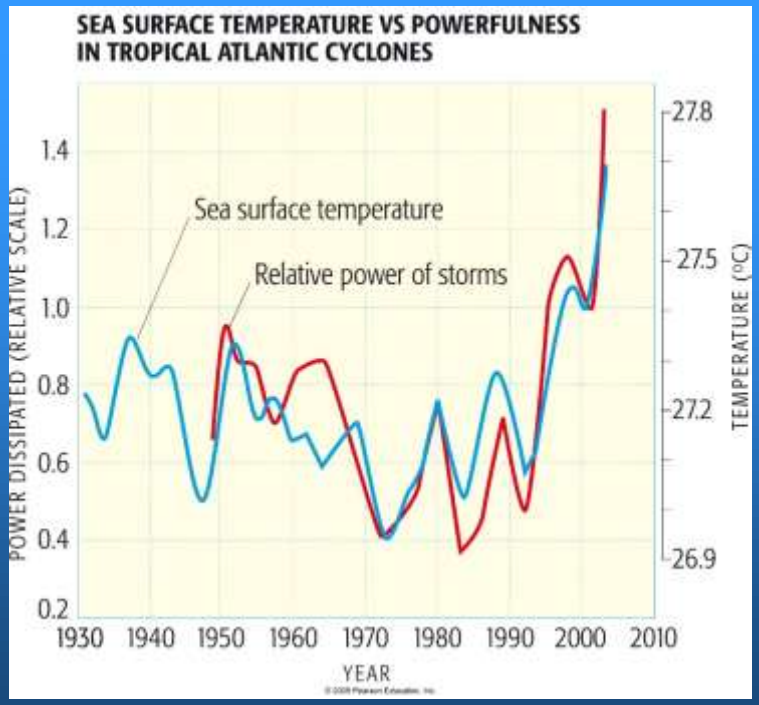
IDS 3211c Global Climate Change: Science, Society and Solutions

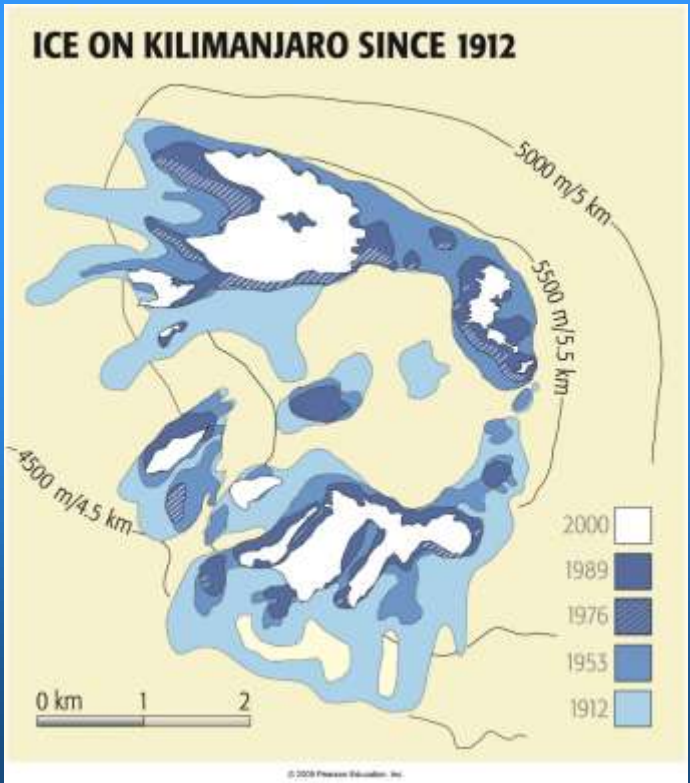
Science Part

http://faculty.fiu.edu/~hajian/IDS3211C/IDS3211C.html

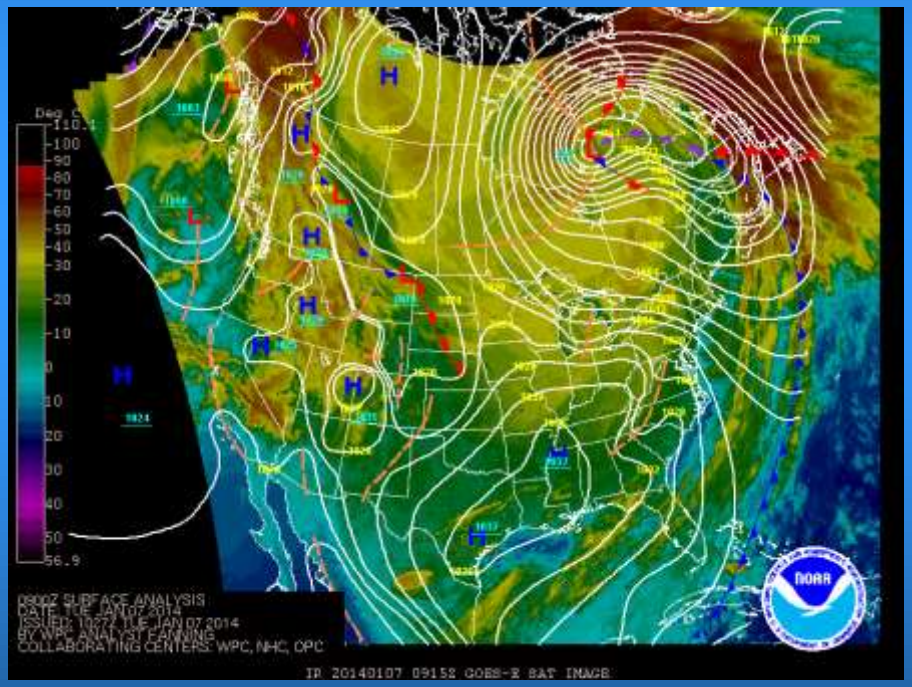
Climate Change & Global Warming

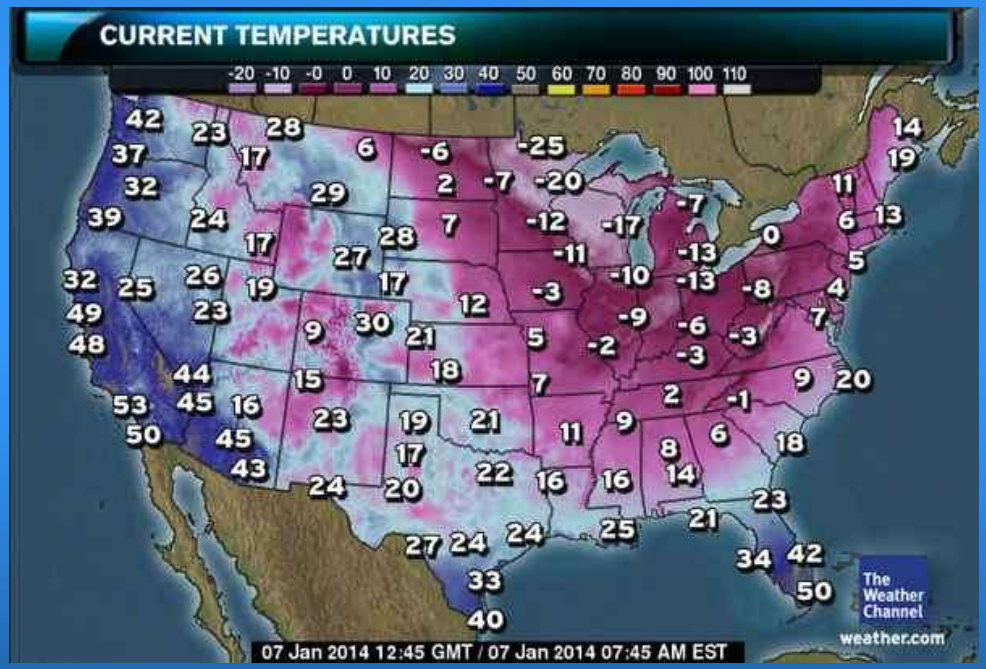
- **Why should we care?** What's your current understanding about the issue?
- **Human activity:** How is it causing climate change?





Polar Vortex Influencing Eastern US Today (01/07/2014): A sign of human-induced climate change?





