

# ENVIRONMENTS and LIFE



## part III The Terrestrial Realm

Notes from (Stanley and Luczaj, 2015) *Earth System History, Chapter 4*

**Alessandro Grippo, Ph.D.**

A lynx, or bobcat, in the suburban Los Angeles *chaparral* vegetation

San Gabriel Mountains, La Cañada Flintridge, California, U.S.A.

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# The Terrestrial Realm

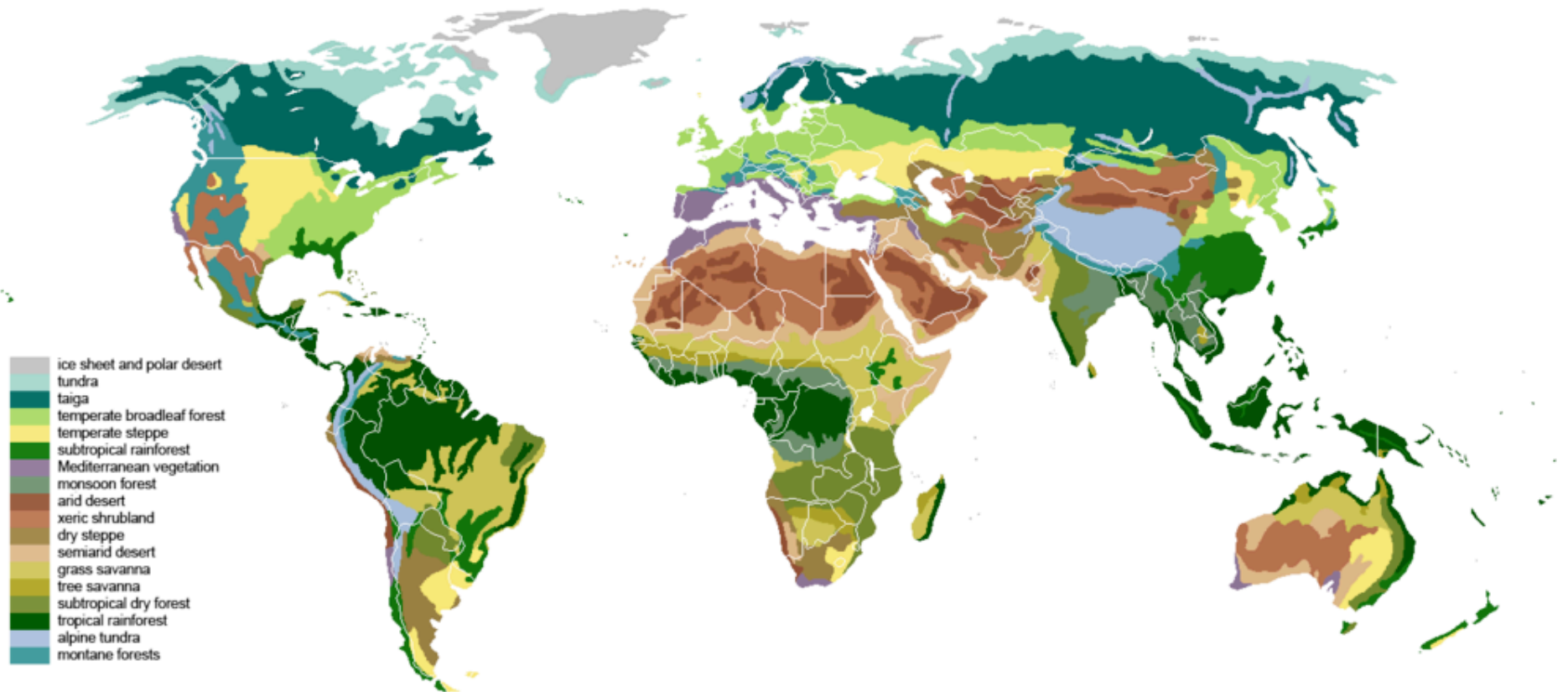
- Climate conditions have a profound effect on the distribution of organisms on land
- Today:
  - lower sea level (more land) than during the last 500 million years)
  - steep temperature gradient between poles and equator
- In the past:
  - higher sea level (less land than today)
  - warmer poles, and a gentler temperature gradient

## vegetation patterns parallel climatic zones

- The distribution of terrestrial vegetation matches the geographic patterns of climate
- On land, plants are the dominant producers of the food web and, as a consequence, strongly affect distribution and abundance of animals
- Plants are not only a source of food, but also offer a variety of different habitats for animals

# major terrestrial communities

every community is characterized by a particular association of plants  
adapted to particular climate conditions





# Tropical climates

- Warm and moist climates
- Within 30° N and S of the equator
  - Average air temperatures between 18°C and 20°C
- Tropical rain forest (jungle)
- Forest is very diverse
  - Offers food and shelter for a wide variety of animals
  - Isolated trees within the forest prevent spreading of parasites, insects, and diseases



## Tropical rain forest

Kipahulu, Maui, Hawai'i

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# Savannahs and grasslands

- Form in areas where rainfall is sufficient for grasses but not forest
- Scattered trees, sometimes in small groves
- Transitional areas between tropical rainforests and subtropical deserts





## Plants and animals from the African Savannah

Tanzania

From <https://blogs.cornell.edu/admissions/2015/09/11/cornell-abroad-studying-in-the-african-savannah/>

