Introducing a Free DVD about Climate Change

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Byrd Polar Research Center @ Ohio State

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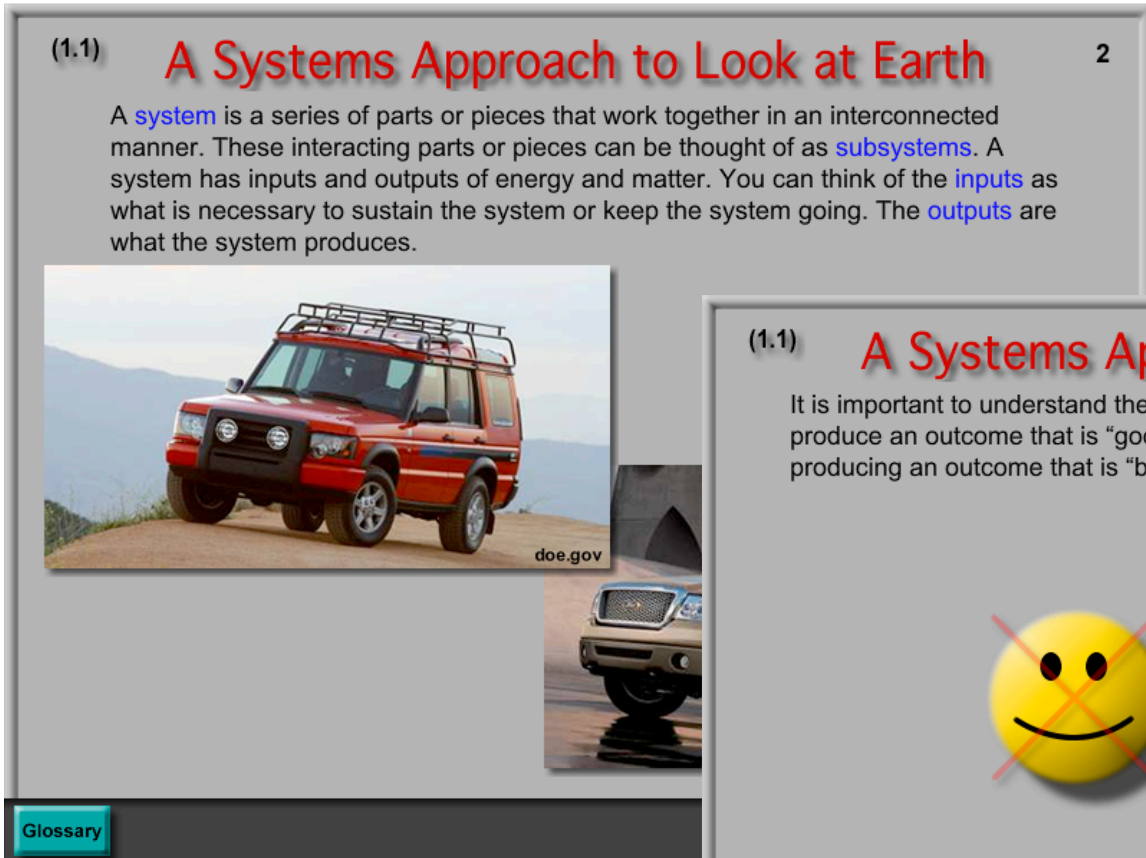
Understanding Global Climate Change

- (1) Looking at Earth as a System
- (2) Earth's Grand Cycles
- (3) Energy in the Earth System
- (4) Historical Perspective
- (5) Remote Sensing
- (6) Glacial Evidence
- (7) Meteorological Evidence
- (8) Ice Core Evidence
- (9) Oceanographic Evidence
- (10) Biological Evidence

Written and Created by
Mark Maley
Ron Pilatowski

Foreword | Selected References | Glossary | Quit

Chapter 1: Looking at Earth as a System



Chapter 1, Continued

(1.1)

A Systems Approach to Look at Earth

13

As our understanding of systems improves, it is possible to break systems down into subsystems. Each of these subsystems becomes a system in and of itself, with its own unique and identifiable inputs and outputs of energy and materials and their own feedback mechanisms. So, it is no surprise that we can recognize distinct subsystems of Earth: the atmosphere, hydrosphere, cryosphere, lithosphere, and biosphere. Earth is also part of a bigger system, the exosphere. In this sense, Earth functions as a subsystem of the exosphere. These subsystems are so complex that their study is often undertaken by a branch of science, with scientists who specialize in them. These scientific specialties will be addressed in the next section as we discuss Earth's subsystems in more detail.

Glossary

(1.3)

Systems Interactions

1

Each of Earth's subsystems does not exist alone. As part of the larger system, they are interconnected. So a change in one system can trigger changes in others. As you can see, these changes can affect other subsystems, resulting in changes that affect others, and so on.

Glossary

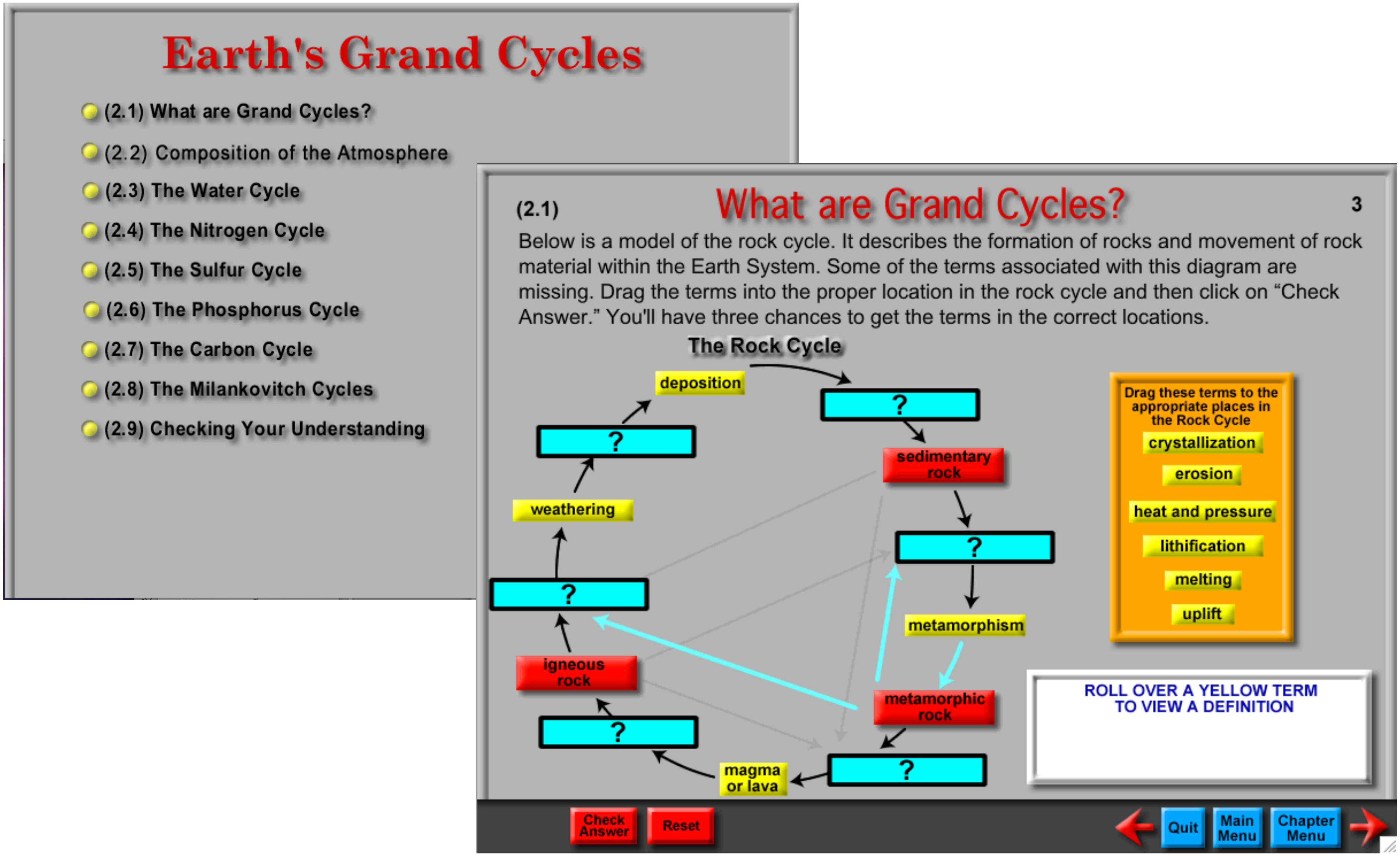
Quit | Main Menu | Chapter Menu

Systems Interactions

Earth's systems interact with each other continuously. An event in one system can ***cause*** an ***effect*** felt in another system. Read the statement between the two red boxes. Drag the appropriate systems into the "Cause" and "Effect" boxes. Click on "Check Answer" to see if you have set up the correct system interaction.

