Chapter 3

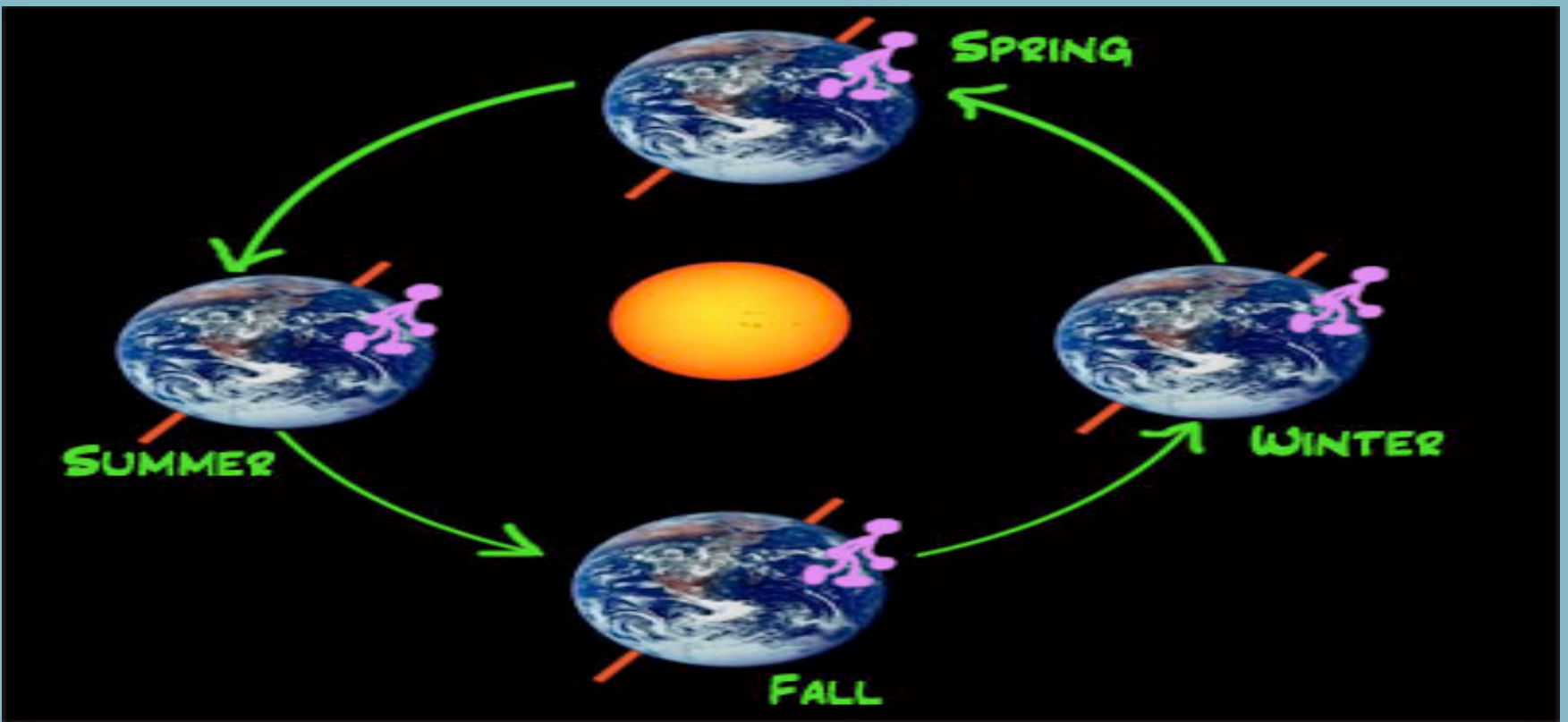
Climate and the Earth

Weather and Climate

- Weather: The condition of the atmosphere in one place during a limited period of time
- Climate: weather patterns that an area typically experiences of a long period of time
- Climate is affected by the sun, wind, water, landforms and even people
- To understand an area's climate, geologists and meteorologists look at extremes of temperature and precipitation

Earth's Tilt and Rotation

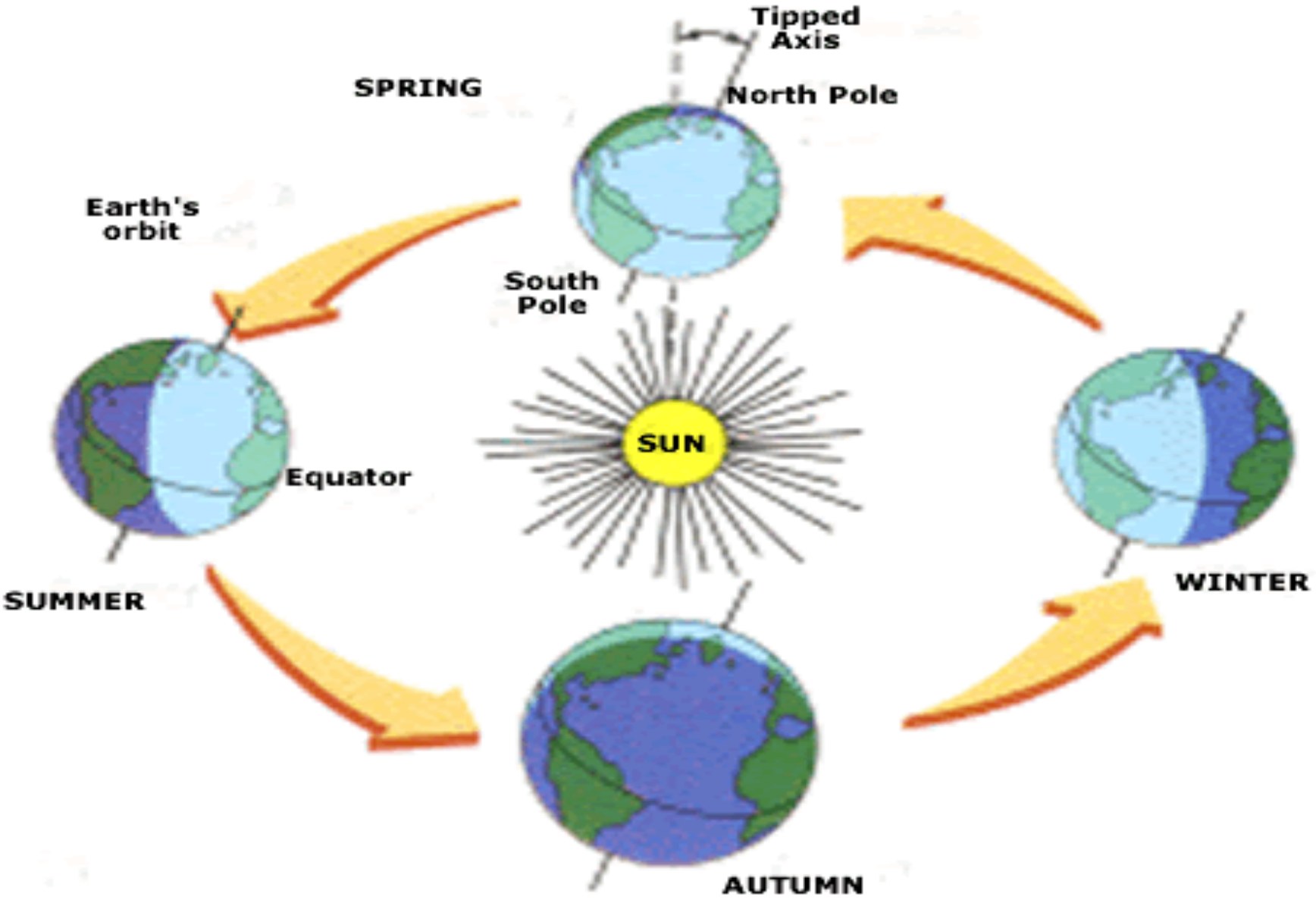
- Axis: imaginary line running from the North to the South Pole through the planet's center
  - Tilted at an angle of 23.5 degrees
- Temperature: affected by the tilt of the axis
  - Measure of how hot or cold a place is
- Light: Dependent on Earth's rotation on axis (every 24 hours)