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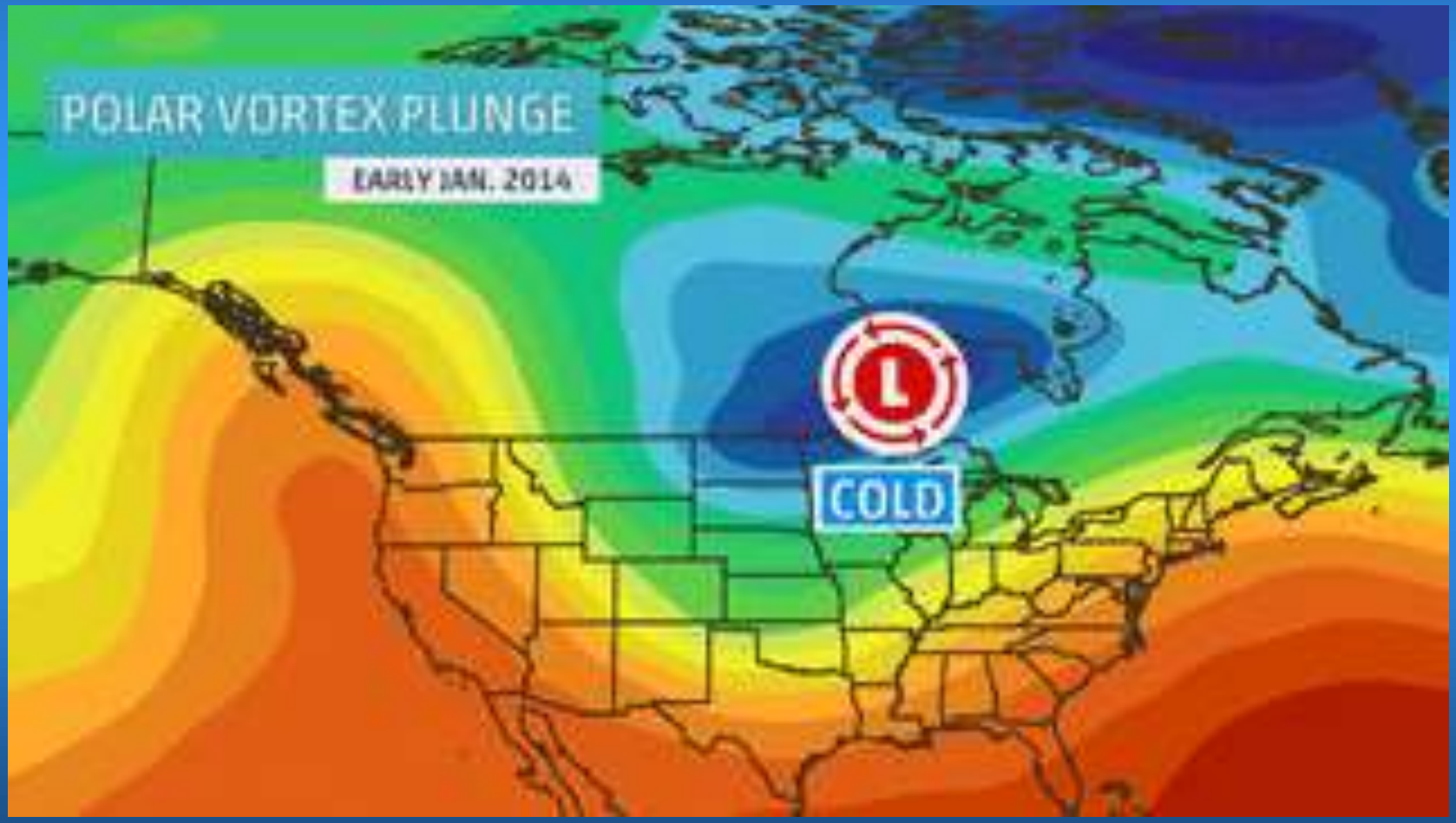
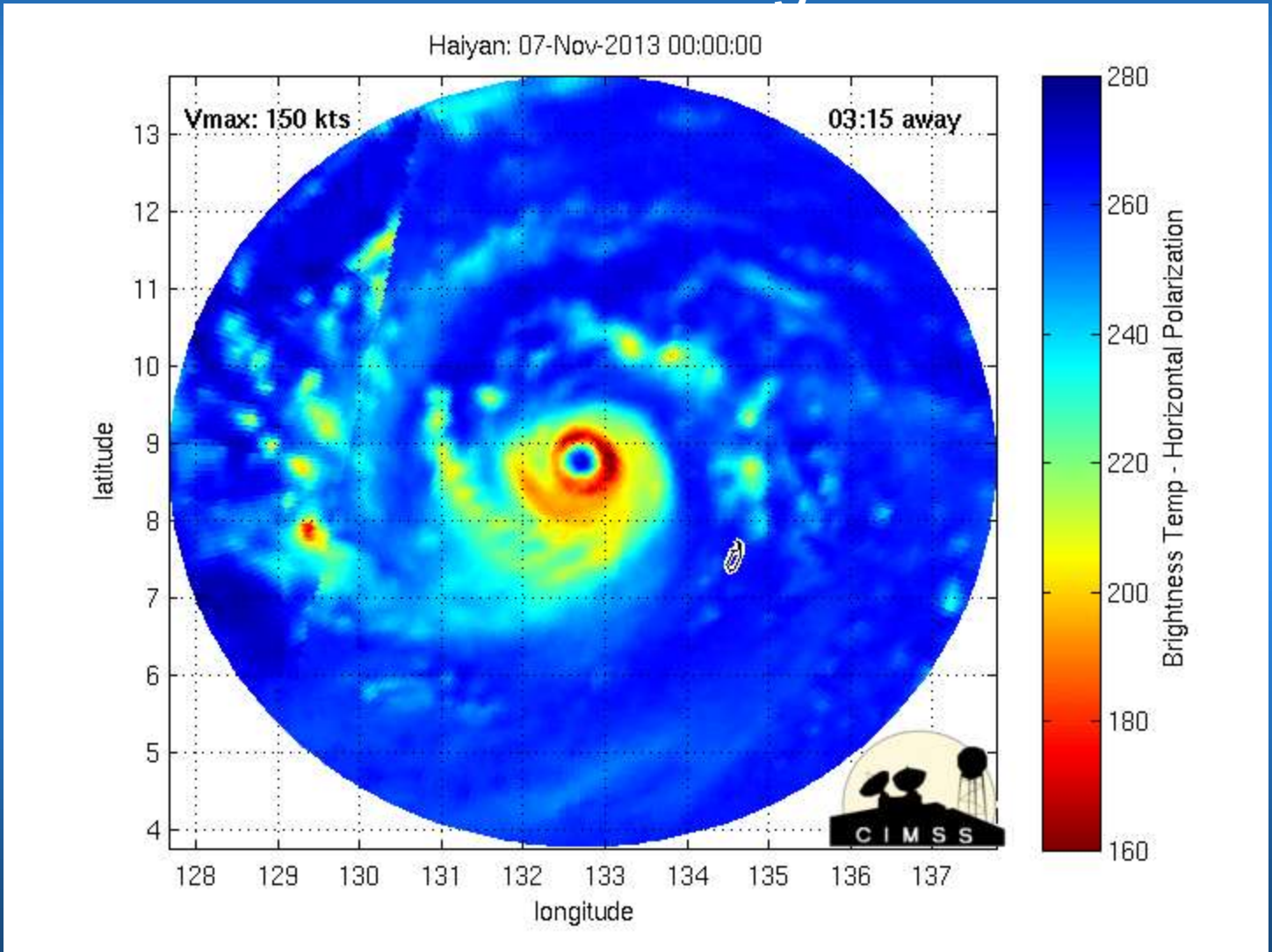


Animation courtesy: weatherunderground.com

Super Typhoon Haiyan in the western Pacific (11/07/2013): A sign of human-induced climate change?

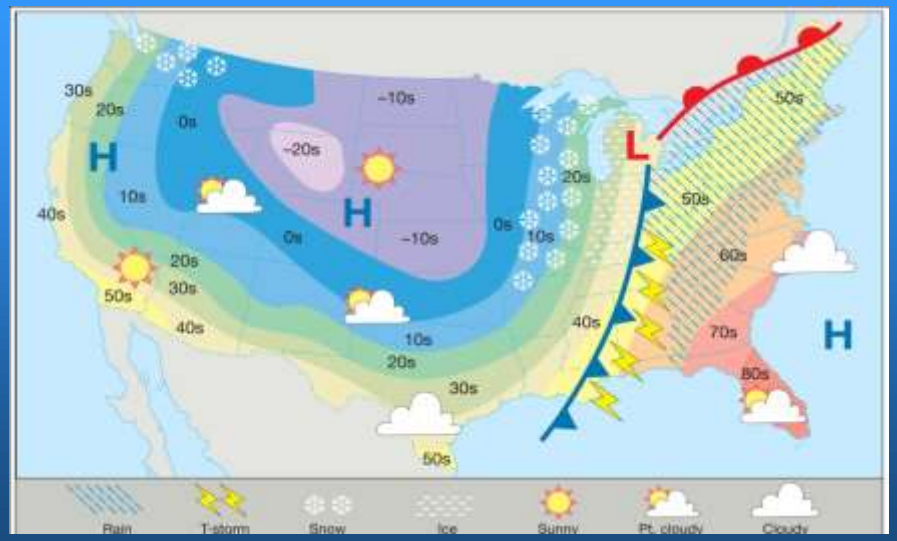


Topics in the Science Part of this course: (Part 1 & 2 of the textbook A)

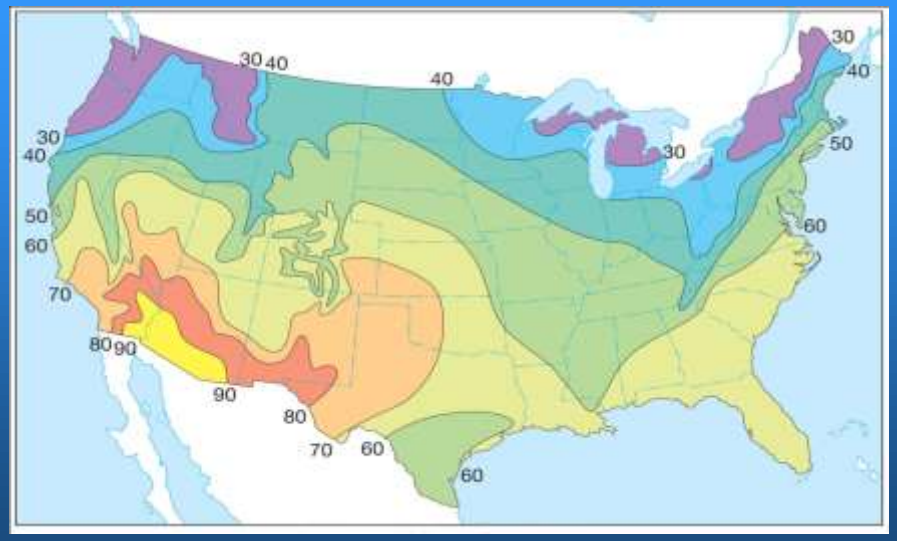
1. Weather and Climate (Page 10)

- **Weather:** state of the atmosphere at a given time and place. It is constantly changing.
- **Climate:** “average” weather conditions, but the average doesn’t stay steady. I.e. Ice ages, El Niño, etc.

A typical weather map for a day in late December



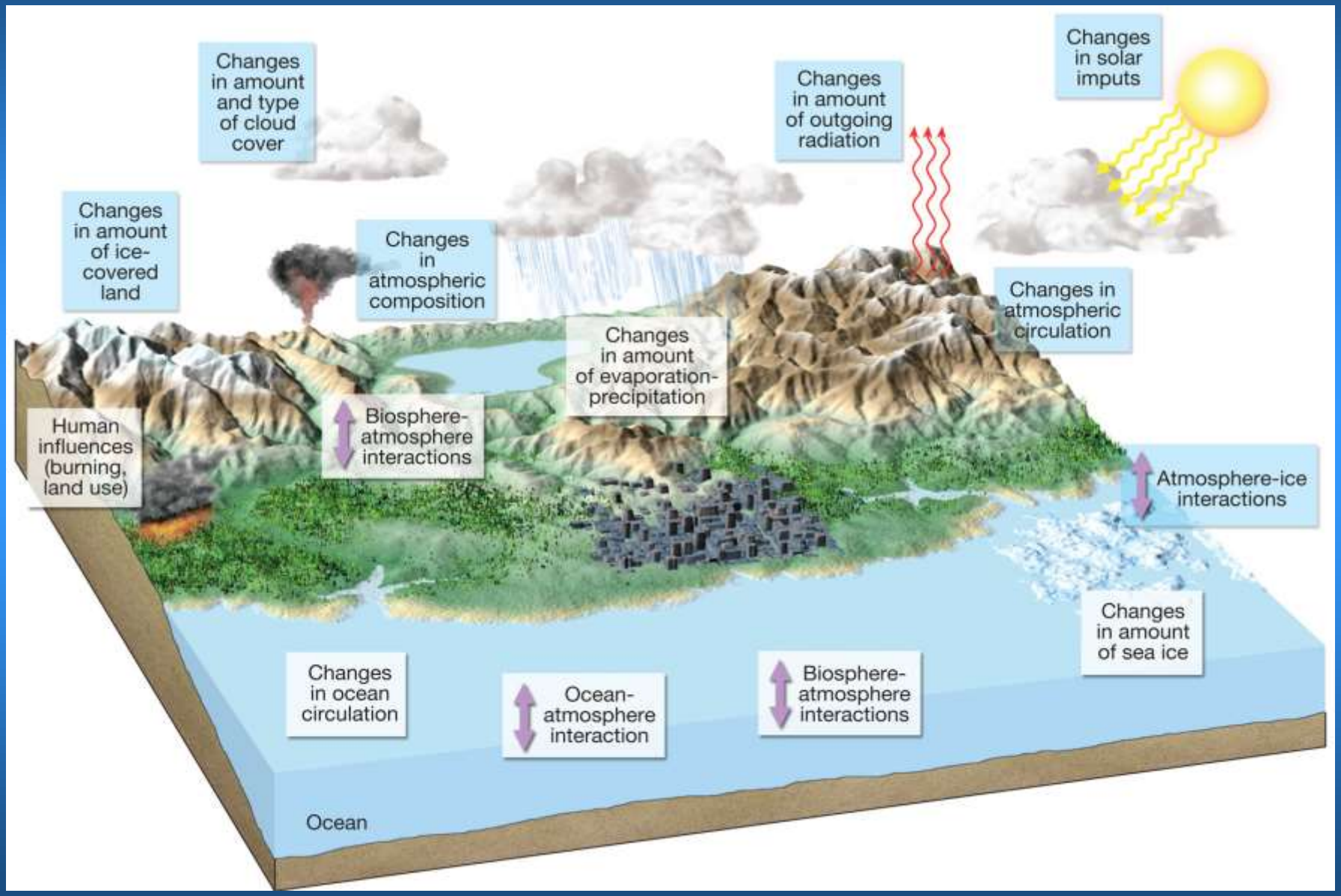
Mean percentage of possible sunshine in November