CAUSE		EFFECT
Drag **CAUSE** sphere here.	Cows produce methane.	Drag **EFFECT** sphere here.

Chapter 2: Earth's Grand Cycles

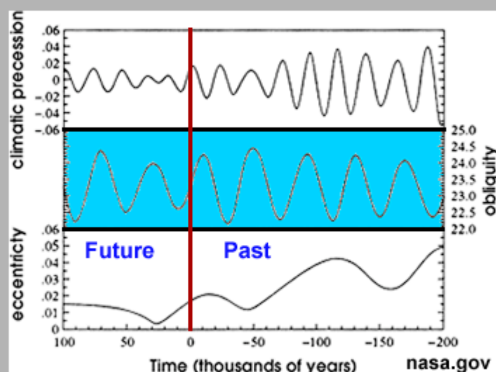


Chapter 2, Continued

(2.8) **The Milankovitch Cycles** 7

Look at the graph below. Actually, it includes three graphs: a graph of precession, obliquity, and eccentricity. Notice the time scale for the graphs. The vertical red line represents present time. To the right of the red line is the past, and to the left of the line is the future. The duration of each of the cycles can be seen in the graphs.

Precession's period is about 26,000 years.
Obliquity's period is about 40,000 years.
Eccentricity's period is about 100,000 years.



Graphic from: http://earthobservatory.nasa.gov/Features/Milankovitch/milankov

Glossary

(2.9) **Checking Your Understanding** 1 /20

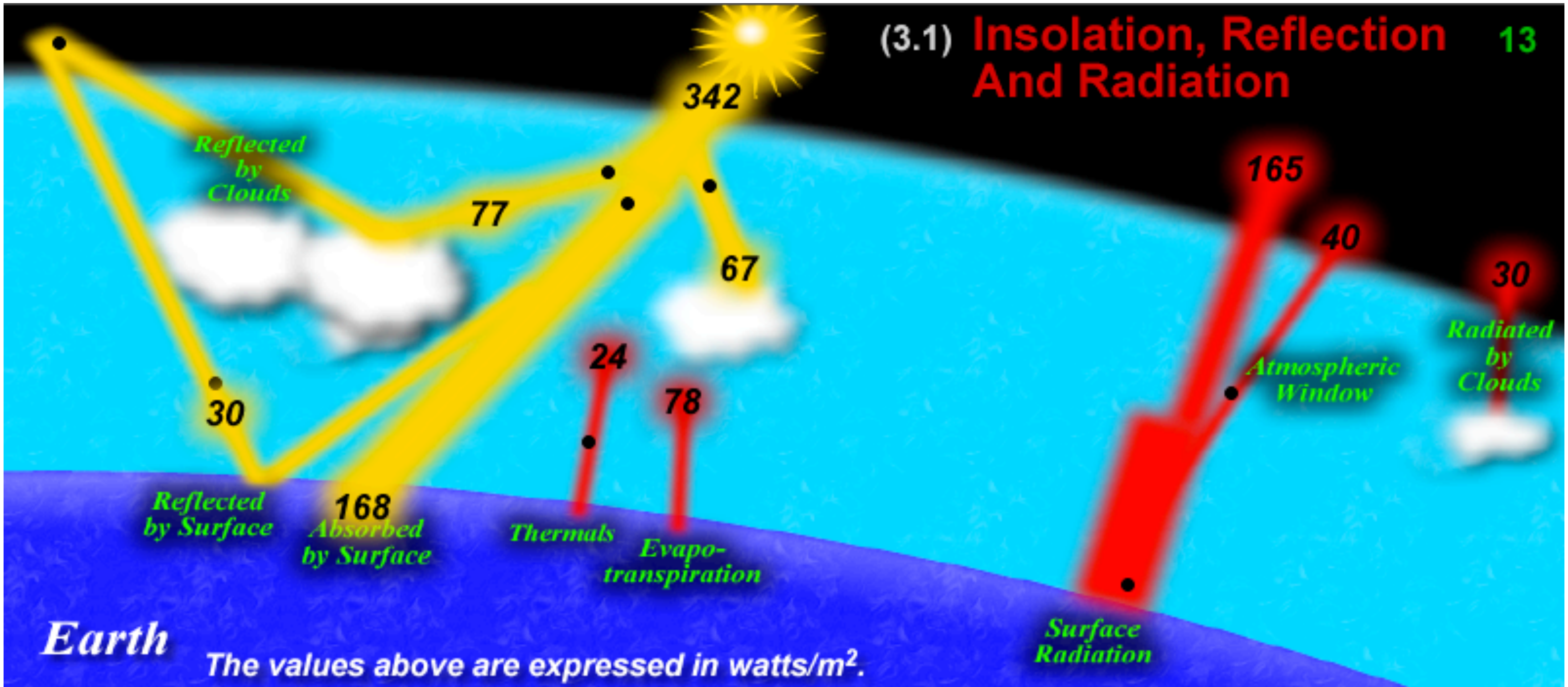
(You get ONE chance to answer this question correctly!)

Check all answers that may apply.

The most abundant gas in the atmosphere is ____.

- [ ] A. argon
- [ ] B. carbon dioxide
- [ ] C. nitrogen
- [ ] D. oxygen

Chapter 3: Energy in the Earth System



Summary

-Earth absorbs energy from the Sun in the form of shortwave radiation.

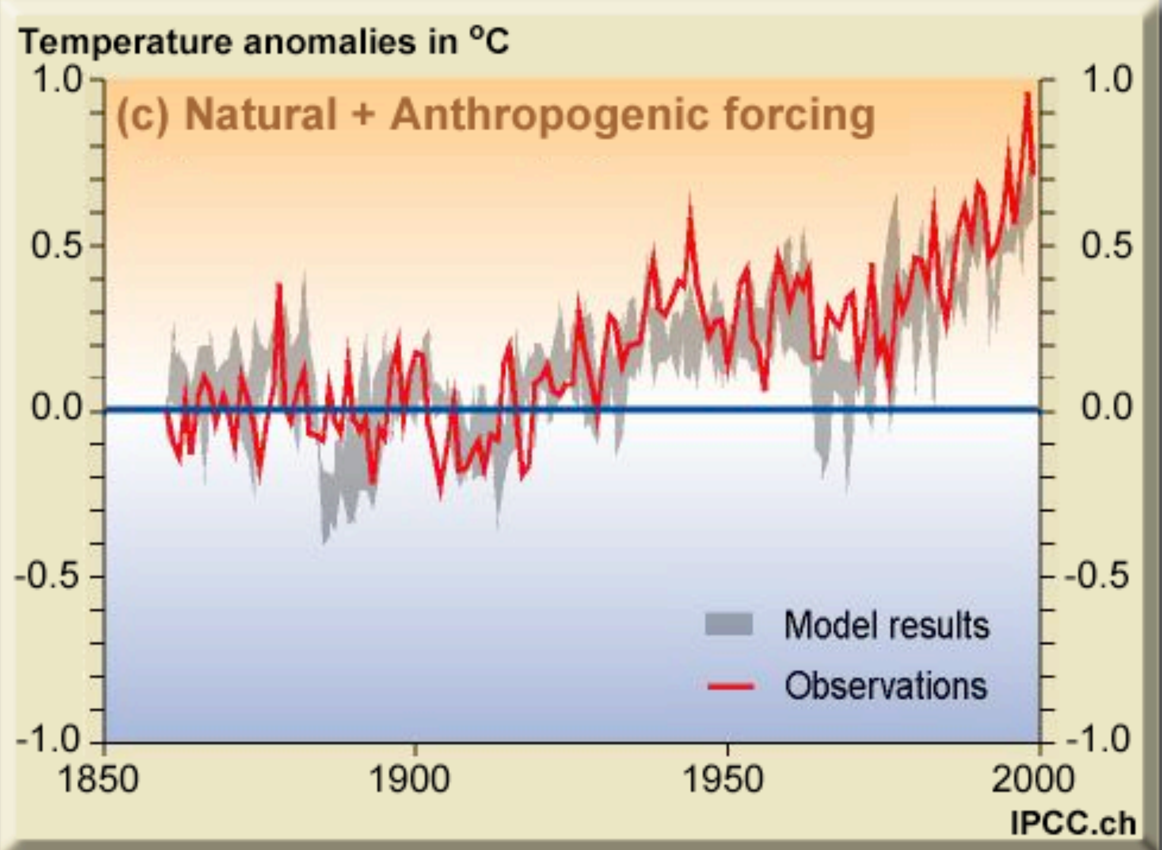
-Clouds can absorb, reflect, and radiate energy.