Earth's Revolution

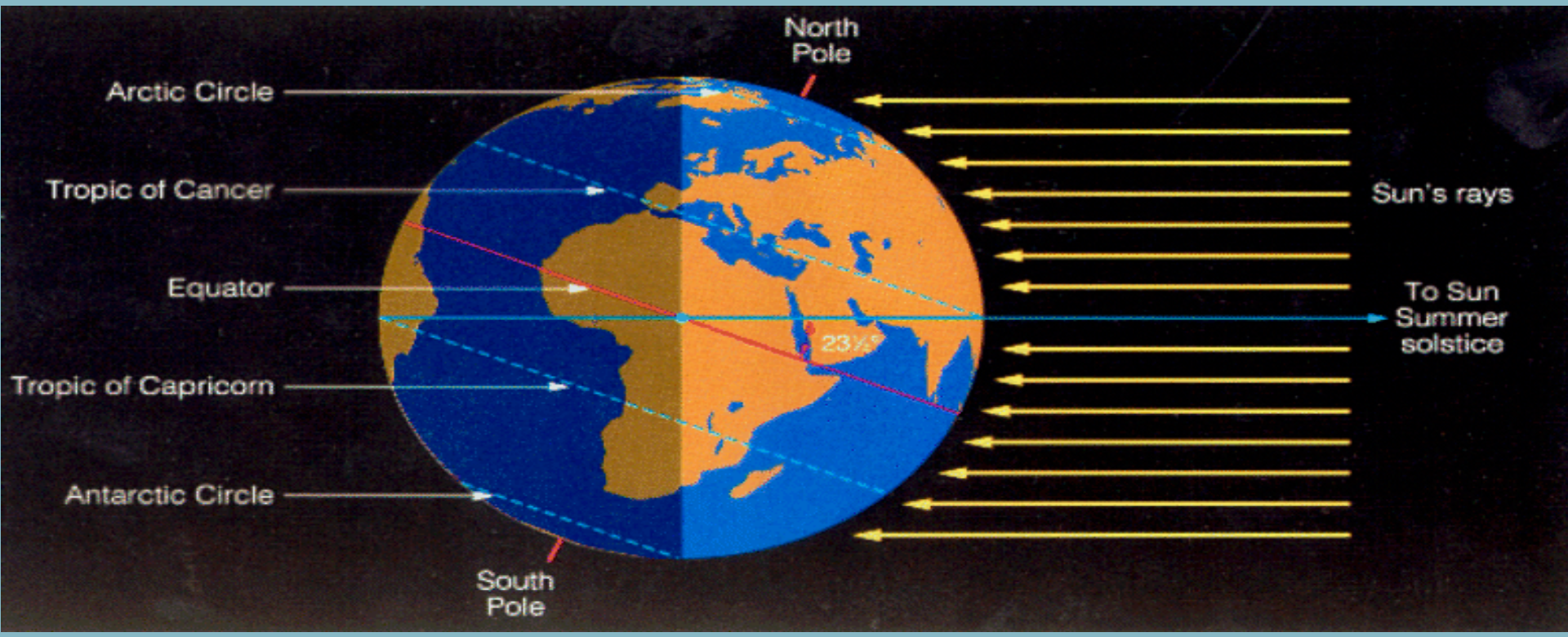
- Revolution: 365 days to go around the Sun once
  - Revolution and tilt cause changes in the angle and amount of sunlight reaching different locations
    - Seasons
  - Equinox: Sun's rays fall directly on Equator
    - Equal hours of day and night
  - Tropic of Cancer: 23.5 degrees N Latitude
    - Northernmost point on earth to get direct rays of the sun
      - Solstice: Longest day of sunlight
  - Tropic of Capricorn: 23.5 degrees S Latitude
    - Winter solstice: shortest daylight in Northern Hemisphere

