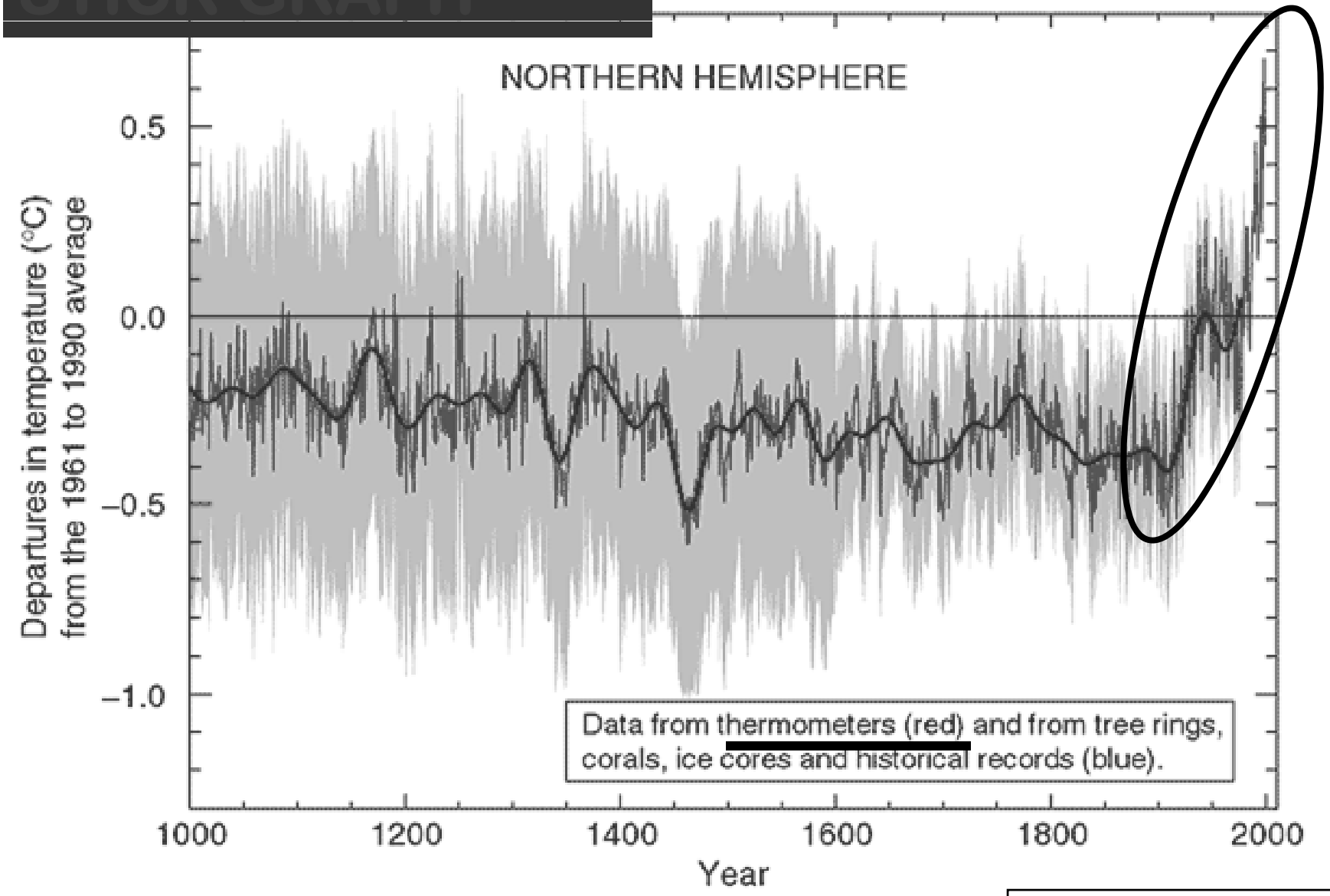


"Medieval Warm Period" (9-14th century) is a regional phenomenon only -- not globally warmer than 20th century!