-Some of this energy remains within the Earth system, and some of it is radiated.

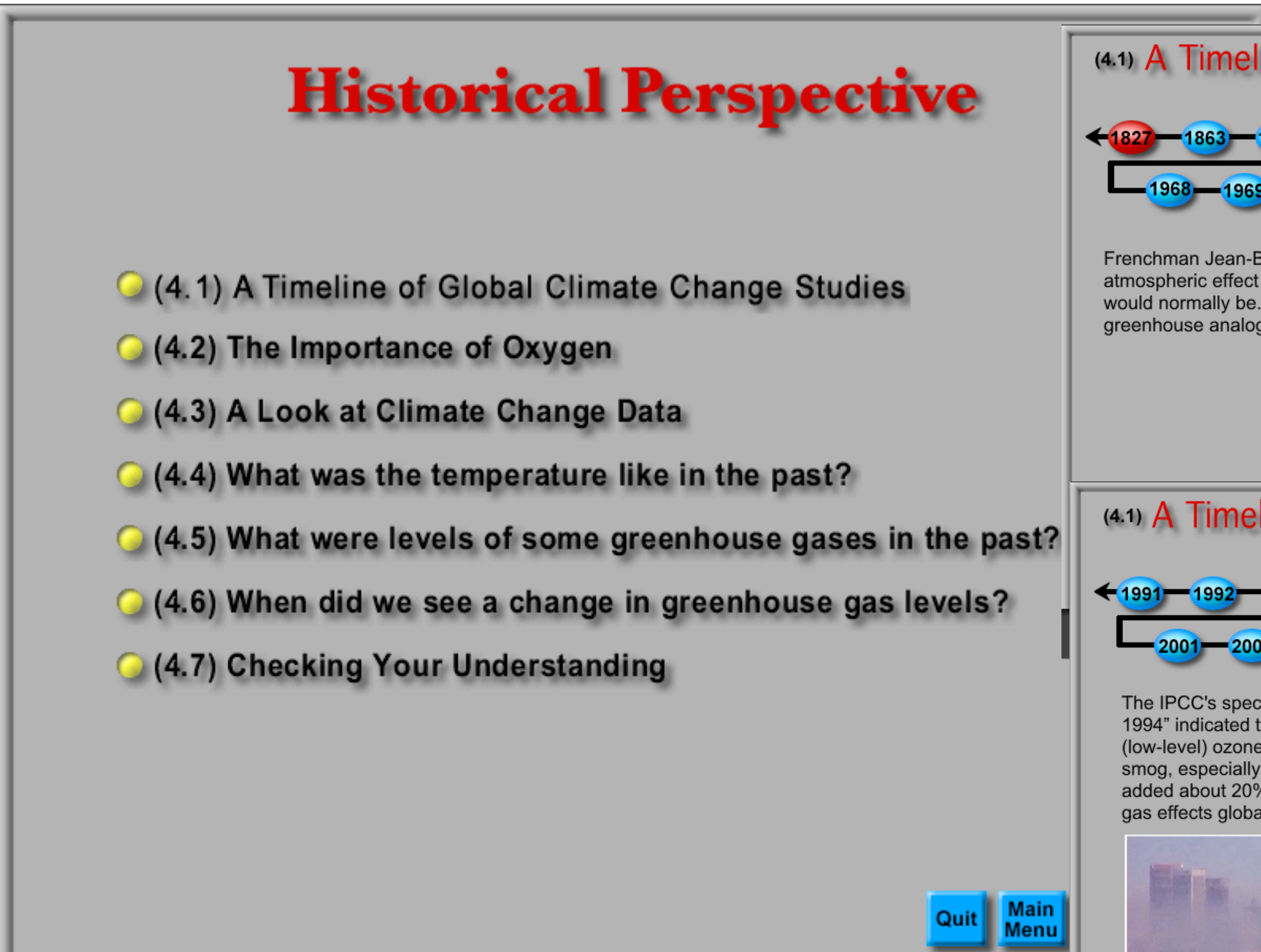
-The radiated energy is in the form of longwave radiation, which is heat energy.

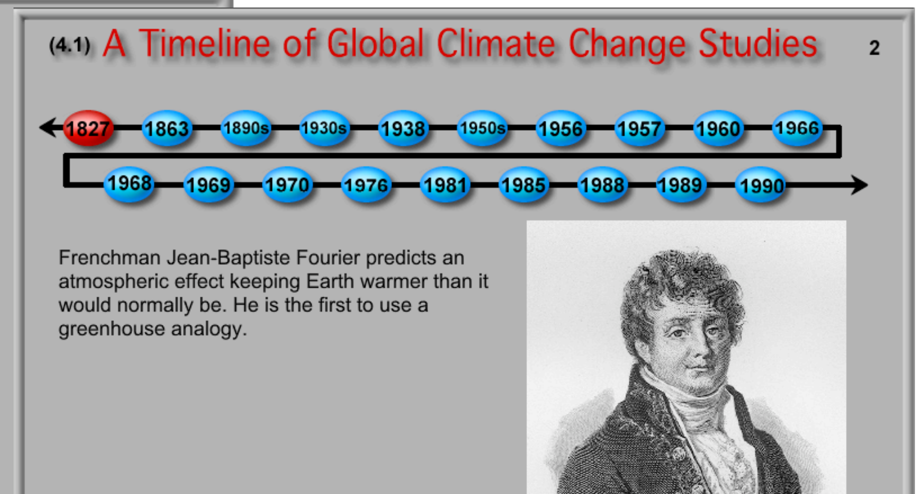
Solar Variability

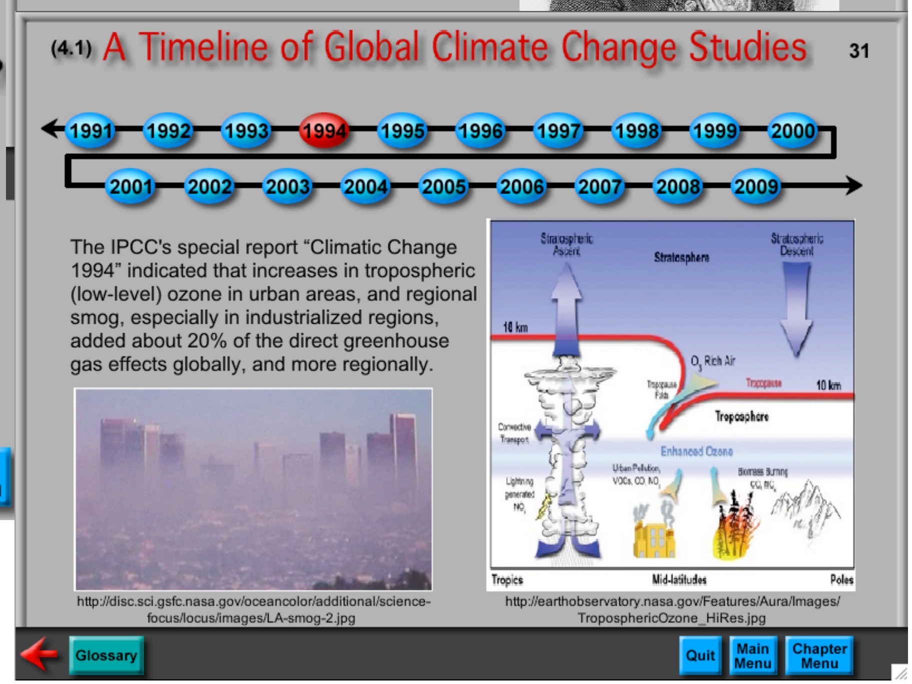
Another way of looking at climate change is to consider the impact of natural forcings compared to human (anthropogenic) forcings. Click on the three forcing buttons below to view three different graphs. Make note of what the gray and red lines signify. Natural forcings are factors that are found in nature that cause a change in the climate. These include solar variability and volcanoes. Anthropogenic forcings are the result of human activities.



