Part II Climates:

Climate is the average of weather over a twenty to thirty year period,

-1.Temperature: by month/year and threshold temperature
-2.Rainfall: by month/year and threshold amounts
-3.Soil-environment/temperature/moisture
-4.Vegitation: xerophyte (cactus)
-5.Economic component: mining farming

Block soil is rich, warms up and cools down fast
In the South we have a red soil. Rain is mixing with Iron to create rust FE2O3.
Yellow color means baked soil (Yellow River/Yellow Sea)

Climate Classification Coded within Last 100 years developed by Vladimir Koppen

A *Temperature Based Tropical Climates*
Average temperature is above 64° F (18° C). Notice that tropical climates have no third letter: there is little or no seasonality in temperature, so no third letter is needed. The seasonality in precipitation is taken care of by the second letter.

Af
Tropical Rainforest. Second letter **f**, no dry season, wet all year, with at least 2.4" (6 cm) of rainfall each and every month Selva vegetation covers the area.

Am

Monsoon. Second letter **m**, seasonally high rainfall, short but distinct dry season with less than 2.4" (6 cm) of rainfall in the driest month.Selva is found here also.

Aw

Savanna. Second letter **w**, dry season in winter with at least one month less than 2.4" (6 cm) of rainfall.This can be of a parkland with isolated trees or primarily grassland.

Dry Climates

B *Precipitation Based Dry Climates*

Evapotranspiration (evaporation plus transpiration from plants) equals or exceeds precipitation. Because of this, there is no surplus water in the B climate areas, and no permanent streams can form there. Streams crossing B climate areas are usually "exotic" meaning that they originate in more humid areas. An example of this would be the Nile. The B climate is by far the largest climate area. 7% or more of the precipitation falls in the summer months; winter precipitation concentration (dry summer) 70% or more of precipitation falls during the 6 winter months; neither summer nor winter precipitation concentration: fits neither of the above conditions, more or less even precipitation. It is important to note that most deserts are not sandy.They may have sandy areas in some locations.

Low latitude (hot) desert. Second letter **W**, arid; third letter **h**, hot. Potential Evapotranspiration is more than twice available precipitation. Mean annual temperature is over 64° F (18° C).Life is quite sparse and adapted to low rain fall.Egypt

BWk

Mid latitude (cool or cold) desert. Second letter **W**, arid; third letter **k**, cold (from German Kalt). Potential Evapotranspiration is more than twice available precipitation. Mean annual temperature is less than 64° F (18° C).Afghanistan

BSh

Low latitude (hot) steppe. Second letter **S**, semi arid; third letter **h**, hot. Potential evapotranspiration is up to twice available precipitation. Mean annual temperature is over 64° F (18° C). This usually has a short grass and is not suitable for cattle grazing but can do sheep or goats.

BSk

Mid latitude (cool or cold) steppe. Second letter **S**, semi arid; third letter **k**, cold (from German Kalt). Potential evapotranspiration is up to twice available precipitation. Mean annual temperature is less than 64° F (18° C).This can be an area of dry cereal farming or cattle grazing.

Question? Why do we find this environment in many western movies?

C *Temperature Based Humid Mesothermal*

The coldest month is between 27° F and 64° F (-3° C to 18° C). At least one month averages above 50° F (10° C), so there are definite summer and winter seasons, although mild. If snow falls, it does not linger long. Those with **a** as third letter are hot-summer, with the warmest month over 72° F (22° C); those with **b** as third letter are warm summer, with warmest month below 72° F (22° C); those with **c** as third letter are cool, short summer, with less than 4 months over 50° F (10° C).These climates are usually located proximal to coasts and may have great amounts of rainfall similar to monsoon locations.

Cfa
Humid subtropical. Second letter **f**, no dry season. Mild, no dry season. Precipitation of the driest month averages more than 1.2" (3 cm). It is possible to have snow and frost in these locations but the growing season is usually long.

Cfb, Cfc
Marine west coast. Second letter **f**, no dry season. Same as above, but cooler due to position on continents with respect to prevailing westerlies.You may find fruit trees, viticulture and bocage or maqui type of vegetation here.

Cwa, Cwb
Subtropical monsoon. Second letter **w**, dry winter season. Dry winter (**w** designation) with a wet season in the summer. 70% or more of the precipitation comes during the 6 summer months.In the US, this is the location of the redwood forests.

Csa, Csb
Mediterranean. Second letter **s**, dry summer season. Dry summer (s designation) with driest summer month less than 1.2" (3 cm). 70% or more of the total precipitation comes during the 6 winter months. Citrus trees and truck crops with irrigation are common in these environments. You can see this type of climate in the Crimea.

D *Temperature Based Humid Microthermal*
Snow climate. The coldest month averages below 27° F (-3° C). The warmest month averages above 50° F (10° C). Snow usually falls and stays for at least part of the year. Third letter designations **a**, **b**, and **c** are the same as for **C** climates. **D** climates with a third letter designation of **d** are very-cold winter climates, with the coldest month below -36° F (-38° C).These climates are found at high latitudes in the northern hemisphere or in interior continental locations.

