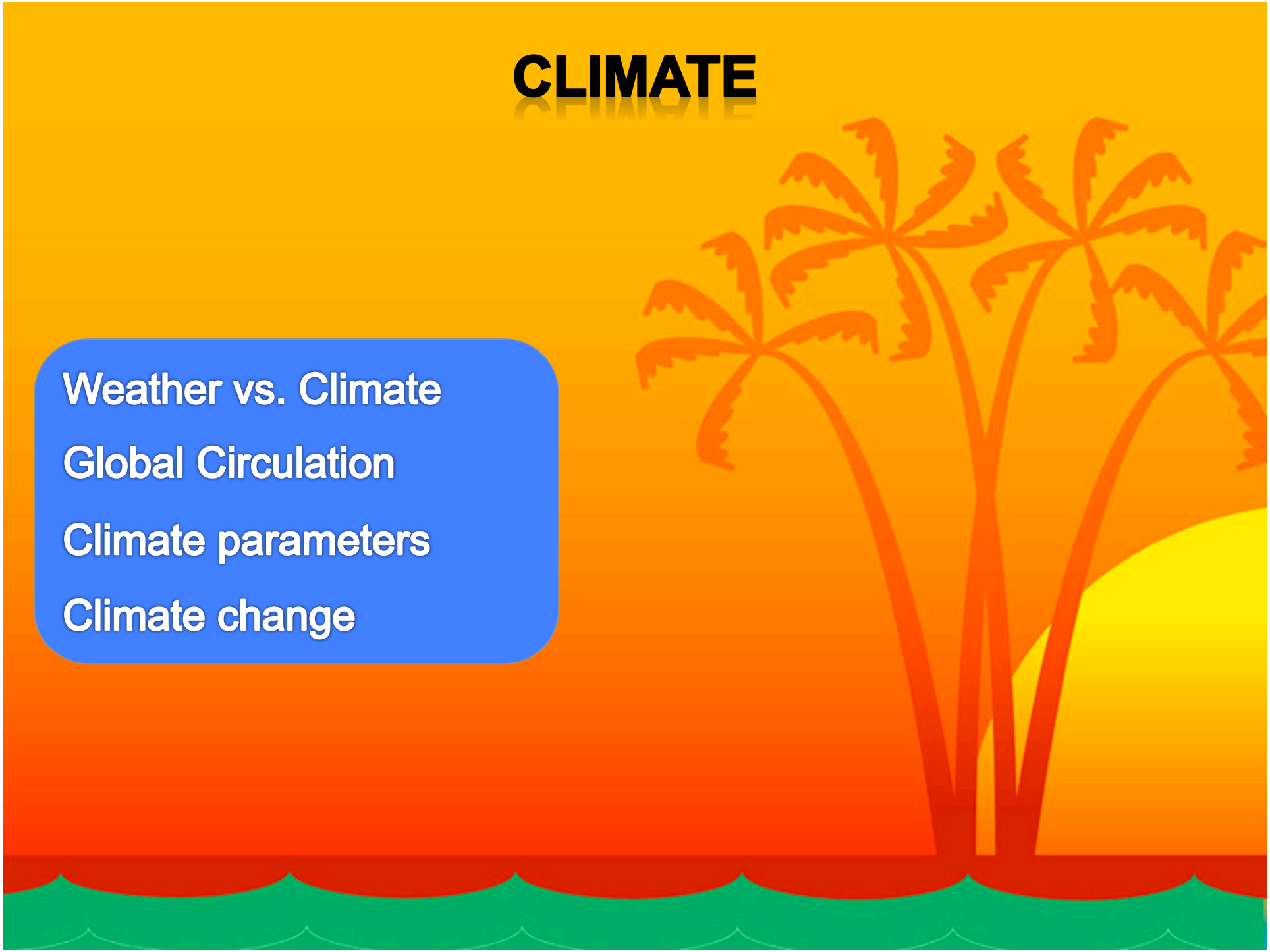
CLIMATE

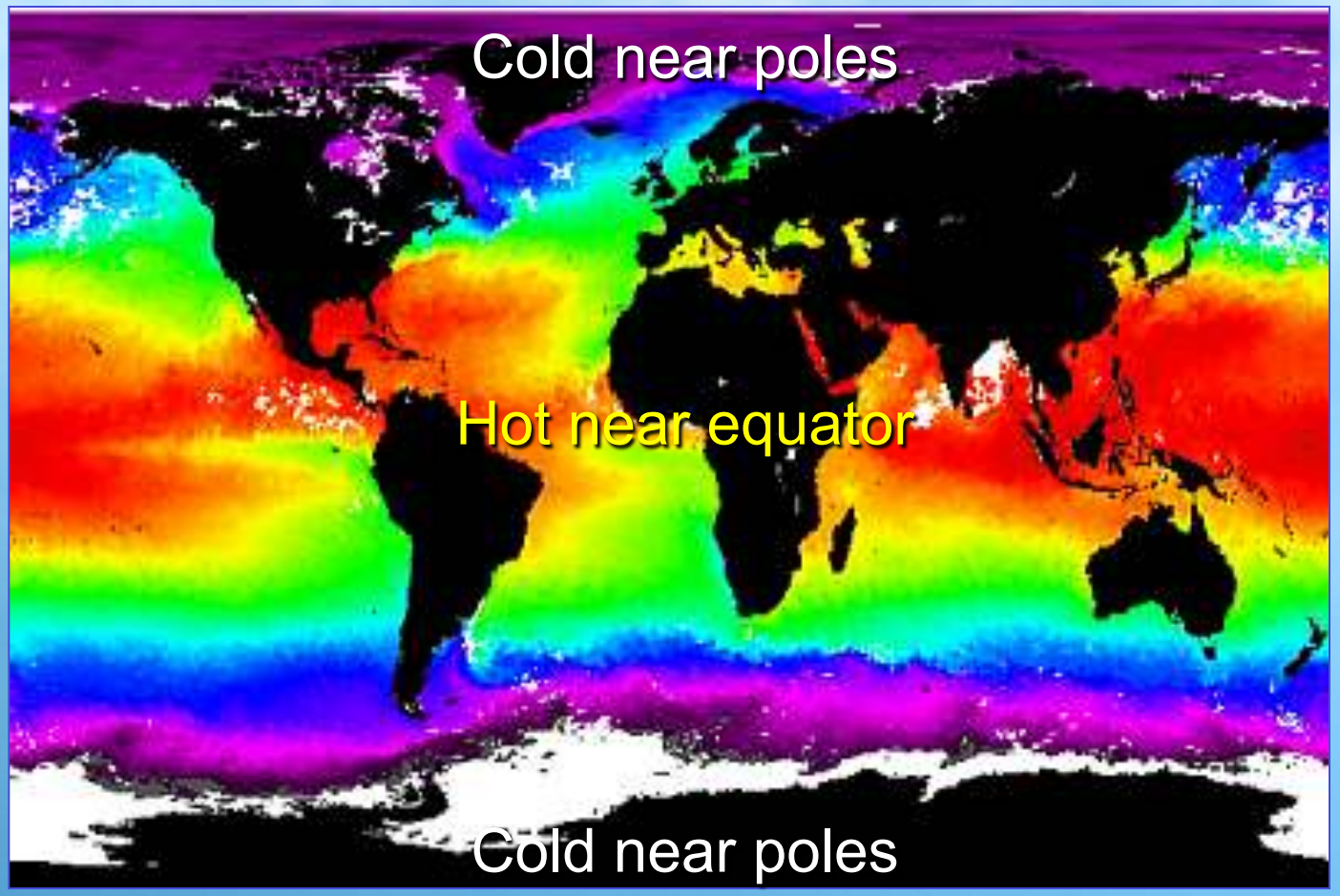


- Weather vs. Climate
- Global Circulation
- Climate parameters
- Climate change

Weather - the physiochemical state of the atmosphere during any short period of time.

Climate - the average physiochemical state of the atmosphere over the course of the year.

Surface Ocean Temperatures

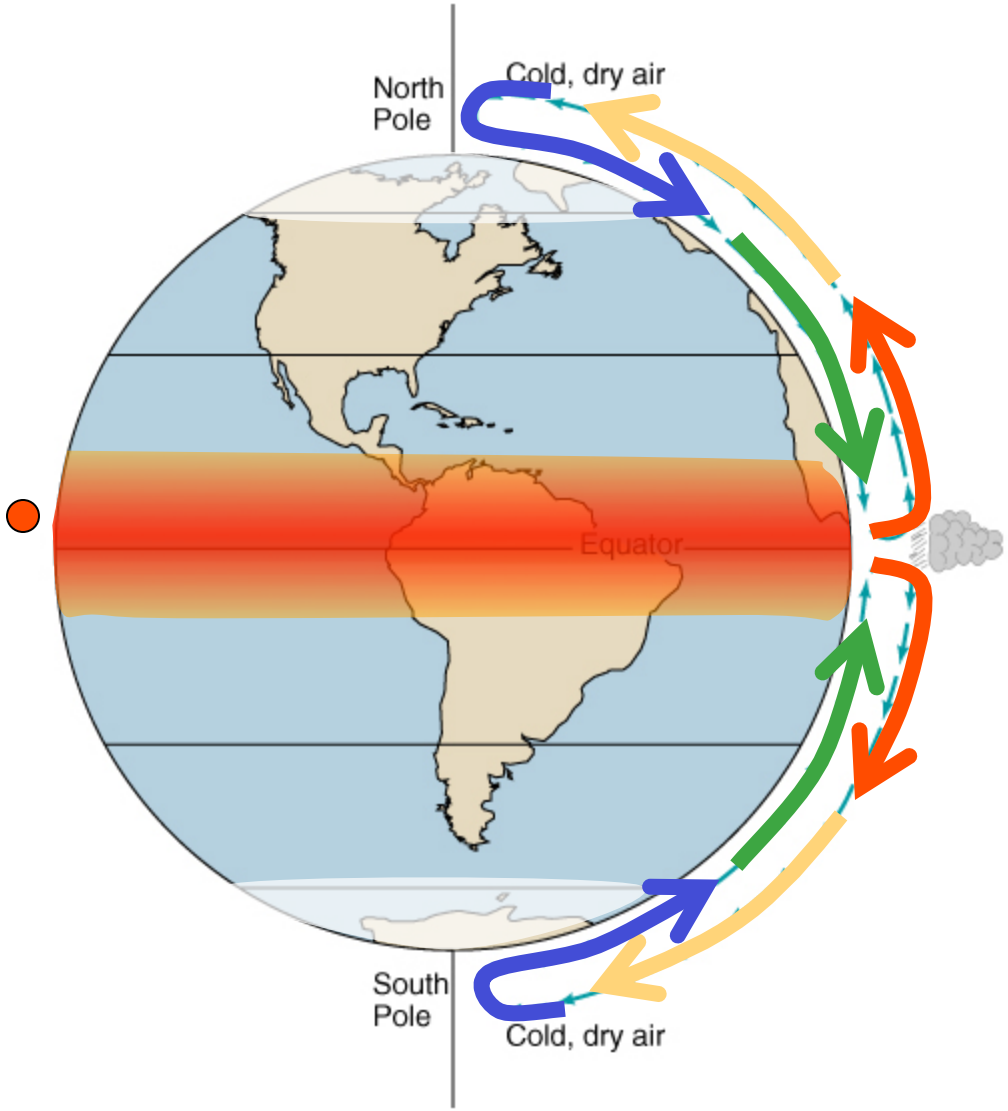


http://www.seafriends.org.nz/oceano/currents.htm

Atmospheric Circulation if the Earth Didn't Rotate

Hot air rises in the equatorial region and travels toward the poles.