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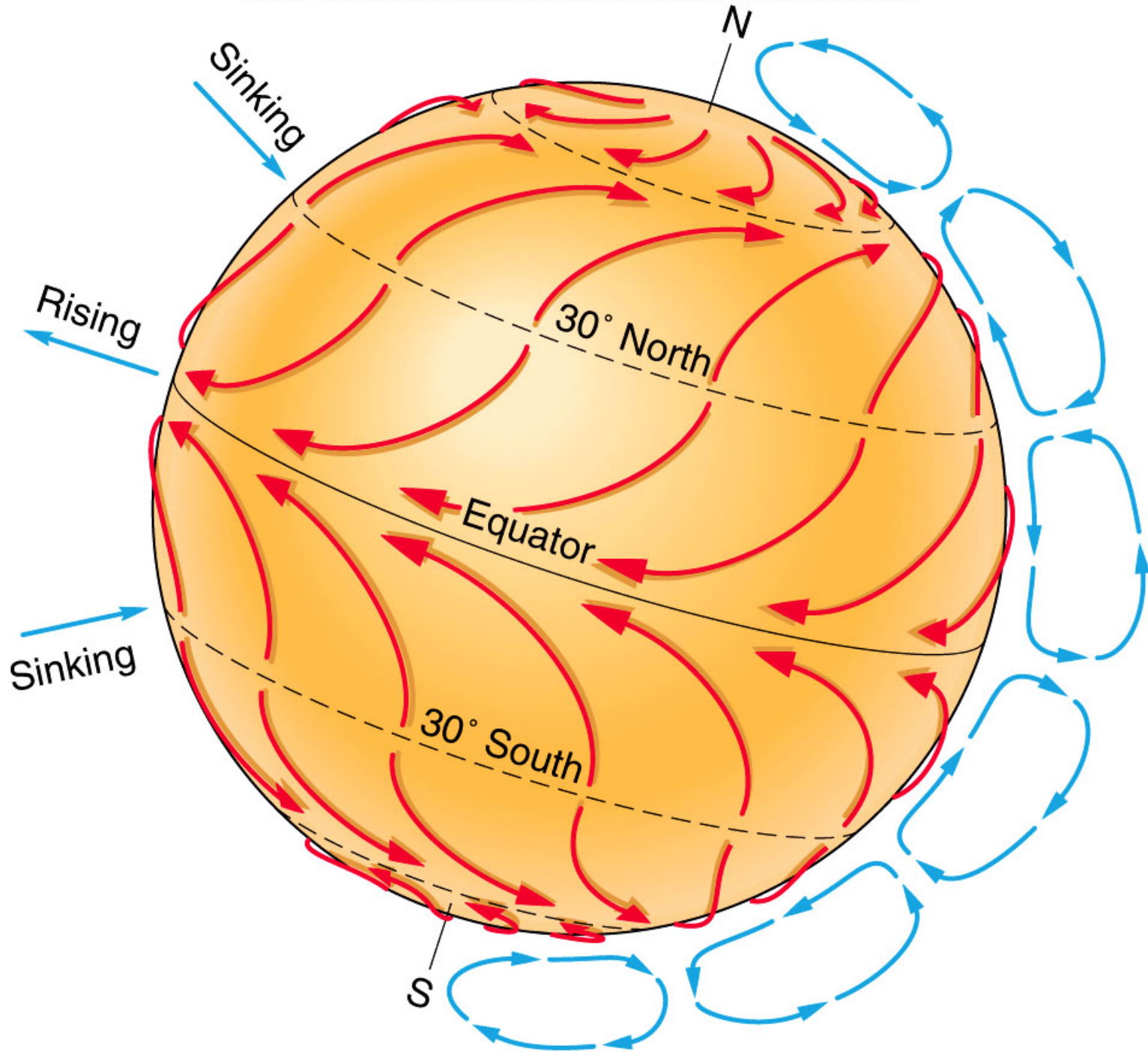
## Grasslands: the North American Prairie

Great Falls, Montana, U.S.A.

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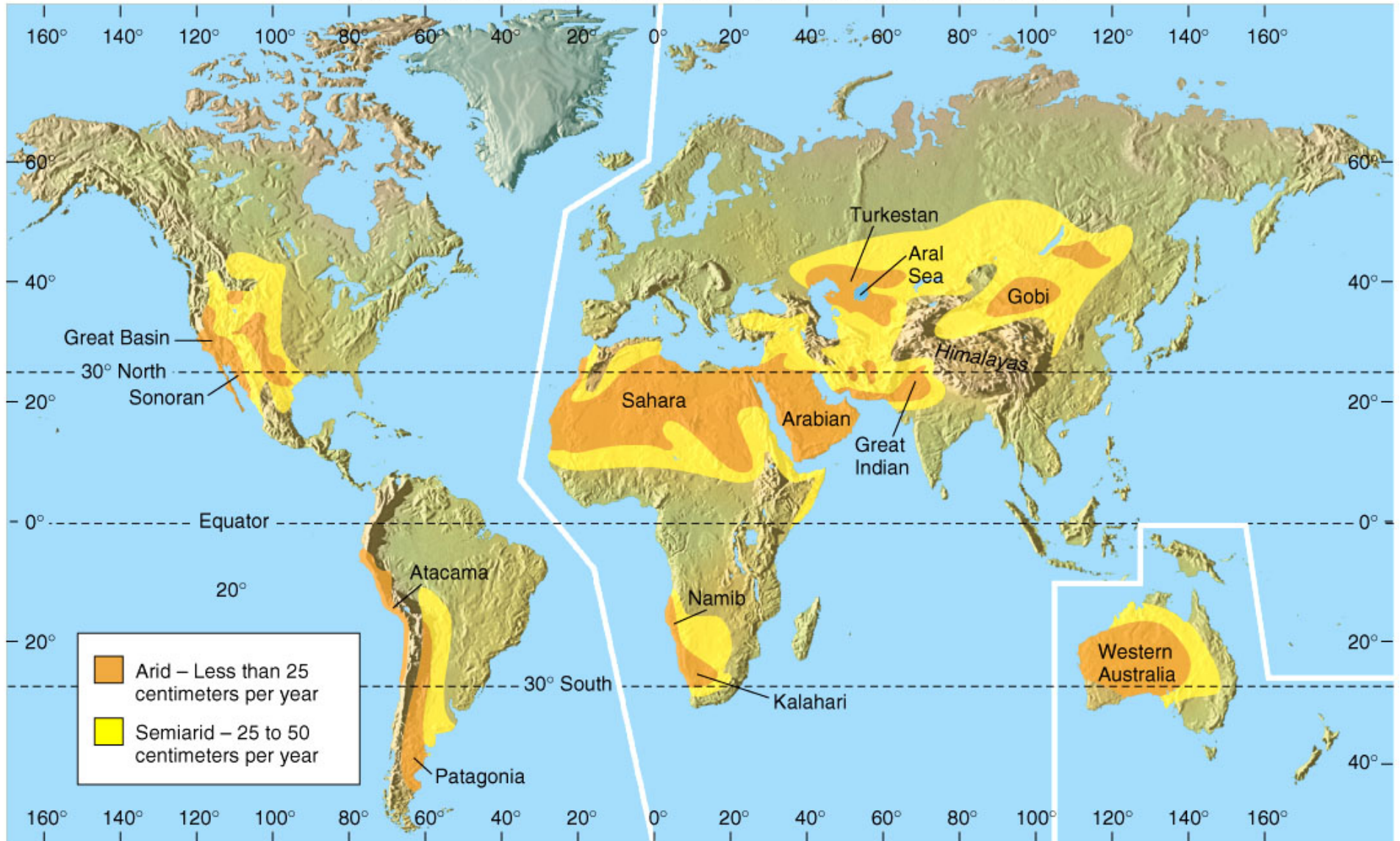
# Deserts

- Form in areas with scant or no precipitation (< than 25 cm, or 10 inches, of rain per year)
- Where do we get so little precipitation?
  - Subtropical highs (where descending air heats up and absorbs moisture) – most common reason
    - Sahara desert, Kalahari desert, Australian desert
  - Behind mountain areas (rain shadow)
    - Nevada Basin and Range desert, Patagonia (Argentina)
  - Landlocked areas away from the ocean
    - Central Asia
  - Western margins of continents: cold ocean currents and upwelling
    - Peru and northern Chile, Baja California, Namibia desert