2. The climate System (Page 10-11)

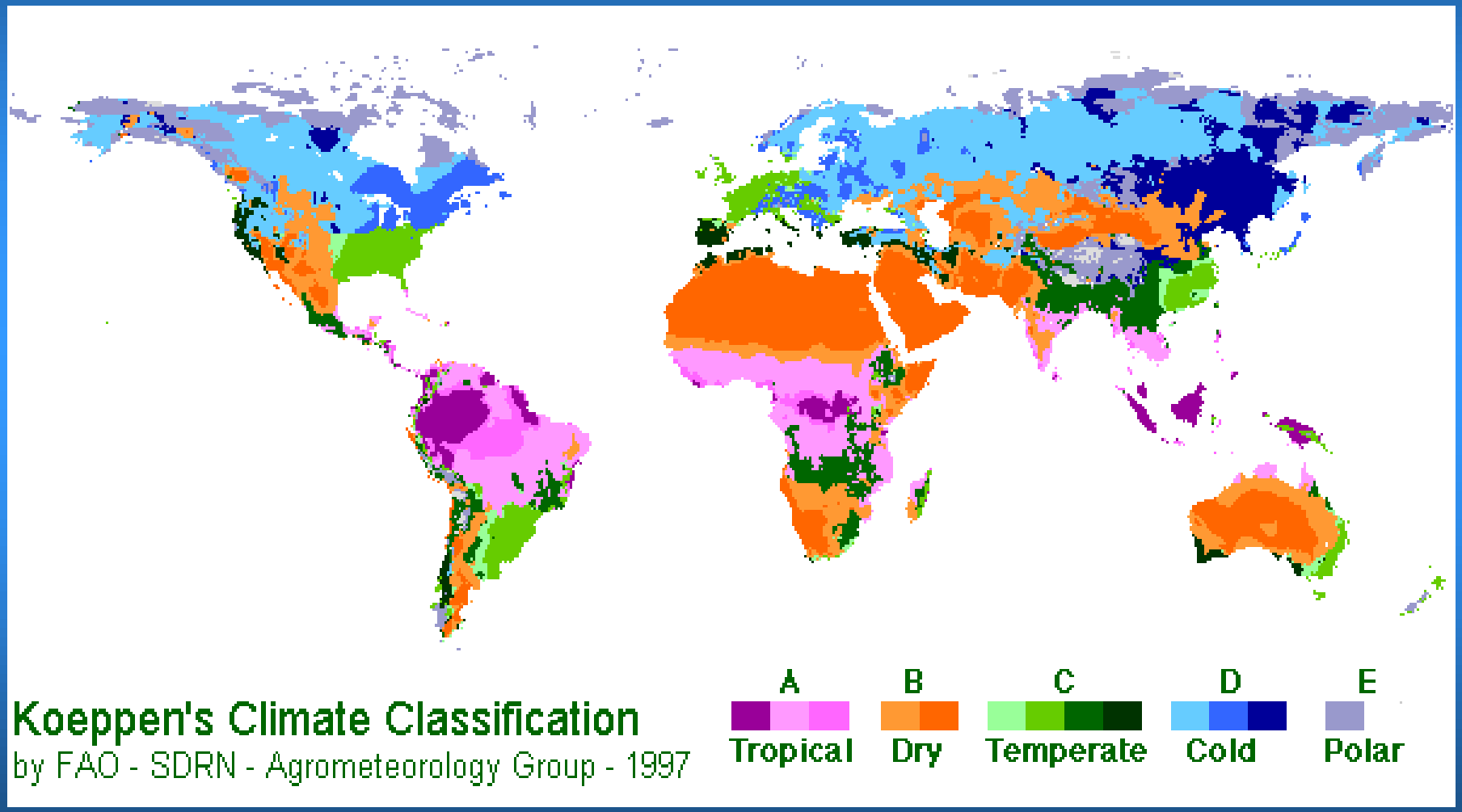
Four “Spheres” in the climate system:
Geosphere, Atmosphere, Hydrosphere, Biosphere

All Parts of the Climate-System Are Linked



3. World Climate (Page 11)

Climate Classification



Climate Controls (pages 10-13)

Latitude
Land and Water
Geographic Position
Mountains and Highlands
Ocean Currents
Pressure and Wind Systems

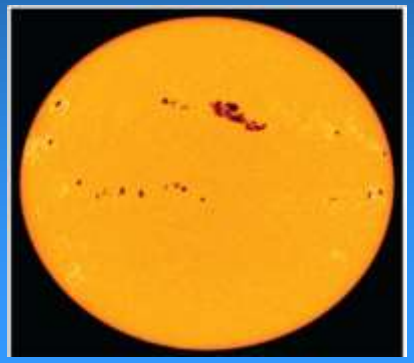
4. Detecting Climate Change (Pages, 40-43)

- Proxy data – indirect evidence using natural recorders of climate variability
  - Sea floor sediments
  - Oxygen isotope analysis
  - Coral deposits
  - Glacial ice rings
  - Tree rings
  - Fossil Pollen
  - Historical documents

- Paleoclimatology

5. Natural Causes of Climate Change (Pages 18, 34, 40,62-63)

Change in Solar energy and activities



Variations in Earth's Orbit

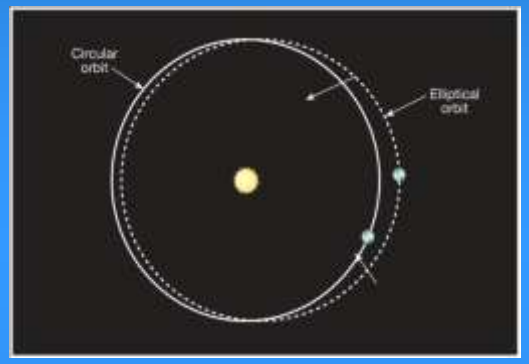
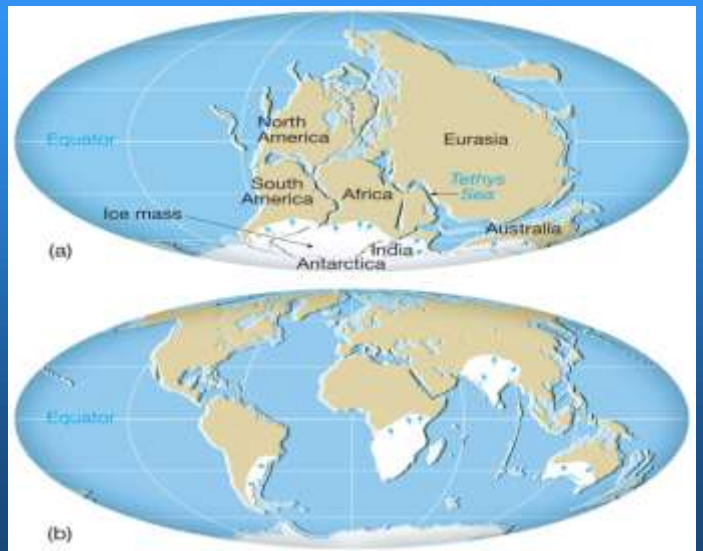