Cold air sinks near the poles and moves toward the equator.

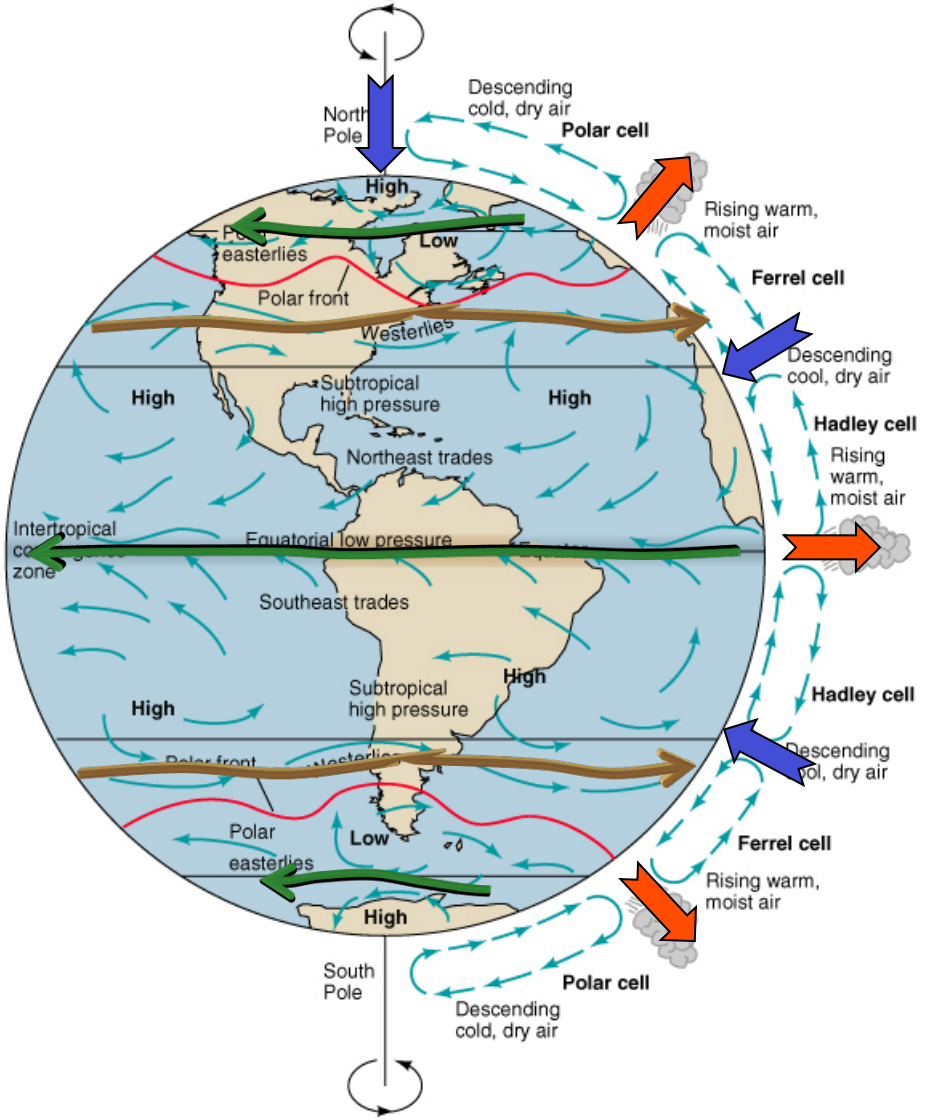


http://www.usd.edu/esci/figures/BluePlanet.html

Circulation on a Rotating Earth

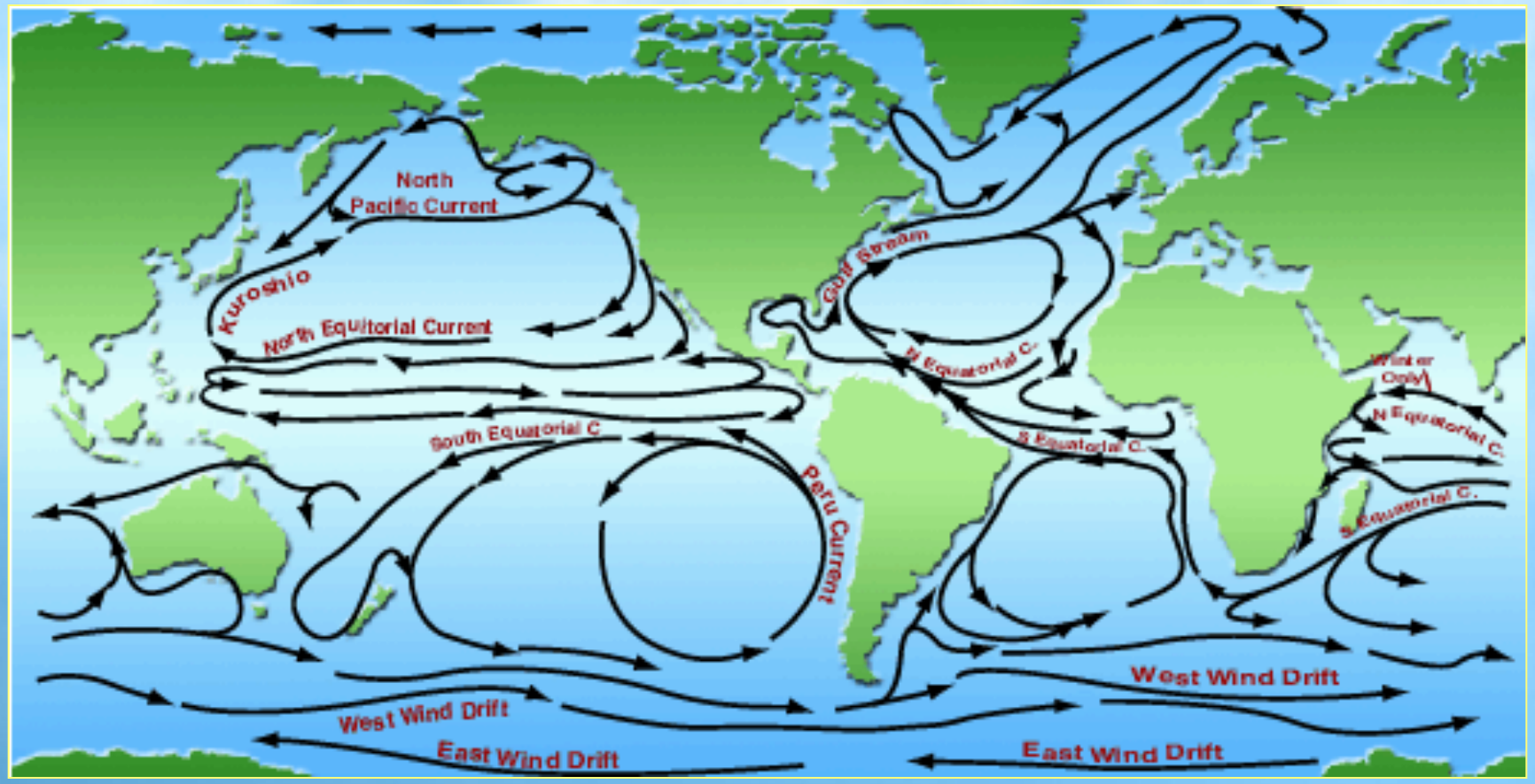
As the Earth rotates, the rising and sinking air is deflected (this deflection is called the Coriolis effect).

The atmosphere is also broken into smaller circulating cells, rather than circulating in an unbroken loop from equator to pole.



http://www.usd.edu/esci/figures/BluePlanet.html

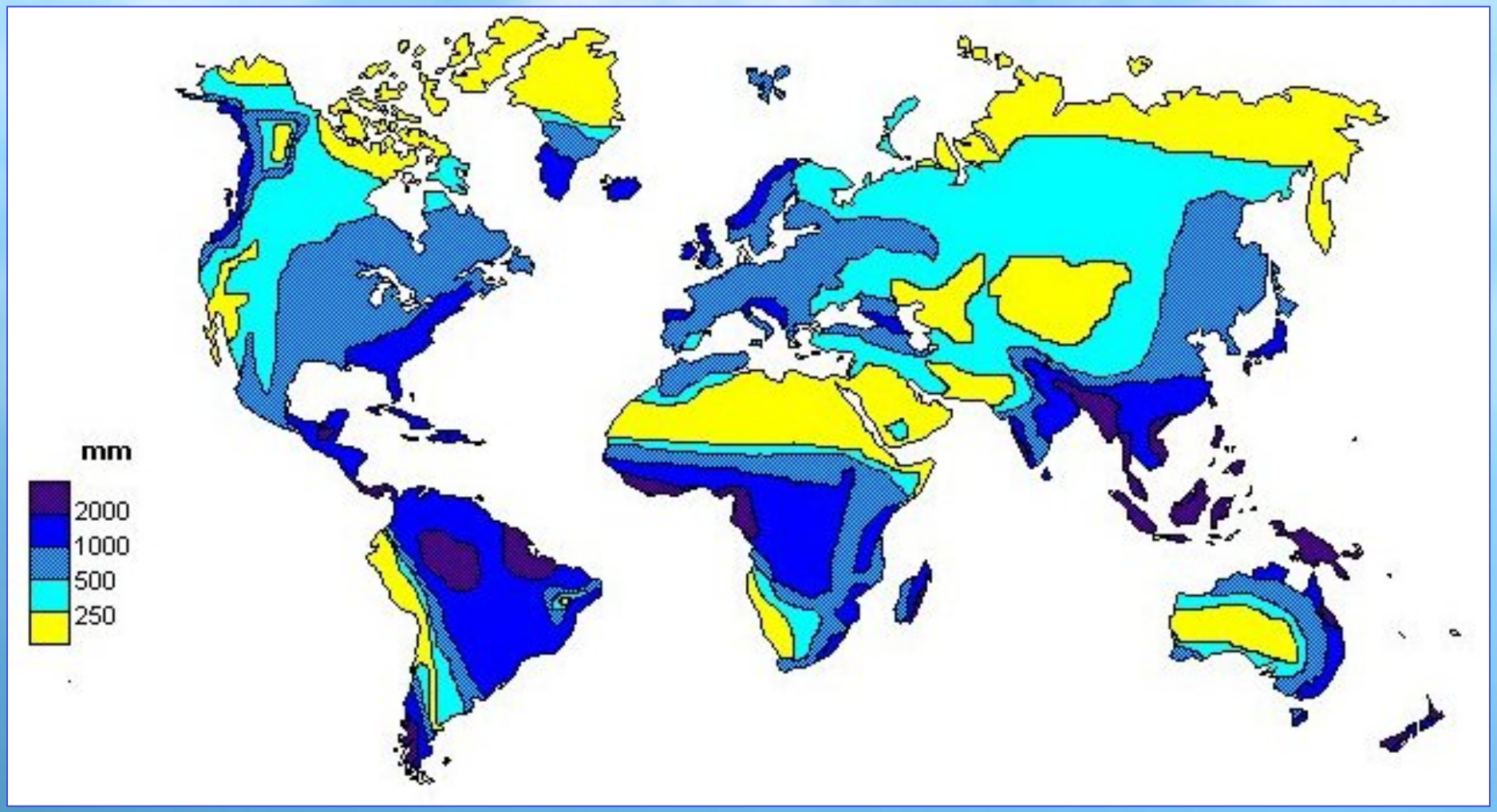
Global Oceanic Circulation



Wind drives water, resulting in global oceanic circulation. Water currents are more strongly affected by land mass than wind currents.