reconstruction (AD 1000-1980)
instrumental data (AD 1902-1998)
calibration period (AD 1902-1980) mean
reconstruction (40 year smoothed)
linear trend (AD 1000-1850)

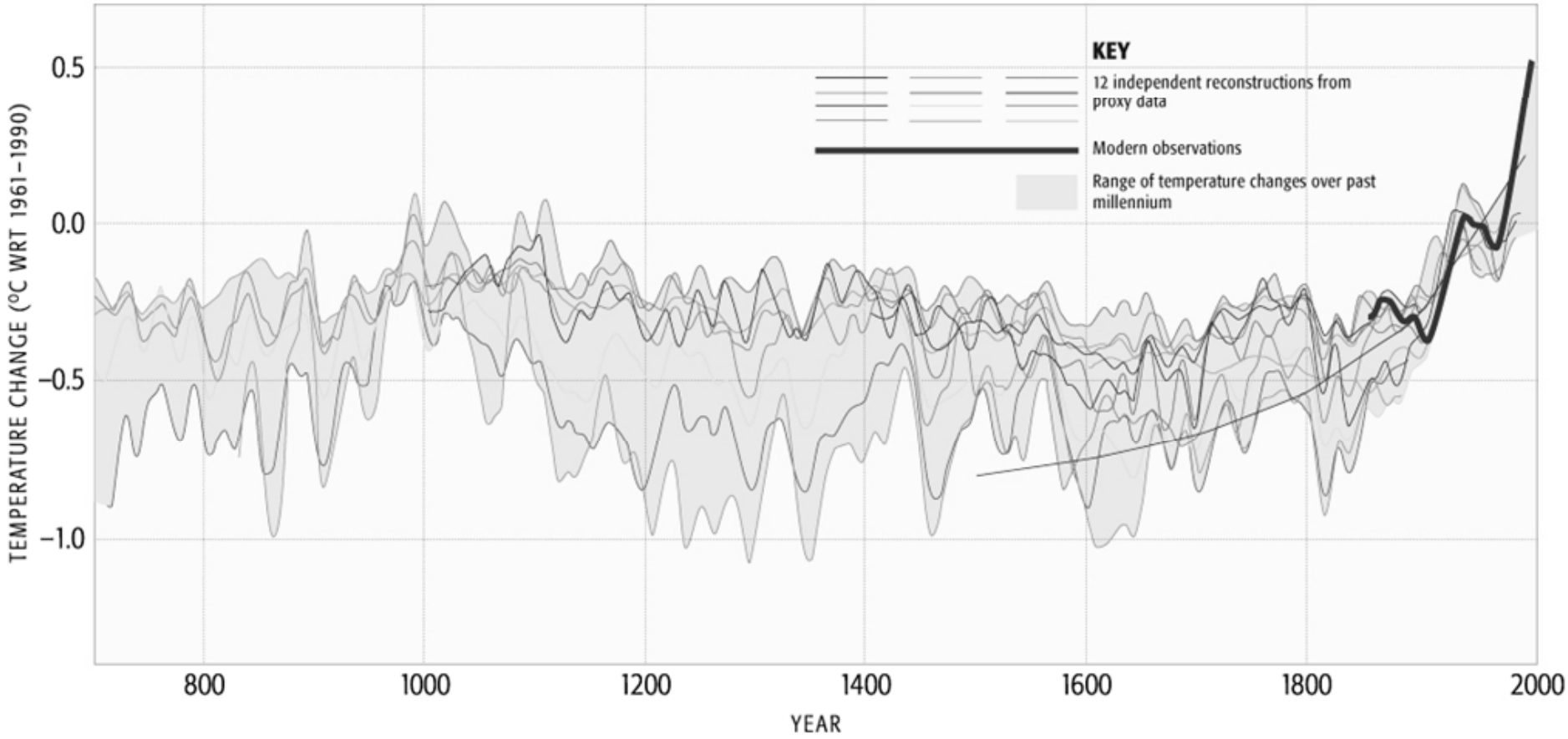
THE "HOCKEY STICK GRAPH

"proxy" data added to thermometer records



Like p 86

NORTHERN HEMISPHERE TEMPERATURE CHANGES OVER THE PAST MILLENNIUM



16 Intro to GLOBAL WARMING

PART D:
Global Warming Early Warning Signs

Flip to p 88 in Class Notes
& take additional notes

GLOBAL WARMING: Early Warning Signs

NEW POINTS!

PHOTOS!

- Home
- About the map
- Regions
  - Africa
  - Antarctica
  - Asia
  - Central America
  - Europe and Russia
  - North America
  - Oceania
  - South America
- Fingerprints
- Harbingers
- Selection Criteria
- References
- Organizations
- Get a copy of the map
- Contact us

Solutions

For Educators

US Climate Impacts

"An increasing body of observations gives a collective picture of a warming world and other changes in the climate system."

Intergovernmental Panel on Climate Change (IPCC), 2001

This map illustrates the local consequences of global warming.

FINGERPRINTS: Direct manifestations of a widespread and long-term trend toward warmer global temperatures

Heat waves and periods of unusually warm weather

Ocean warming, sea-level rise and coastal flooding

Glaciers melting

http://www.climatehotmap.org/

"Global Warming Fingerprints"

Events that are direct manifestations of a widespread and long-term trend toward warmer global temperatures as projected by models of a changing climate.

The following events are identified as global warming fingerprints:

Heat waves and periods of unusually warm weather

Ocean warming, sea-level rise and coastal flooding

Glaciers melting

Arctic and Antarctic warming


Grinnell Gl, Glacier Nat. Park, 1911. Nat. Park Service


Grinnell Gl, Glacier Nat. Park © 2000 Braasch • worldviewofglobalwarming.org


Marr Glacier, Anarctica. © 2000 Gary Braasch. www.worldviewofglobalwarming.org


Alaska • © 2002 Gary Braasch • www.worldviewofglobalwarming.org

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“Harbingers” of climate change

Events that foreshadow the types of impacts likely to become more frequent and widespread with continued warming.