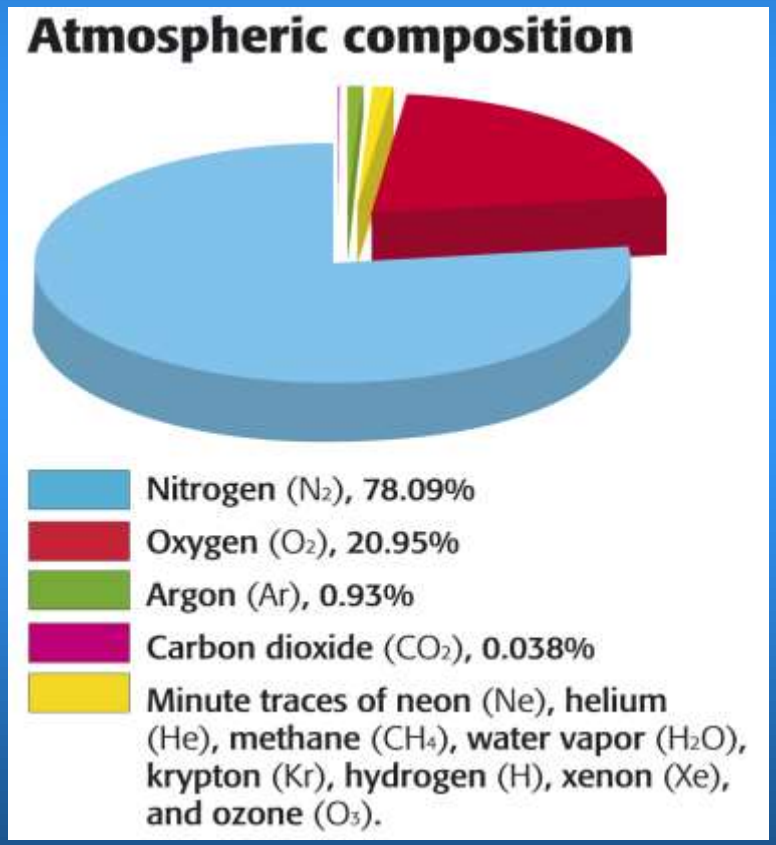
Plate Tectonics



Volcanic Eruptions

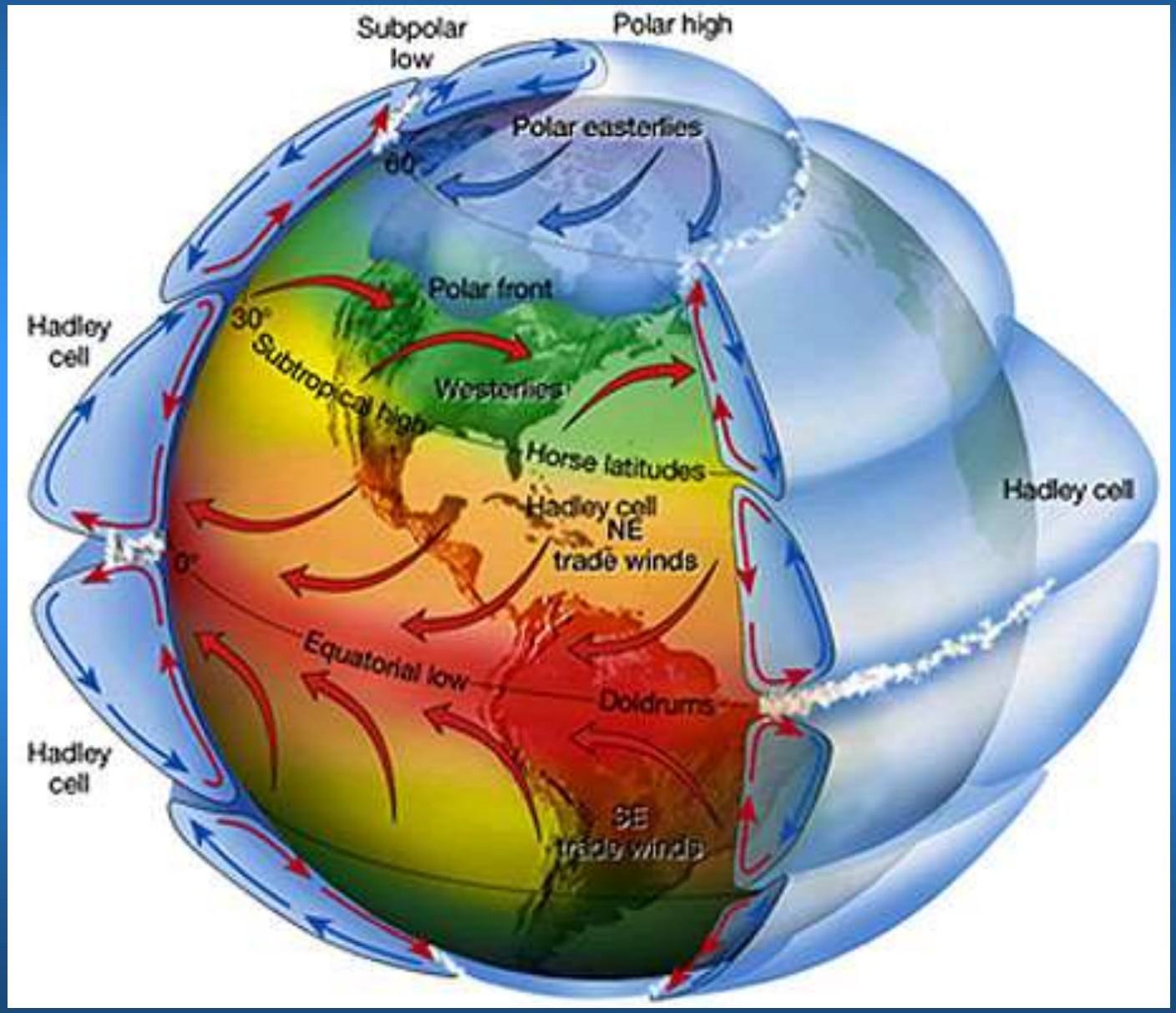
6. Climate and Atmosphere (Pages 12, 13)

Composition of atmosphere



Vertical structure of atmosphere

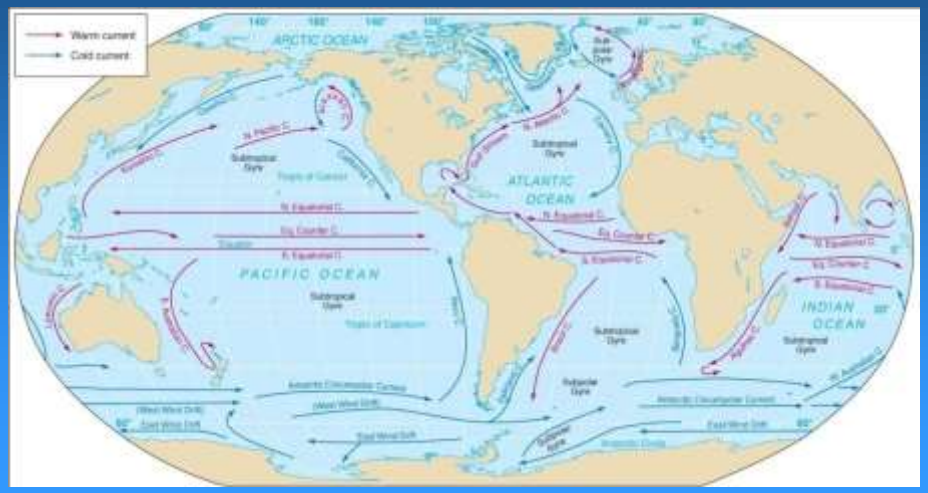
What drives atmospheric motions? (Page 13)



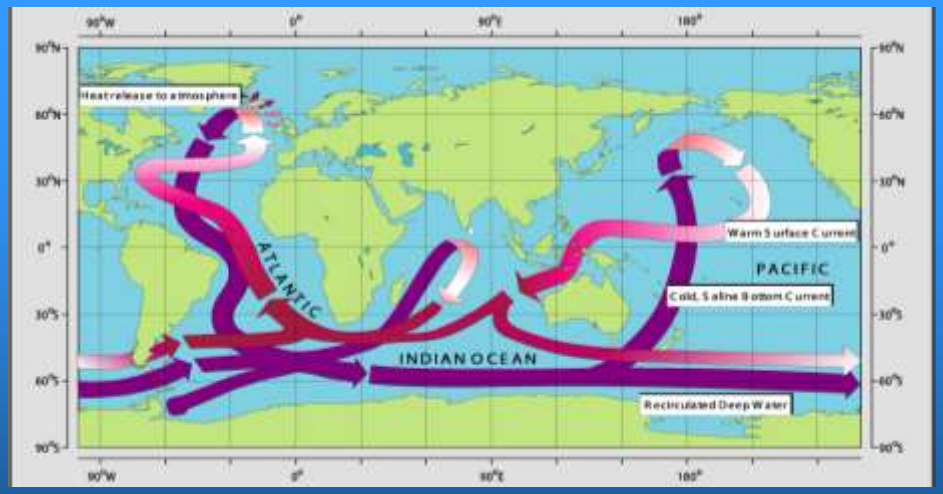
7. Climate and Ocean Currents (Pages 11, 49, 61)

Surface Current:

Wind driven



Deep ocean current:
Density driven



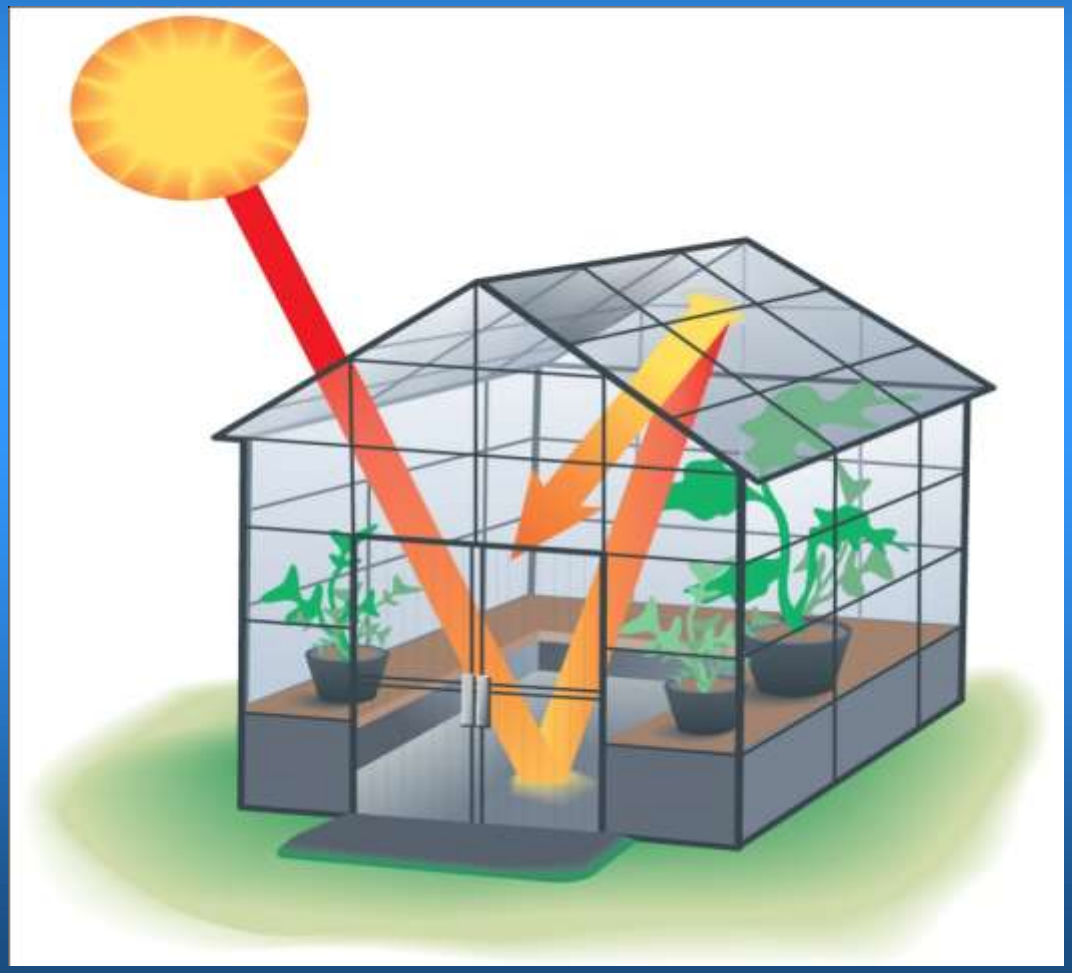
- Currents equalize global temperatures
- Currents control climate

