Bison on rangeland in South Dakota, NPS photo

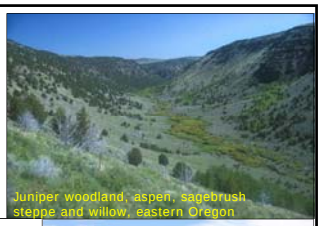
Causes of Landscape Pattern

What is meant by 'landscape pattern'?

Causes of landscape pattern

Your text discusses:

- Abiotic factors
- Biotic factors

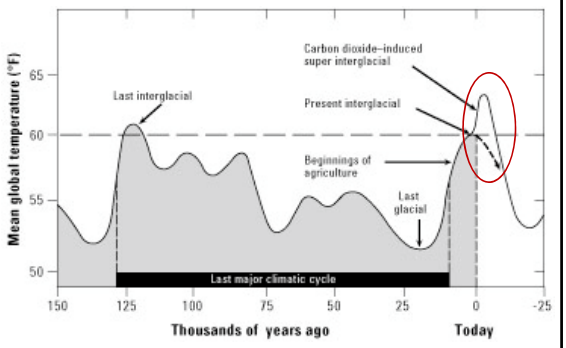


Juniper woodland, aspen, sagebrush steppe and willow, eastern Oregon

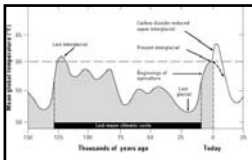
Mixed prairie, Sandhills, western Nebraska

Spruce forest, aspen, and willow, southeastern Alaska

Climate change over the past 150,00 years



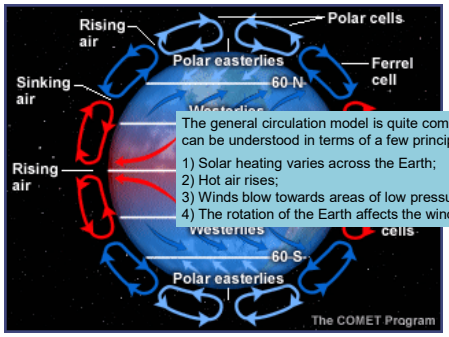
Source: T,G & O 2001, Figure 4.2



Glacials and interglacials

- Glacials and interglacials occur in fairly regular repeated cycles.
- The timing is governed to a large degree by predictable cyclic changes in Earth's orbit, affecting the amount of sunlight reaching Earth's surface.
- The three orbital variations are:
  - o changes in Earth's orbit around the Sun (eccentricity)
  - o shifts in the tilt of Earth's axis (obliquity)
  - o the wobbling motion of Earth's axis (precession)

Global Atmospheric Circulation Model

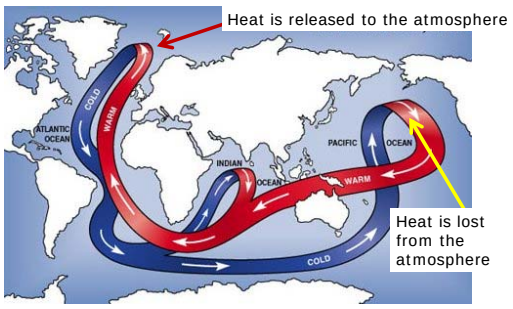


The general circulation model is quite complex but can be understood in terms of a few principles:

1) Solar heating varies across the Earth;
2) Hot air rises;
3) Winds blow towards areas of low pressure;
4) The rotation of the Earth affects the winds

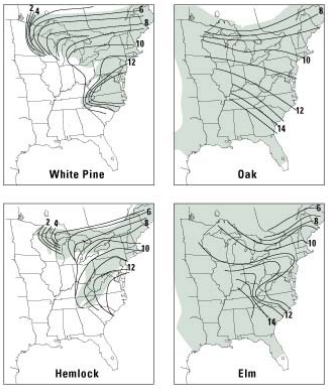
Source: DLESE

Global Ocean Circulation



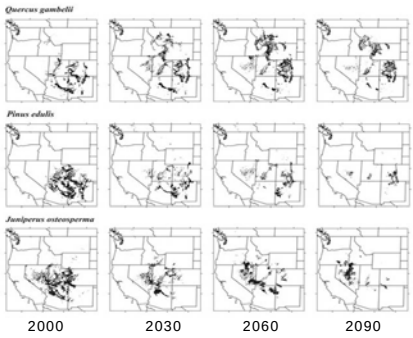
Source: NASA

Changes in range limits for four tree taxa during the late Quaternary Period based on pollen records