Question? Why are these climates not found in the southern hemisphere?

Dfa, Dfb, Dfc, Dfd
Snow climate with wet winter, no dry season. Third letter designations: **a** is hot summer, **b** is warm summer, **c** is cool summer, **d** is cold winter (subarctic).

Dwa Dwb Dwc Dwd
Snow climate with dry winter. Third letter designations: **a** is hot summer, **b** is warm summer, **c** is cool summer, **d** is cold winter (subarctic).

Note. Many of the D climates resemble deserts but with low temperature comes short growing seasons and a minimal need of water.

E *Temperature Based Polar*

Average temperature of the warmest month is below 50° F (10° C). Only two letters are needed because these climates have no summer. They are routinely cold and usually the precipitation comes in the form of snow. Vegetation is hardy and stunted and animals are adapted to the cold and snow .

ET
Tundra. The warmest average month is above 32° F (0° C) but less than 50° F (10° C). Very short growing season. Permafrost is common to this environment.

EF
Ice cap. Permanent snow and ice, average temperature of all months is below 32° F (0° C). There is no growing season. Glacier may migrate during the summer months in both north and south hemispheric locations.

EM
Island locations at high latitude. Very few locations. Cold and windy suitable for sheep.

H
TC,TT,TF and Paramos

Elevation Based Mountain Climates
This designation is for those areas in which climatic conditions change so quickly over a short horizontal distance due to elevation changes. Mountain climates are variable over a short distance, but they must fit into the surrounding general climate. In general, mountain climates are colder and wetter with increased altitude, although there are some exceptions to the wetter generality. (Sometimes shown as "G" climates on some maps.) These have some of the oldest cultures associated with them and have specialized crops and farming techniques also

The Changing Climate *extra reading notes*

-Average Atmospheric Values
-Variability of elements
-occurrence of extreme events

Exchange of energy and moisture within Atmosphere

-hydrosphere
-Biosphere
-Lithosphere
-cryosphere

Climate has varied extensively through time
Human Activities effect environment

Evidence used to detect change
- -Sea floor sediment
- -Oxygen Isotope analysis
  - -glacial Ice
  - -old Soils
  - -tree rings
  - -documentation

Sea floor sediment contains remains of organisms that once lived at the surface.
- -Surface and organisms changed and adapted with climate
- -JOIDES Resolution collects cores from sea floor

Oxygen Isotope analysis
- -precise measurement of ratio between common Oxygen16 and heavier uncommon Oxygen18
- -O16 evaporates more readily from Oceans leaving greater amounts of)18 in ocean

Study of Buried soils Paleosols
Yearly growth of tree rings
Pollen in Sediment

Natural Mechanisms of Climate Change

1.**Plate Tectonics**: continental plates shifting
2.**Volcanic Activity**: reducing solar radiation, changing landscape
3.**Solar Variability**: variations in output, sunspot surplus can cause global temperature to rise
4.**Variations in Earth's orbit**: Milonkovitch cycle:axial tilt change(obliquity), wobble(precession) shape of orbit(eccentricity)

Human Impact on global Climate
- -use of fire
- -overgrazing
- -modifying surface albedo
- -Addition of C02 in the atmosphere
- -Addition of trace gasses
  - -Methane
  - -Nitrous Oxide
  - -CFC's
- -These all lead to global warming trends
  - -Sea level rise
  - -Melting of glaciers
  - -increase in ocean volume due to temperature expansion of water molecules
  - -shoreline erosion

Climate of Urban areas/Cities different from surrounding or non urban areas

-Cloudier
-Foggier
-Warmer
-Wetter

Urban Heat Island

-Highest temperatures are seen where building density is highest, and industry is present

end of reading notes

Eastern Massachusetts is a **Cfa** climate
Western Ma is like a **D** climate

Characteristics of Climate Types

A
every month has temp over **64** degrees F
Selva
Tropical evergreen dense hardwoods
Vines connecting to ground **liana**
Bottom story is **fern**
bananas, cacao, nuts, fruits rubber
plantations
Soil is Tierra (red)

B
Steppes, Desert
Mining, raw materials
indigenous peoples, nomad
Camels, sheep, goat
short grasses

C
Influenced by the sea
one or months above 50 degrees F
Deciduous leaf trees
Pedocal Soil, Podzol soil
Fruit trees ex.) pecan, apples, walnuts, peaches

D
One or month above 50 degrees F and one or month below 32 degrees F
Evergreen and **Taiga** trees
Coniferous forest
paper pulp

E
Average Temp of warmest month is less than 50 degrees F

Ice cap, Frozen tundra, **permafrost.**

H
Paramous is highest elevation: devoid of vegetation
Tierra Fria
Tierra Templada
Tierra Caliente Lowest elevation