Earth's Tilt and Seasons



The Poles

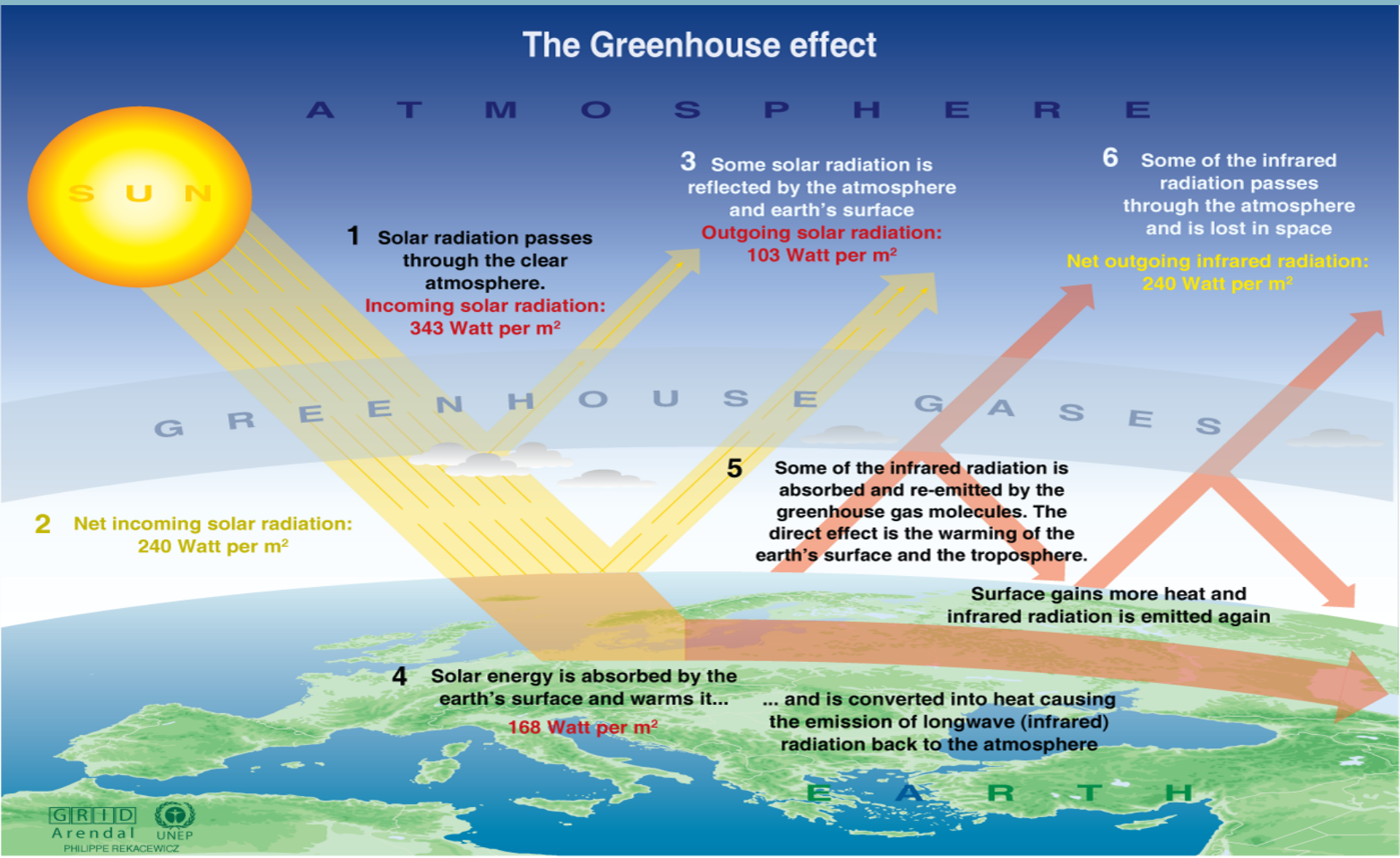
- Poles have dramatic changes in amount of sunlight
- Six months out of the year, one Pole is tilted toward the sun and receives continuous sunlight
  - At this time, the other Pole (tilted away from the sun) receives very little or no sunlight
- At the North Pole, the sun never sets from March 20-Sep 23
  - Midnight Sun



The Greenhouse Effect

- Some of the sun's radiation passes through earth's atmosphere
  - Warms the surface
- Atmosphere traps the sun's warmth for growing plants
  - Greenhouse Effect
- Gasses in the atmosphere such as water vapor and carbon dioxide absorb the heat reflected by the earth
- Rise in current CO2 levels traps more heat
  - Global Warming (90-95% caused by human activity)

The Greenhouse Effect



Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

Factors Affecting Climate

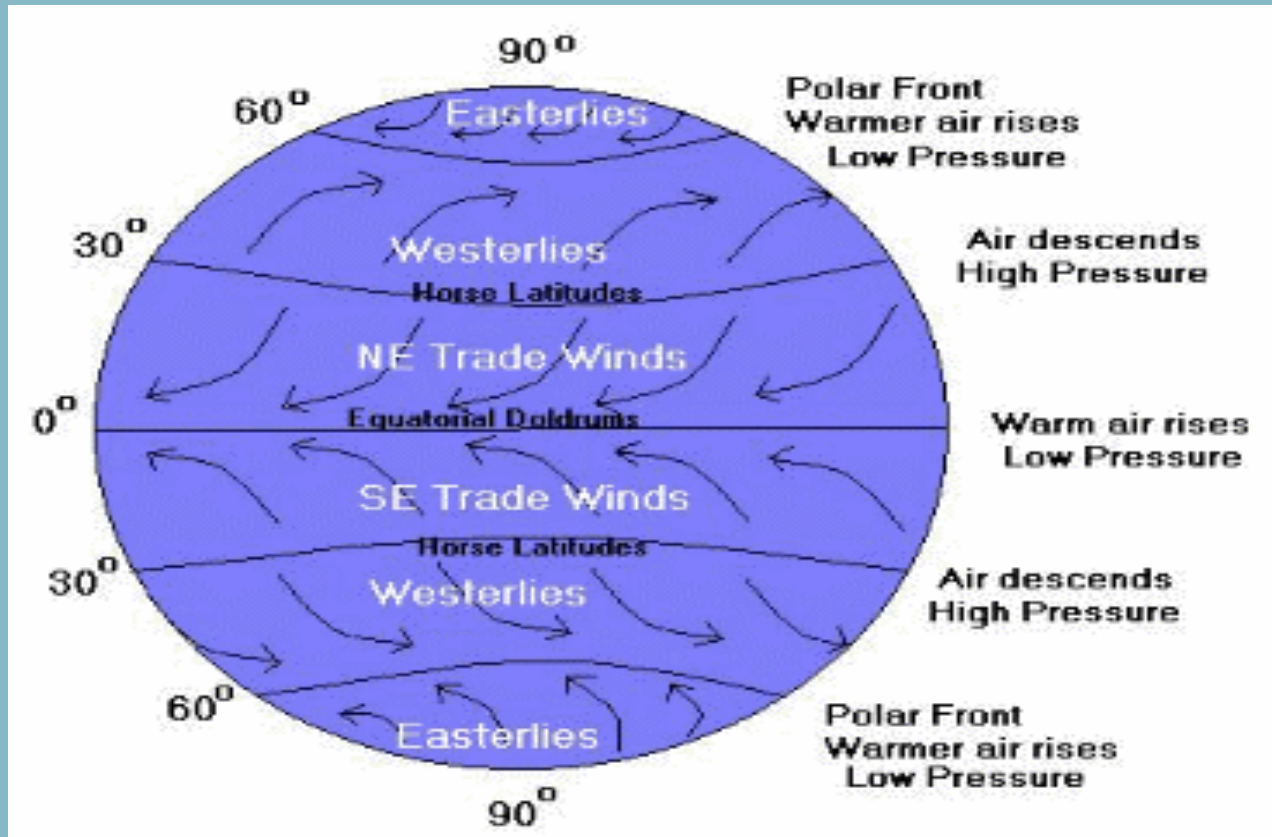
- Latitudes
  - Low Latitudes, direct rays of sun year-round
    - Tropics
  - High Latitudes: continuous, but indirect sunlight
  - Mid-Latitudes: between Tropic of Cancer and Tropic of Capricorn
    - Most variable weather on earth
- Elevation: atmosphere thins as altitude increases
  - Retains less heat
  - As elevation increases, temperature decreases