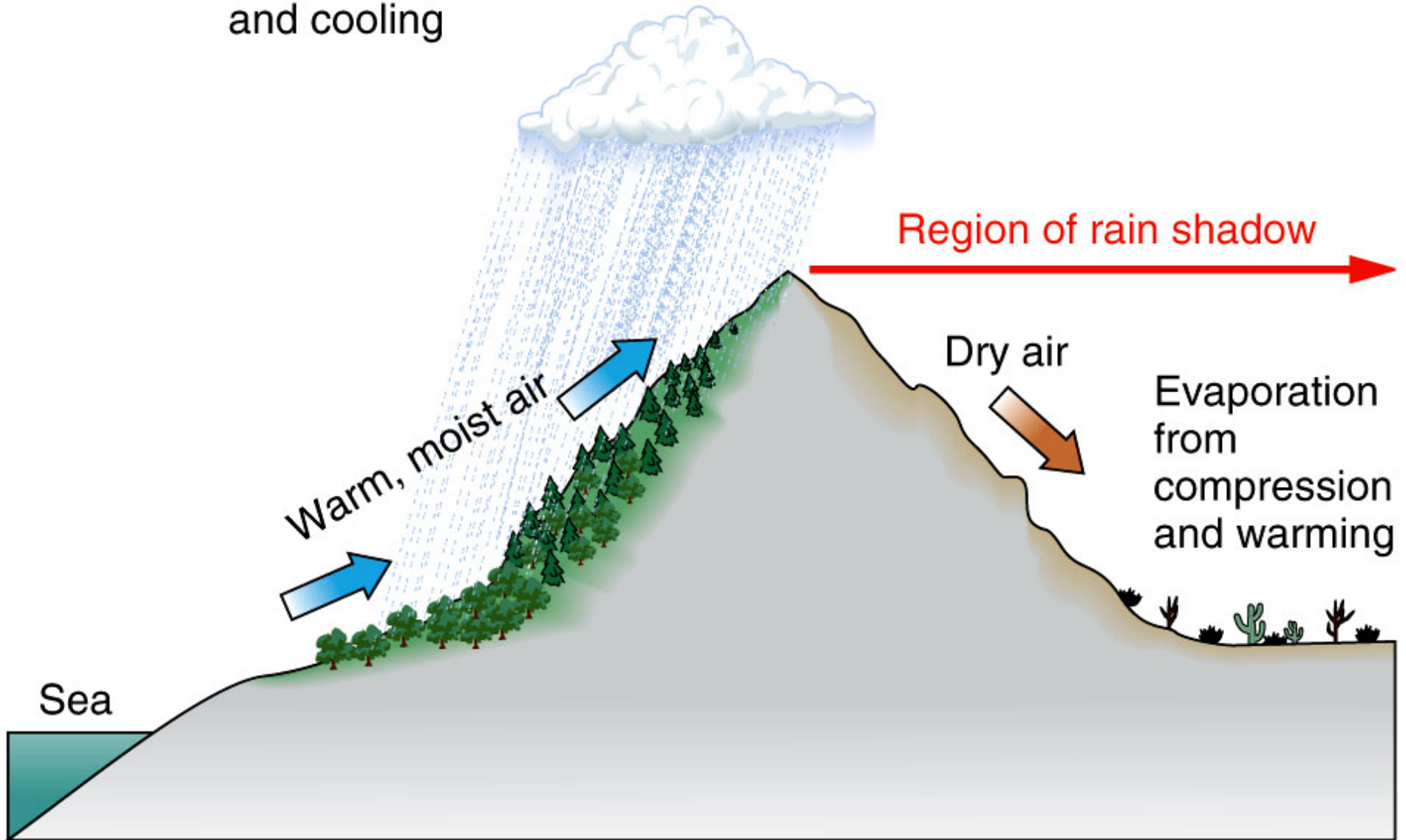
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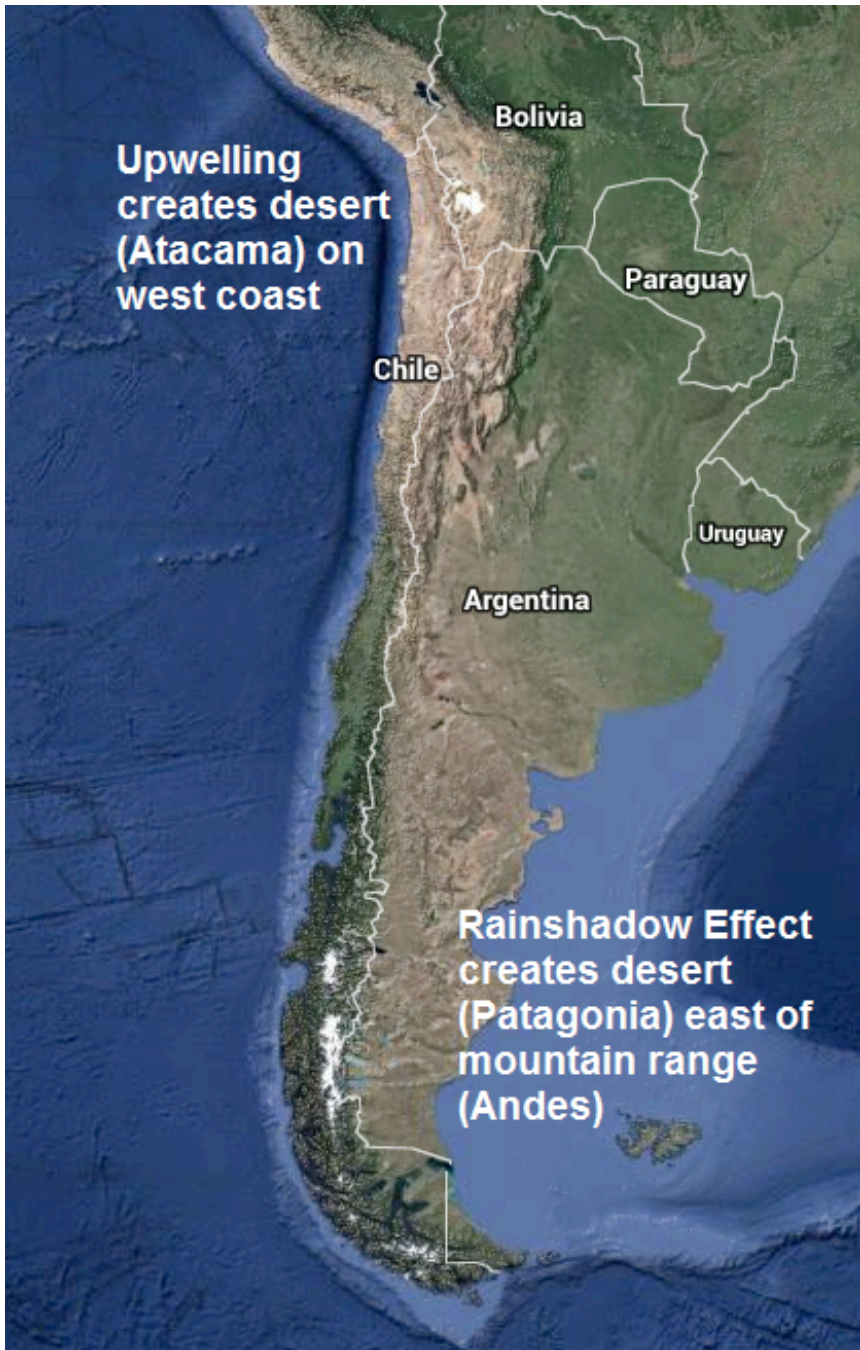