Chapter 4: Historical Perspective

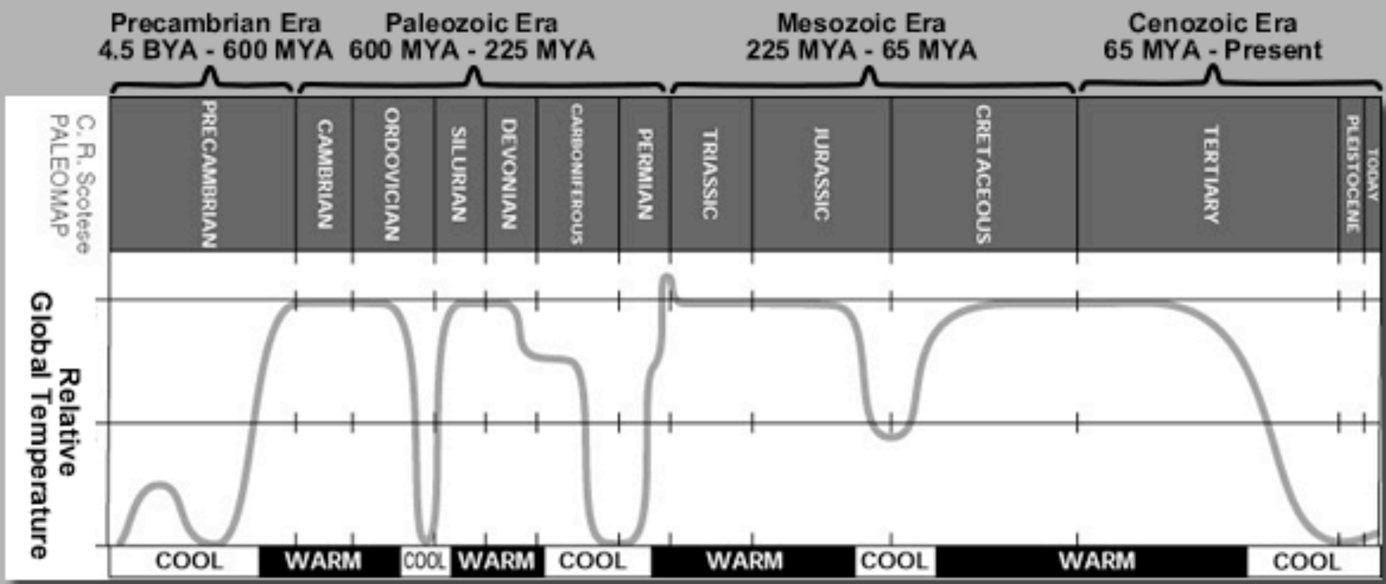






What was the temperature like in the past?

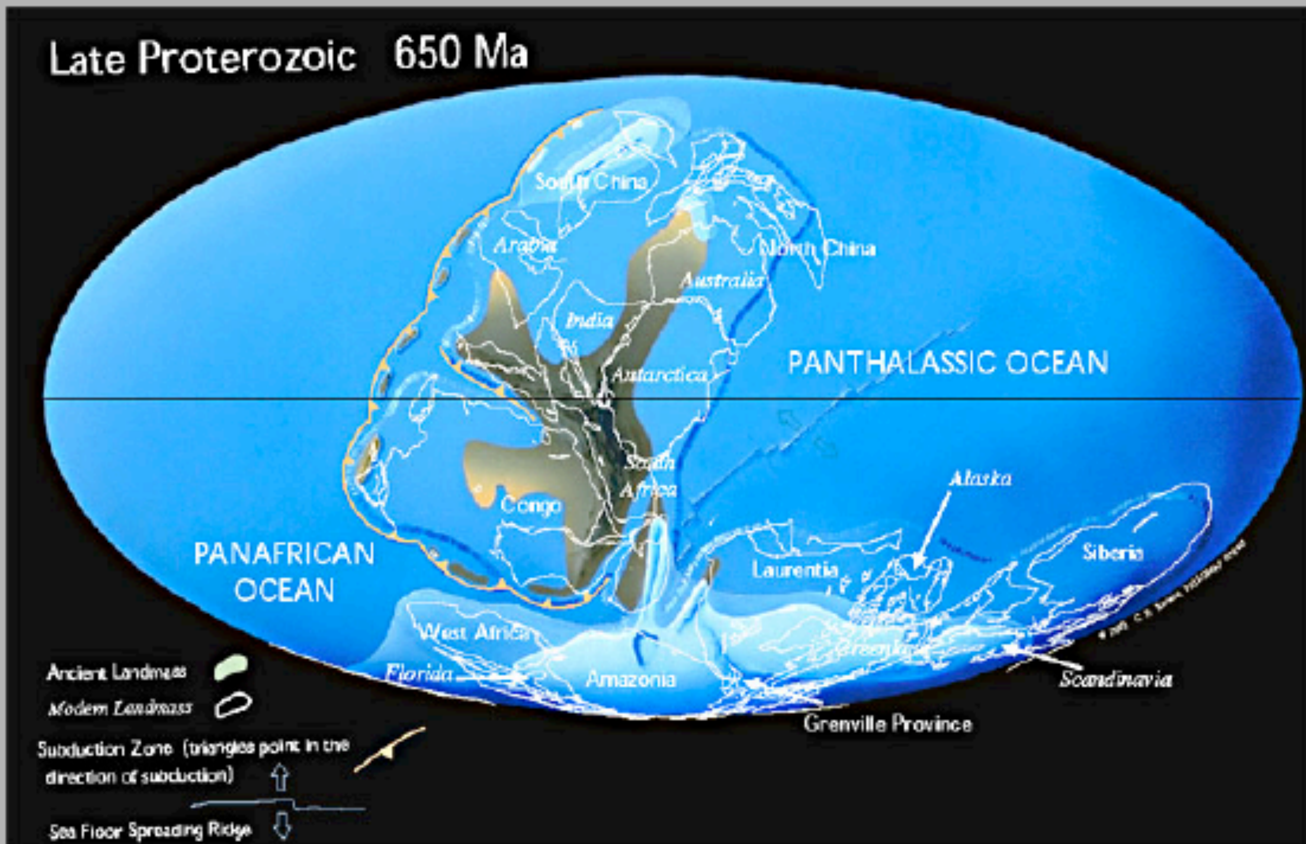
Much information in geology is based on proxy data. In the graph below, the author used geologic proxy data and instrumental record data to construct a temperature record for geologic time.

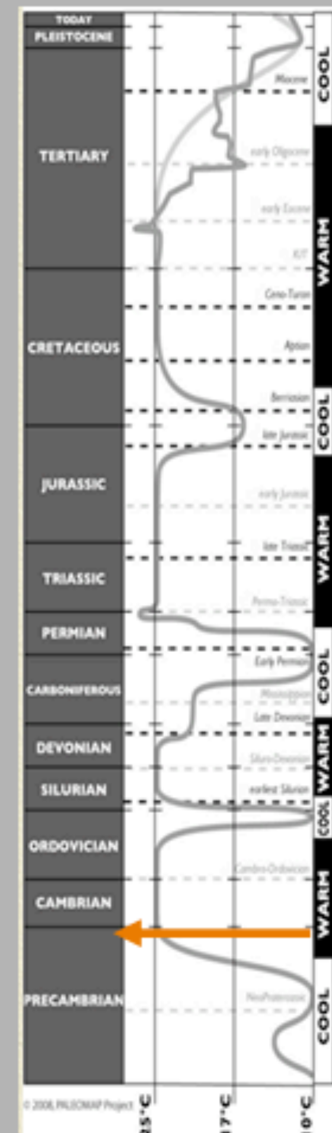


Relative Global Temperature Through Geologic Time
Modified from www.scotese.com

Click on the units of geological time in the illustration above to learn more about conditions on Earth at that time.