Spreading disease

Earlier spring arrival

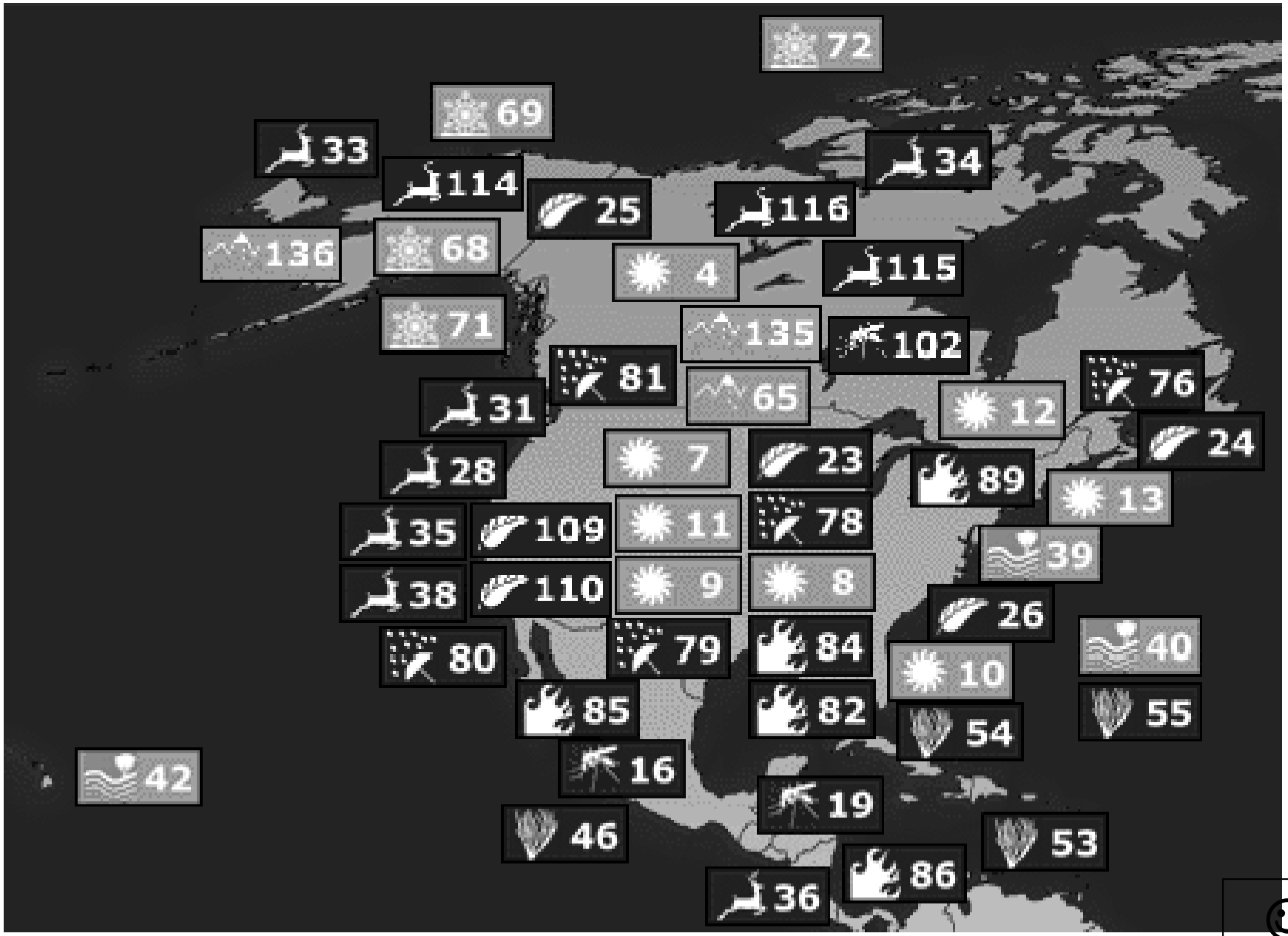
Plant & animal range shifts & population changes

Coral reef bleaching

Downpours, heavy snowfalls, and flooding

Droughts and fires

NORTH AMERICA: Early Warming Signs




Quercus robur.
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Edith's Checkerspot.
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Alaska • © 2000 Gary Braasch • www.worldviewofglobalwarming.org