8. Humans and Climate Change (Pgaes 19, 32-35,46-47)

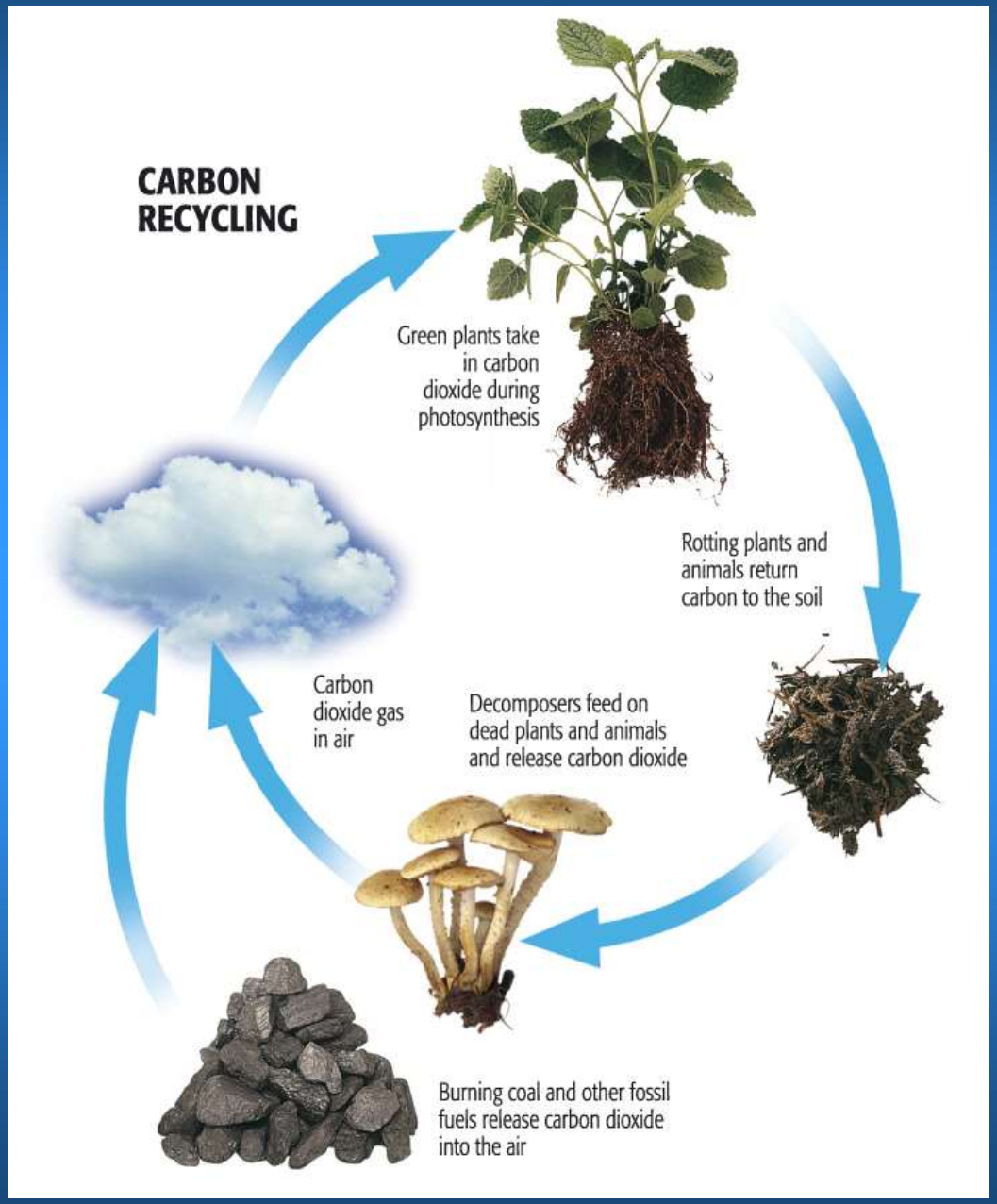
Human impacts

- Green house gas production
- Land use
- Deforestation
- Pollutants
- “bad” compounds for the atmosphere…

Atmosphere's Greenhouse Effect (Pages 14, 22-27,34-35,41-43



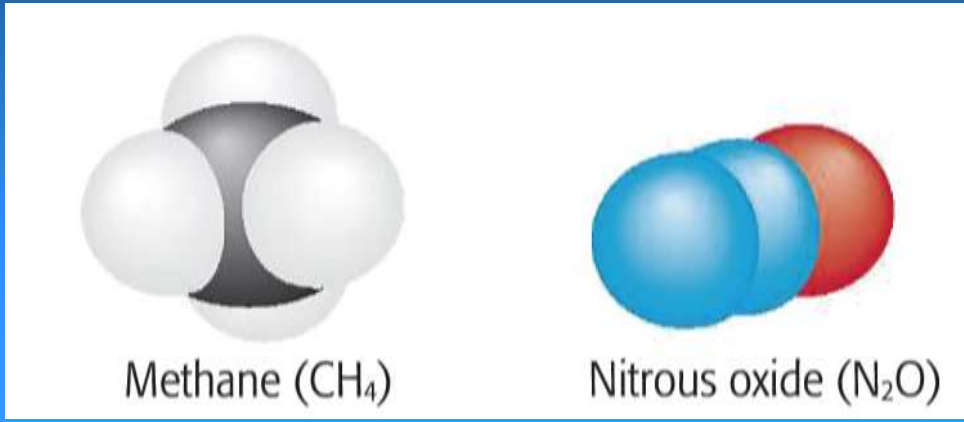
Carbon Cycle

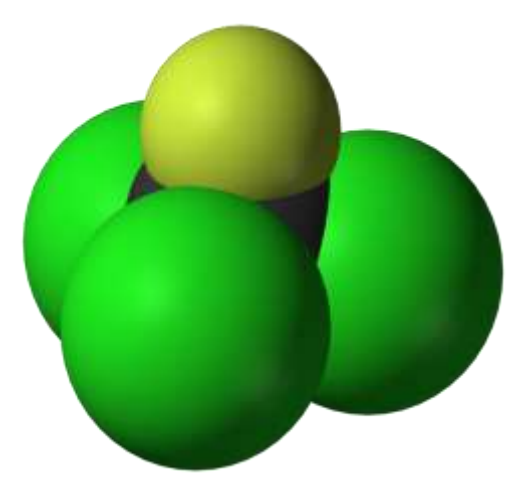


The lifetime of CO_2 in the atmosphere is about a decade. But this uptake and release Is balanced. It just recycle it. Ocean can dissolve some CO_2 as a removal mechanism. But it is a very slow process (hundreds or thousands of years).

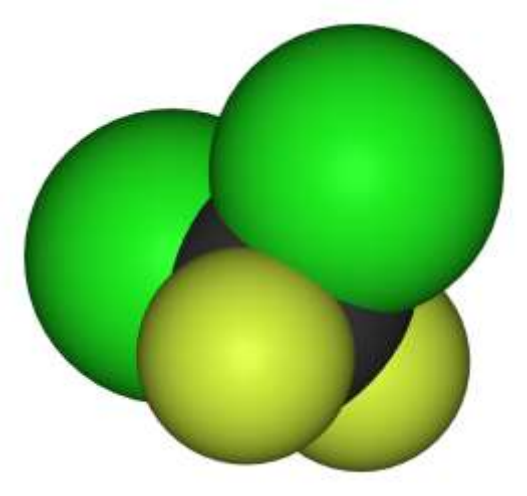
But excessive use of fossil fuels break the balance.

Trace gases, other important greenhouse gases (Pages 28-29)

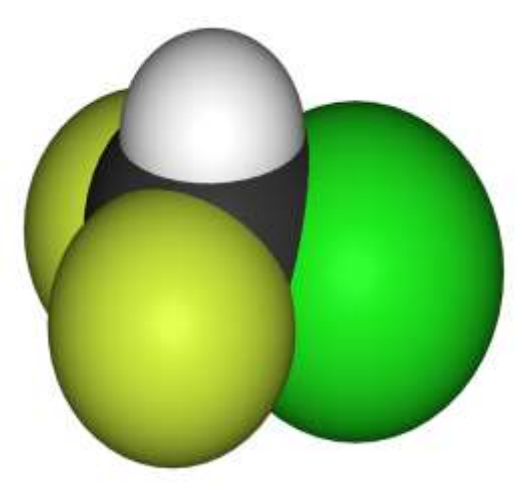




CFC-11



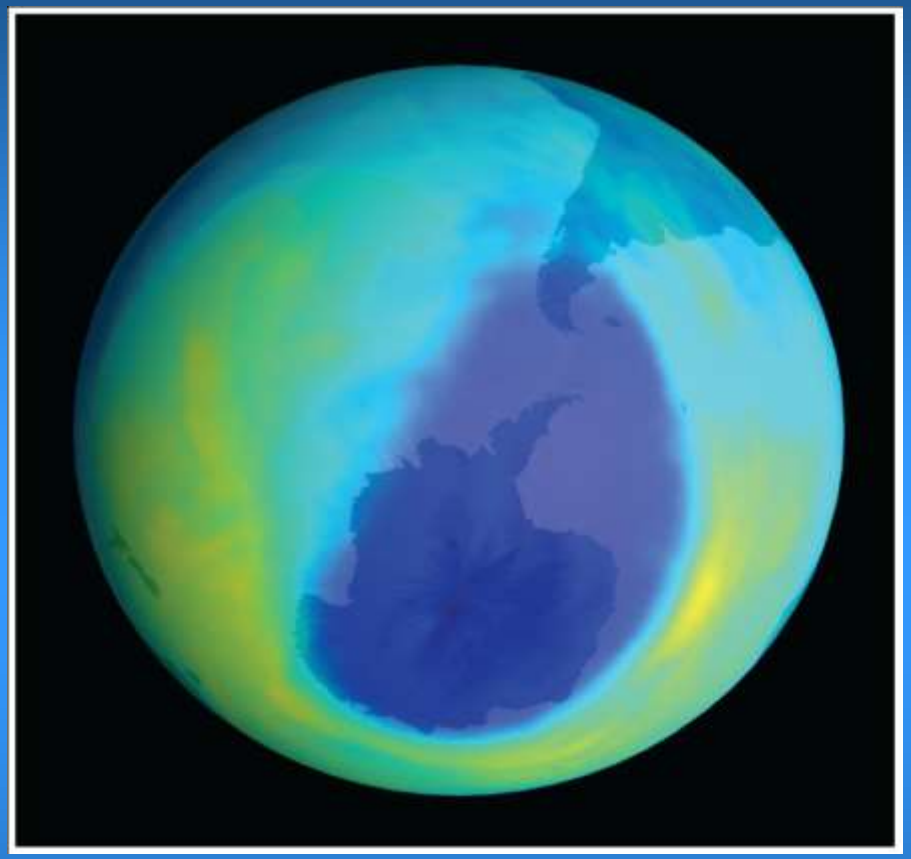
CFC-12



HCFC-22

Ozone layer and climate (Pages 30-31)