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## Rain from expansion and cooling





Deserts of South America:

Coastal Atacama desert of Peru, Bolivia, and Chile

Rain shadow effect Patagonia desert of Argentina

- Since only a few type of plants can live in very dry conditions, many deserts are characterized by sand and rocks
- Succulents are able to store water and develop spines rather than leaves to minimize water loss
- Few mammals survive in desert areas, mostly small and nocturnal ones





## Great Sand Dunes National Park

Mosca, Colorado, U.S.A.

© Alessandro Grippo





Barrel cactus, Mesquite trees, Creosote bushes and giant Saguaros of the Sonora desert

Tucson, Arizona, U.S.A.

© Alessandro Grippo

# Mediterranean climates

- Characterized by wet winters and dry summers
- Prevail along coastlines at 40° N or S
  - Central and southern Italy, southern California, central Chile, South Africa, southeastern Australia
- Warm summers warm up land and air rises, causing winds to blow from ocean and absorbing moisture
- Cold winters cause cooling of air that releases precipitation





## Mediterranean vegetation along the California coast

Goleta slough, Santa Barbara, California, U.S.A.

© Alessandro Grippo

# Temperate climates

- Found from 40° to 60° latitude
- Characterized by lower temperatures and high precipitation, snowy in winter
- Abundant angiosperms (flowering plants)
  - Maples, oaks, beeches, and more
- High diversity in animals and, particularly, birds





Fall in a temperate climate: deciduous tree leaves on the ground

downtown Seattle, Washington, U.S.A.

© Alessandro Grippo

# Northern coniferous forests

- From 60° poleward
- Moisture still abundant, but flora is dominated by gymnosperms forests
  - Firs, spruces, pines
- Shorter summers, low temperatures prevent angiosperms to thrive
- Low animal diversity (low temperatures and fewer plants)
- Trees can flourish side by side because low temperatures prevent insects from surviving in winter and attack plants





## A coniferous forest along the north Pacific Coast

Wickaninnish Bay, Ucluelet, British Columbia, Canada

© Alessandro Grippo



# Tundra

- Subarctic locations
  - Only in the northern hemisphere: no land mass around Antarctica
- Characterized by year-round cold conditions
- Permafrost: water is never really available
  - dry conditions
- Mosses, sedges, lichens, shrubs, very small trees
- Low animal diversity
  - Rodents, snowshoe hares, reindeers, foxes, wolves, bears



The transition from conifer forest to tundra and to glaciers

Skagway, Alaska, U.S.A.

© Alessandro Grippo

# Glaciers

- Masses of ice in motion
- Form where more snow falls in winter that can melt in the summer
- Found on polar land masses
  - Antarctica, Greenland
- but also as alpine glaciers
  - Alps, Himalayas, Rocky Mountains, Andes
- Calving of icebergs at polar latitudes



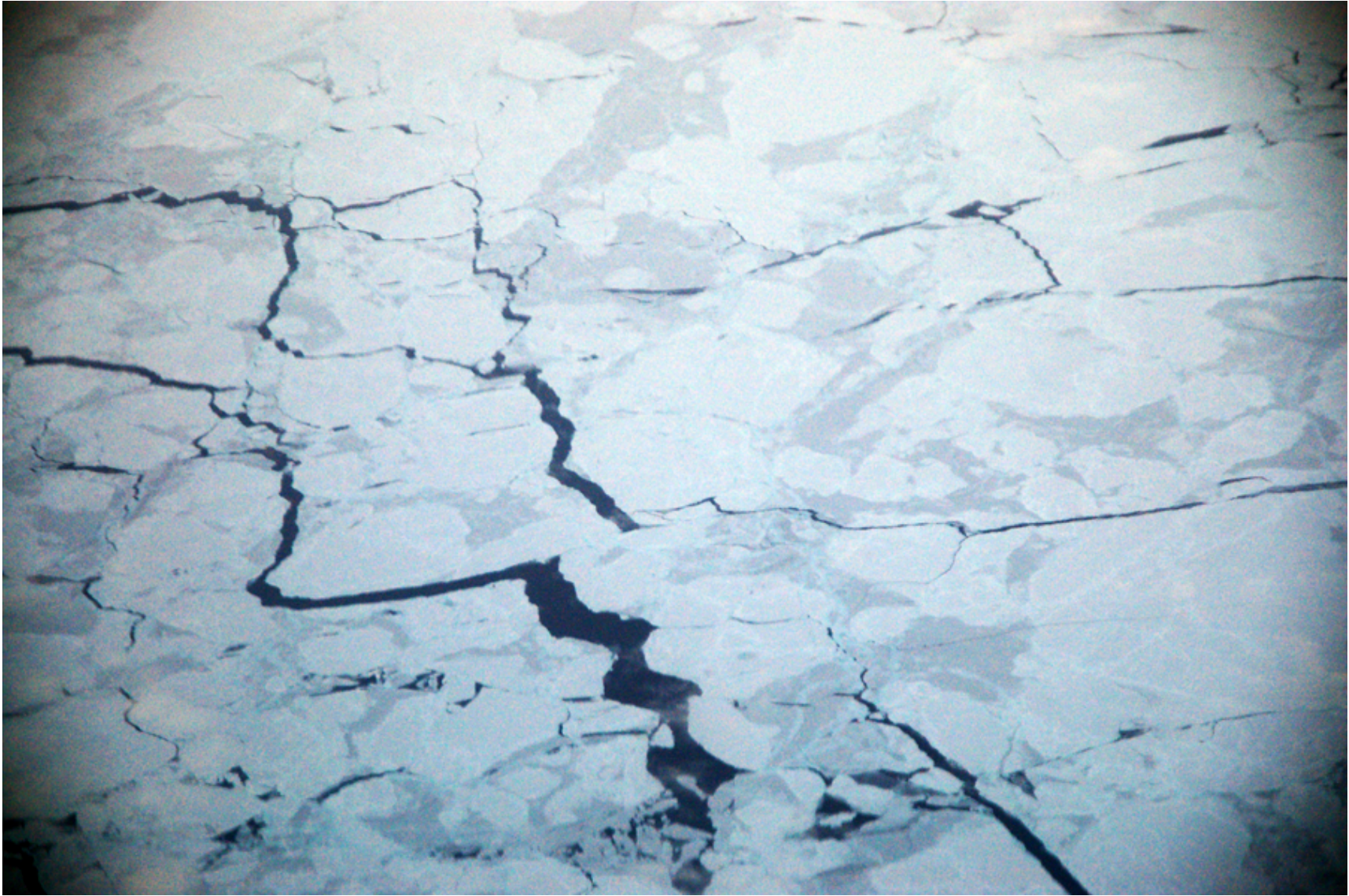


A glacier advancing into the ocean and the calving of small icebergs

Glacier Bay National Park, Gustavus, Alaska

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## Sea ice forming and breaking