Wind and Ocean Currents

- Wind: movements over the Earth's surface
  - occurs because the sun heats up the earth's atmosphere and surface unevenly
  - Warm air rises and creates areas of low pressure
  - Falling cool air causes areas of high pressure
  - Cool air flows in to replace the warm, rising air

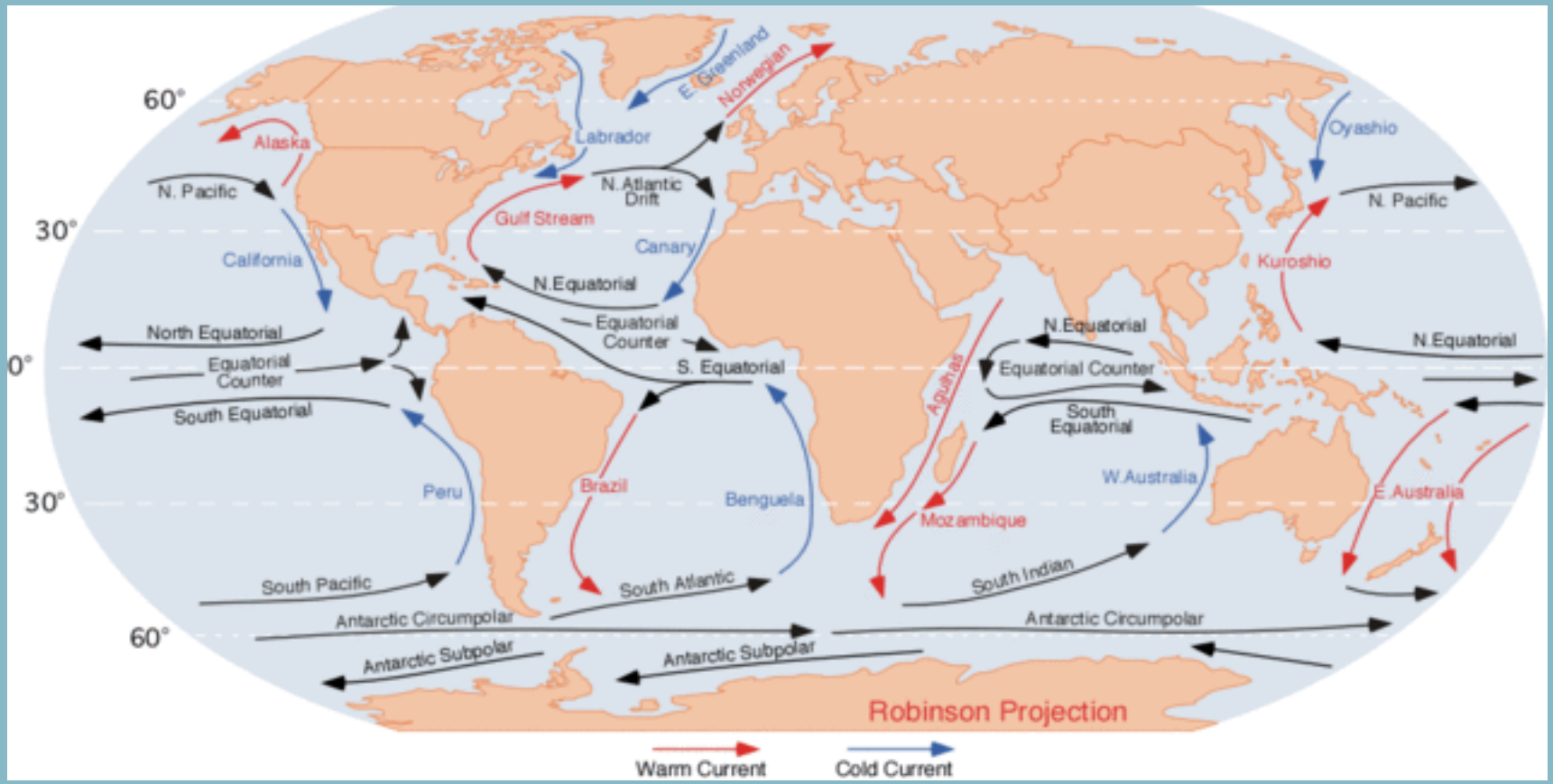
Winds Cont.