(4.4) **Position of the Continents: Precambrian Era** 1.1

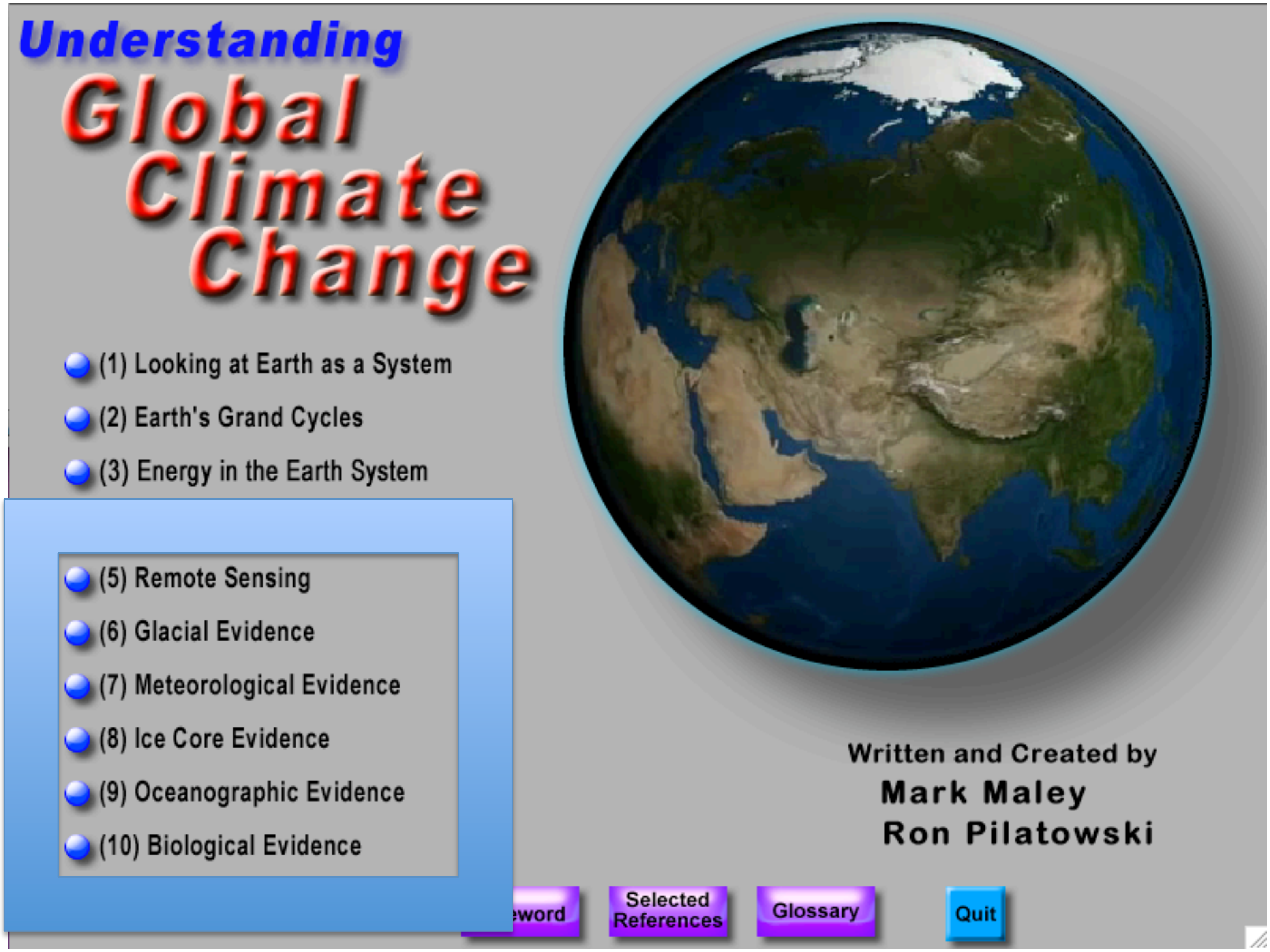




The Late Precambrian was an "Ice House" World, much like the present-day.

Scotese, C.R., 2002, http://www.scotese.com

Types of Evidence



Chapter 5: Remote Sensing

- (5.1) What is remote sensing?
- (5.2) Examples of Remote Sensing Tools
- (5.3) How is remote sensing used?
- (5.4) Case Study: Melt Lakes and Moulins
- (5.5) Checking Your Understanding

(5.2) **Examples of Remote Sensing Tools** 2

Active remote sensing requires that the device used (onboard an airplane in the illustration below) must transmit some type of electromagnetic radiation. This radiation is directed to the surface below. Some of the radiation may be absorbed and some is reflected back toward a receiver (or sensor) onboard the aircraft or satellite (the “platform” carrying the instruments). Keep in mind, when viewing the illustration below, that all electromagnetic radiation travels at the speed of light. The velocity of the radiation in the illustration is reduced to permit easier understanding of this concept.

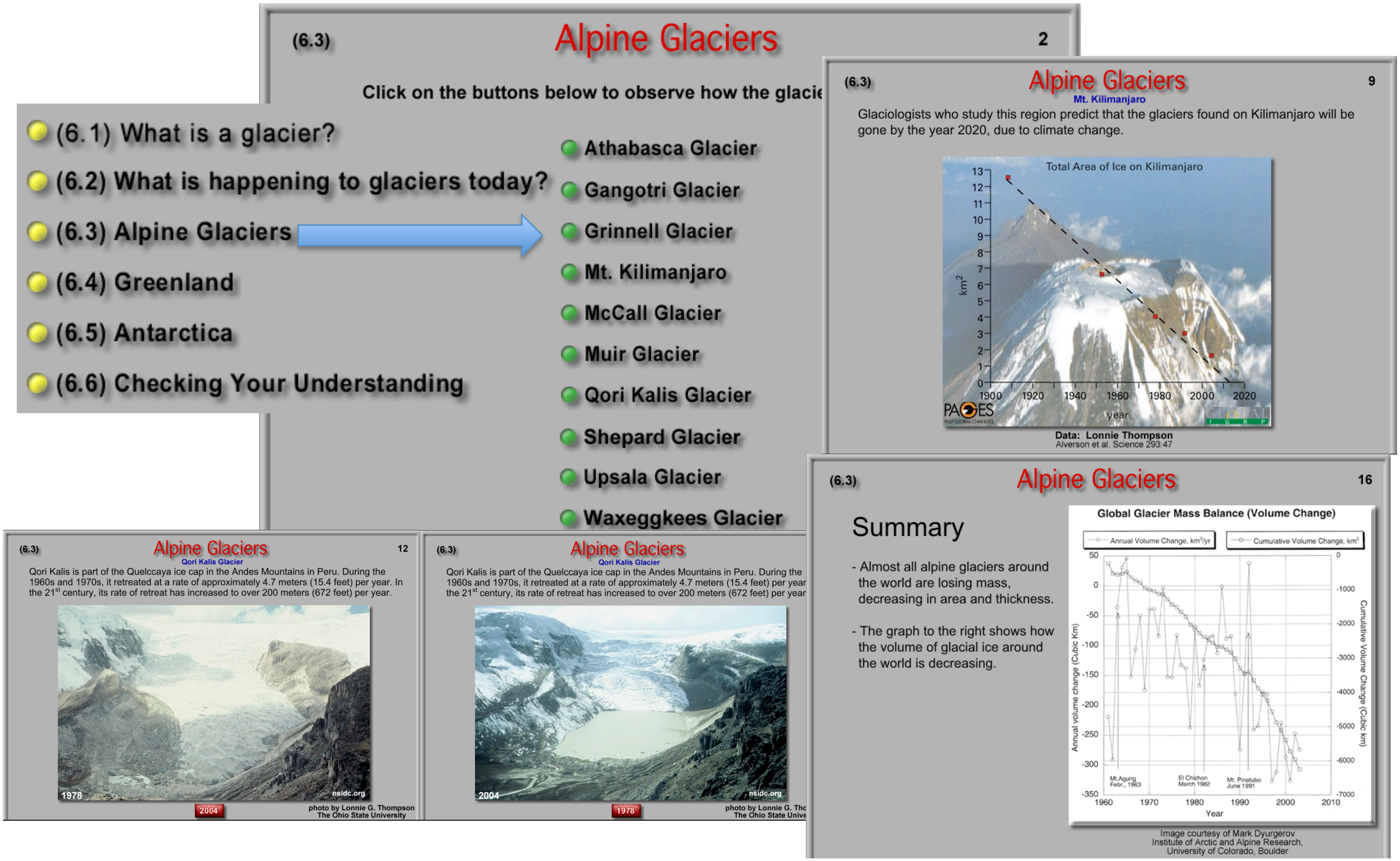
Passive Remote Sensing | Remote Sensing Instruments & Platforms | Remote Sensing Summary | Quit | Main Menu | Chapter Menu | End