Marmot
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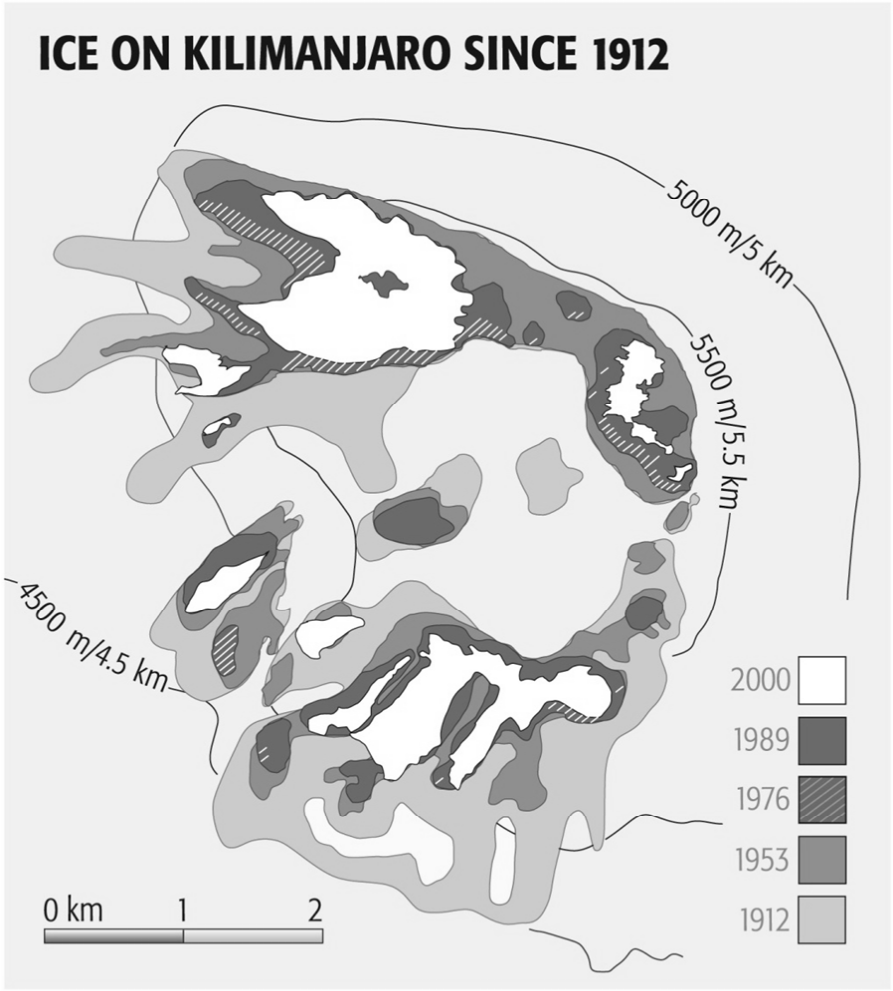
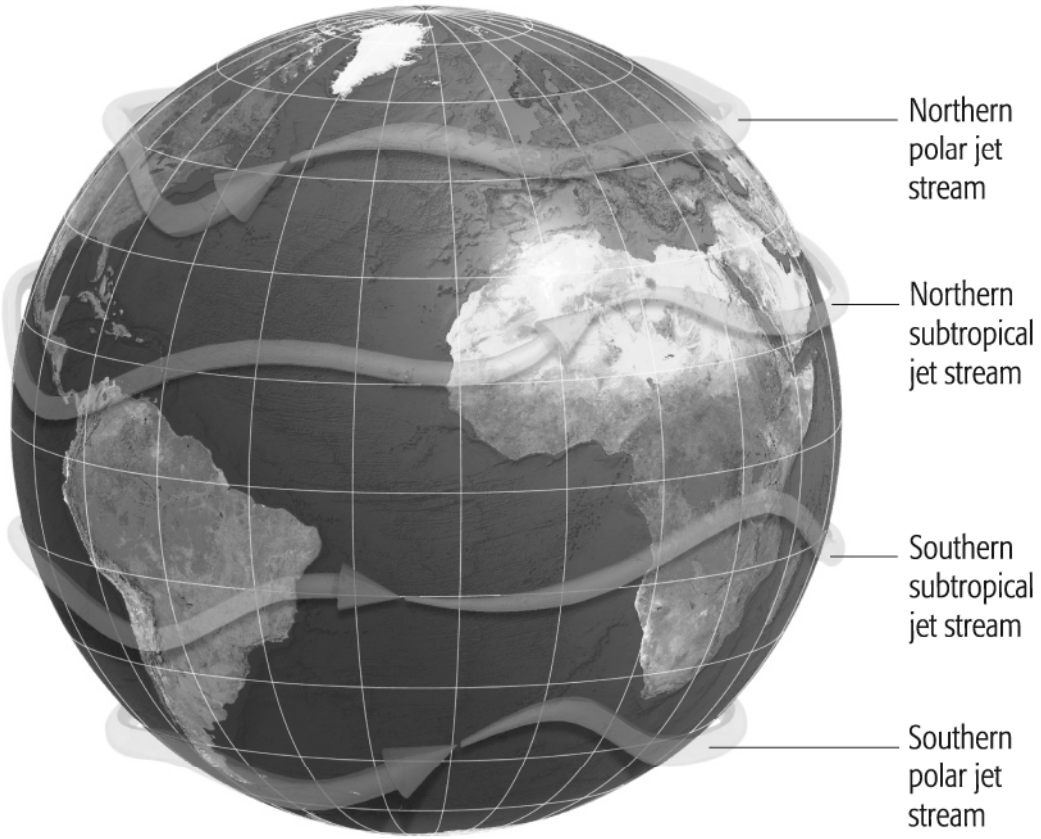
From *Dire Predictions:*