http://www.onr.navy.mil/focus/ocean/

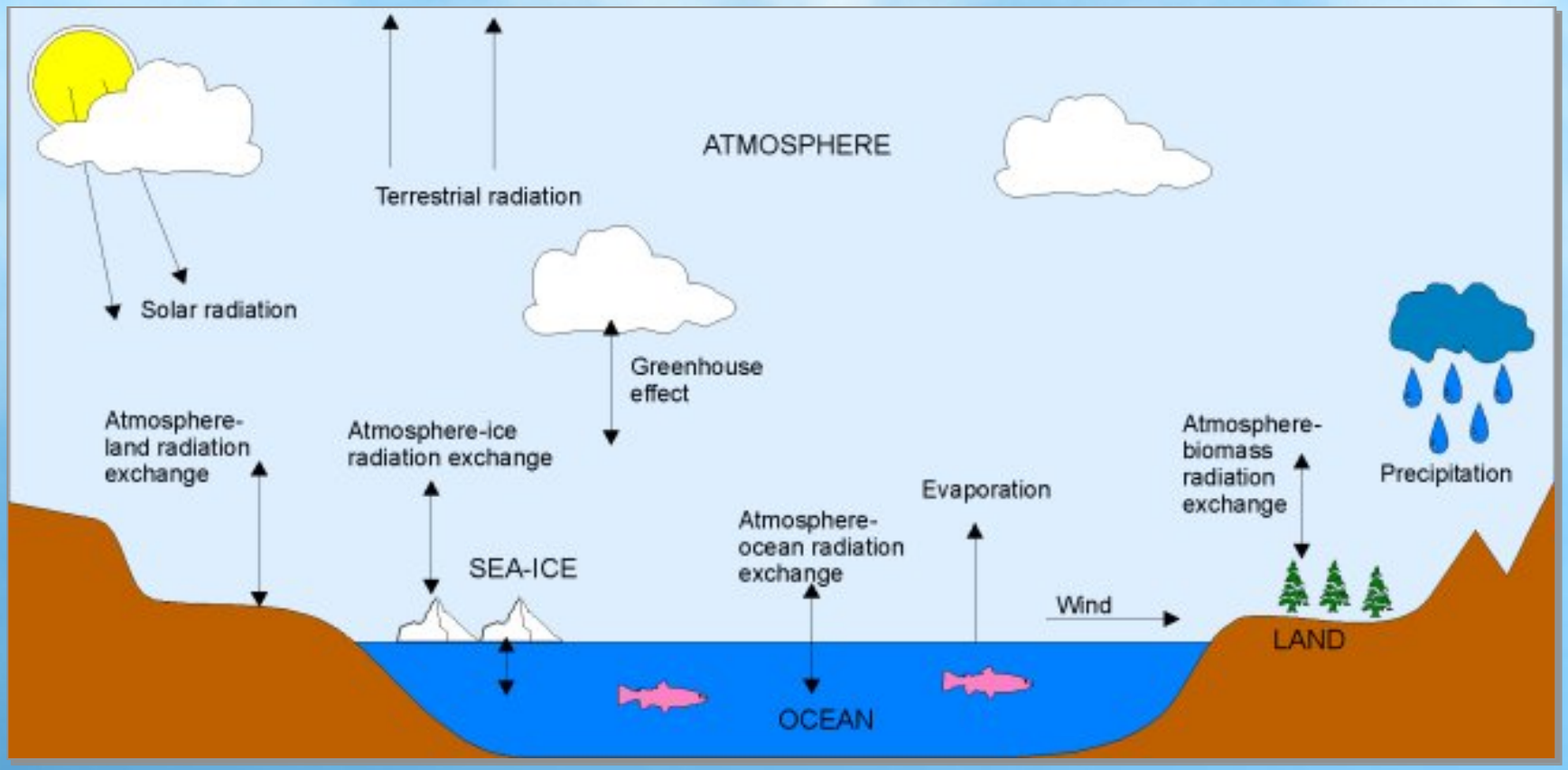
Global Rainfall



Temperature and precipitation patterns are strongly controlled by global circulation.

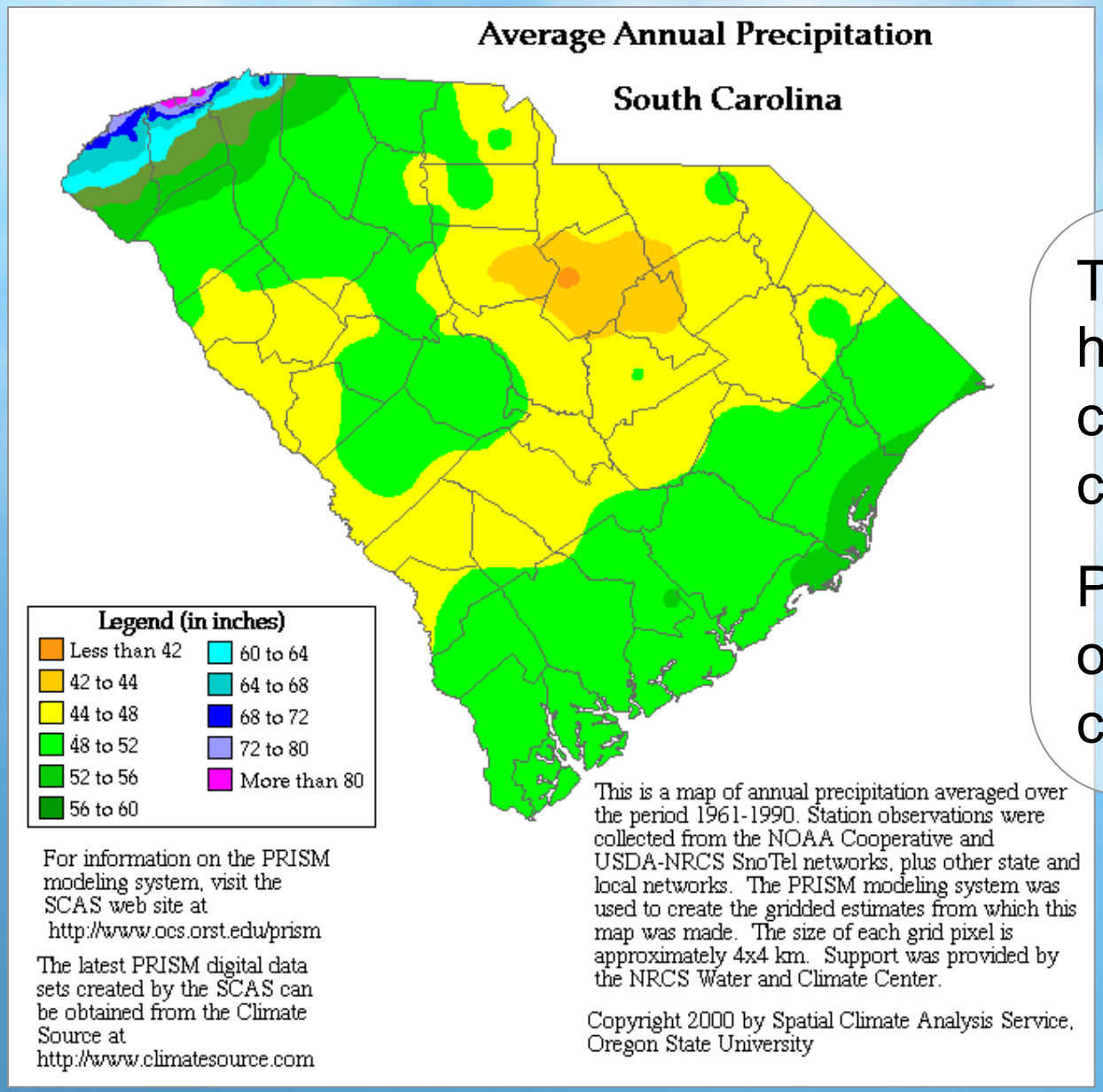
http://www.doc.mmu.ac.uk/aric/eae/english.html

Other Factors Affecting Climate



In addition to latitude and global circulation, climate at any specific place on Earth is strongly affected by altitude and topography, which affect both temperature and precipitation.

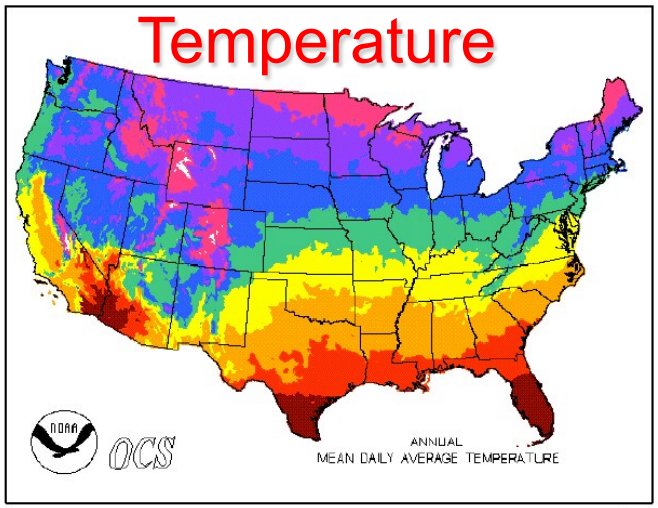
http://www.doc.mmu.ac.uk/aric/eae/english.html



Topography can have a strong control on local climate.

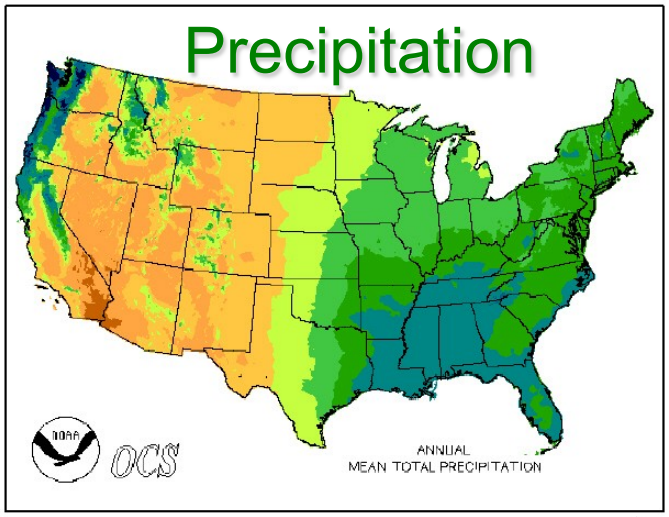
Proximity to the ocean also affects climate.

http://www.ocs.orst.edu/pub/maps/Precipitation/Total/States/SC/sc.gif



STATES
13 MEAN DAILY AVG TEMP (DEG_F)
- ANNUAL -
A < 32.0
B 32.0 - 40.0
C 40.1 - 45.0
D 45.1 - 50.0
E 50.1 - 55.0
F 55.1 - 60.0
G 60.1 - 65.0
H 65.1 - 70.0
I > 70.0
TITLE