Source: T,G & O 2001, Figure 4.3

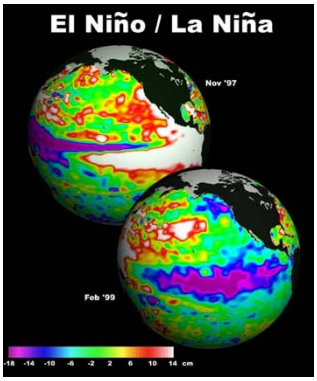
Forecasted continued change



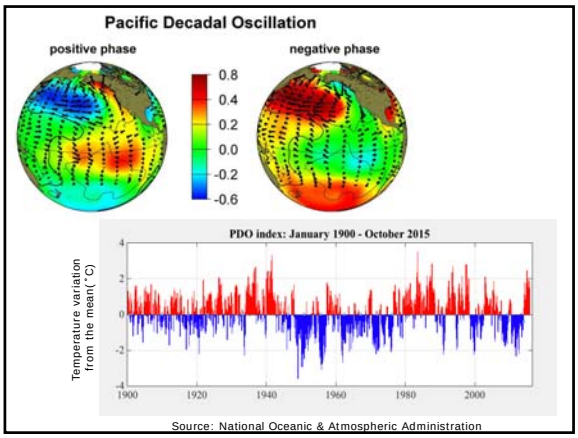
from Rehfeldt et al. 200

El-Nino, La-Nina, Southern Oscillation (ENSO)

- Describes fluctuations in temperature between the ocean and the atmosphere in the east-central Equatorial Pacific
- El Niño - warm phase
- La Niña - cold phase
- El Niño and La Niña episodes typically last 12 months but can last for several years.
- Typically occur every 3-5 years
- What phase do you think we are in now?

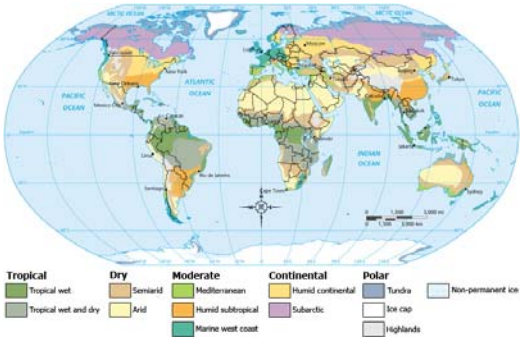


Source: National Oceanic & Atmospheric Administration



Source: National Oceanic & Atmospheric Administration

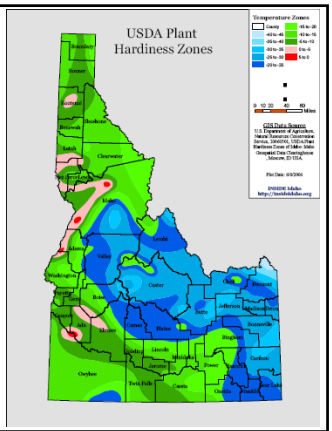
Climate Zones of the World



Source: http://en.wikipedia.org

Macroclimate variation in Idaho

What factors influence regional climate?



Source: http://insideidaho.org/asp/atlas_home

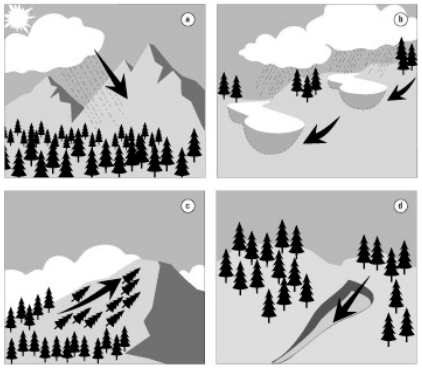
Topographic influence on:

A) rain and radiation

B) soil and surface water flow

C) Wind flow patterns

D) Soil surface movement and landslides



Source: T,G & O 2001, Figure 4.5

These topographic influences then in part result in the pattern we see for this area in the Steens Mountains in eastern Oregon.

What evidence of other influences on pattern do we see evidence of in this photo?

Causes of landscape pattern

- **Environmental conditions**
  - Topography, climate, geomorphology, soils, etc.
  - Regional biota

Why would biota be considered part of the environmental conditions?