The Ozone Hole

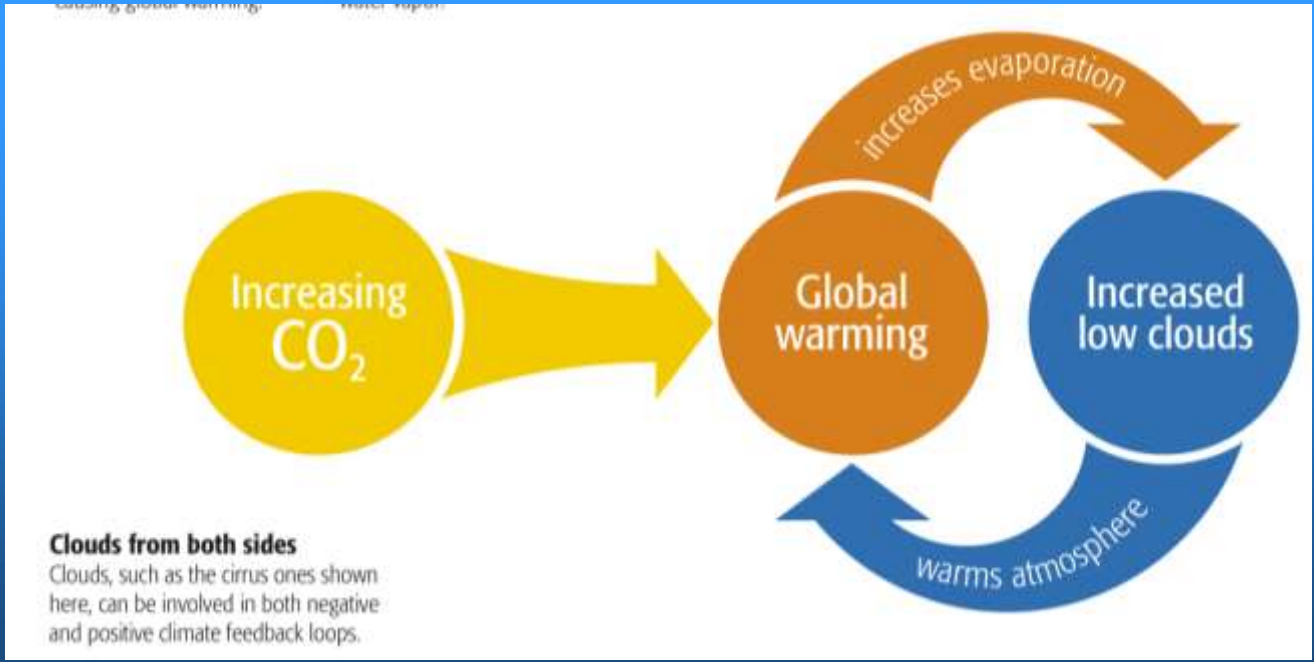


First Exam

9. Complication in Climate Change (Pages 24-25)

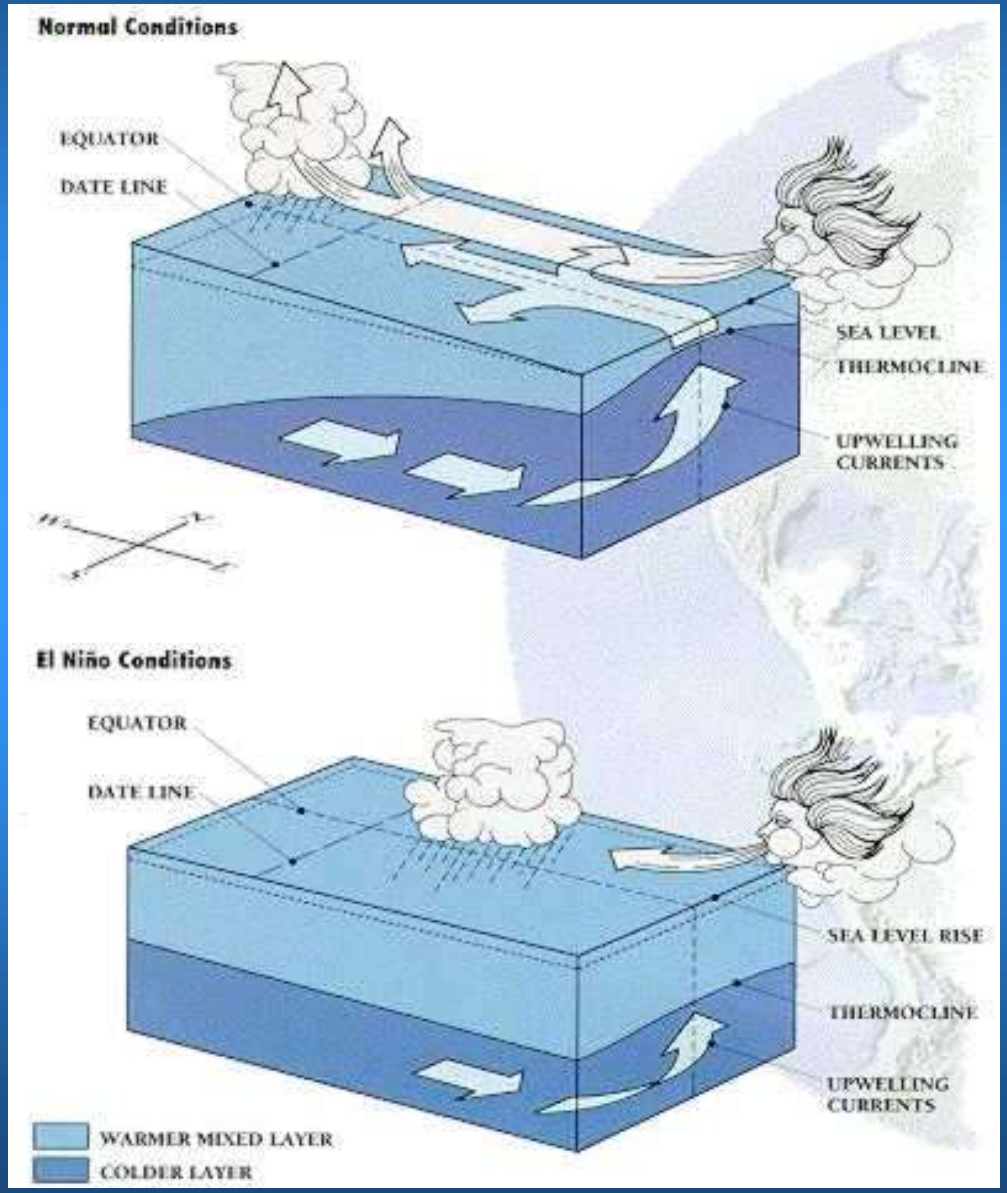
Systems

Feedback

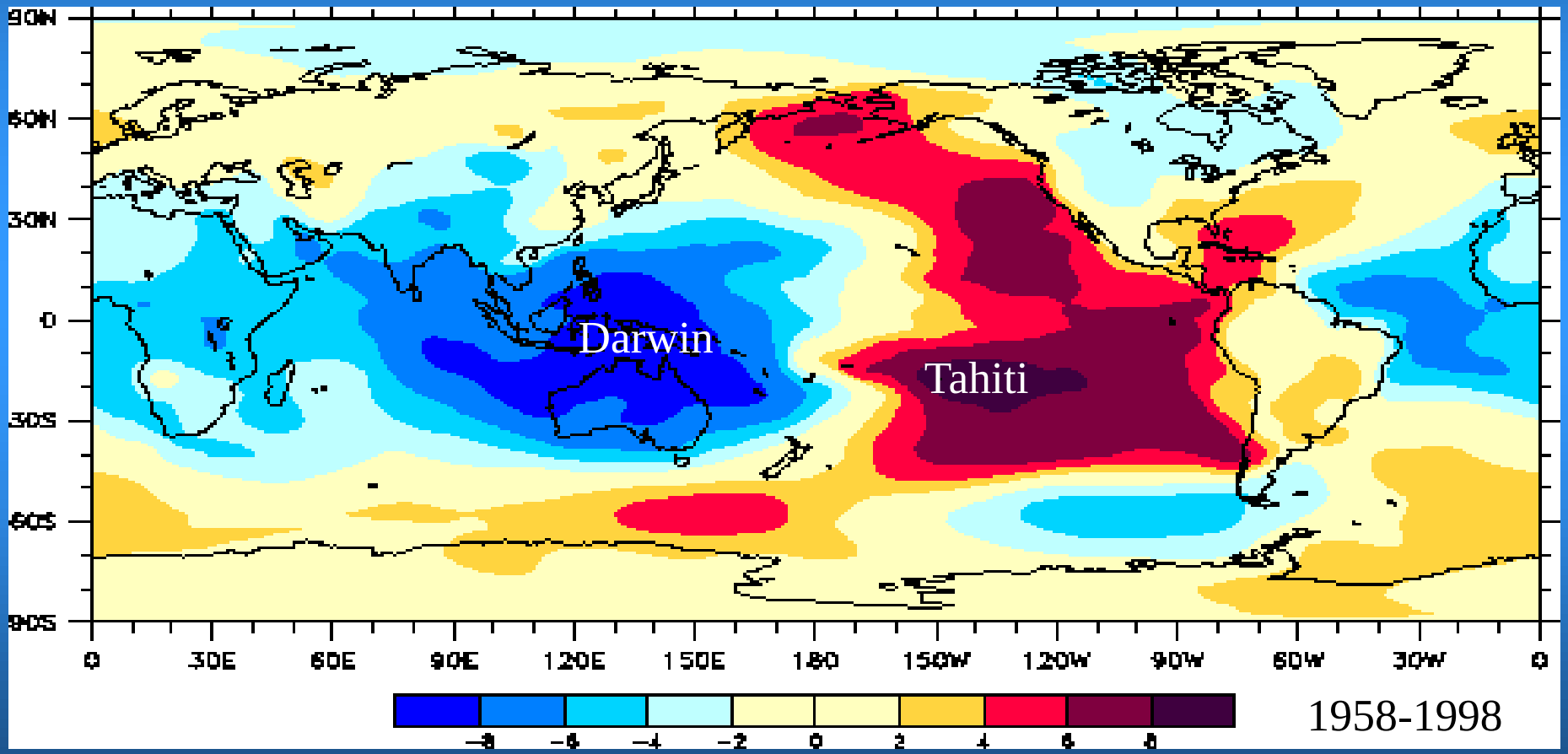


Clouds from both sides
Clouds, such as the cirrus ones shown here, can be involved in both negative and positive climate feedback loops.

10.El Niño and La Niña (Pages 49-50, 90-91,103)

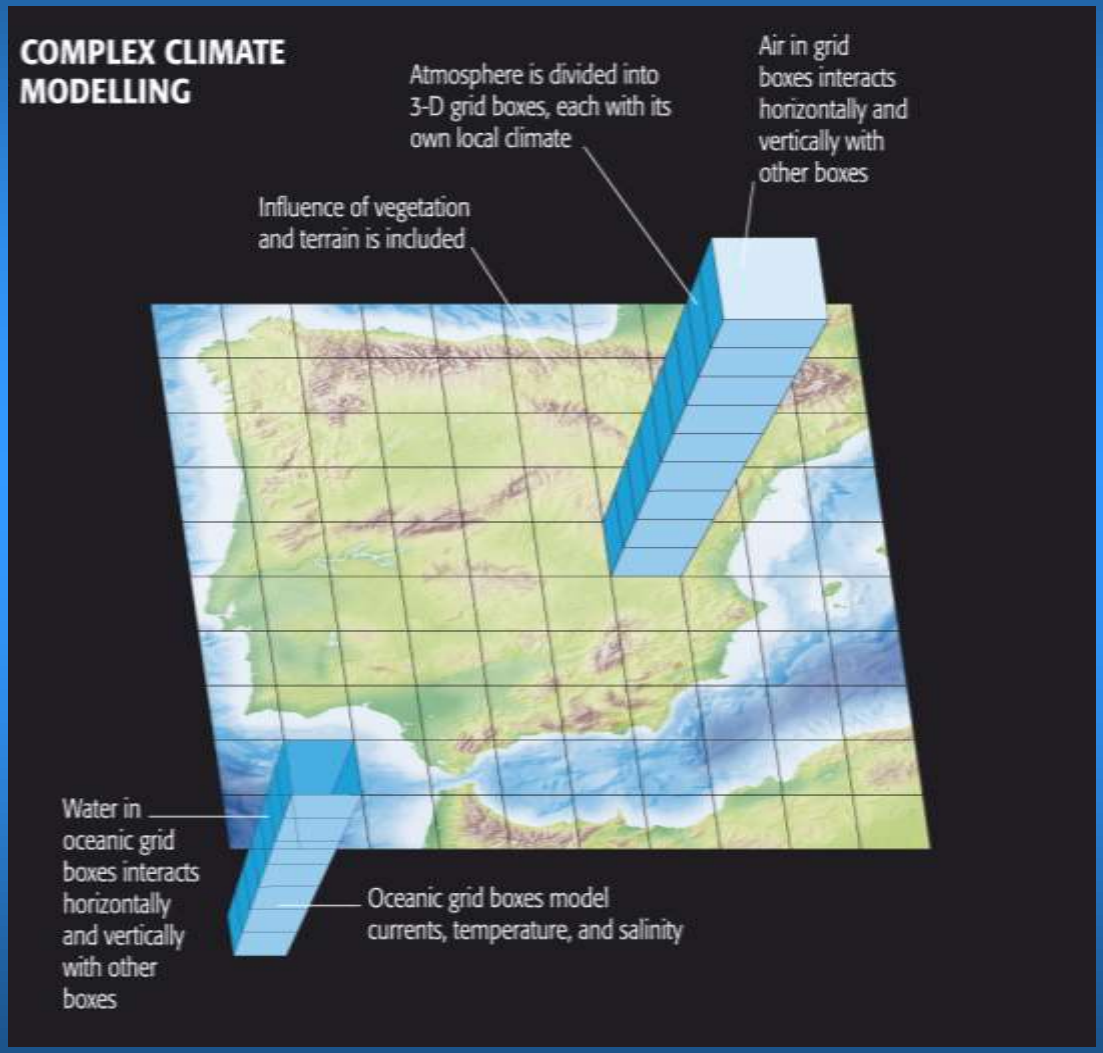


El Niño-Southern Oscillation (ENSO) (Pages 90, 199)