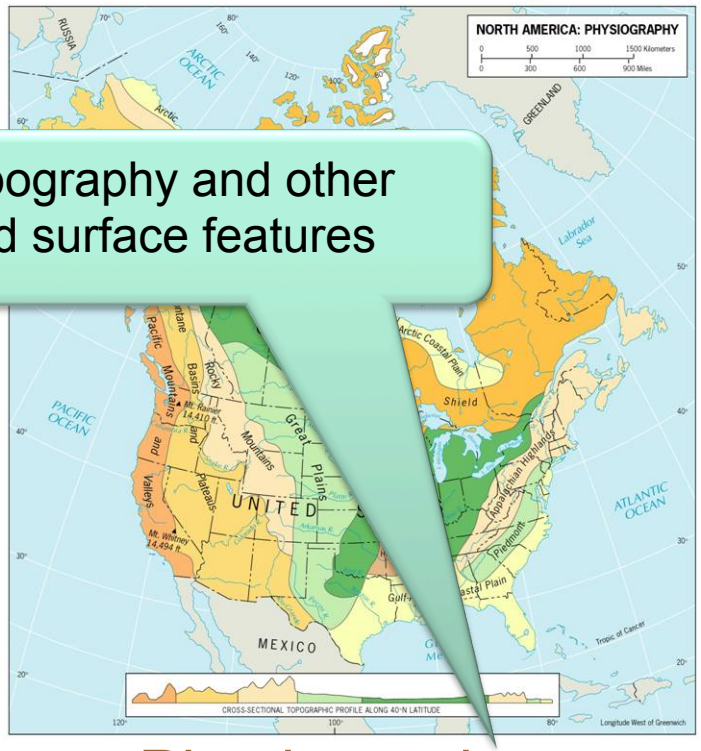
+



STATES
13 MEAN TOTAL PRECIP (INCHES)
- ANNUAL -
A < 5.01
B 5.01 - 12.00
C 12.01 - 20.00
D 20.01 - 30.00
E 30.01 - 40.00
F 40.01 - 50.00
G 50.01 - 70.00
H 70.01 - 100.00
I > 100.00
TITLE

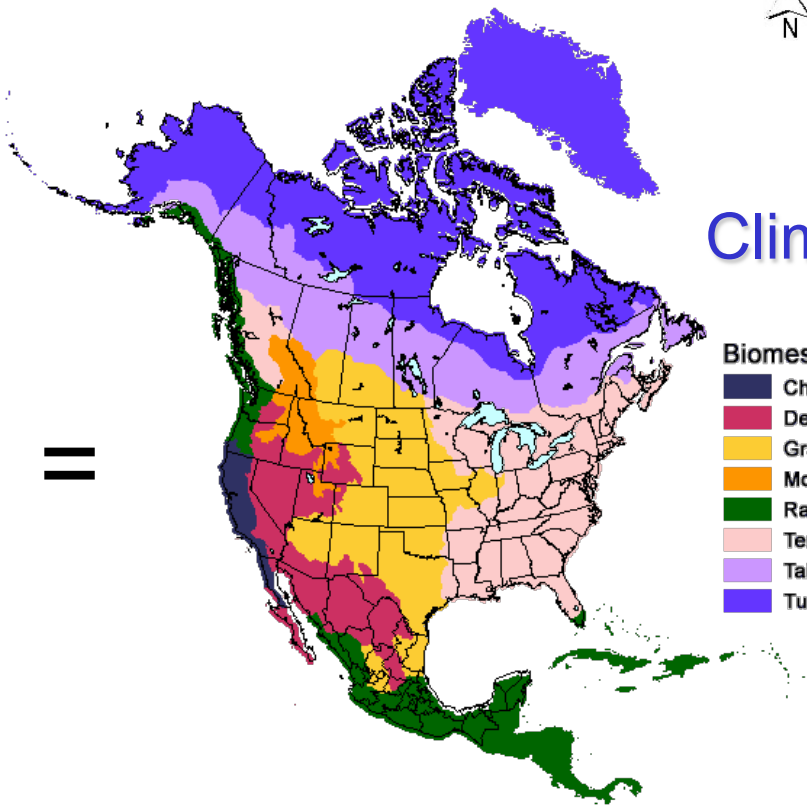
Topography and other land surface features

+



Physiography

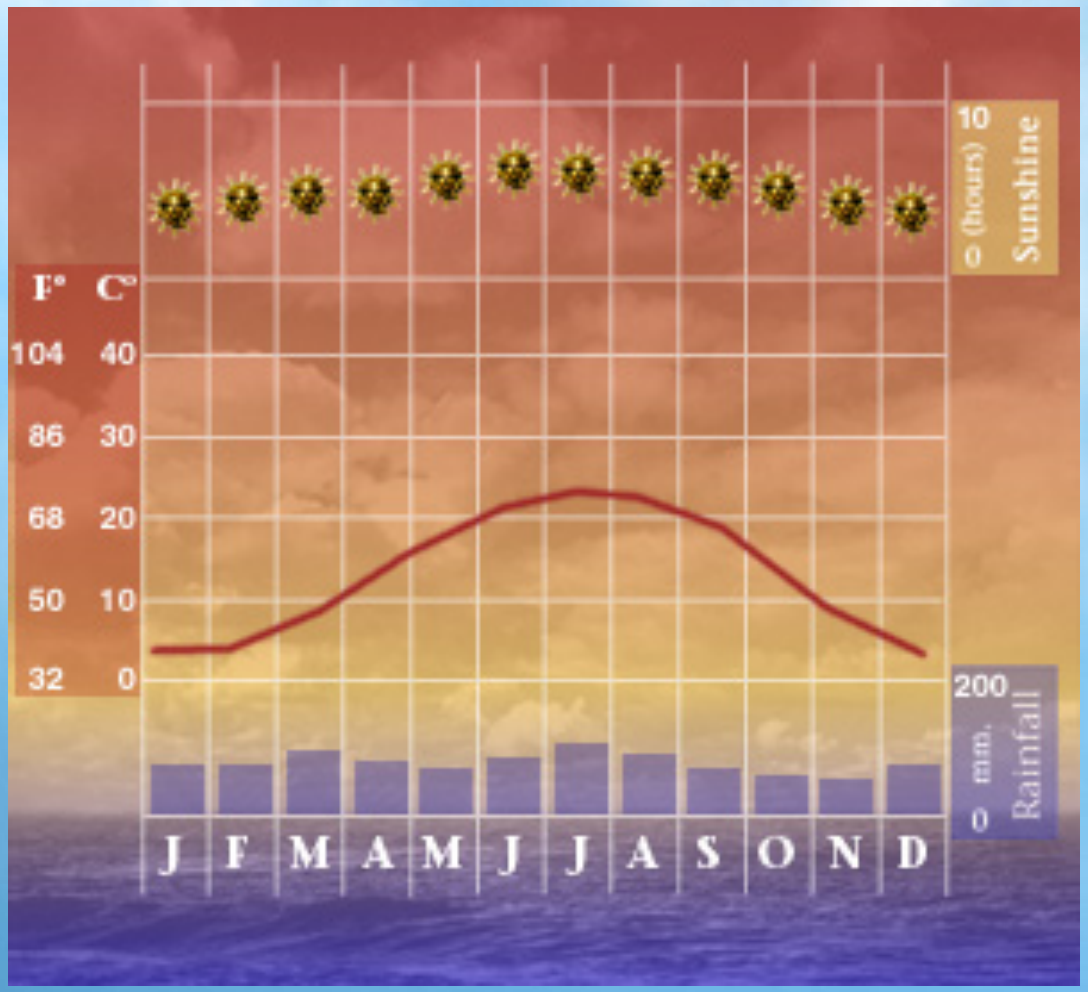
=



Climate

Biomes
Chapparral
Desert
Grassland
Mountain
Rainforest
Temperate Deciduous Forest
Taiga
Tundra

http://www.mobot.org/education

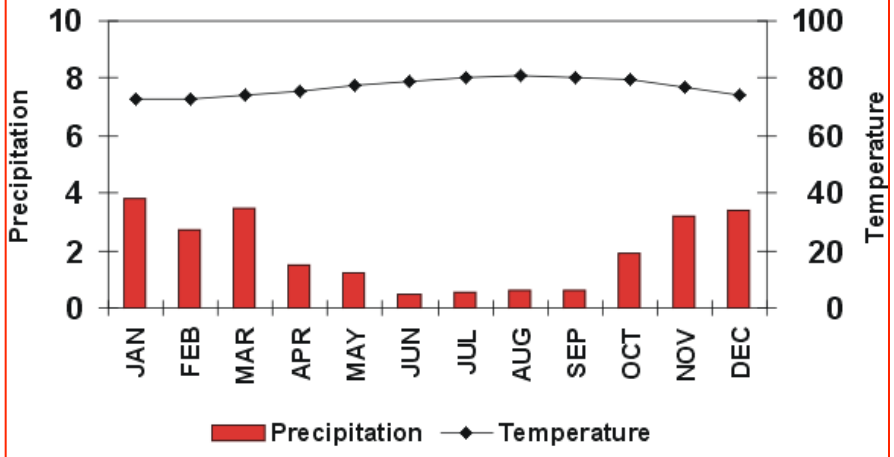


Climograph – a graphic showing average monthly precipitation, temperature and sometimes other climatic parameters

This is a climograph for Charlotte, North Carolina. The graphic came from a website touting Charlotte's climate as a plus for businesses.

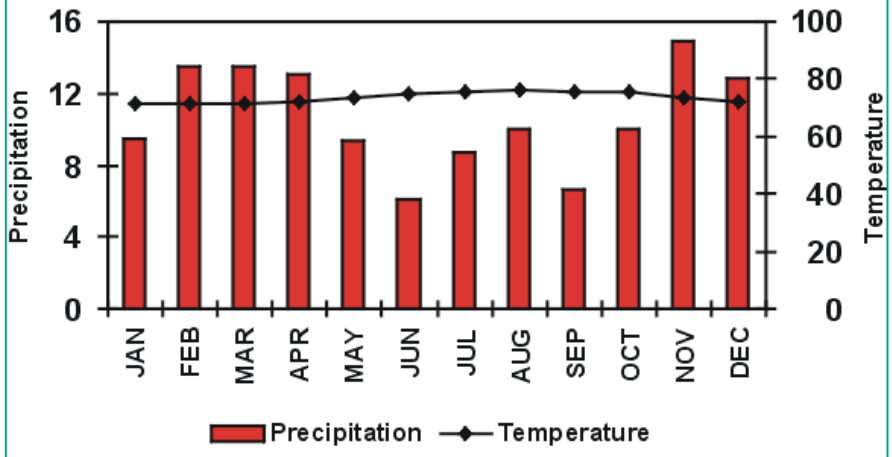
http://www.worldexecutive.com/cityguides/charlotte/weather.shtml

Honolulu, Hawaii

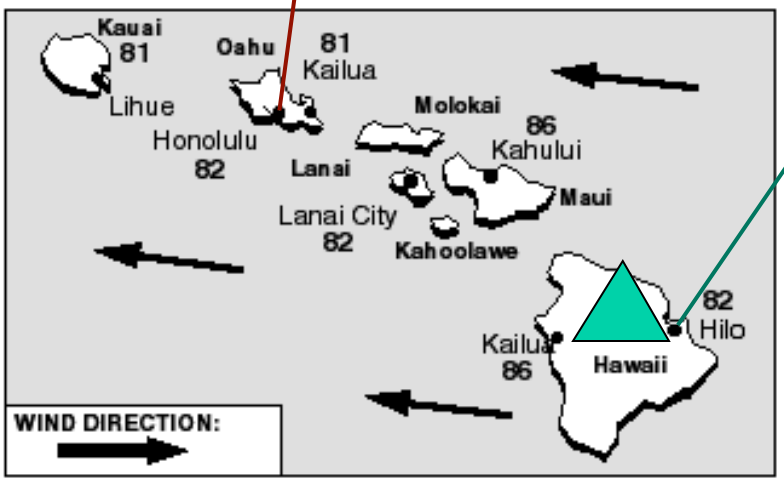


Lat.: 21° 20' N
Long.: 157° 56' W
Elevation: 7 ft. asl
Total Annual Precip.: 23.47"
Avg. Annual Temp.: 77.0°F