- **Secondary succession** as driven and affected by the biotic processes such as: mortality-natality (birth-death), dispersal, reproductive strategy, disease, herbivory, competition, etc.
- **Disturbance and stress:** human-caused and natural
- **Data and map resolution**
  - Spatial and temporal grain and extent
  - Thematic resolution: # of classes

Biotic components that may impact landscape pattern

Species interactions

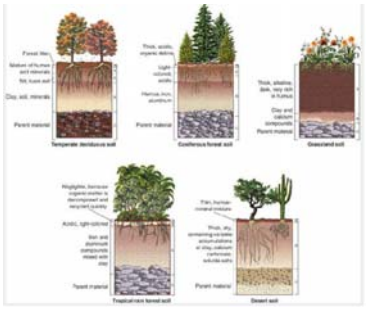
Mutualism (++), Commensalism (+0), Predation, Herbivory, Parasitism (+-), Amensalism (0-),

Competition (- -)

Soil formation factors

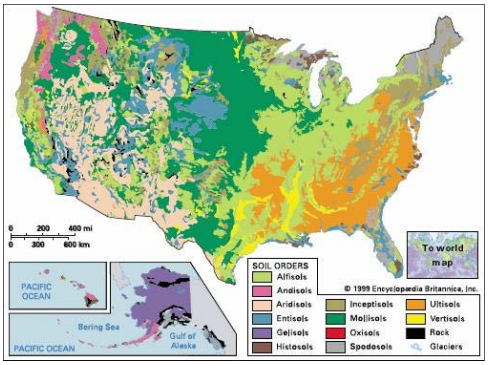
Soil = f(parent material, topography, organisms, climate and time)

Typical soil profiles from different ecosystems



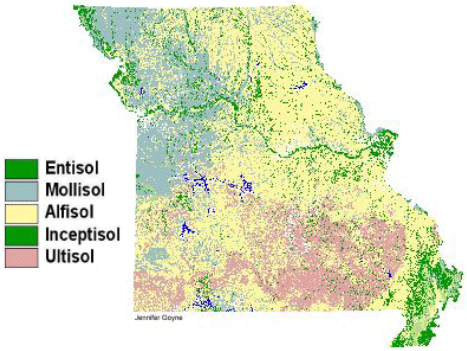
Source: www.geography.hunter.cuny.edu

Soil Orders of the United States



Source: http://soils.ag.uidaho.edu/soilorders/

Soil Orders for Missouri

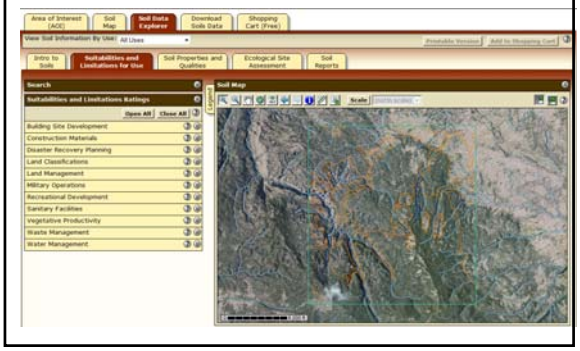


Source: Missouri State Cooperative Soil Survey

Web soil survey

http://websoilsurvey.sc.egov.usda.gov/

Soil polygons, web soil survey



Major disturbances resulting in landscape pattern

Fire

Photo by Dale Wade, forestryimages.org

Herbivory

Photo by Minnesota Public Radio

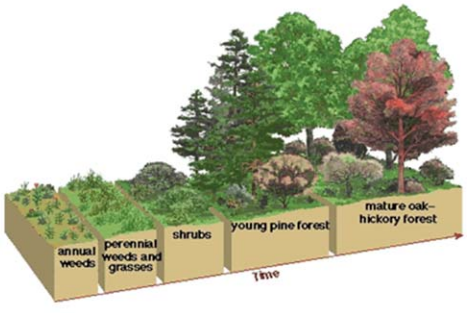
Human activities

Photo by Dennis Knight, T,G & O 2001 Figure 1.2

Climatic variation

Photo by James Solomon, forestryimages.org

Example of secondary succession in hardwood forest vegetation- classic old field succession

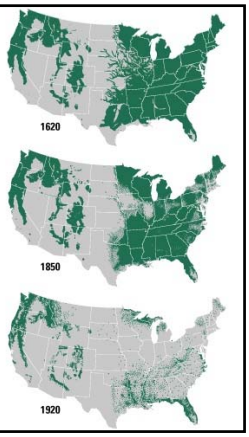


Source: Department of Geosciences, University of Arizona

Effects of human land use and subsequent disturbance

Approximate area of old growth forest in the contiguous United States in 1620, 1850, and 1920

How has the changing extent and pattern of forest influenced ecological processes?



