

# Effects of Greenhouse Gases CLIMATE CHANGE

## Natural Causes

### • Volcanic Eruptions:

- Emits volumes of *ash & dust & sulfur* into atmosphere

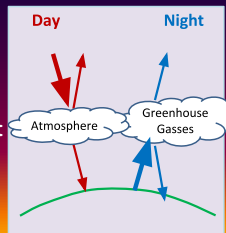


## Global Temperatures: A Delicate Balance

- Earth is the “Goldilocks Planet”—not too hot or too cold.
- There is a balance between . . .
  - Incoming heat (Daytime)
    - Atmosphere blocks most solar radiation = warmth without burning
  - Outgoing heat (Nighttime)
    - Greenhouse effect prevents too much heat loss = cooling without freezing

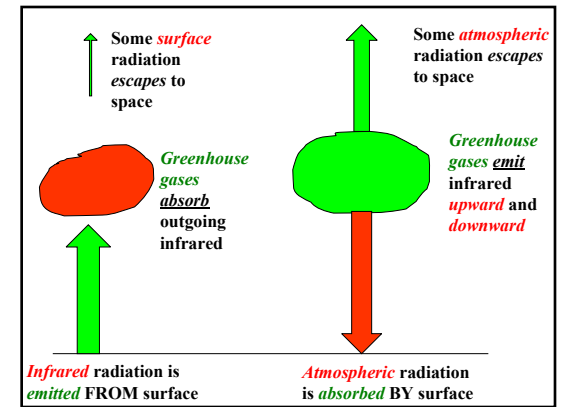
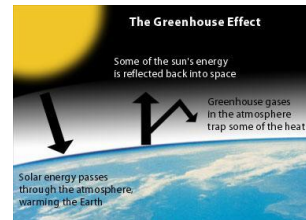
## Greenhouse Effect

- Infrared radiation is trapped on the planet by greenhouse gases and other particles:
  - Water vapor
  - Carbon Dioxide
  - Smoke, dust, ash
- This is a natural process necessary for life to exist



## Greenhouse Gases

- **Natural** warming of lower atmosphere and surface
- **Gases Involved:**
  - *Water vapor*
  - *Carbon dioxide*
  - *Methane*
  - *Sulfur Dioxide*
  - *Nitrous oxides*
  - *ozone*



## Atmospheric Gases

GAS	% Abundance
Nitrogen	75-78%
Oxygen	21-23%
Argon	1%
Water Vapor	0.3%
CO <sub>2</sub>	0.06%

Key  
Greenhouse  
Gases

## Climate: Variations vs. Change

### Variations

- Single, abnormal event
- Always short-term
- Examples:
  - Droughts: period of below-normal rainfall
  - Heat Waves: period of above-normal temperatures
  - Cold Wave: period of below-normal temperatures

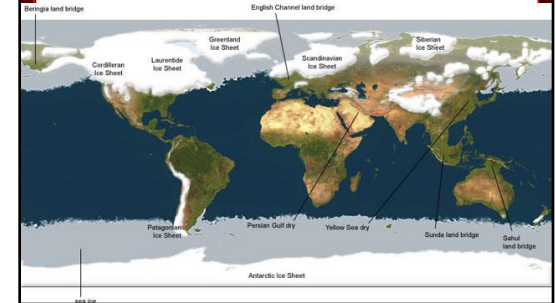
### Change

- Can be short-term or long-term
- Examples:
  - Seasons (short-term)
  - El Nino (short-term)
  - La Nina (short-term)
  - Ice Age (long-term)



Climatic Changes

## ICE AGES



Climatic Changes

## ICE AGES

- Periods where **average global** temps **decrease** by **~5°C** with extensive **glaciers**
- Most **recent** ice age ended **10,000** yrs ago



## Causes of Natural Change

### Short-Term

- Volcanic eruptions
- Forest Fires
- Seasons (Earth's tilt)
- El Nino / La Nina

### Long-term

- Solar radiation
- Continental drift
- Earth's tilt
- Earth's orbit

## Cause: Volcanic Eruptions

- Volcanic eruptions = increased greenhouse gases & particles (water vapor, CO<sub>2</sub>, ash)
- Increased temperatures (big particles) OR
- Decreased temperatures (small particles)



### Cause: Forest Fires

- Forest fires = increased greenhouse gases & particles\* = increased temperatures
- \*Water vapor, carbon dioxide, ash

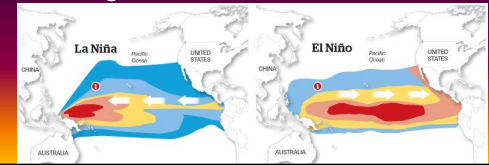


### Cause: Seasons

- During its orbit, the Earth's Northern and Southern Hemispheres alternately tilt toward and away from the sun.
  - Tilted towards the sun = direct solar radiation = increased temperatures
  - Tilted away from the sun = indirect solar radiation = decreased temperatures

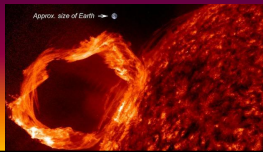
### Cause: El Niño & La Niña

- Changes in trade wind movement
- El Niño: Tradewinds (near the equator) weaken = unusual warming of the eastern Pacific Ocean
- La Niña: Tradewinds strengthen = unusual cooling of the Pacific Ocean



### Cause: Solar Radiation

- Sun's energy production changes year to year
- Periodic solar flares & sun spots release extra solar radiation
- More solar radiation = warmer global temperatures = ???

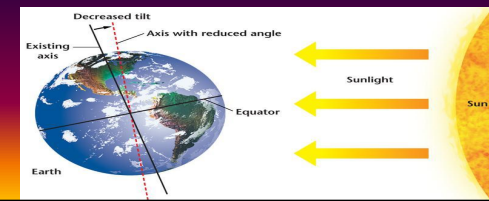


### Cause: Continental Drift

- Land vs. water surface area
  - More land area with lower specific heat capacity = increased temperatures
  - More ocean area with higher specific heat capacity = decreased temperatures
- Currently, global land area is decreasing, so the temperatures should be \_\_\_\_\_, however, more gasses in atmosphere due to human interference (human enhanced)

### Cause: Earth's Tilt

- Tilt of the axis varies from 22.1° to 24.5° every 41,000 years!
- More tilt = less direct solar radiation = lower temperatures



## Cause: Earth's Orbit (path around the sun)

- Elongated orbit =  
Earth closer to the sun  
= warmer  
temperatures
- Circular orbit = Earth  
further from the sun =  
cooler temperatures