Hilo, Hawaii



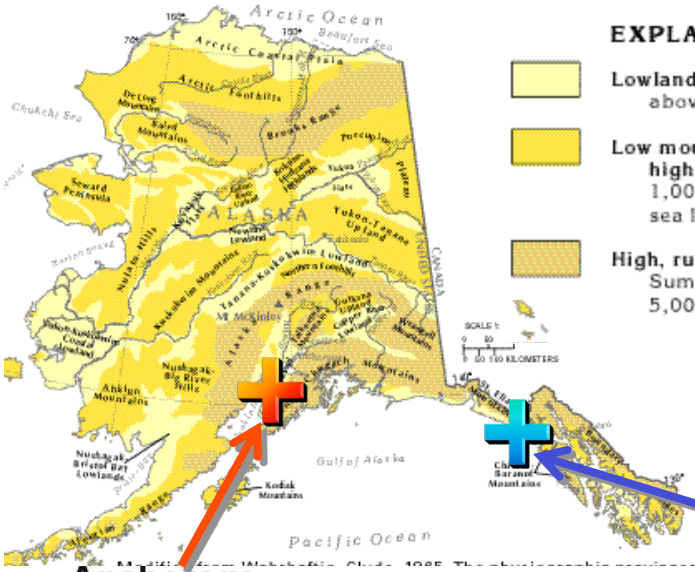
Lat.: 19° 43' N
Long.: 155° 04' W
Elevation: 27 ft. asl
Total Annual Precip.: 128.15"
Avg. Annual Temp.: 73.6°F

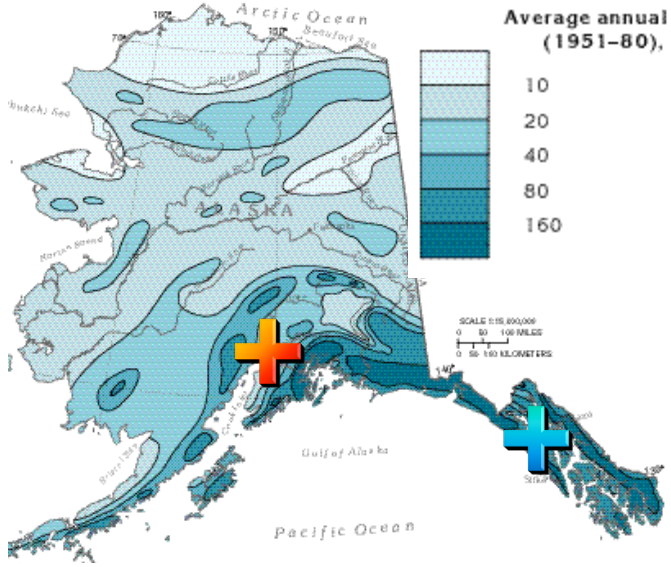


The precipitation differences between these Hawaiian cities is due to orographic lifting and dependant on the prevailing wind direction

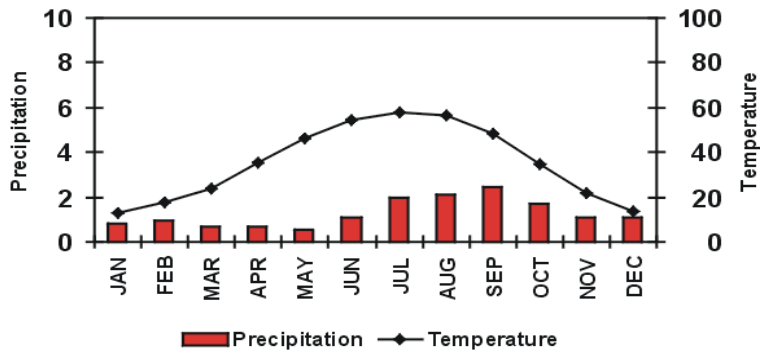
http://starbulletin.com/

http://www.drought.unl.edu/whatis/climographs.htm



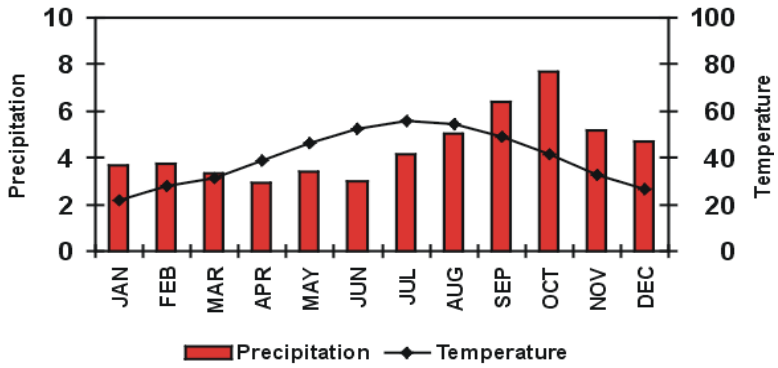


Anchorage, Alaska



Lat.: 61° 13' N
Long.: 149° 53' W
Elevation: 114 ft. asl
Total Annual Precip.: 15.20"
Avg. Annual Temp.: 35.3°F

Juneau, Alaska



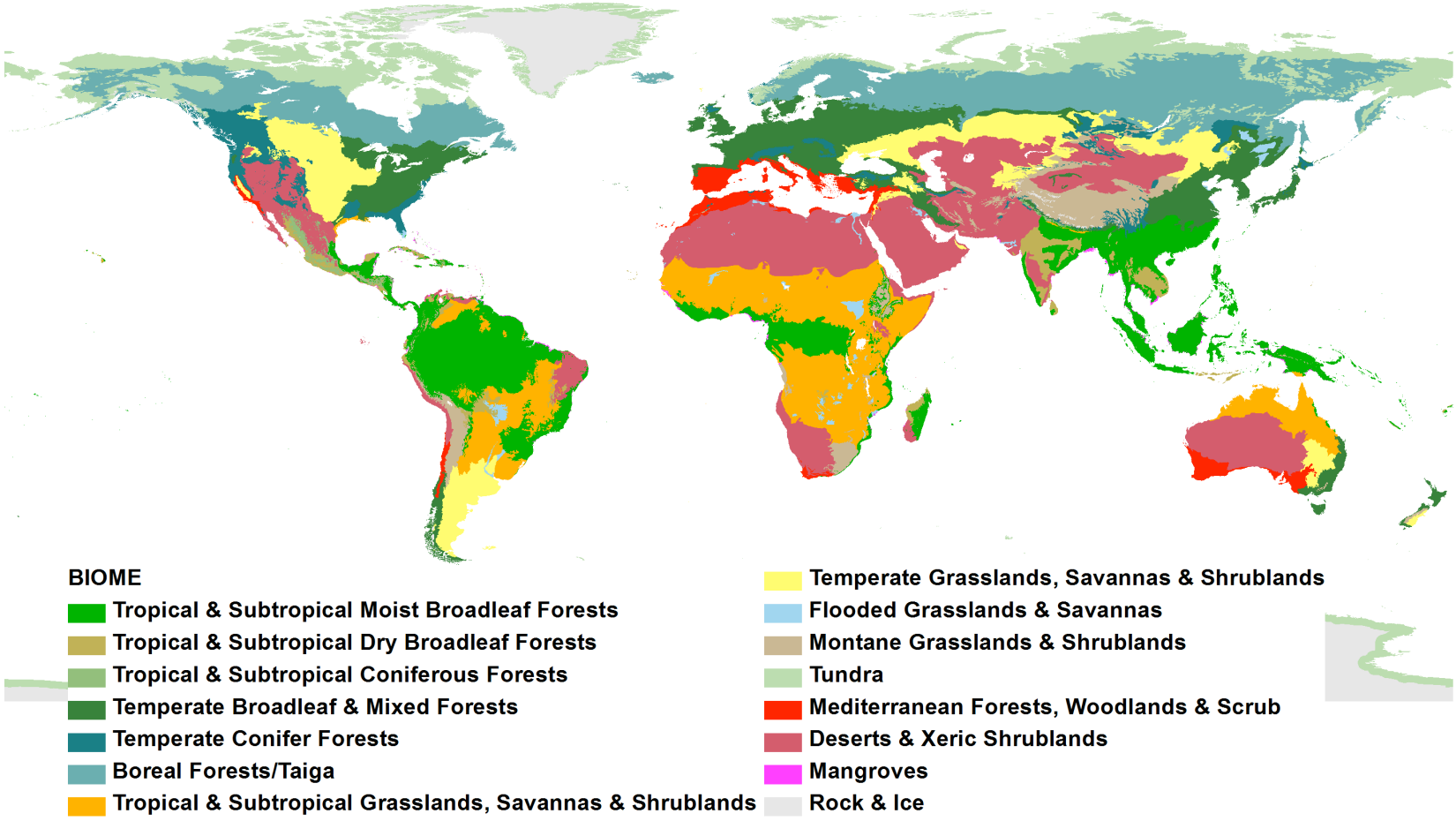
Lat.: 58° 22' N
Long.: 134° 35' W
Elevation: 12 ft. asl
Total Annual Precip.: 53.15"
Avg. Annual Temp.: 40.0°F

Anchorage is in the rain shadow of the Alaska Range; Juneau is a coastal city.

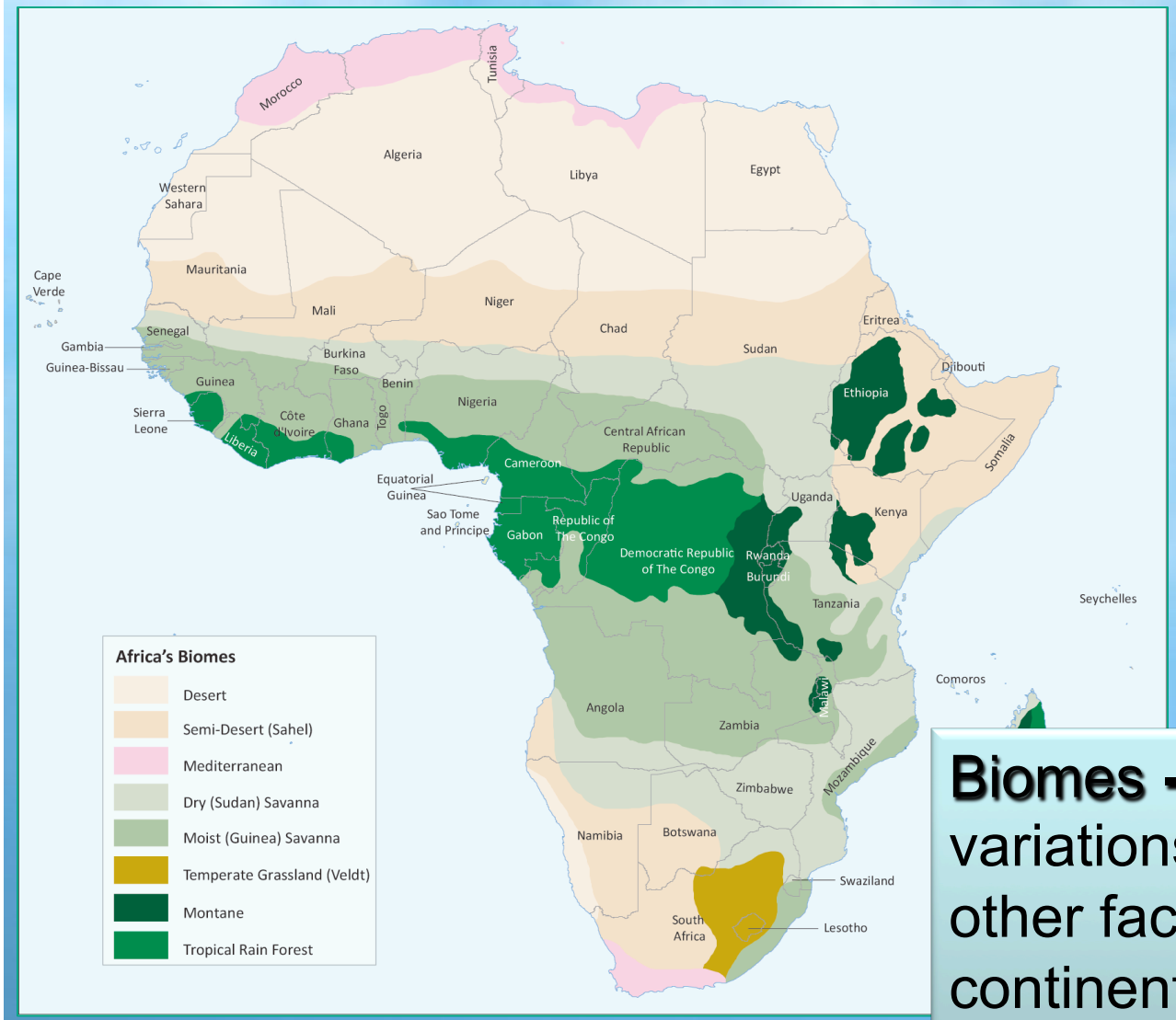
http://capp.water.usgs.gov/gwa/ch_n/gif/N010.gif

http://www.drought.unl.edu/whatis/climographs.htm

Biomes - largest level ecologic communities, defined by type of vegetation and environmental conditions (especially temperature and precipitation for terrestrial biomes).