- Prevailing winds: fairly constant pattern
- Coriolis Effect:
  - Earth's rotation causes winds to go clockwise in Northern Hemisphere and counterclockwise in Southern Hemisphere
- Doldrums: Equator, winds diverted north and south so area is generally windless



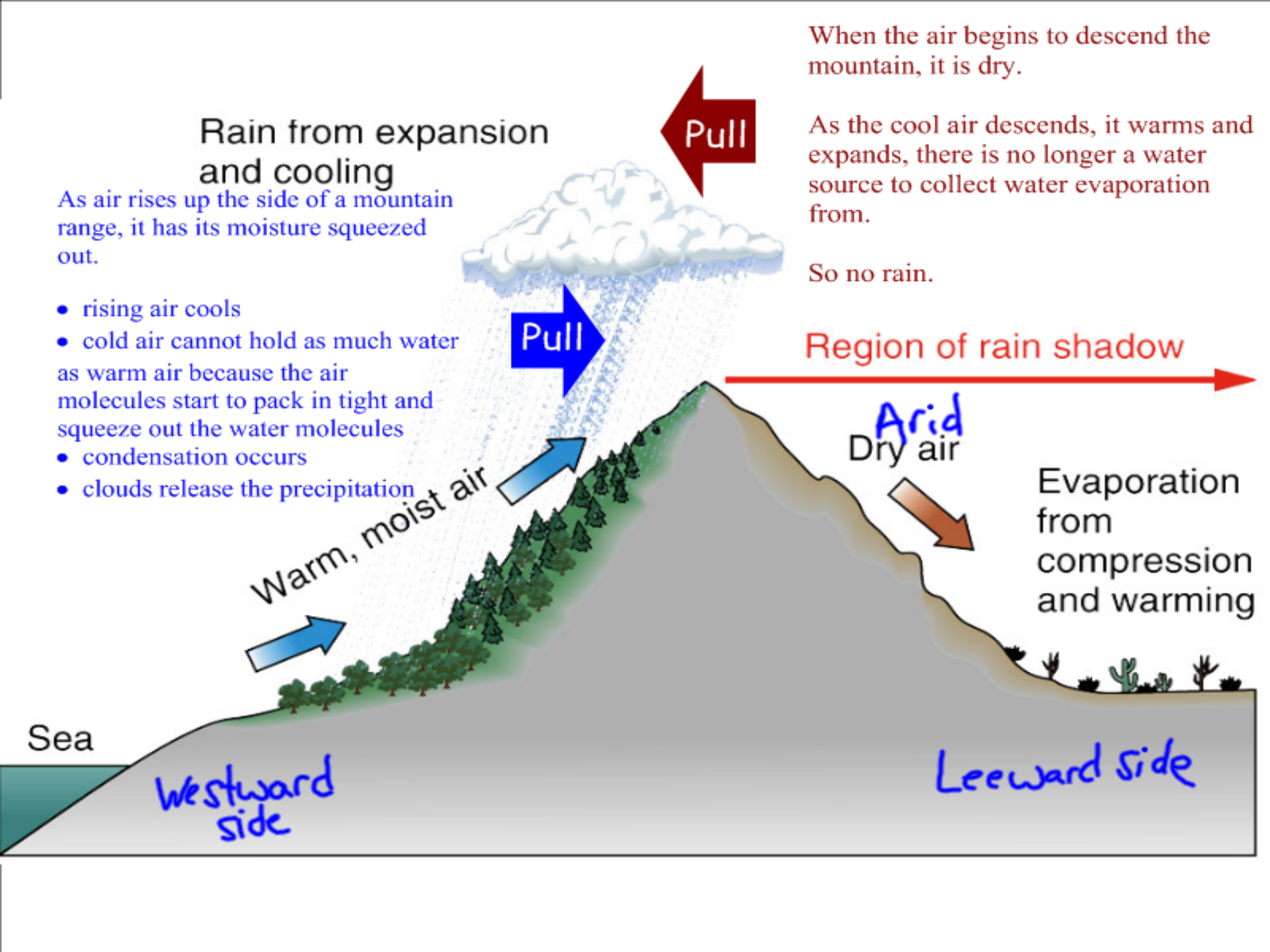
Ocean Currents

- Patterns of cold and warm streams of water
  - Cause by many of the same factors as wind patterns
  - Circulate clockwise in Northern Hemisphere and counter-clockwise in Southern Hemisphere