Hudson Bay, Quebec, Canada

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“iceberg alley”, April 19, 2017  
Ferryland, Newfoundland, Canada



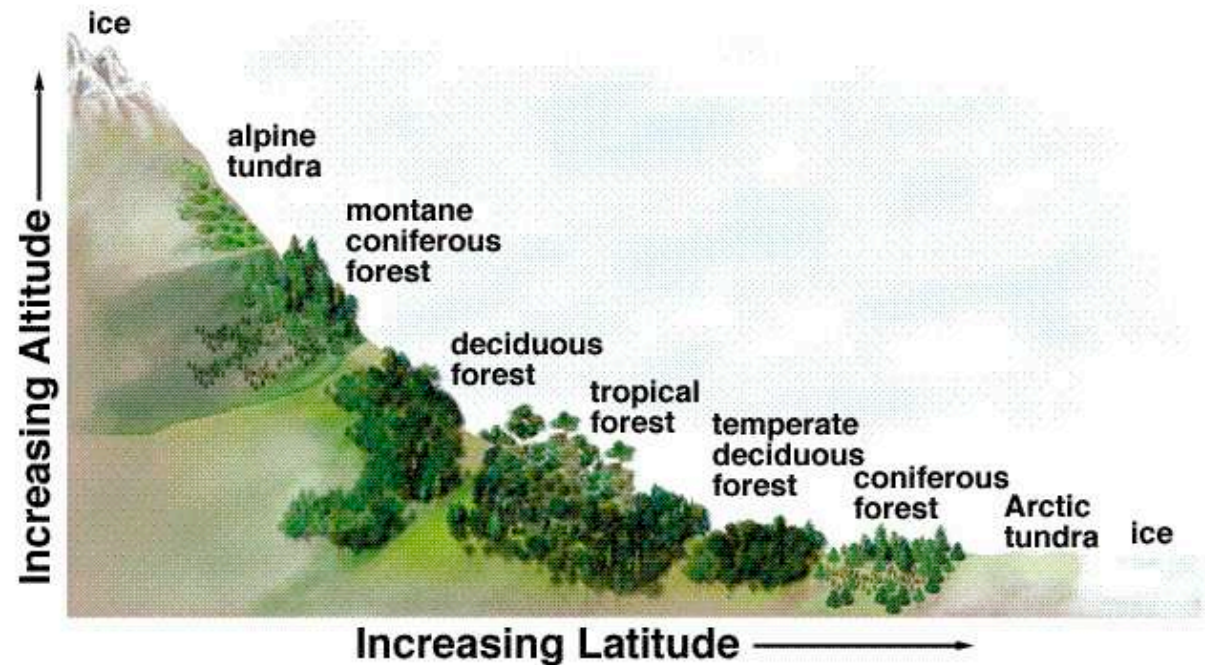


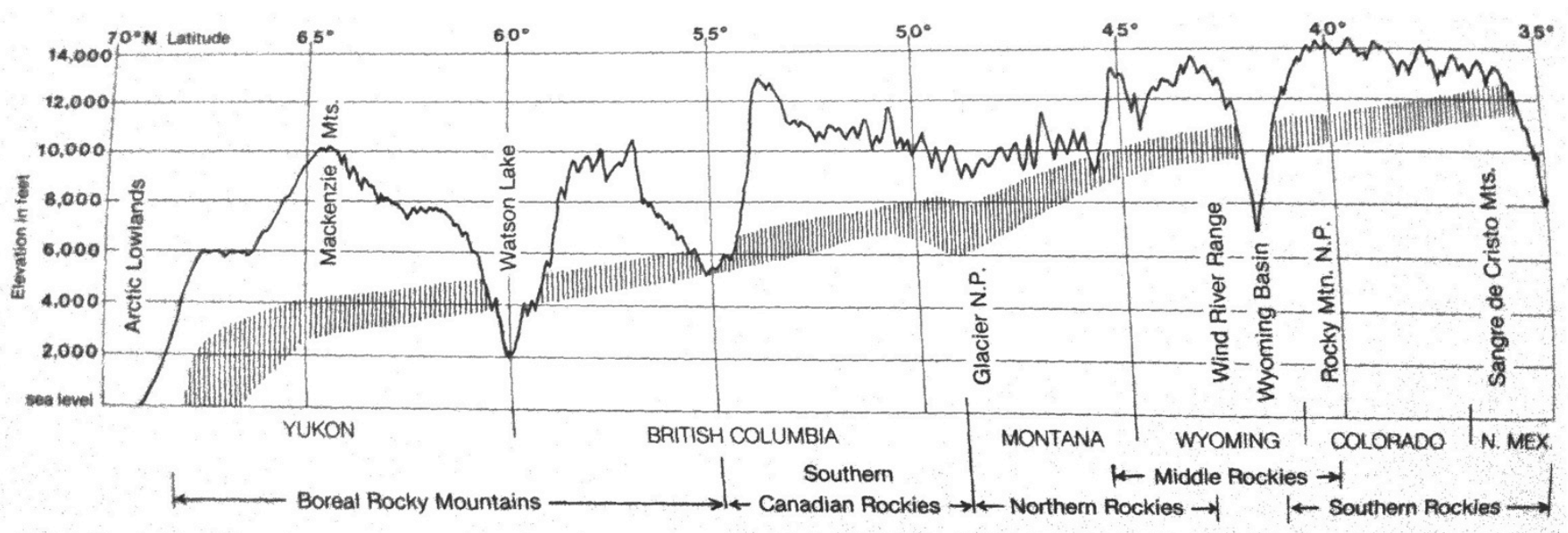
# Climate Changes with Elevation

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- The temperature gradient between the base of a mountain and its top resembles the latitudinal gradient between a warm climatic zone and a polar region

## Climate and biomes





**A north-to-south section along the crest of the Rocky Mountains, from Yukon, Canada, to New Mexico, U.S.A., showing the southward rise in the alpine timberland (shaded zone). Sectioned distance is about 2300 miles**