From: Olson et al. (2001)Terrestrial ecoregions of the world: New map of life on earth. Bioscience 51:933-938



Biomes - because of variations in topography and other factors, most continents are a complex mosaic of biomes.

http://na.unep.net/atlas/africaWater/book.php

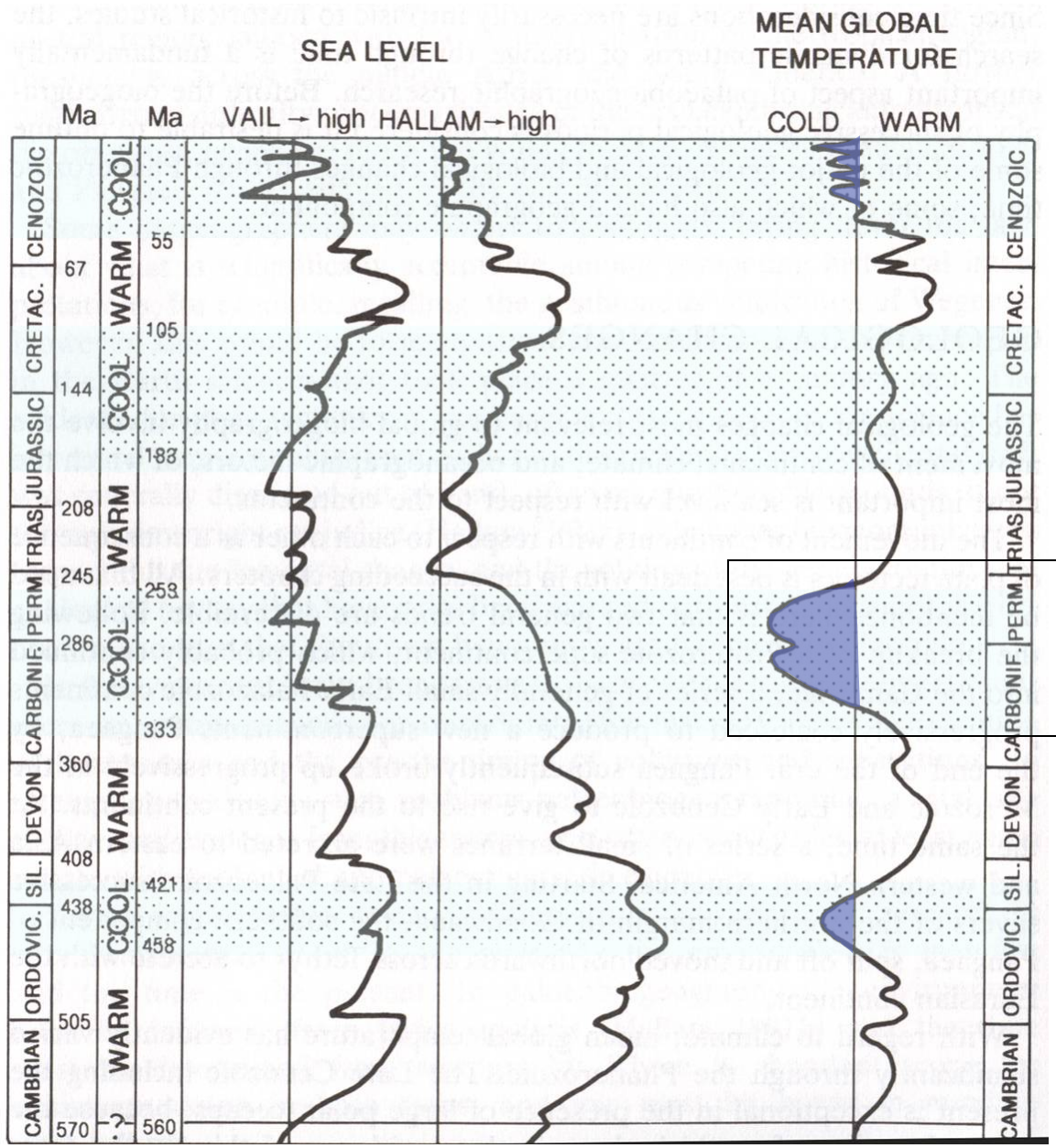
Global Climate Change

The geologic record indicates that there have been extreme climate changes in the past. These changes have several major causes, including:

- Mega-cycles in global warming and cooling
- Movement of continents over time
- Changes in elevation due to mountain building

These changes have affected the distribution of organisms in both time and space throughout Earth's history.

http://www.floridawildlifemagazine.com/globalwarming.htm



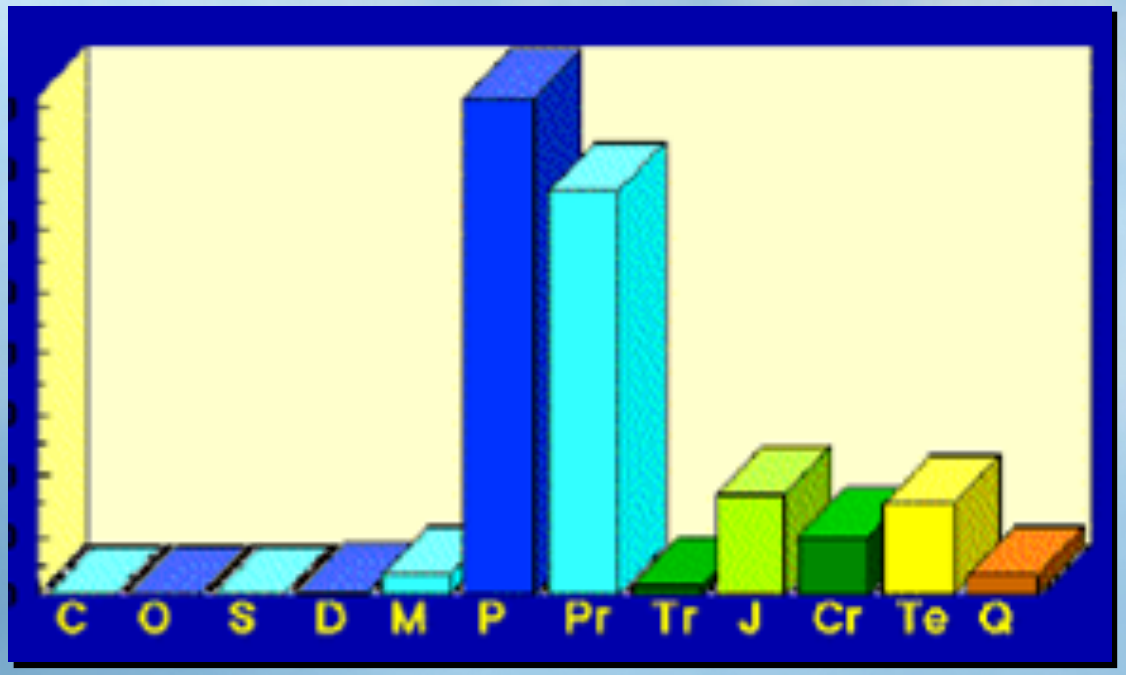
Today

The Age of Coal

540 Million Years Ago

Hallam, A. 1994. An outline of Phanerozoic biogeography. Oxford Univ. Press.

Carboniferous - The Age of Coal



Most of Earth's economic reserves of coal were deposited in the Carboniferous and Permian Periods.

By dumb luck, most of these deposits are located in modern North America and Europe - a historical accident with obvious socio-economic consequences.

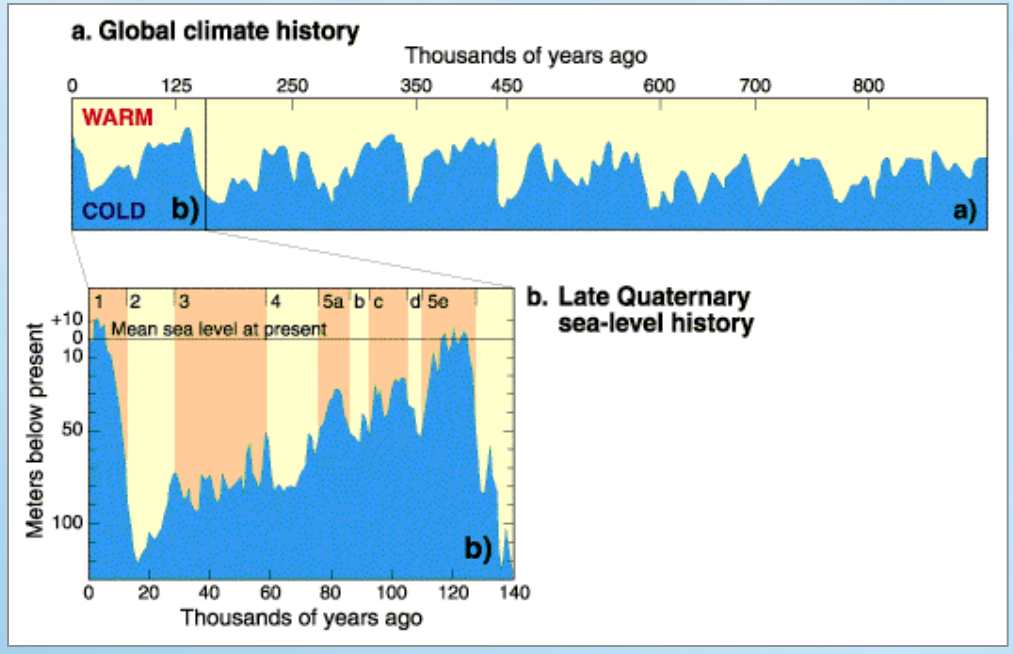
http://earthsci.org/energy/coal2/peat.gif

Global climate change is also driven by paleogeography (the geography of the Earth of the past). The Earth's continents move in relationship to each other over time, causing new seas and oceans to open and close.