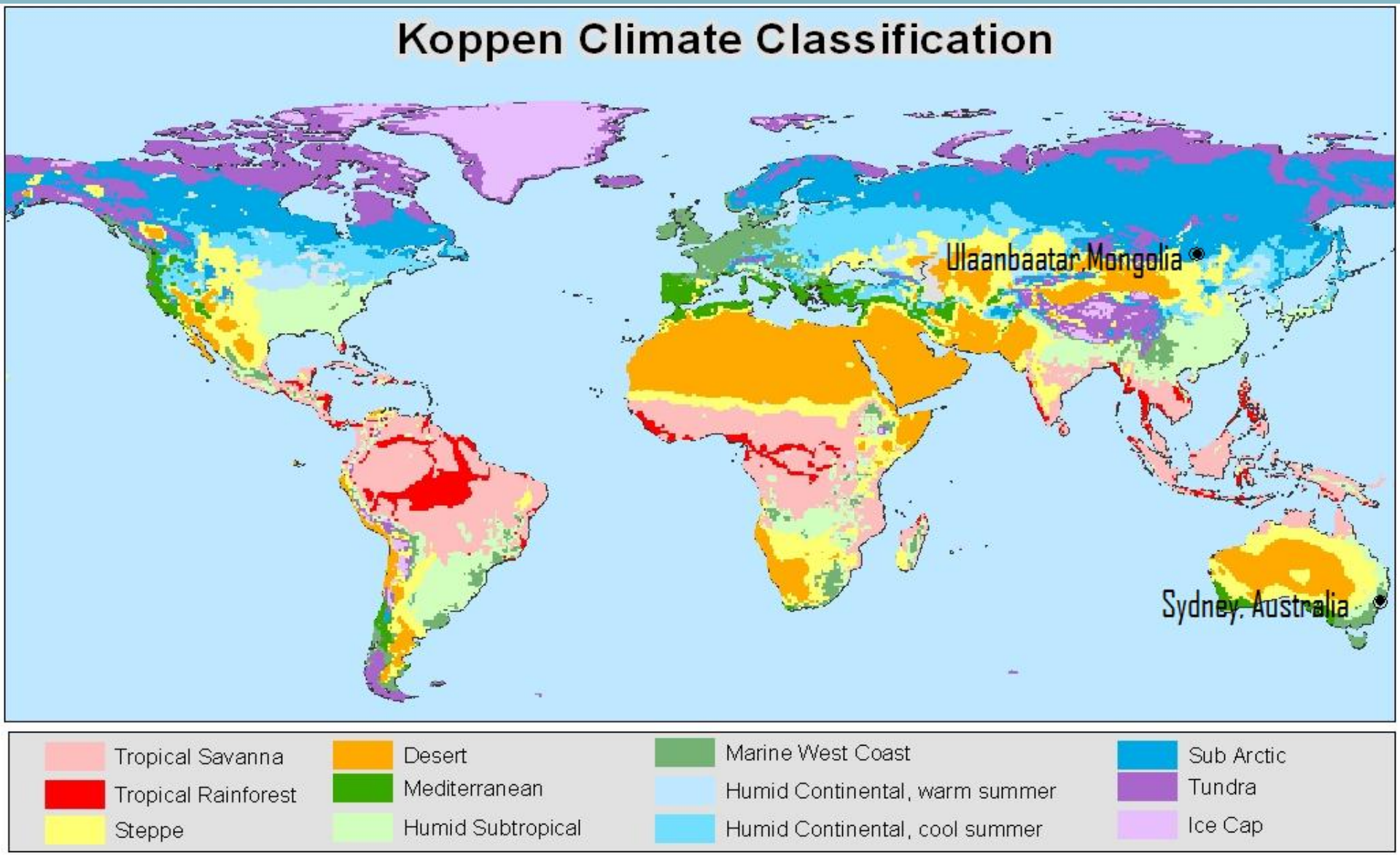
Pattern Changes

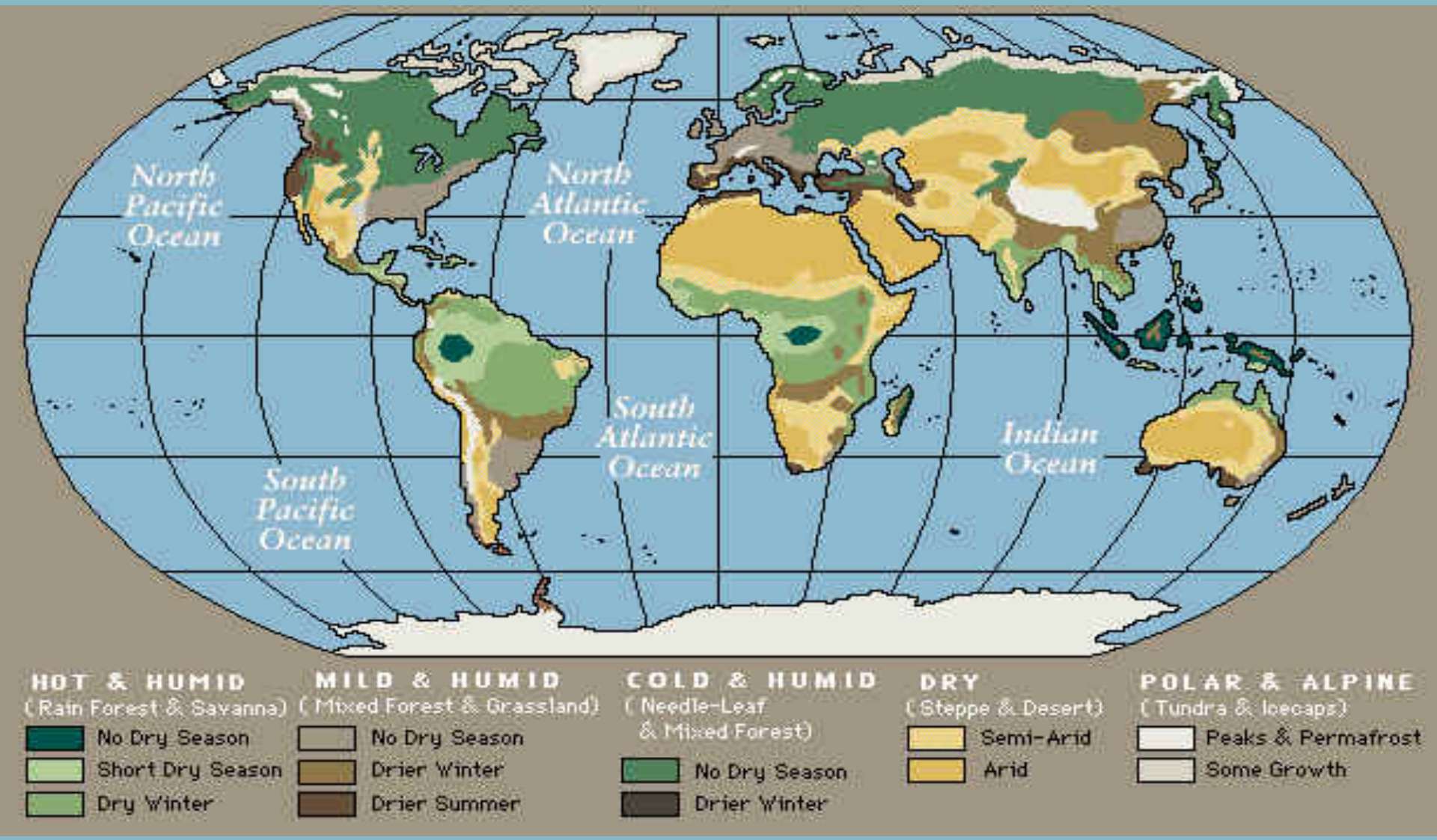
- El Nino: periodic change in the pattern of ocean currents and water temperatures in the mid-Pacific region
  - May have some link to global warming
- Landforms can influence weather patterns
  - Mountains: influence precipitation and climate
  - Winds that blow over ocean are pushed upward at mountain range
  - Rising air cools and releases moisture on windward side of the mountain (side facing the wind)
  - Winds become warmer and drier as they pass to the leeward side of the mountain
  - Rain Shadow Effect: air is hot, dry and produced little precipitation on leeward side of mountains


