

Chapter Outlines

NOTE: This is intended to help students 'organize' their understanding of each topic. It is not a comprehensive study guide for quizzes or midterms, i.e. study your text!

Chapter 20 – World Climates

I. The climate system

Climate is an aggregate of weather involving the exchanges of energy and moisture that occur among the: atmosphere, hydrosphere, solid Earth, biosphere, and cryosphere (*ice and snow*)

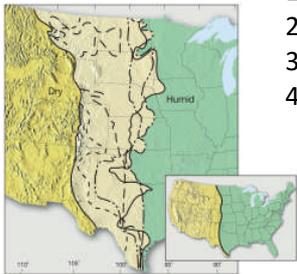
II. World climates - the most important elements in a climatic description are t° and precipitation

III. Climate classifications – many climate classification systems have been devised

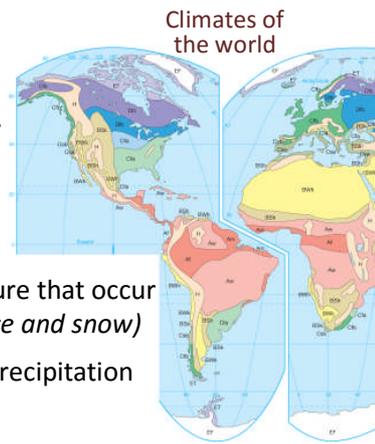
A. Köppen classification of climates – the best known and most used system

1. Uses mean monthly and annual values of t° and precipitation
2. Divides the world into climatic regions in a realistic way
3. Boundaries Köppen chose were largely based on plant associations
4. Five principal climate groups:
 - a. **Humid tropical (A)**
 - b. **Dry (B)**
 - c. **Humid middle-latitude with mild winters (C)**
 - d. **Humid middle-latitude with severe winters (D)**
 - e. **Polar (E)**
5. A, C, D, and E climates are defined on the basis of t° characteristics
6. Precipitation is the primary criterion for the B group

Köppen Climate classifications



The U.S. is much more humid in the east...



HUMID TROPICAL	
Wet Tropics (Af, Am)	
Tropical Wet and Dry (Aw)	
DRY	
Steppe	Low Latitude (BSh) Middle Latitude (BSk)
Desert	Low Latitude (BWh) Middle Latitude (BWk)
HUMID MIDDLE-LATITUDE (Mild Winter)	
Dry-Summer Subtropics (Csa, Csb)	
Humid Subtropics (Cfa)	
Marine West Coast (Cfb)	
HUMID MIDDLE-LATITUDE (Severe Winter)	
Humid Continental, Warm Summer (Dfa, Dwa)	
Humid Continental, Cool Summer (Dfb, Dwb)	
Subarctic (Dfc)	
POLAR	
Tundra (ET)	
Ice Cap (EF)	
HIGHLAND	
Highland (H)	

IV. Köppen climates

A. Humid tropical (A) climates

1. Winterless climates, with all months having a mean t° above 18°C (65°F)
2. Two main types

- a. Wet tropics - high t° and year-round rainfall...
luxuriant vegetation (*tropical rain forest*), discontinuous belt astride the equator, strongly influenced by the equatorial low pressures
- b. Tropical wet and dry - poleward of wet tropics and equatorward of the tropical deserts...
tropical grassland (*savanna*), and seasonal rainfall



Tropical rain forest

B. Dry (B) climates - evaporation exceeds precipitation and there is a constant water deficiency

1. Boundary determined by formulas involving three variables:
average annual precipitation, average annual t° , seasonal distribution of precipitation
2. Two climatic types

- a. Arid or desert (**BW**)
- b. Semi-arid or **steppe (BS)** - More humid than arid climate, and may surround desert

3. Causes of deserts and steppes

- a. In the low latitudes – N. Africa to northwestern India, northern Mexico, SW United States...
coincide with the dry, stable, subsiding air of the subtropical high-pressure belts
- b. Mid-latitude deserts and steppes - most are located in the Northern Hemisphere...
due to locations in the deep interiors of large landmasses and/or the presence of high mtns



Global distribution of deserts



Savanna/Steppe

C. Humid mid-latitude climates with mild winters (C climates)...

Average t° of the coldest month is below 18°C (65°F) but above -3°C . Subgroups include:

- a. Humid subtropics...
eastern sides of continents, 25° to 40° latitude (*SE United States*) range, hot, sultry summers, mild winters, winter precipitation is generated along fronts
- b. Marine west coast...
western (*windward*) side of continents, 40° to 65° north (*Washington & British Columbia*) and south latitude, onshore flow of ocean air, mild winters and cool summers
- c. Dry-summer subtropics...