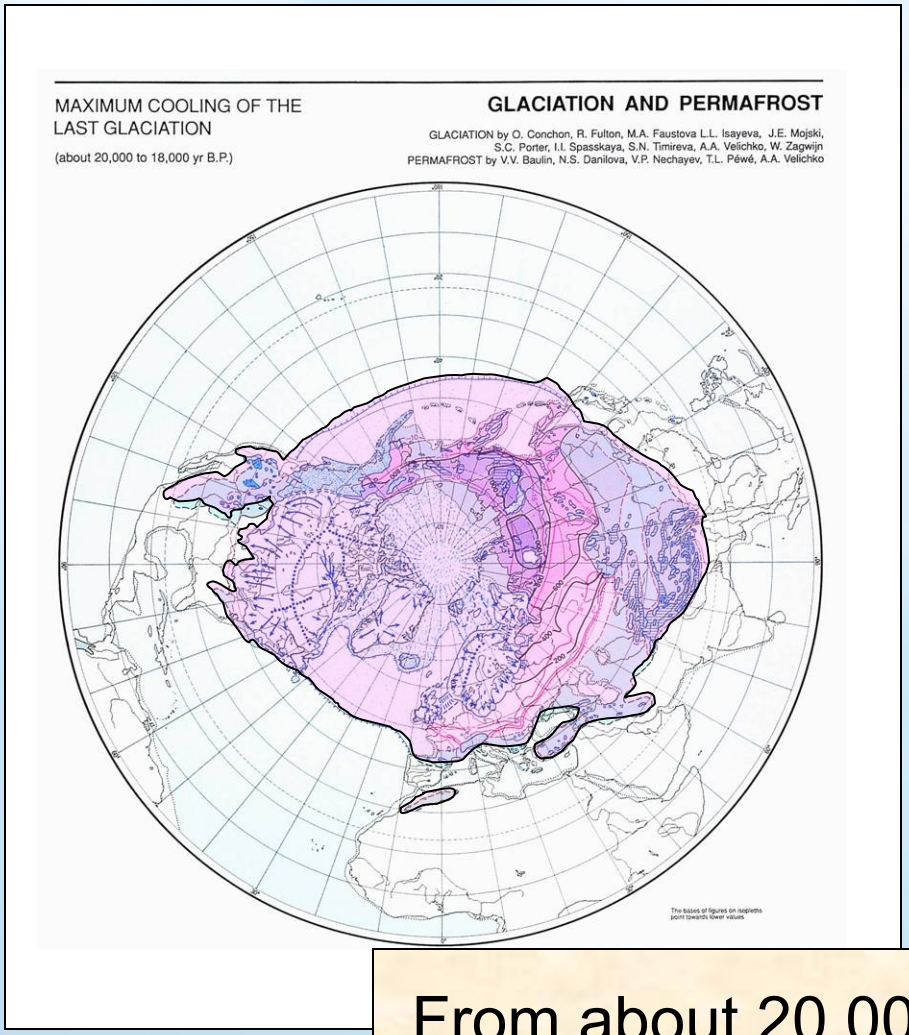
The modern Earth is unusually cold compared to times in the past primarily because both poles are segregated from the temperate zones.

Pleistocene to Recent

Recurrent ice ages. Small variations in orbital parameters caused cyclic glacial advance and retreat.

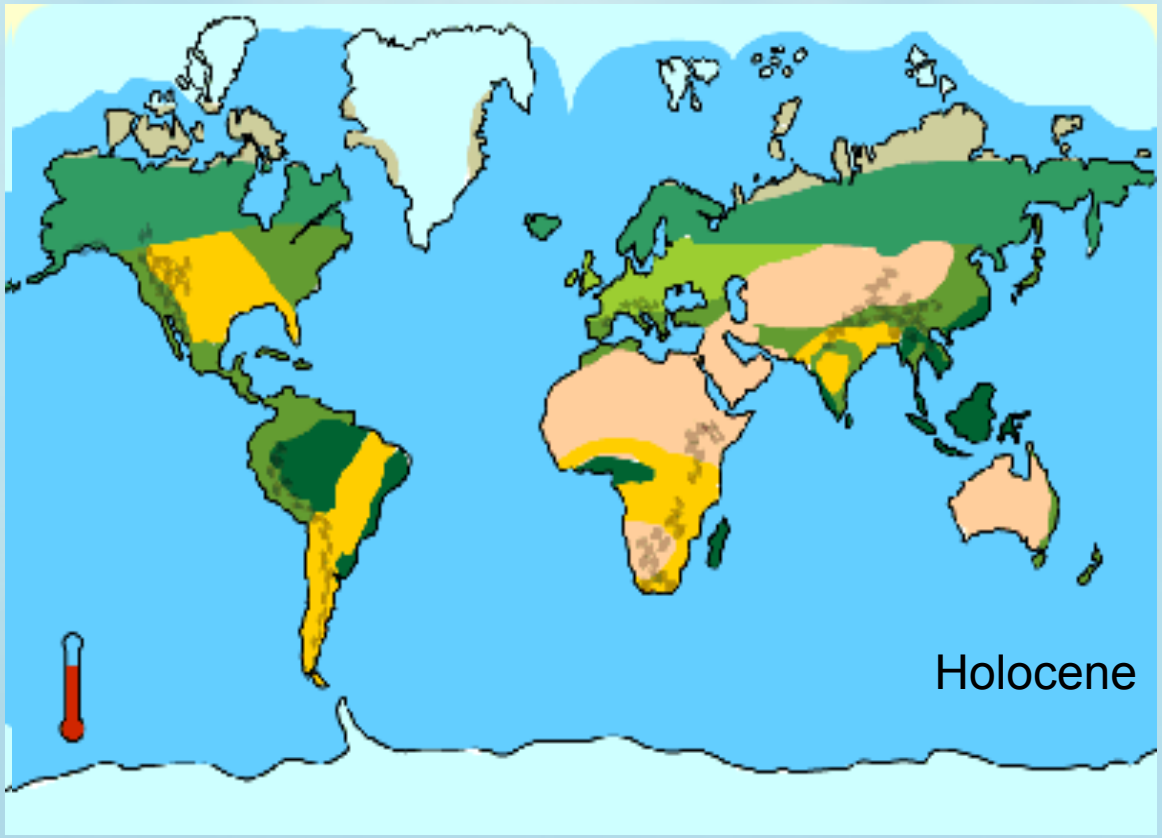


http://www.ngdc.noaa.gov/paleo/ctl/clisci100k.html



From about 20,000-18,000 years ago, much of the northern hemisphere was covered in large sheets of ice.

http://www.pangaea.de/Projects/PKDB/PaleoAtlas.html

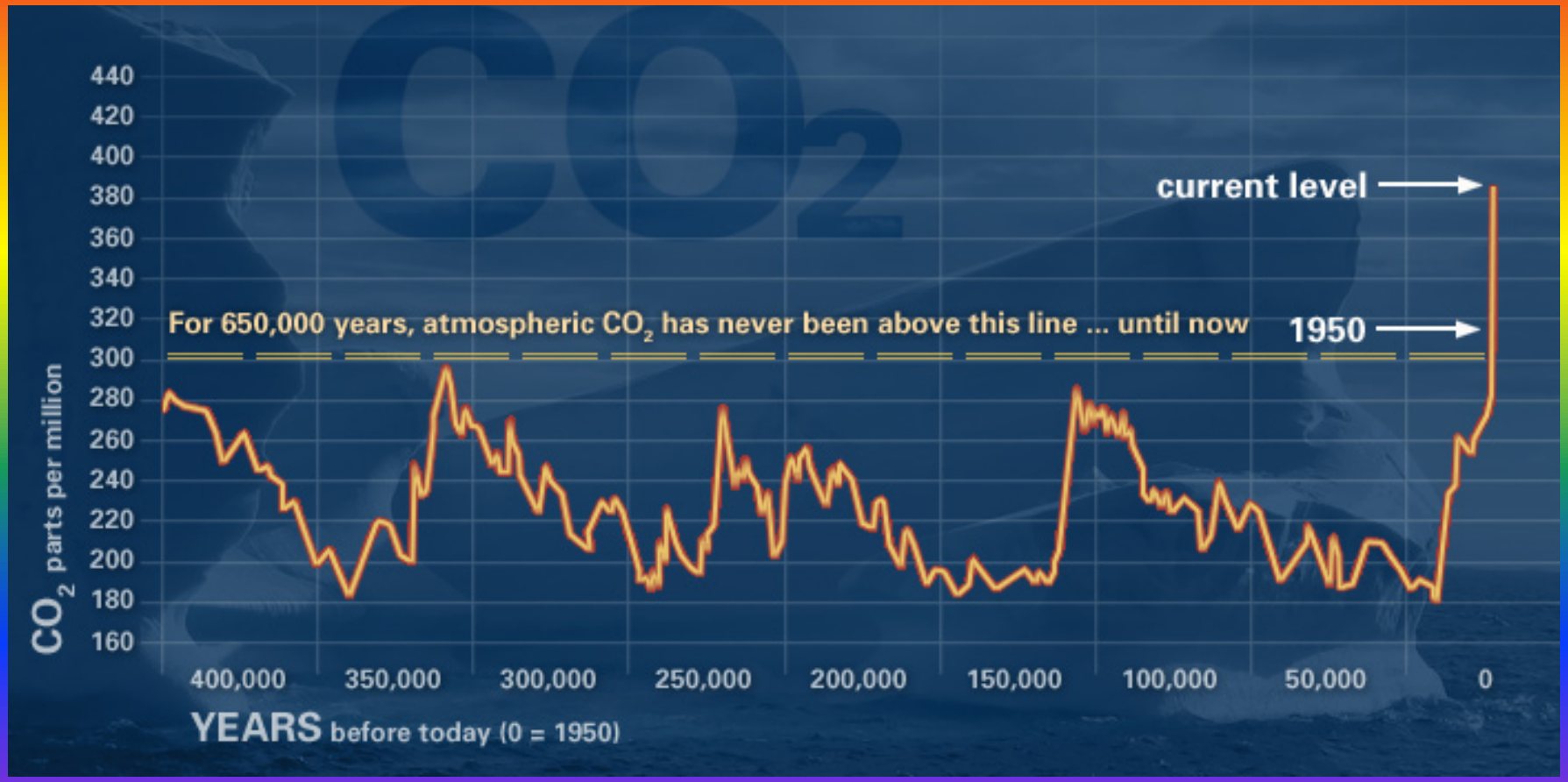


Global drying is another trend of the last few million years

KEY:
- Fossil sites
- Warm surface current
- Cold surface current
- Warm deep current
- Cold deep current
- Tropical rainforest
- Sub-tropical forest
- Deciduous forest
- Conferous forest
- Tundra
- Desert
- Savannah/Prairie
- Ice