When the air begins to descend the mountain, it is dry.
As the cool air descends, it warms and expands, there is no longer a water source to collect water evaporation from.
So no rain.
Rain from expansion and cooling
As air rises up the side of a mountain range, it has its moisture squeezed out.
• rising air cools
• cold air cannot hold as much water as warm air because the air molecules start to pack in tight and squeeze out the water molecules
• condensation occurs
• clouds release the precipitation
Pull
Pull
Region of rain shadow
Arid
Dry air
Warm, moist air
Evaporation from compression and warming
Sea
Westward side
Leeward side

Climate Regions

- Divided – Tropical, dry, mid-latitude, high latitude and highlands
- Further divided into smaller regions with their own characteristics




North Pacific Ocean
North Atlantic Ocean
South Atlantic Ocean
Indian Ocean
South Pacific Ocean
HOT & HUMID
(Rain Forest & Savanna)
No Dry Season
Short Dry Season
Dry Winter
MILD & HUMID
(Mixed Forest & Grassland)
No Dry Season
Drier Winter
Drier Summer
COLD & HUMID
(Needle-Leaf & Mixed Forest)
No Dry Season
Drier Winter
DRY
(Steppe & Desert)
Semi-Arid
Arid
POLAR & ALPINE
(Tundra & Icecaps)
Peaks & Permafrost
Some Growth

Climates

- Tropical: low latitudes,
  - Rain forests and Savannas
  - Hot/wet throughout the year
  - Amazon – Largest tropical rainforest
    - Located in South America
- Dry Climates: desert and steppe
  - Very little rainfall
    - Desert less than 10inches/year
  - Sahara almost entire northern 1/3 of Africa

Steppe – treeless grasslands

Climate Regions

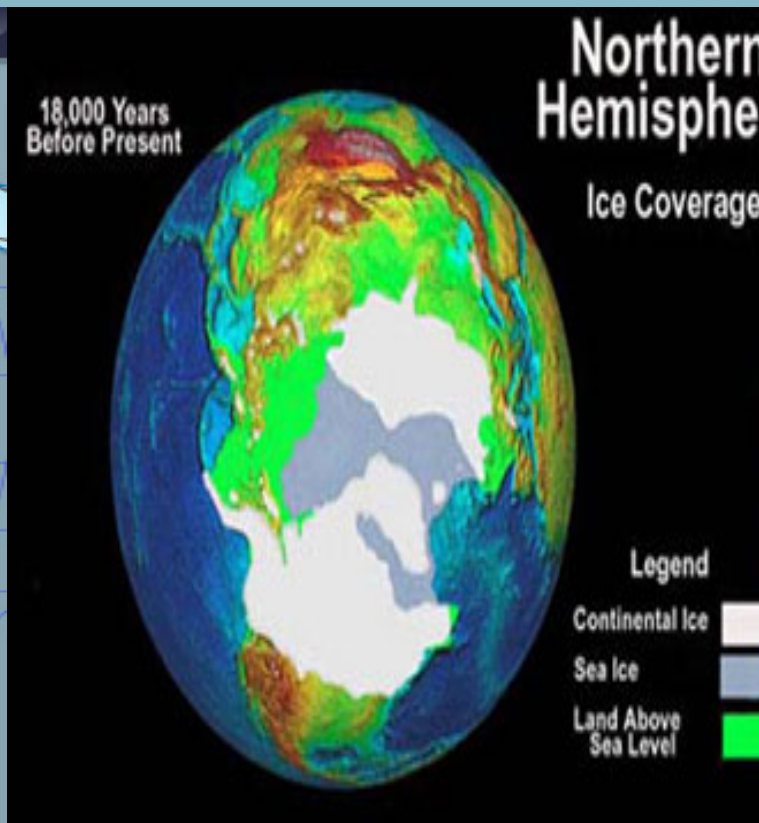
- Mid-Latitude: divided into four zones
  - includes Mediterranean area (coastal areas with similar climate and vegetation
  - Prairies: inland grasslands, and forests of evergreens
- High Latitude Climates
  - Freezing temp for much of the year
  - lack of direct sunlight
- Highland Climates: elevation makes it colder!
- Arctic Circle: subarctic climate region

High Latitude cont.

- Permafrost: permanently frozen subsoil
- Tundra: at polar regions, indirect rays bring constant light but little heat
- Ice Cap: Snow and ice about 2 miles thick, constantly covers the surface area
- Earth's largest polar ice cap covers almost all of Antarctica