# Rocky Mountains

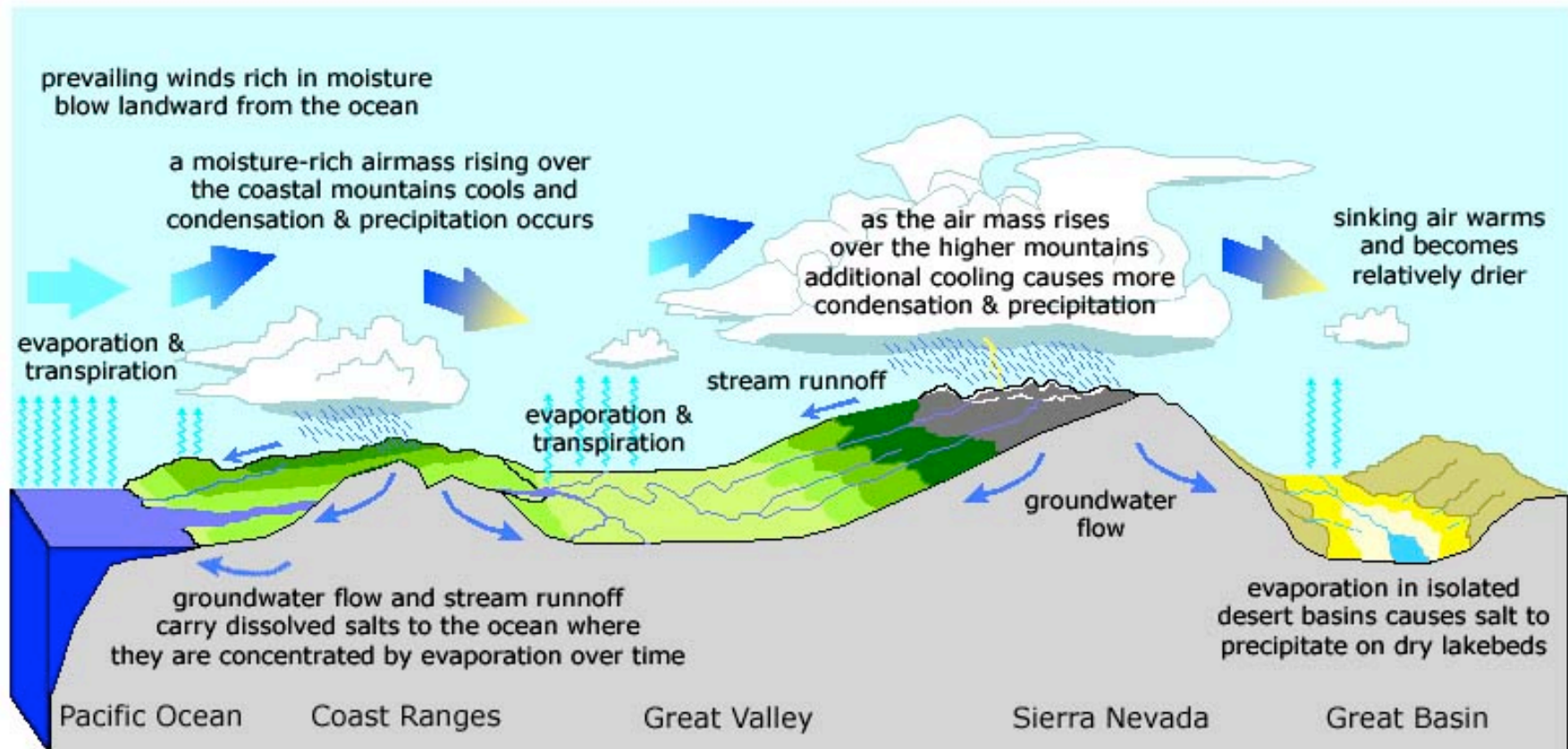


- This map shows the location of the Rocky Mountains from Alaska to Mexico, in reference to the previous figure