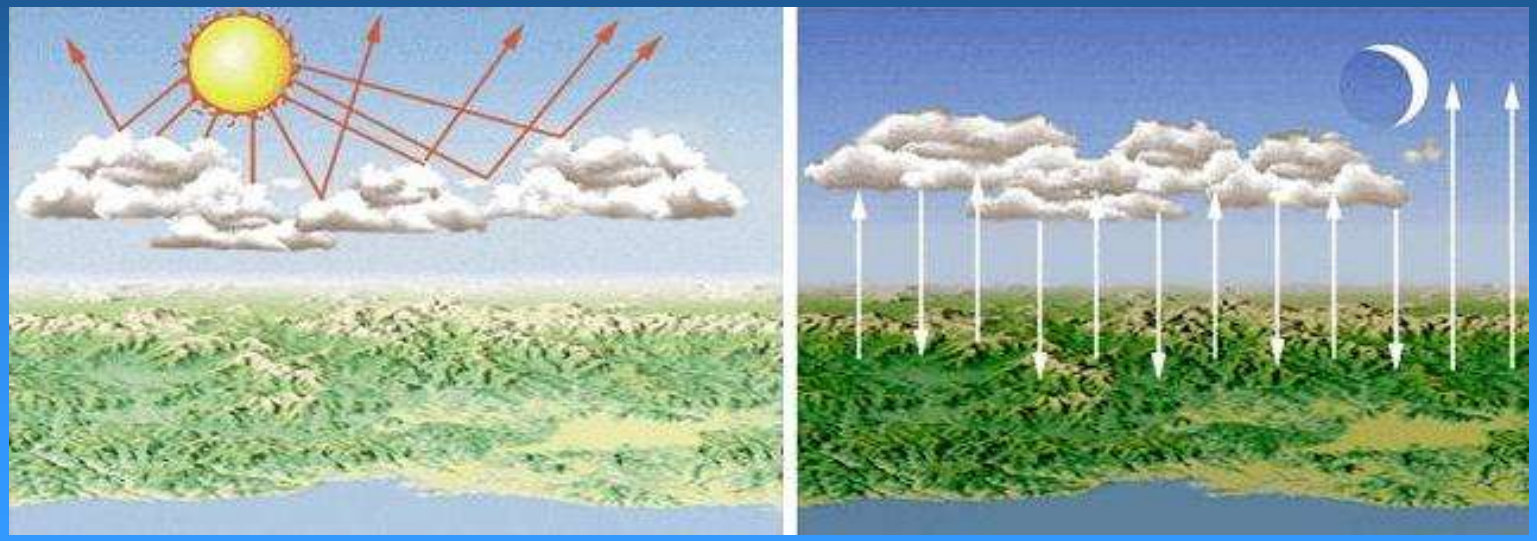


11. Extreme climate anomalies:
Western North American drought,
2003 European heat wave,
hurricane activity,
snow vanishing
(Pages 48-59)

12. General Circulation Models (Pages 65)



13. Climate-Cloud feedback (Pages 25, 31, 178)



14. Climate-Aerosol feedback (Pages 18-19, 45, 179, 184)

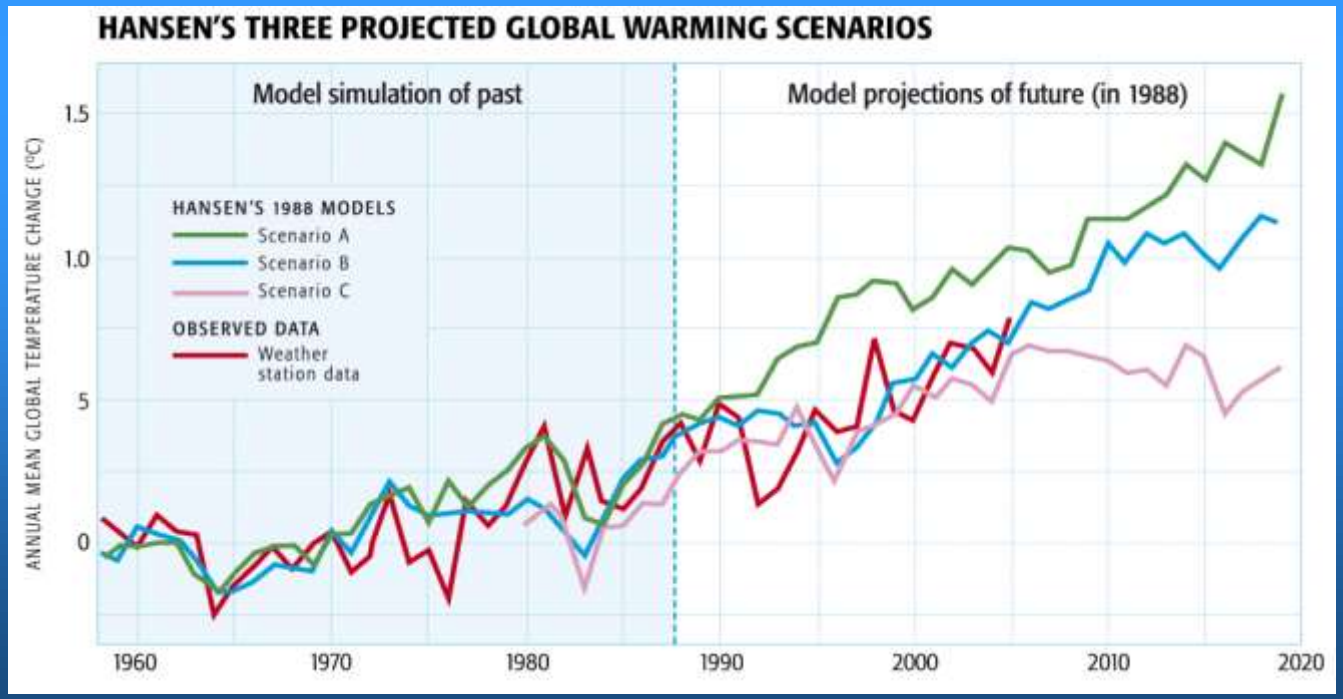
15. How sensitive is the climate? (Page 78-85)