Changing Climates

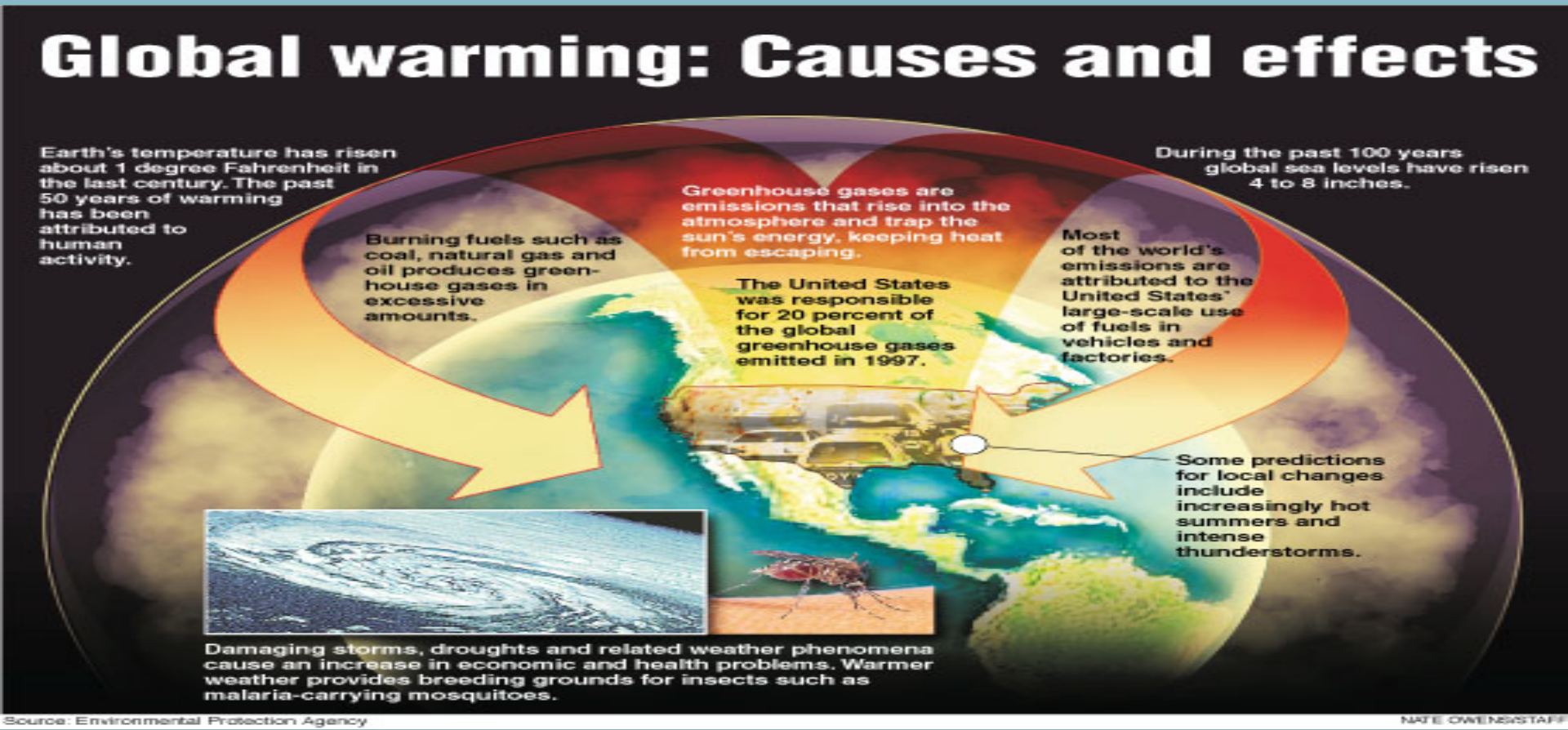
- Earth's Climate Change: during the last 1-2 million years earth passed through four ice ages (naturally)
  - Earth absorbed less solar energy, possibly because the sun's output of energy changed
  - Dust clouds could change climate
  - Last major one was 18,000 years ago

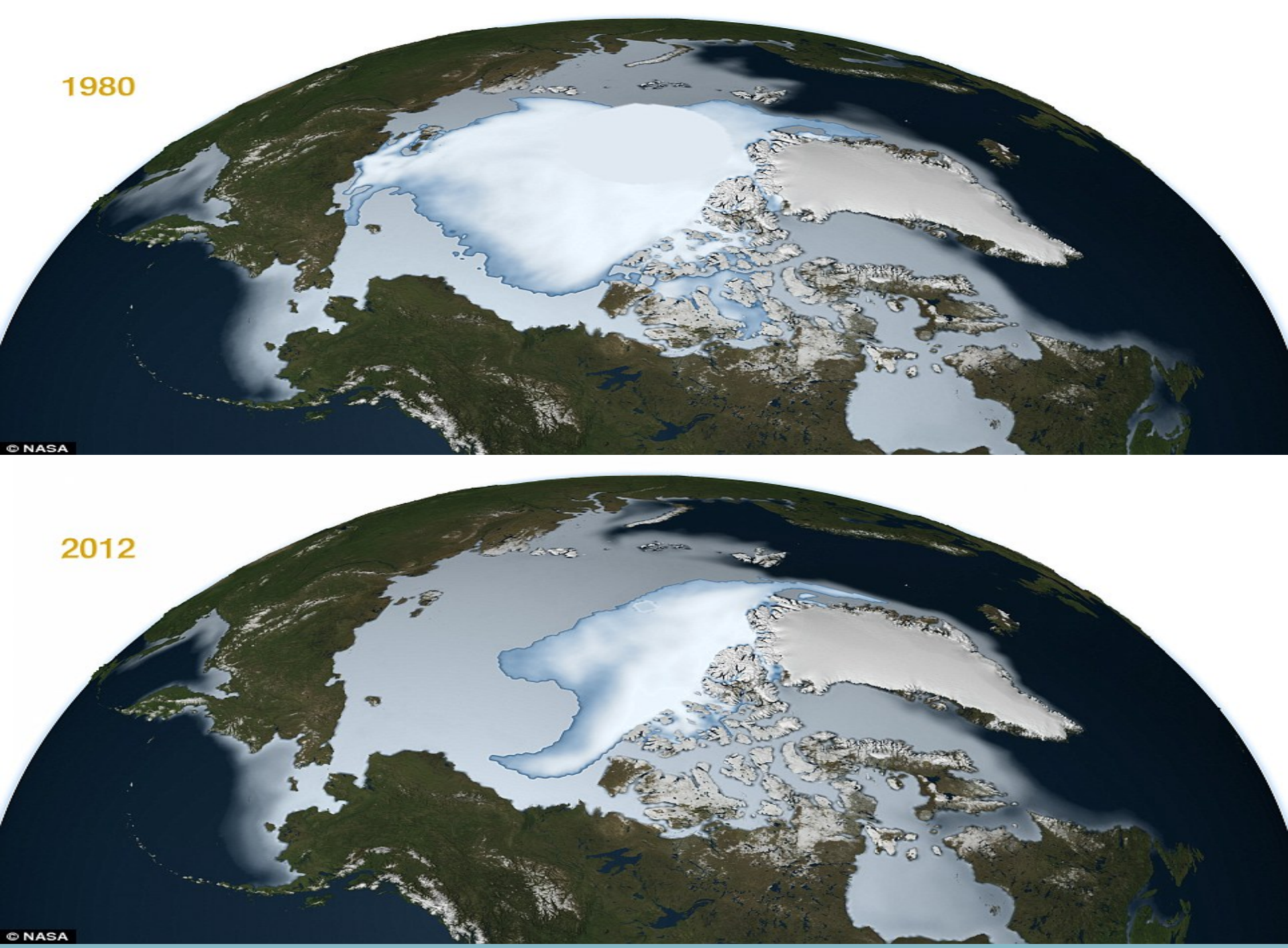


Human/Environment Interaction and Climate Change

- Most scientists agree that humans have sped up climate change at an alarming rate
- Burning of fossil fuels
- Acid Rain

- Some of the consequences
  - ICE CAPS MELTING
  - Smog: visible chemical haze in the atmosphere
  - Sea levels rising

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Smog over LA

Smog Mexico City