(5.2) **Examples of Remote Sensing Tools** 4

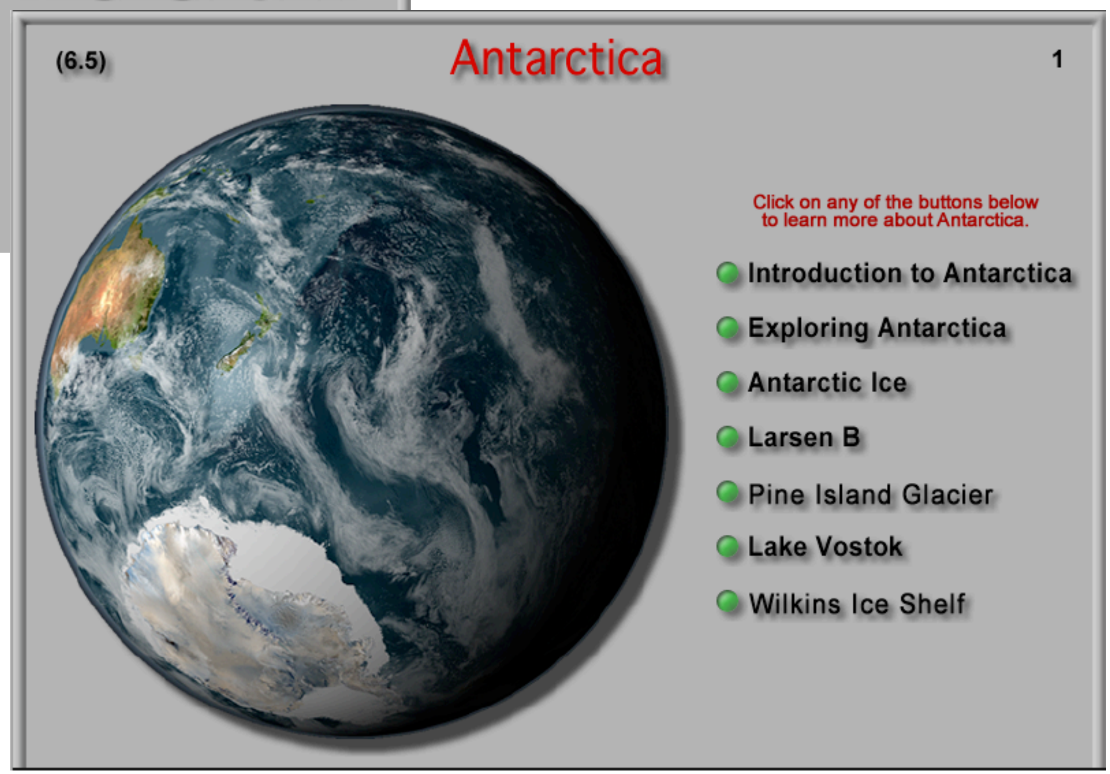
Listed below are several platforms (objects such as ships, planes, and satellites) that carry instruments (such as cameras, sounders, radiometers) that are used by scientists to better understand the workings of the Earth system. Click on any to learn about them in more detail.

- AVHRR
- GRACE
- ICESAT
- LANDSAT
- MERIDIAN
- MODIS
- RADARSAT
- The Paths They Follow