ICE & SNOW COVER LOSS!

From *Dire Predictions:*

SUBTROPICAL ZONE EXPANSION



SUBTROPICAL DRY-AREA EXPANSION!

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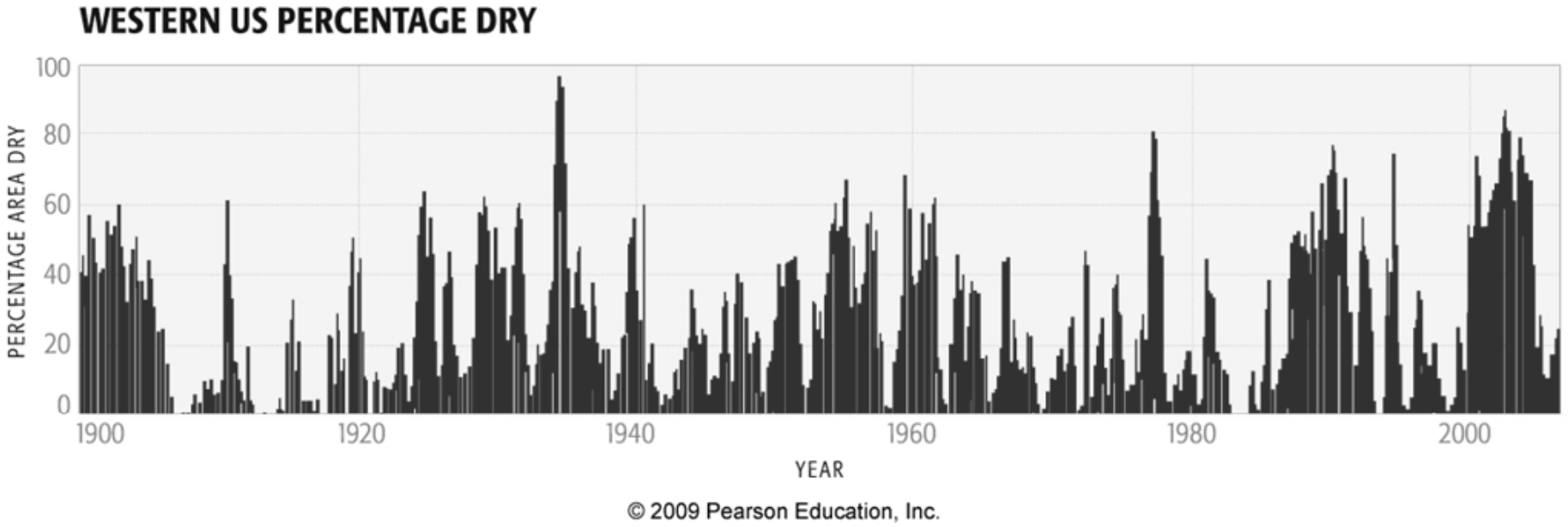
From ***Dire Predictions:***