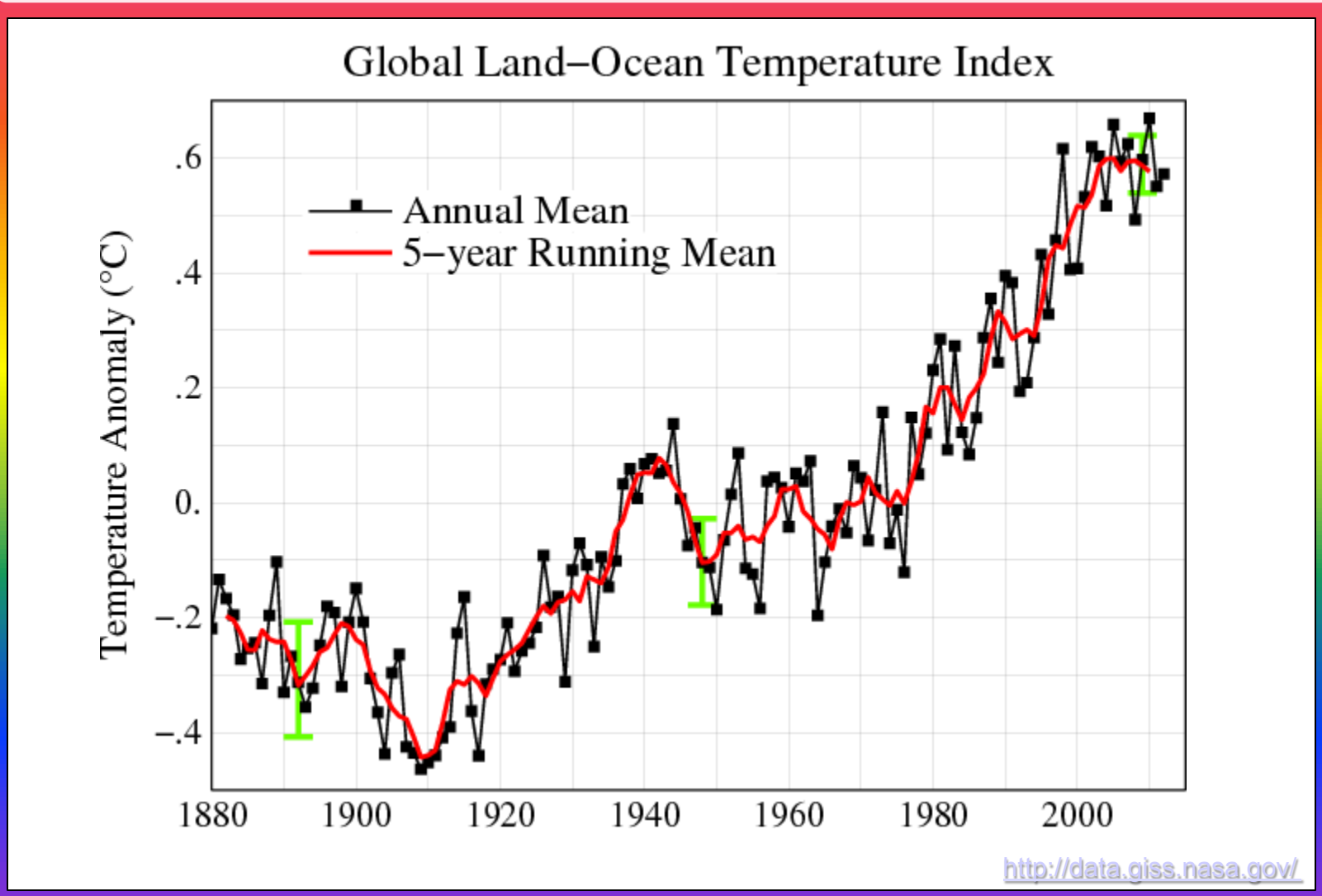
http://www.bbc.co.uk/beasts/

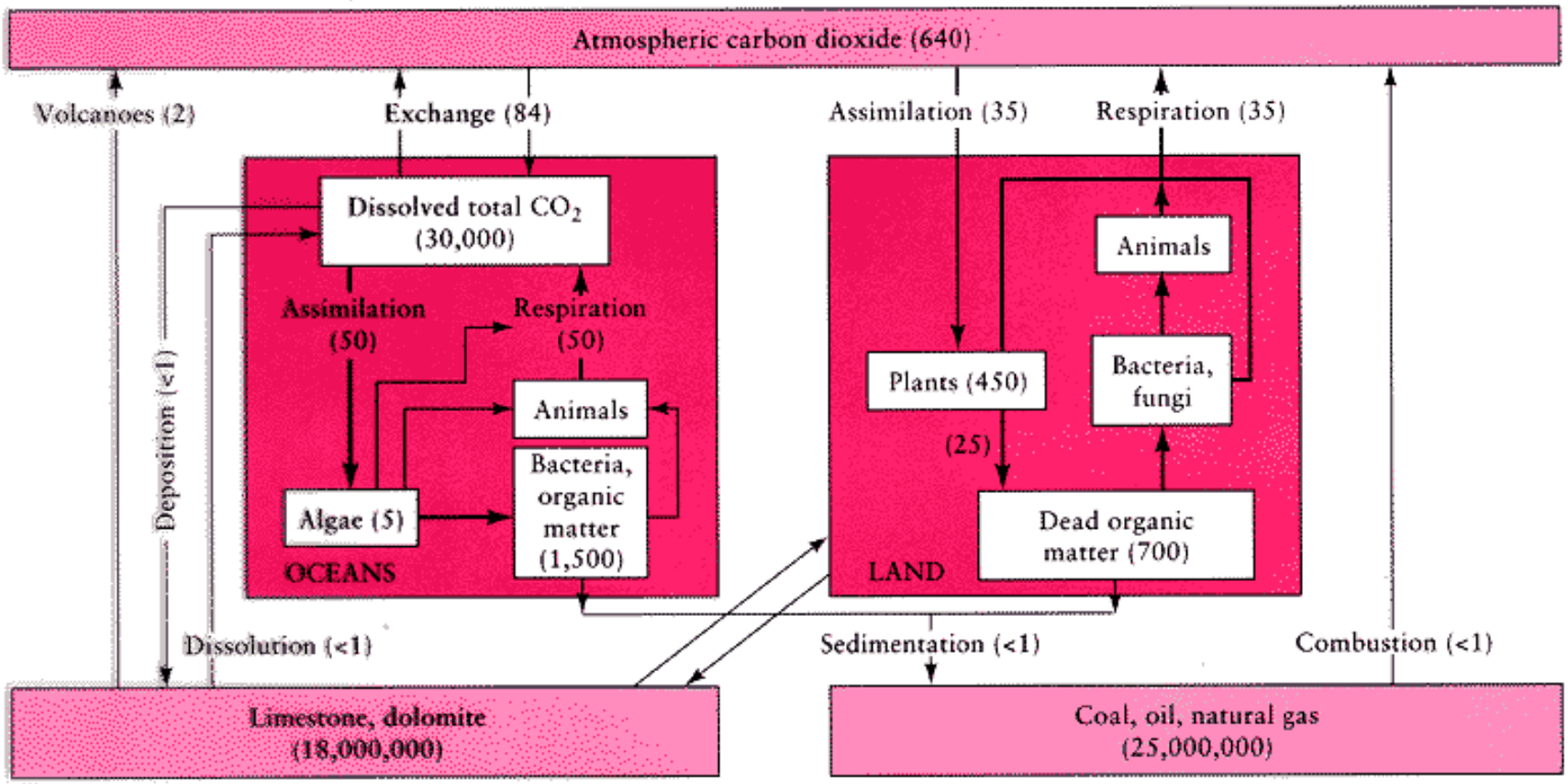
The rate of carbon dioxide accumulation in the atmosphere has risen at a rather alarming rate when viewed against the historical trend of the past half million years.



http://climate.nasa.gov/evidence

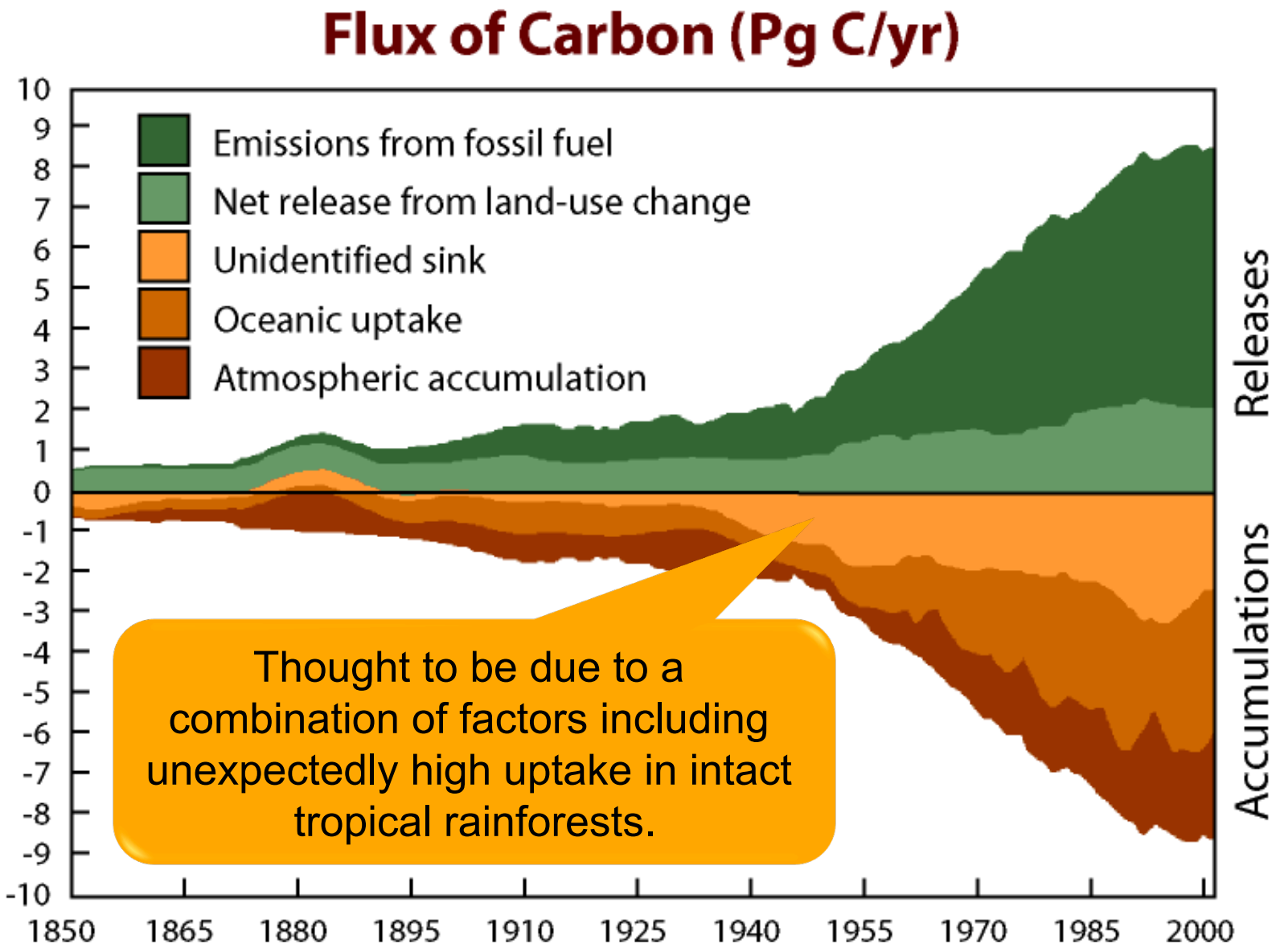
This rise in atmospheric carbon dioxide correlates with global temperature anomalies and global climate anomalies.





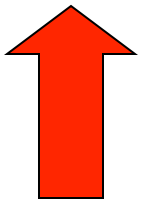
Tracking the interactions between all of the various groups of sources and sinks or CO_2 is quite complex. A linear change in one set of processes may cause an exponential change elsewhere!

http://essp.csumb.edu/esse/climate/climatefigures/Ccycle.html



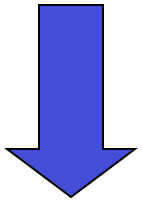
http://www.blog.thesietch.org/2007/06/24/exactly-where-does-all-that-co2-go-scientists-close-in-on-missing-carbon-sink/

Non-atmospheric CO_2 does not lead to warming!



Adds to atmospheric CO_2:

Respiration + Fossil Fuel Emission + Land Use Change



Takes away atmospheric CO_2:

Photosynthesis + Ocean Uptake + Land Uptake + *Missing Uptake*

http://www.whrc.org/science/carbon/carbon.htm