Chapter 6: Glacial Evidence



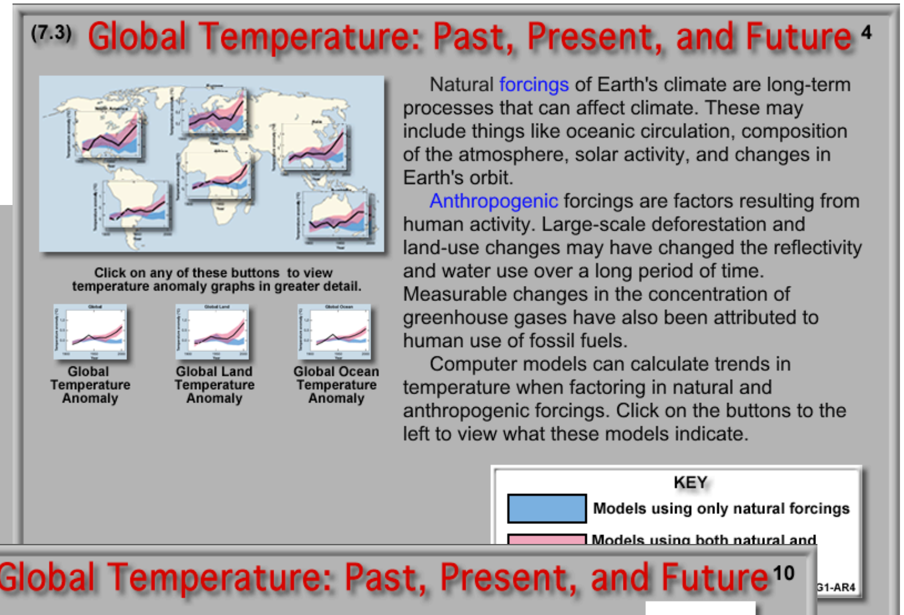
Chapter 6: Glacial Evidence

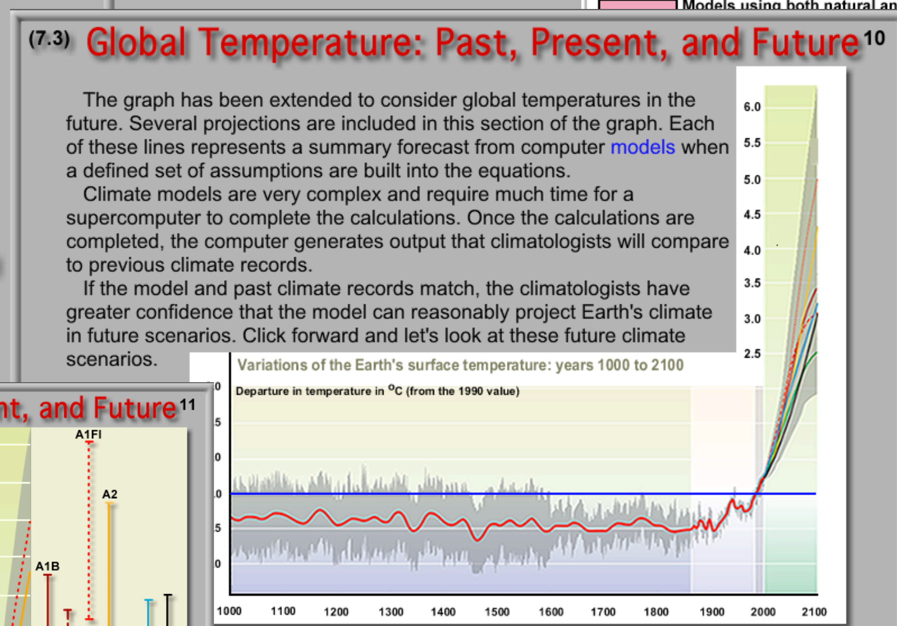


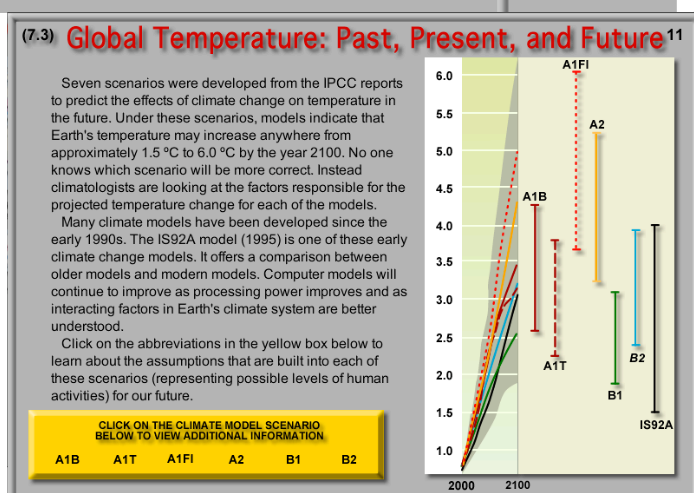
Chapter 7

Meteorological Evidence

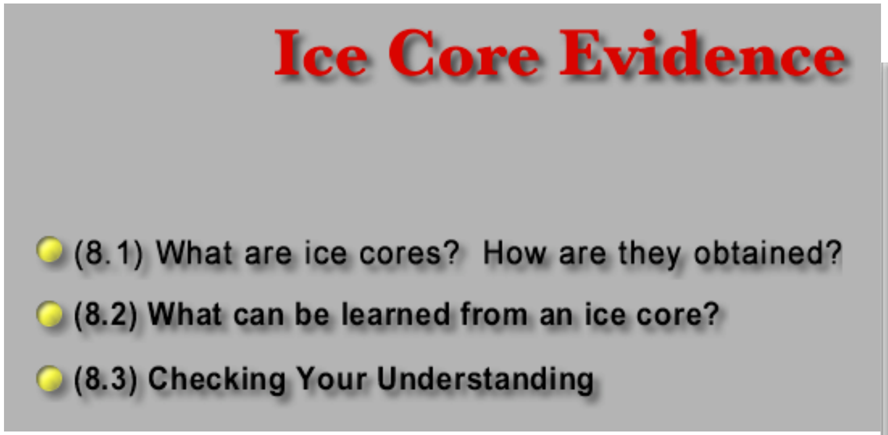
- (7.1) An Introduction to Weather
- (7.2) What is Unique About the Polar Regions?
- (7.3) Global Temperature: Past, Present and Future
- (7.4) Change In the Composition of the Atmosphere
- (7.5) Observed Polar Climate Change Trends
- (7.6) The Ozone Hole and Climate Change Connection
- (7.7) Checking Your Understanding

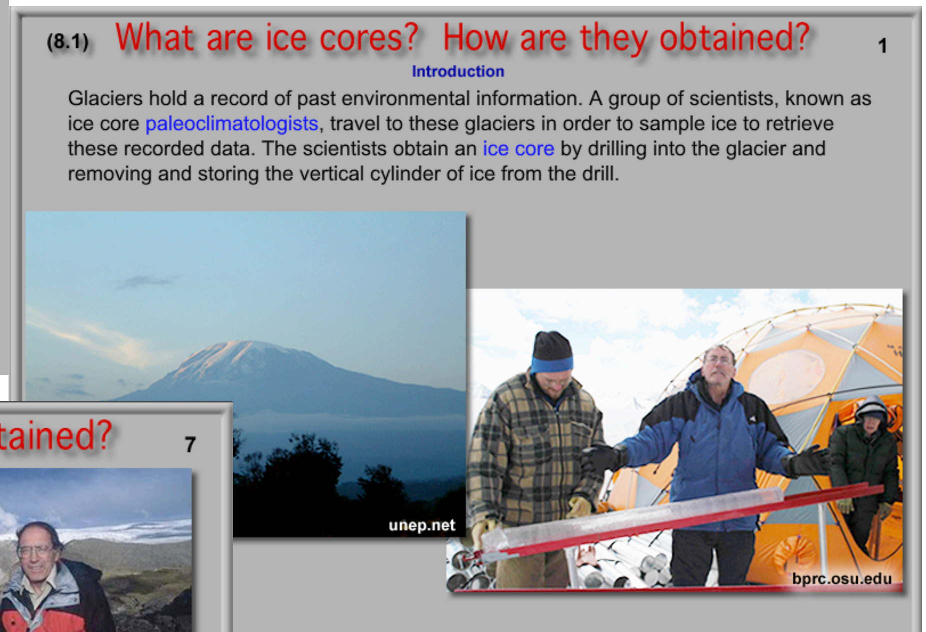


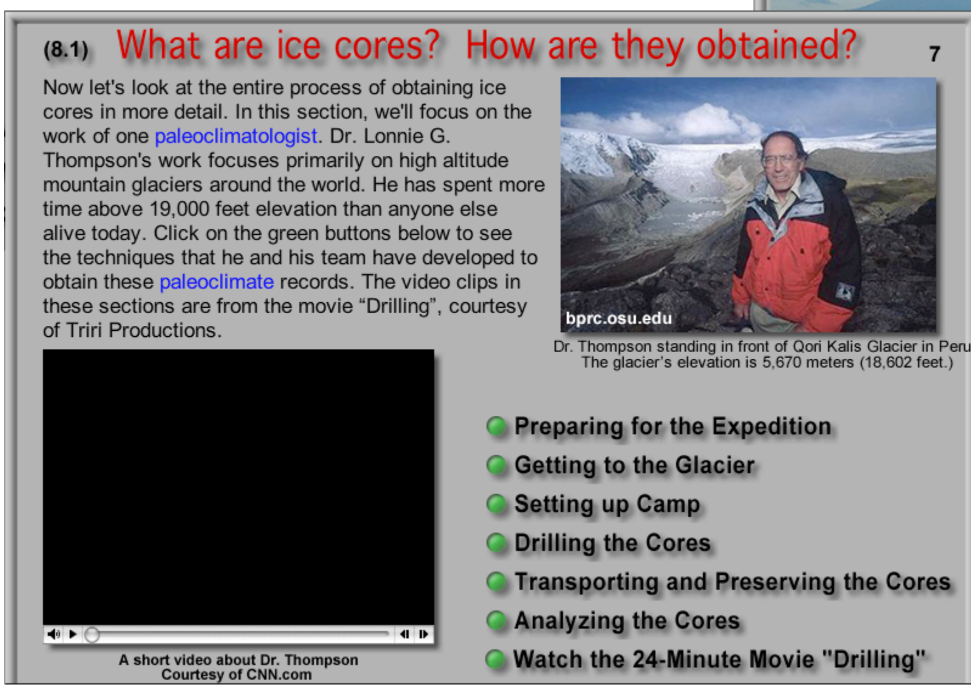




Chapter 8: Ice Core Evidence





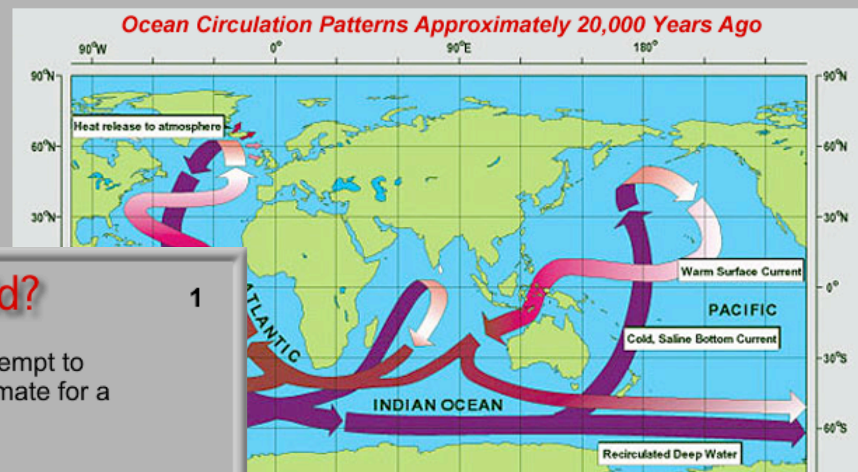


Chapter 9: Oceanographic Evidence

- (9.1) Historical Connections
- (9.2) Obtaining Core Samples in the Oceans
- (9.3) What the Fossils Say
- (9.4) What Dust and Mineral Grains Say
- (9.5) Icebergs
- (9.6) What Else Does A Sediment Core Yield?
- (9.7) Checking Your Understanding

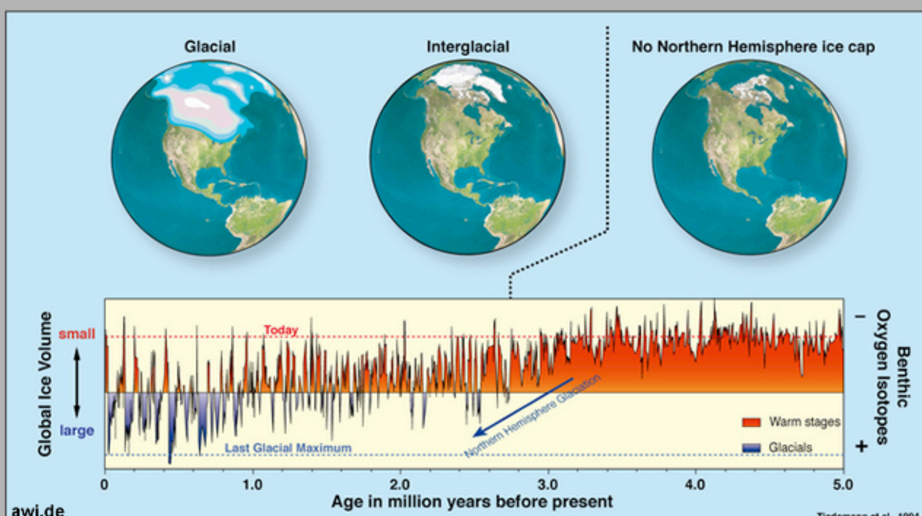
(9.3) **What the Fossils Say** 3

By identifying cold-water forams of the same age elsewhere in the oceans, paleoclimatologists were able to generate maps that showed where extremely cold waters existed at different points in Earth's history.



