BIOMES

- Causes of biome patterns:
  - Why are there tropics?
  - Why are there deserts?
  - Why do different biomes occur where they do?

- Causes of climate variation:
  - Why do temperatures vary?
  - Why does rainfall vary?

Weather vs. Climate

- Weather is short-term:
  - "Heavy rains all day"
  - Influenced by changing atmospheric pressure zones & seasons.

- Climate is long-term (>year)
  - Average
  - Variability

Three Factors Setting Climate Averages

1) Latitude & Insolation
2) Ocean Currents
3) Topography

Latitude & Insolation

- Tropical Insolation
  - Concentrated
  - Heats up surface

- Polar Insolation
  - Spread out
  - Ice cap albedo reflects it
    - Albedo ↓ w/ global warming

- Why is Nova Scotia like Scotland?
- Why isn't it like Spain?

Latitudinal Distance
Spain-Scotland
- SF Cabs
A Second Global Influence
On Climate Averages

1) Latitude & Insolation
2) Ocean Currents
3) Topography

Spinning Earth
Creates Ocean Currents

- Water has inertia
- Spinning creates gyres
- Gyres move ocean's temperatures - Gulf Stream

The Gulf Stream:
A Gyre Moving Heat

- Gulf Stream:
  - Spain warmer than Nova Scotia
  - Nova Scotia is like Scotland

Gyres Move Heat,
Affecting Climates

Different Climates
On East Vs. West Coasts

- East Coasts get equatorial currents.
- West Coasts get polar currents.
Different Climates
On East Vs. West Coasts
- East Coasts get equatorial currents.
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  - also have upwelling.
- Cold air holds less moisture.
  - Fog as a result.

Coasts Have
More Stable Climates
- East Coasts get equatorial currents.
- West Coasts get polar currents
  - also have upwelling.
- Cold air holds less moisture.
  - Fog as a result.
- Water more stable

The Last Factor
Setting Climate Averages
1) Latitude & Insolation
2) Ocean Currents
3) Topography

Adiabatic Cooling & Heating:
Principles & Precipitation
- Rising air expands and cools.
  - Cooling air holds less moisture.
  - It falls as precipitation - as in the mountains.

Adiabatic Cooling & Heating:
Rain Shadows
- Mountains cause air masses to rise, losing H\textsubscript{2}O.
- Hence, the leeward side - Lahaina - is dry.
  - So is the Tibetan plateau.
Another Mountain Effect: 
What Causes This?

- 1000 ft elevation = going north 300 miles

What You’ve Learned So Far:
Distribution Of Climates

- Insolation
  - Northern latitudes get less sun.
  - Albedo of ice caps reflects solar energy.
- Ocean Currents
  - Ocean gyres move tropical warmth along East coasts.
  - Upwelling & polar waters cool West coasts & make fog.
- Topography
  - Mountains cause adiabatic cooling and rainfall.
  - This also caused "rain shadow" effect.
  - But why are there deserts where there are no mountains?
  - Let’s apply adiabatic cooling to a new setting.

Hadley Cells Drive Movement
Of Heat And Moisture

- Heating creates Hadley cells.
  - Adiabatic heating and cooling
  - It’s a global pattern.

Biomes Match Hadley Cells

- These reflect average climates.

What Causes
The Solar Equator & The ITCZ: Inter-Tropical Convergence Zone

Tropics of Cancer & Capricorn are where?
How does rotation around Sun affect seasonal rainfall patterns?

Climate Change Is Real

Nature & Science: The World's Top Science Journals

• Both agree:
  - global warming is very real
  - it’s not part of a normal cycle
  - its cause is OUR CO₂

realclimate.org
skepticscientific.com
Some of our best scientific minds are working on the problem.

Unfortunately, some of our worst political & business minds are too.

El Sapo Dorado of Monte Verde: 1500 in '87

El Sapo Dorado of Monte Verde: Only 1 seen in '88 & '89
What Changed?

- Cloud base moved up
  - With hotter Caribbean SST
- Far longer dry season
  - Favor Chytrid fungus
  - 20 of remaining 50 amphibians now gone

What Else Has Changed?

- Extinctions: several lizard species
- Arrivals: low elevation bird species

Mountains & Climate Change

- ↑ 1000 ft elevation = going north 300 miles
- As Earth warms, mountains get "lower".

Pikas Occupy Mountain Refugia

- Pikas die if exposed to >80°F.
- >25 Great Basin populations found decades ago;
  - only 16 are still there.
- They've moved up 1300' in elevation.
Plants Move Too. Slowly.

- Rapid changes in a vegetation gradient across >2,000m in elevation along the Santa Rosa Mountains in southern California over a 30 yr period.
Species have moved in the past.

• But today our biomes are fragmented.

Everyone talks about the weather, but no one does anything about it.*

• Rely on uninvented technology fix?
• More likely than political/social change?
• What’s the conservative thing to do?

*Charles Dudley Warner