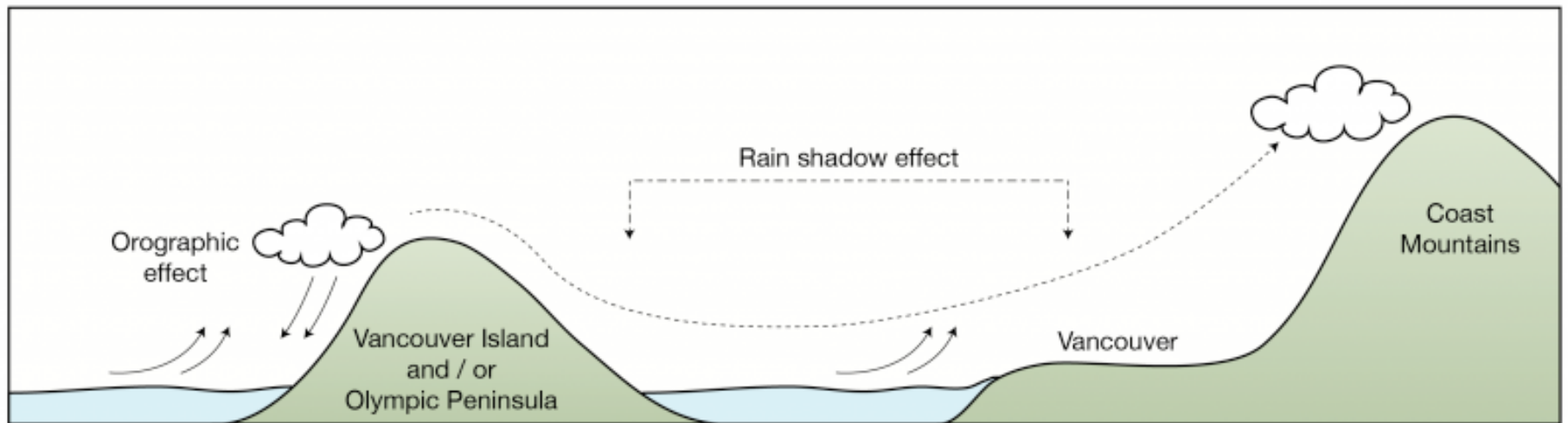
# mountains and rain shadow

## California



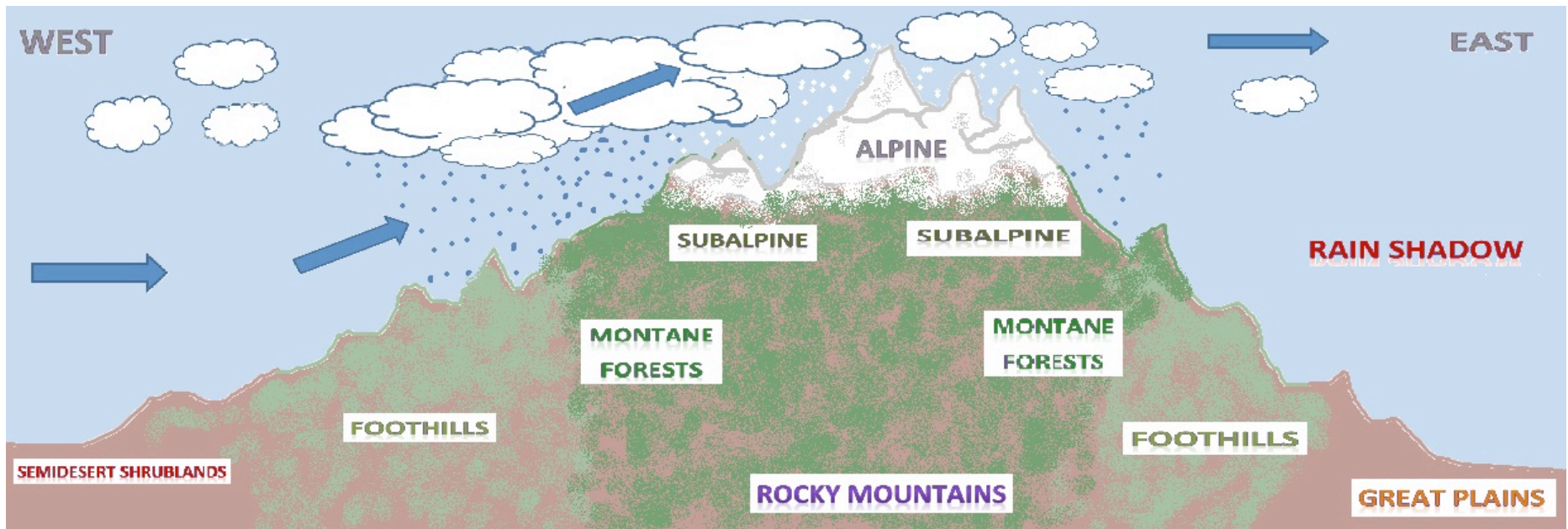
# mountains and rain shadow

British Columbia, Canada



# mountains and rain shadow

## Colorado and Wyoming





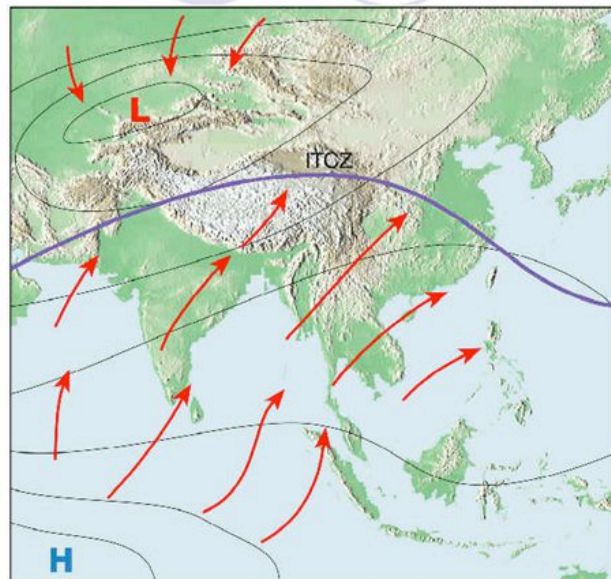
Land and water influence seasonal temperature change

- The **high heat capacity of water** tends to moderate climate in the ocean, in coastal areas, and around great lakes
  - Lakes, lagoons, bays can still be affected by winds and display temperatures that are much more extreme than those of the open ocean nearby
- This increases seasonality in areas away from coastlines

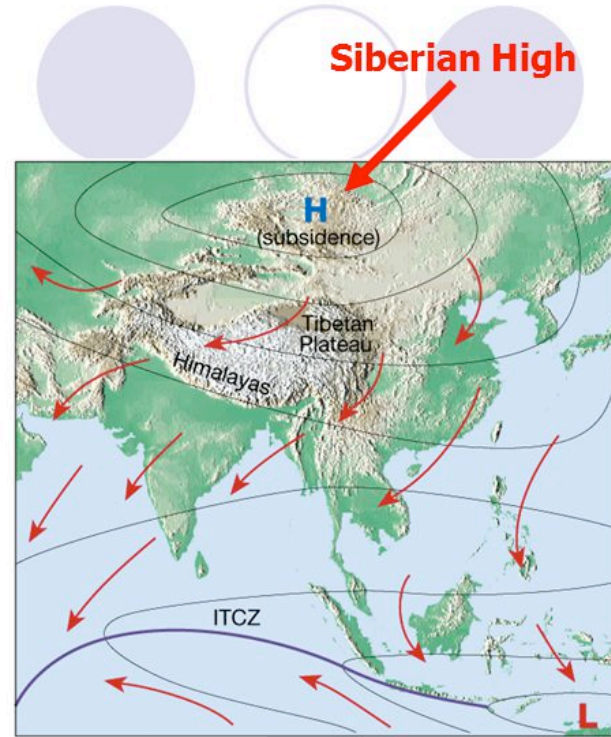
# monsoons

- Strong onshore and offshore winds caused by the difference in heat capacity between land and water