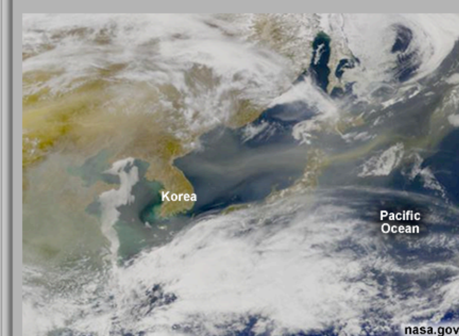
(9.6) **What Else Does A Sediment Core Yield?** 1

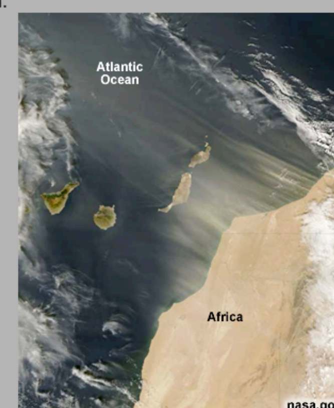
Ocean sediment cores provide a valuable tool for scientists as they attempt to reconstruct Earth's climate history. These cores provide a record of climate for a considerable part of Earth's history, dating back millions of years.



(9.4) **What Dust and Mineral Grains Say** 1

Dust in ocean sediment cores can also tell paleoclimatologists about weather and patterns in ocean currents. Plumes of dust from the Sahara desert blow from Africa across the Atlantic to North and South America. Dust from the Mongolian desert and other deserts from Asia's interior blows toward the Pacific Ocean.





Chapter 10: Biological Evidence

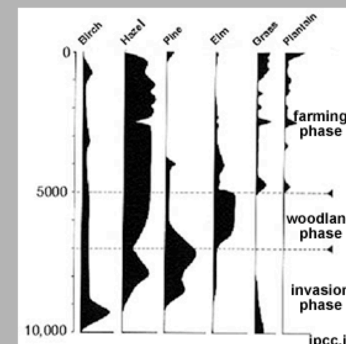
- (10.1) Types of Biological Evidence
- (10.2) Direct Biological Evidence
- (10.3) Indirect Biological Evidence
- (10.4) What are Some Potential Trends for the Future?
- (10.5) Checking Your Understanding

(10.2) **Direct Biological Evidence** 2

Several studies of pollen grains from these sources have yielded some interesting results. Fossil pollen recovered from peat in various places in the U.S. Midwest has revealed a rapid change in vegetation over a time span of at most 200 years. The vegetation changed from conifers like pines (which dominated the landscape near the glacial margin at the time of maximal glaciation) to oak trees, which can tolerate much drier, warmer conditions. Radiocarbon dating of these pollen grains provided additional evidence suggesting that a change in climate occurred much more quickly than most scientists had believed was possible.

Sampling a bog for pollen

Sampled pollen from a bog



Graph representing pollen species over the last 10,000 years in Ireland

(10.3) **Indirect Biological Evidence**

For the past 1,200 years, observations of the timing of peak cherry blossoms have recorded in Japan. More modern records of “ice-in” and “ice-out” in the U.S.A, Can
Finland, and Russia also provide evidence of climate history for those regions.

Postponed freezes, earlier thaws

Researchers found evidence of global warming by studying data o
freezing and thawing of 26 bodies of water. The study concludes t
past 150 years, the freezing occurred an average of 8.7 days late
thaw occurred about 9.8 days earlier. Here are selected results.

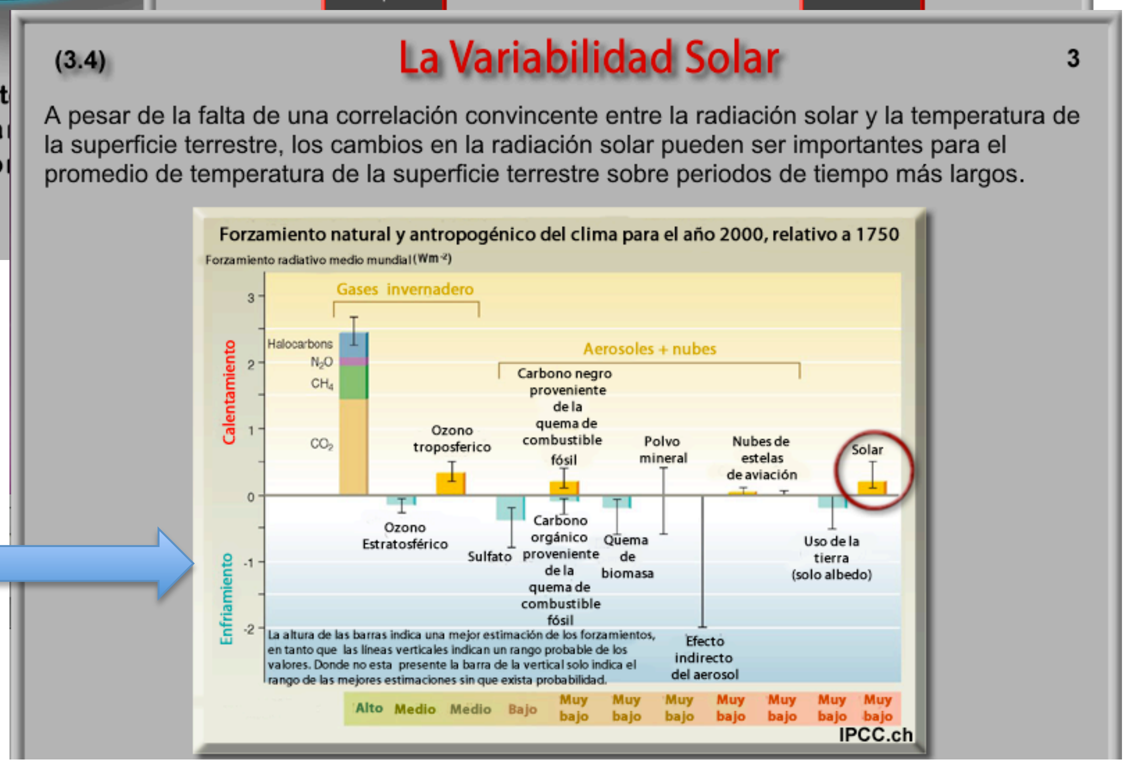
Selected location	Freeze Days later per 100 years	Thaw Days earlier per 100 years
1. Mendota Lake, Wisconsin	6 days	7.5 days
2. Monona Lake, Wisconsin	7.2	12.2
3. Grand Traverse Bay, Minnesota	11.4	11.8
4. Ostego Lake, New York	4.8	6.5
5. Toronto Harbor, Canada	36.9	7.4
6. Red River, Canada	13.2	10.6
7. Nasijarvi Lake, Finland	5.7	8.8
8. Kallavesi Lake, Finland	5.3	9.2
9. Baikal Lake, Russia	11.0	5.1
10. Angara River, Russia	8.5	2.1

Source: Science AP

(10.4) **What are Some Potential Trends for the Future?** 1

Changes in the timing of biological events have the potential to adversely affect humans. The existence of many plants depends upon animal-mediated pollination. Flowering plants and their pollinators co-evolved. Factors that keep the timing of flowering in synchrony with the availability of particular animal pollinators are complex and unknown. It is quite possible that peak plant flowering times and pollinator availability could get out of synchrony - flowers would be opening before pollinating agents are available. This could have disastrous effects on agriculture.

Spanish Version



The captions/titles/labels were also translated, and the graphics were re-worked.

Conclusion

English version

•Over 5,000 DVDs (discs) given out; unknown numbers downloaded.

•Served as basis of HS courses, teacher workshops, & online course

•Supplemental docs: Outlines, Notebook, Table of Contents, Image Credits

•Downloadable from: https://www.cresis.ku.edu/education/DVD

Spanish version will be highlighted at International Geography Conference in Santiago, Chile, in November, 2011.

Proposal submitted to NOAA to test effectiveness in 3 geographic regions with different % of Latina/o students (K-12)

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