Marine West Coast

west sides of continents between latitudes 30° and 45° (*California*), strong winter rainfall maximum, often called a Mediterranean climate

D. Humid mid-latitude climates with severe winters (**D climates**) - absent in the S. Hemisphere, average temperature of the coldest month is below -3°C and the warmest monthly mean exceeds 10°C, these are land-controlled climates. Subgroups include:

a. **Humid continental...**

confined to the central and eastern portions of N. America and Eurasia between 40° and 50° N latitude (*Wisconsin*), severe winter and summer t°, high annual t° ranges (*spread*), precipitation is generally greater in the summer than in the winter, snow remains on the ground for extended periods



Eastern N. America

b. **Subarctic...**

north of the humid continental climate (*mid to northern Canada*), often referred to as the taiga climate, largest stretch of continuous forests on Earth, source regions of **cP** air masses, frigid winters, remarkably warm but short summers

E. Polar (**E**) climates - enduring cold, meager precipitation, mean t° of the warmest month is below 10°C

Two types of polar climates:

a. **Tundra climate (ET)...**

treeless climate, almost exclusively in the N. Hemisphere, severe winters, cool summers, high annual t° range (*spread*)



Arctic Tundra (summer)

b. **Ice cap climate (EF)...**

no monthly mean above 0°C, permanent ice and snow

F. Highland climates (**H**)...

usually cooler and wetter than adjacent lowlands, great diversity of climatic conditions, best described by the terms *variety* and *changeability*

V. Human impact on global climate

A. Humans have been modifying the environment over extensive areas for thousands of years by using fire, and by overgrazing of marginal lands

B. Most hypotheses of climatic change are to some degree controversial

C. Global warming

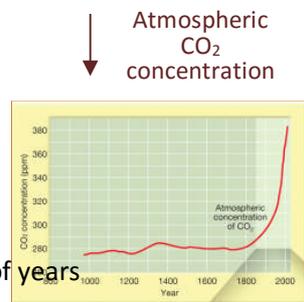
1. Water vapor and CO₂ absorb heat and are largely responsible for the greenhouse effect of the atmosphere
2. Burning fossil fuels has added great quantities of CO₂ to the atmosphere



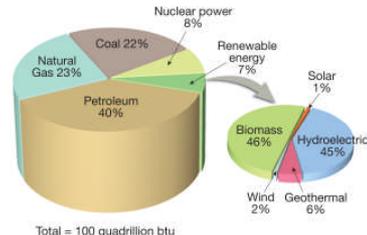
Human activity

D. Response of the atmosphere...

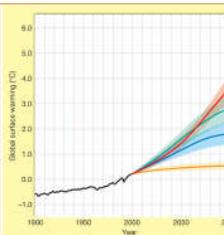
1. Global temperatures have increased...
 - a. Balance of evidence suggests a human influence on global climate
 - b. Globally averaged surface t° is projected to increase by 1.4° to 5.8° by year 2100
2. The role of trace gases - taken together, their warming effects may be nearly as great as that of CO₂
 - a. Atmospheric trace gasses include: methane, nitrous oxide, certain chlorofluorocarbons
 - b. Absorb wavelengths of outgoing Earth radiation



Atmospheric CO₂ concentration



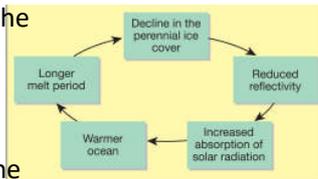
Where our energy comes from...



T° increase & "guessed" future increase...

VI. Climate feedback mechanisms - possible outcomes of altering the climate system:

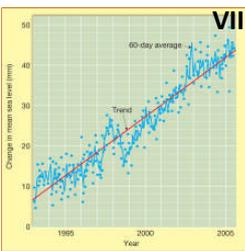
- A. Positive-feedback mechanisms reinforce the initial change
- B. Negative-feedback mechanisms produce results that are the opposite of the initial change and tend to offset it



Melting ice gives positive feedback

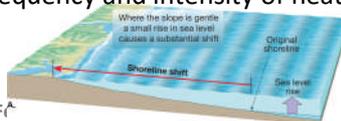
VII. Some possible consequences of global warming

- A. Altered distribution of the world's water resources and the effect on the productivity of agricultural regions
- B. Rise in global mean sea level thereby impacting coastal inhabitants
- C. Changing weather patterns may include: higher frequency and intensity of hurricanes, shifts in the paths of large-scale cyclonic storms, changes in frequency and intensity of heat waves and droughts



Sea level rise 35mm since 1980

← 35 mm →



Sea level rising