Modern evidence

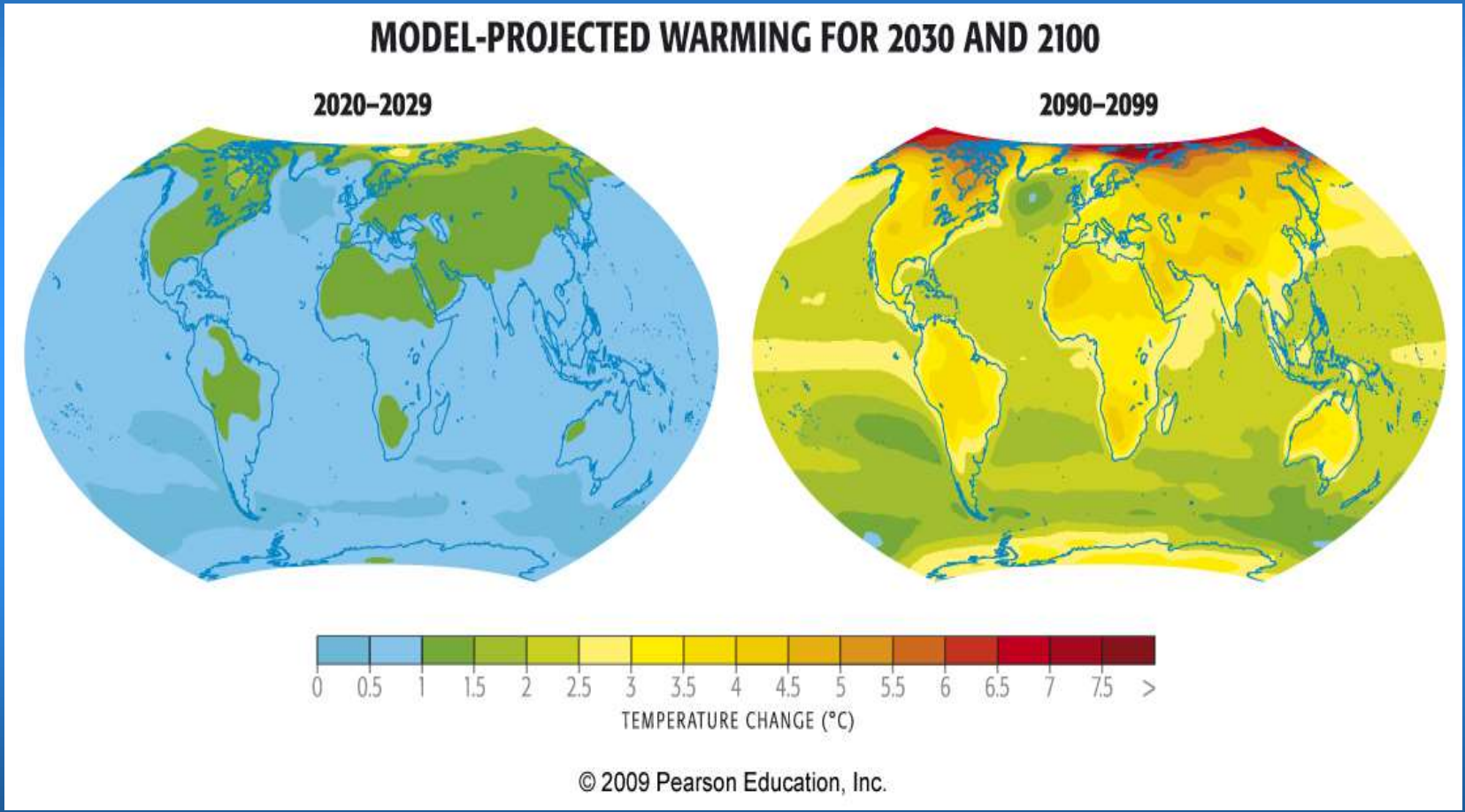
Evidence from the past centuries

Evidence from deep time

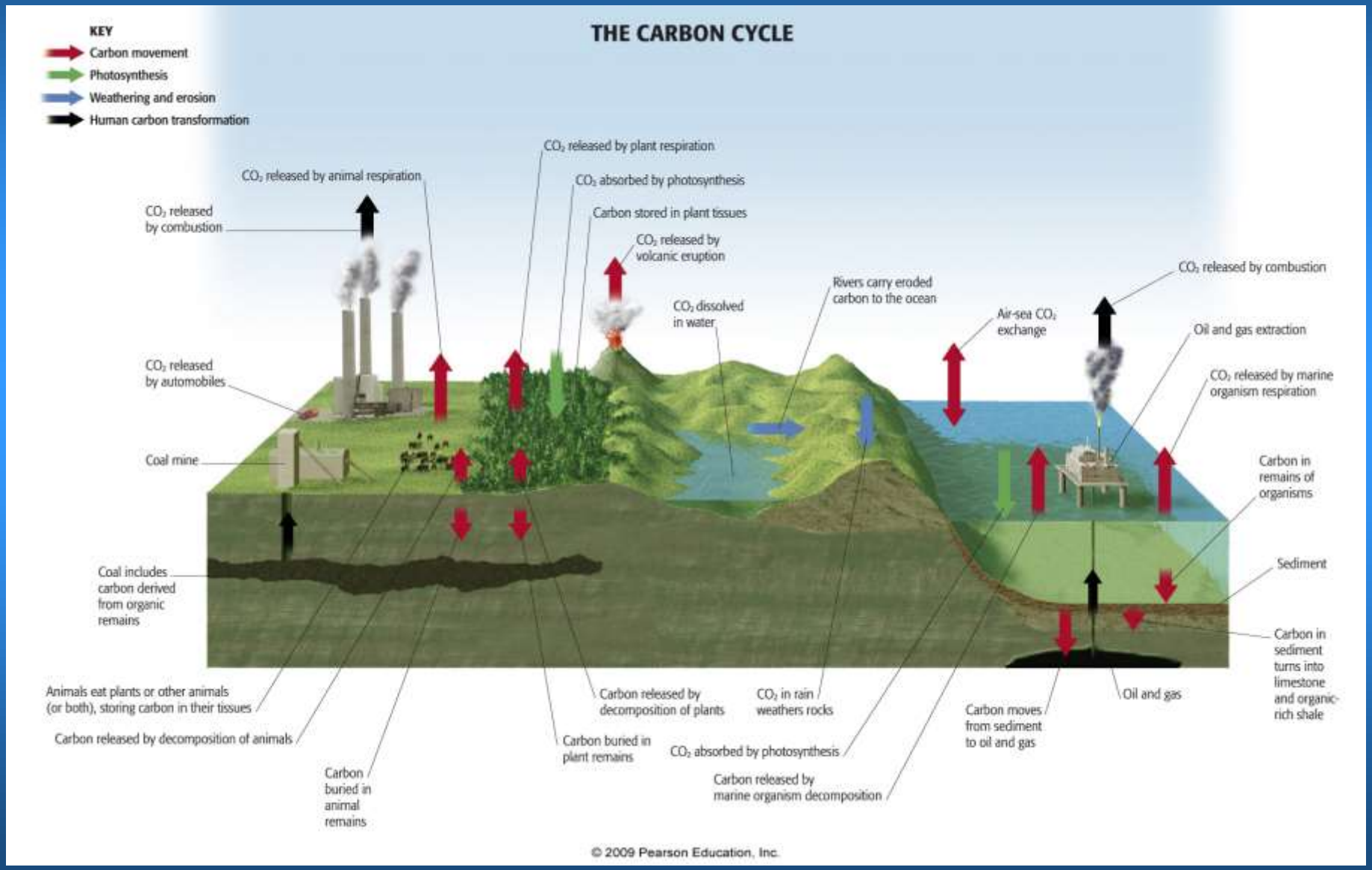
16. Fossil-fuel emissions scenarios (Page 86-91)



17. Geographical pattern of future warming
(Page 92-93)



18. Nature's response to CO2 increase (Page94-97)

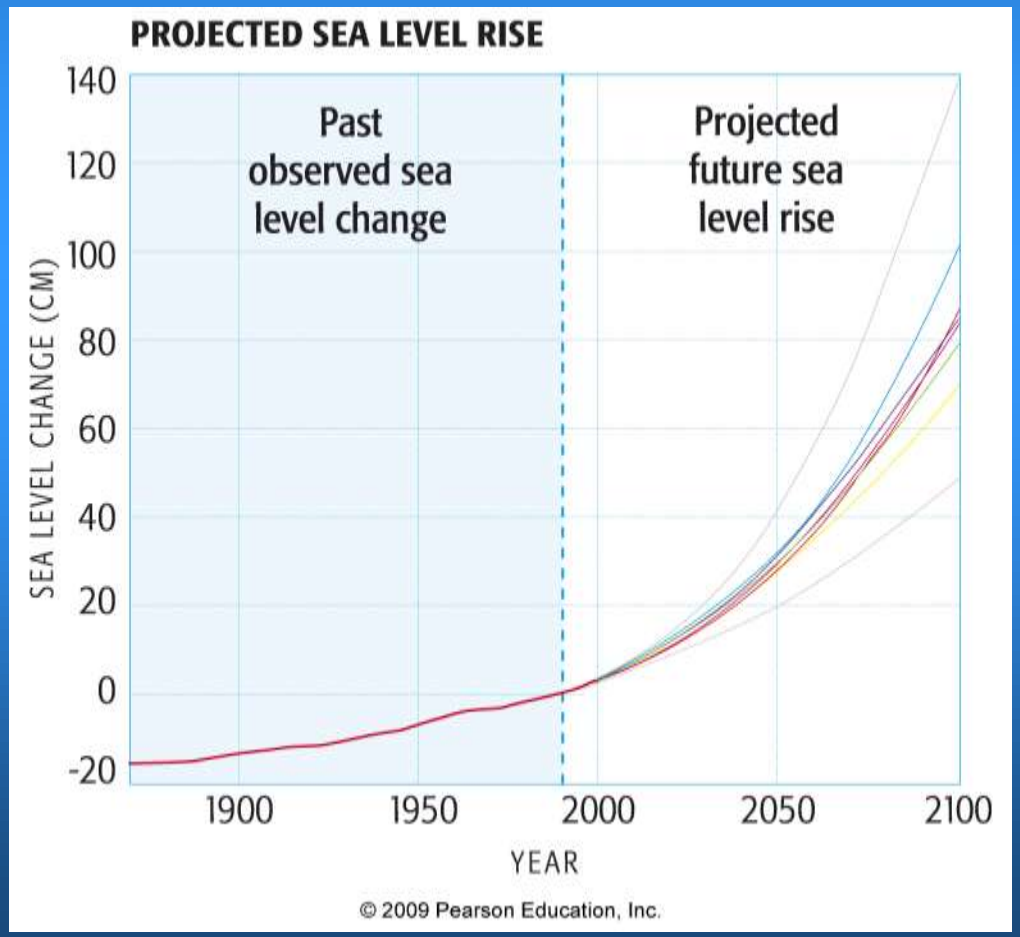


19. Changes in the Oceans (Page 98-99)

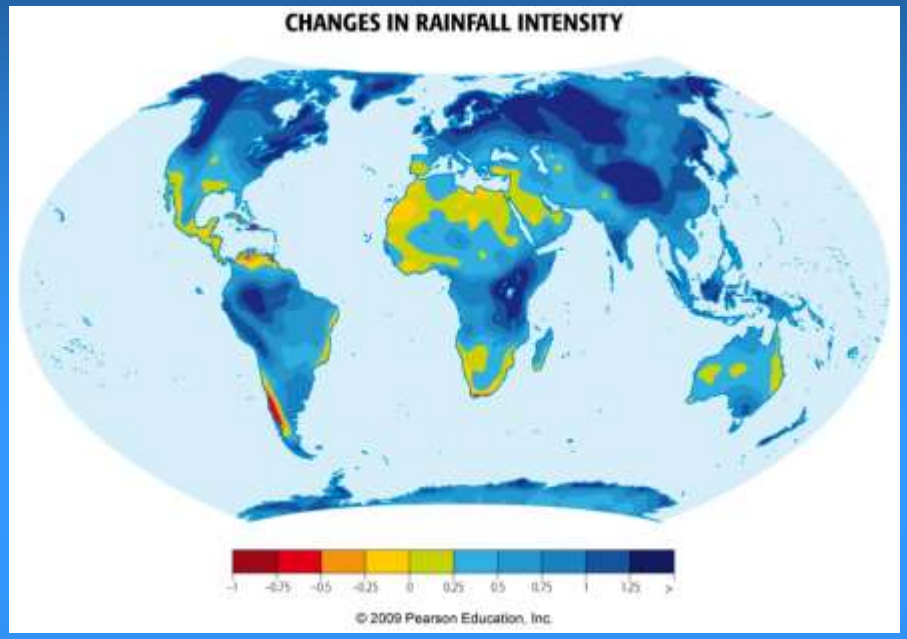
Polar Ice Melting

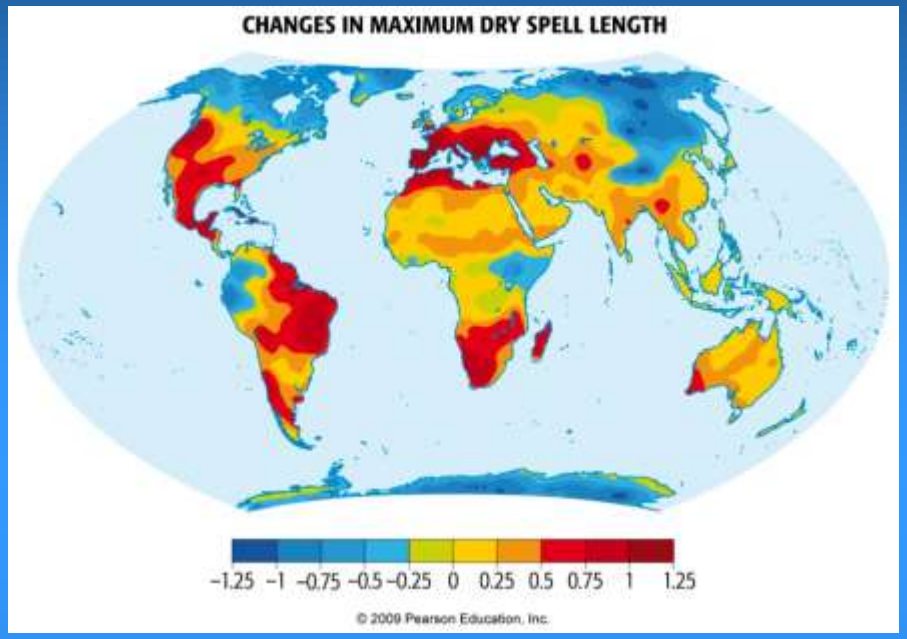
Ocean acidity increase

Rising Sea Level



20. Future changes in extreme weather
(Page 100-103)





21. Is a greenhouse world a better world
(Page 104-105)

Second Exam