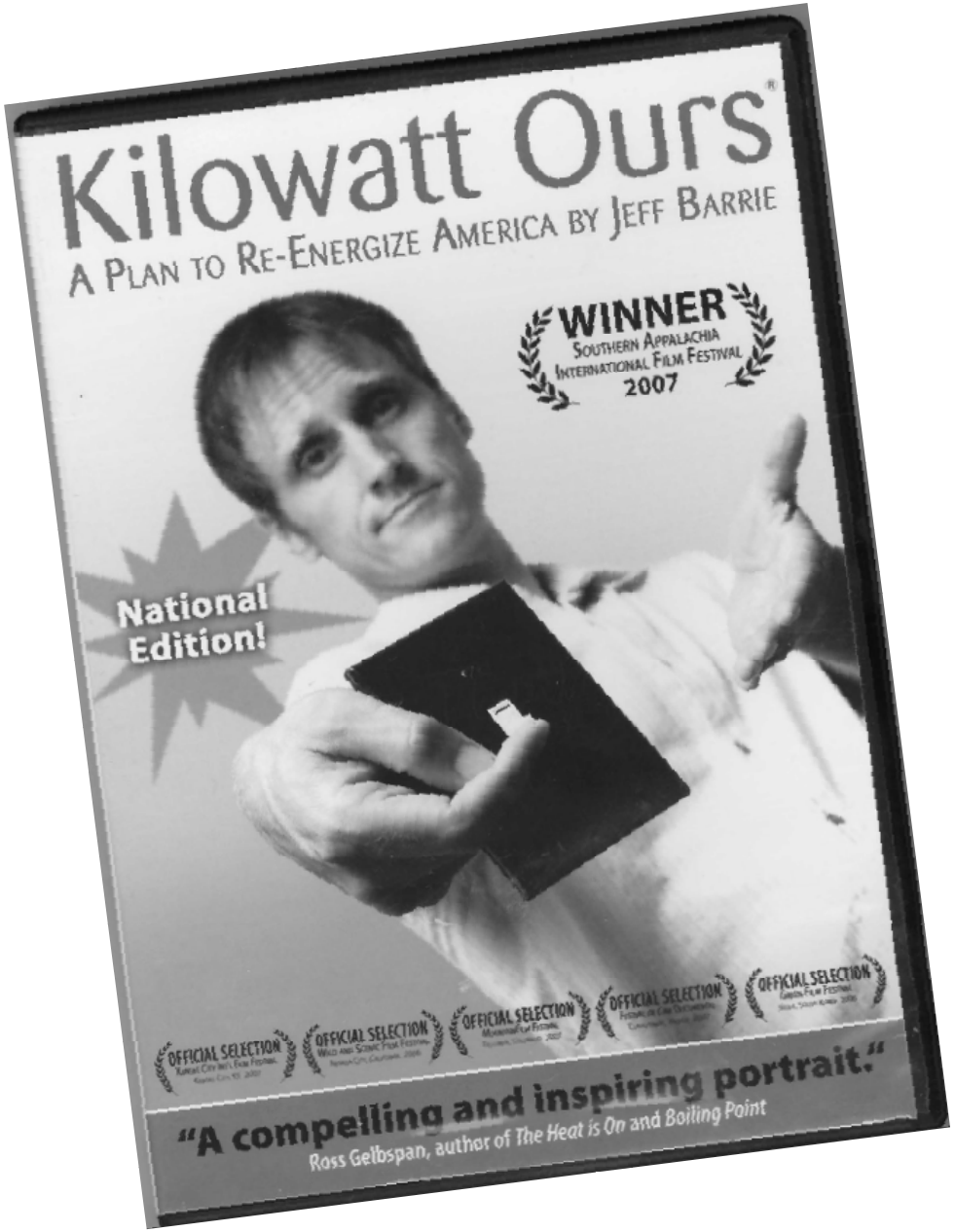


DROUGHT!

http://www.earthweek.com/

G-6 DIRE PREDICTIONS PLANNING

- **Double check your assignment**
- **Select a date**
- **Your group has 5 minutes to present the topic in an interesting way to your classmates!**



MOVIE TIME!!

http://www.kilowattours.org/