Source: T,G & O 2001, Figure 4.7

Landscape pattern

- Spies et al. (1994) contrasted the pattern and extent of coniferous forest (in green) through time on adjacent private and public lands

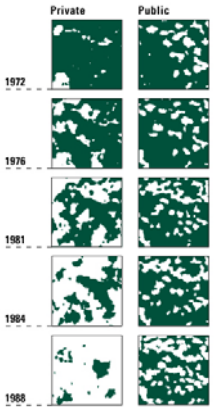


Figure 5.3 from T, G & O. 2001, redrawn from Spies et al. 1994

Fragmentation

- Breaking up of a habitat or cover type into smaller, disconnected parcels (Turner et al. 2001)
- Changes in patch distribution, size and characteristics
  - Fewer patches → less total area of habitat
  - Smaller patches
    - Less interior habitat
    - More edge habitat
  - Increasing isolation of residual habitat patches

Modern Agriculture

Snake River Plain, southern Idaho

Landscape pattern has changed greatly in many places due to agriculture and urbanization

- Changing forest cover in Cadiz township, southeastern Wisconsin
- Extent and pattern have changed
- What are the ecological implications of this change?
- Similar patterns on the Palouse Prairie

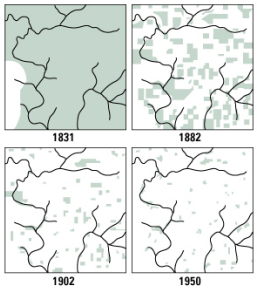
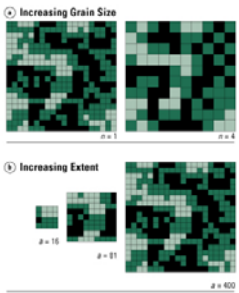


Figure 5.1 from T, G & O 2001, adapted from Curtis 1956

The characteristics of data can influence pattern

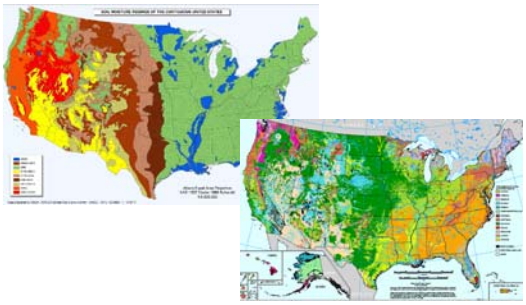
Data and map resolution- grain & extent



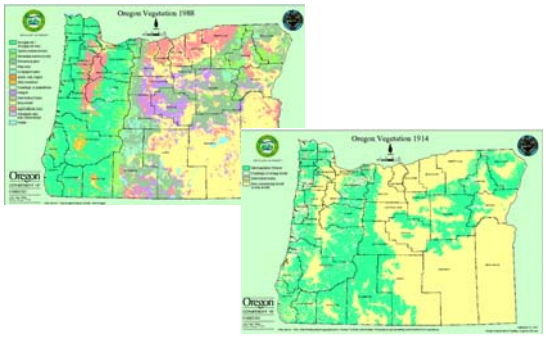
Source: T,G & O 2001, Figure 2.2

The nature characteristics of data can influence pattern

Data and map resolution- thematic resolution



Changing Thematic Resolution



Source: www.odf.state.or.us/atlas/maps/v1988.gif

What are the limitations to increasing thematic resolution?

- Increased data requirements
- Increased computational time
- Decreased map accuracy
- The important variables may actually be masked by more classes

Summary points

- Pattern may be caused by both abiotic and biotic factors
- These factors' influences may be nearly static (e.g. topography) or dynamic (e.g. disturbance)
- Some factors are a combination of abiotic (e.g. climate) and biotic factors (e.g. herbivory)
- Humans play an increasing role in the pattern of landscapes
- The nature of our data may result in different patterns