## Asian Monsoon

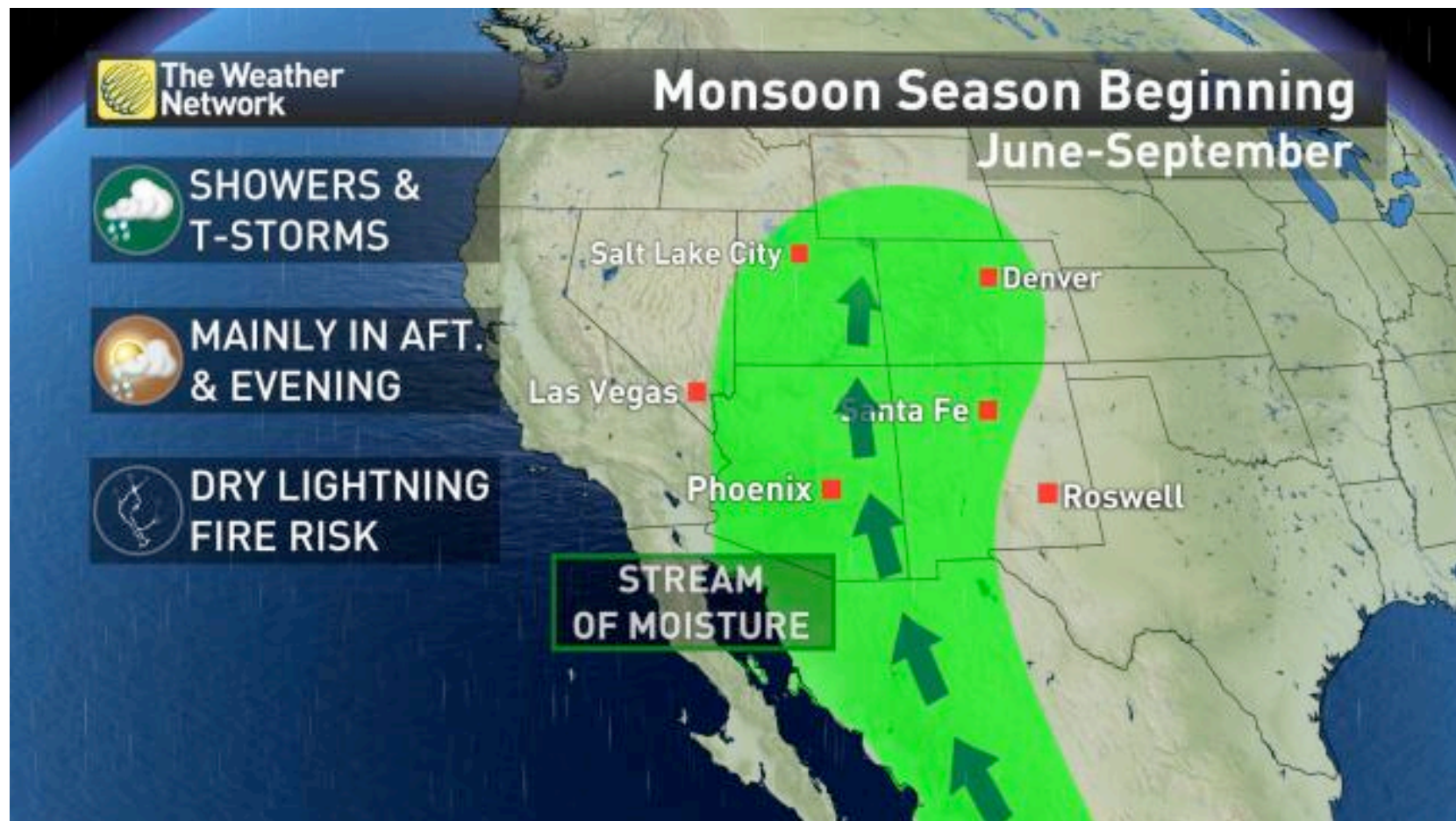


**SUMMER MONSOON**



**WINTER MONSOON**

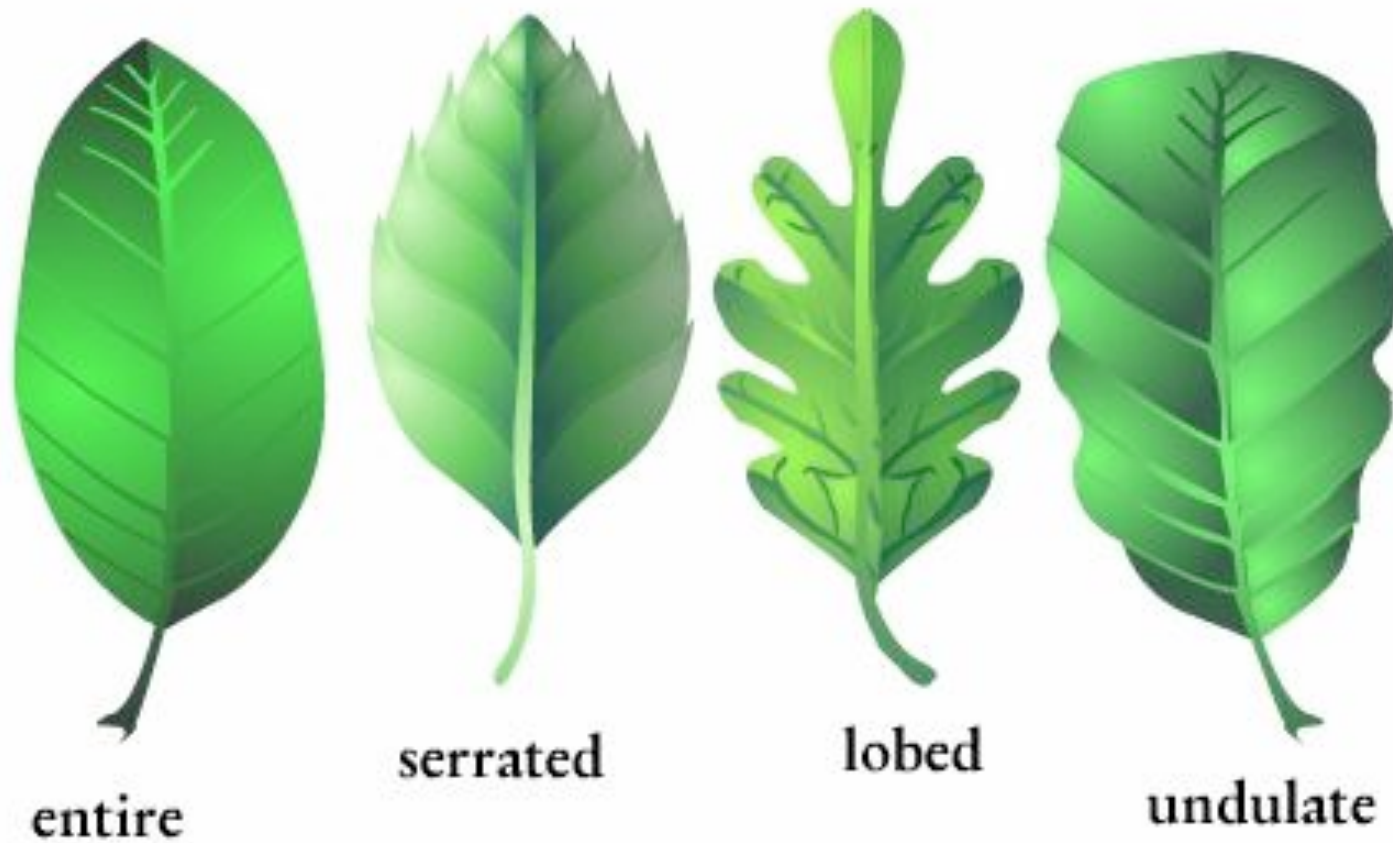
- The most powerful monsoons occur in southern Asia, but they are also present in other regions, including American Southwest





# Fossil plants reflect ancient climatic conditions

- Plants are very sensitive to environmental conditions
- Many can be used to infer climate conditions of the past
  - Certain plants only live in certain climates, such as cycads
  - Waxy leaves indicate trees that lived in warm climates
  - The margin of fossil leaves may indicate past temperatures
  - The ratio of fossil floras to fossil faunas indicates past temperatures



A simple illustration showing leaves with different margins

A smooth, entire margin indicates a warmer climate.  
Going polewards into cooler climates, the leaves become more toothed and lobed.

# Environments and Life, part III

**the end**