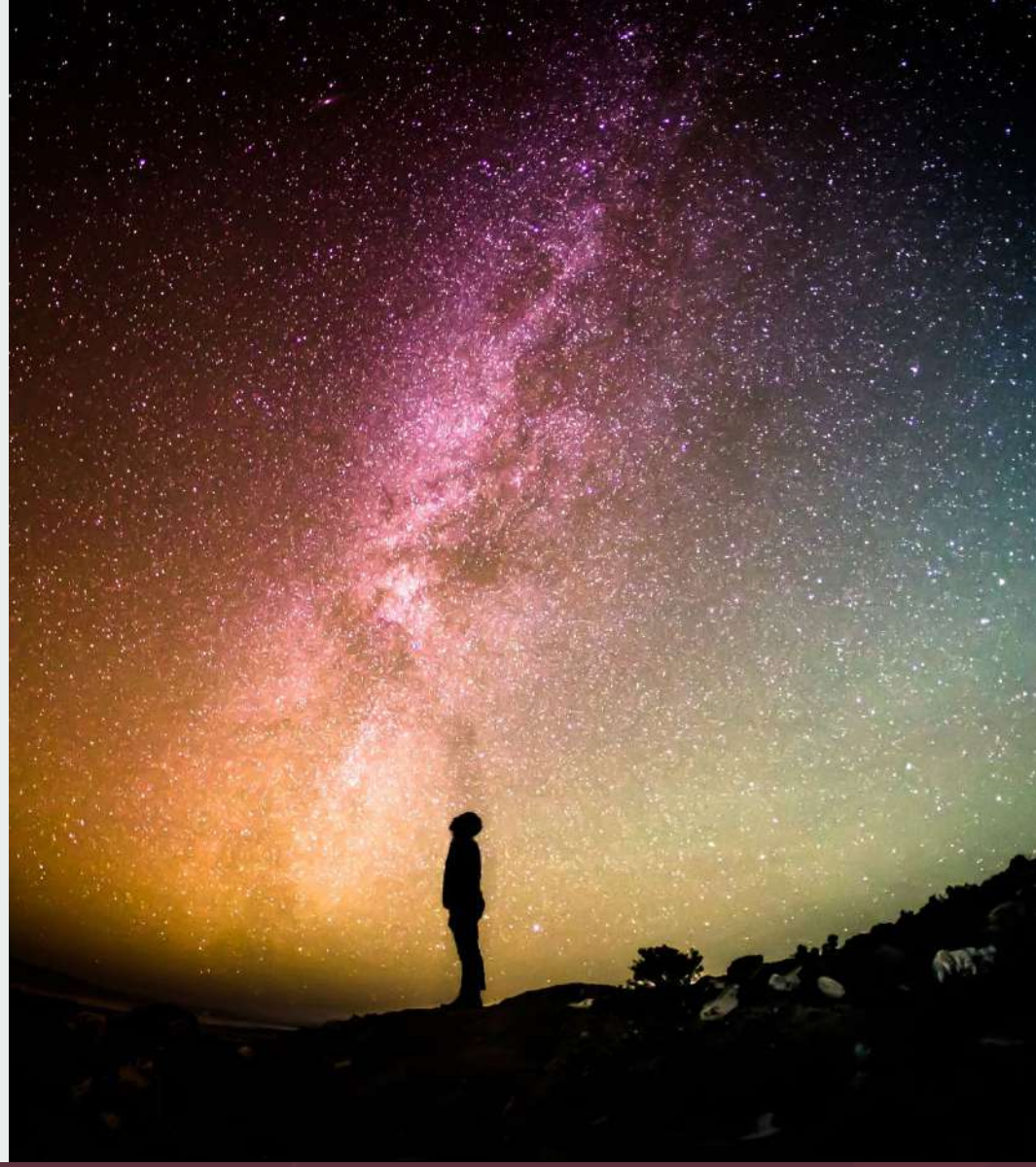
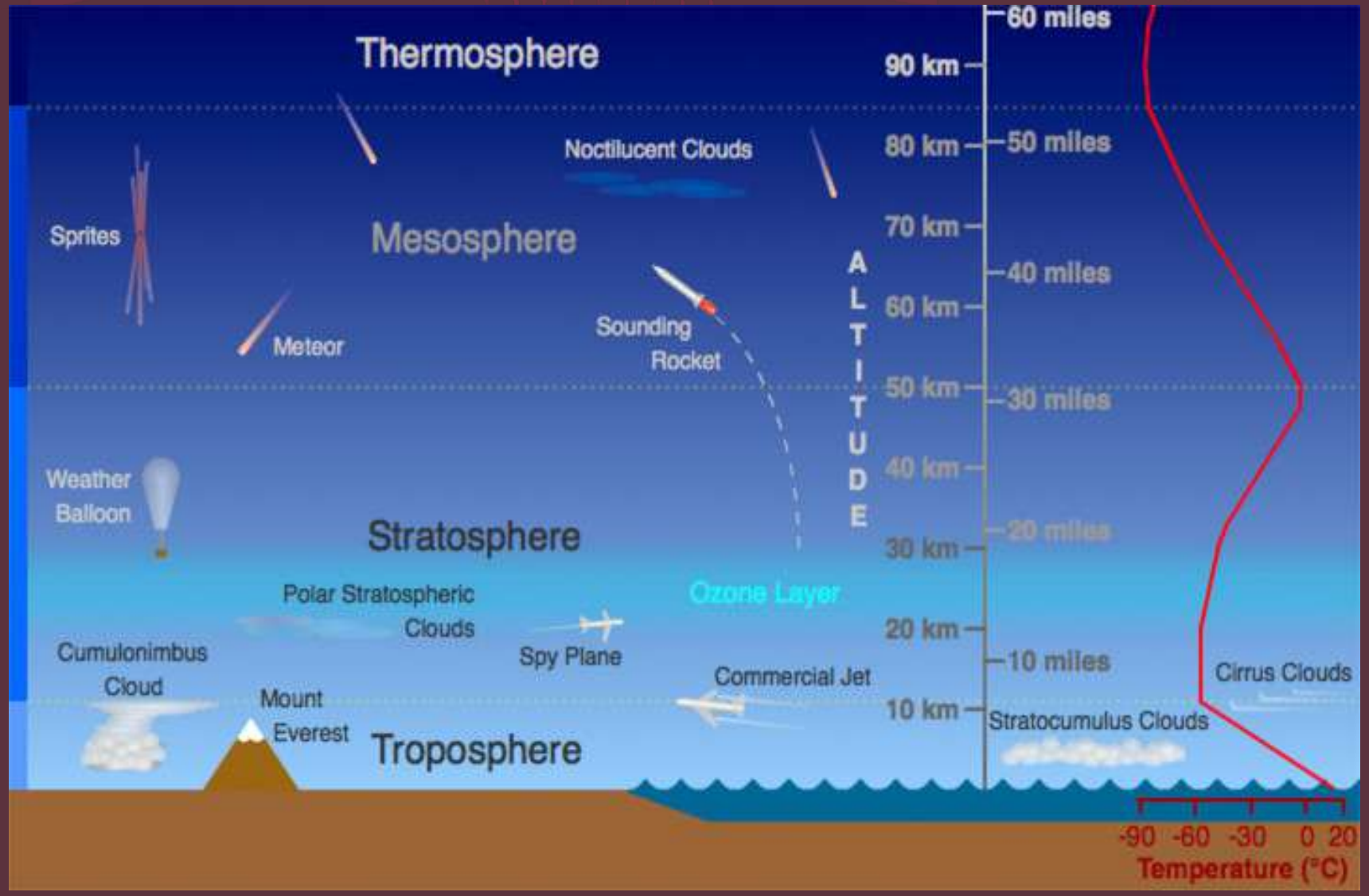
Atmosphere

Climate regulation with a changing atmosphere



Refresher

Remember your layers!



(*Layers of Earth's Atmosphere | UCAR Center for Science Education*, n.d.)

Troposphere-

- The troposphere extends from Earth's surface to approximately 5-7 miles up.
- This is the layer we live in! This is the layer with all weather! Also, referred to as the mixed layer.
- Rain, clouds, tornadoes, and thunderstorms exist in this layer!
- Humidity is the highest in this layer! Can you think of why? Hint you can swim in it!
- 75% of the total mass of the atmosphere in within the Troposphere!

Stratosphere-

- The stratosphere is located at an altitude of 7-11 miles above the earth's surface
- Commercial jets fly in the lower stratosphere to avoid turbulence!
- The temperature of the stratosphere increases moving up in altitude
- Ozone is an unusual form of oxygen (O_3) that is abundant in the stratosphere
- Ozone located in the stratosphere protects humans from ultra-violet radiation

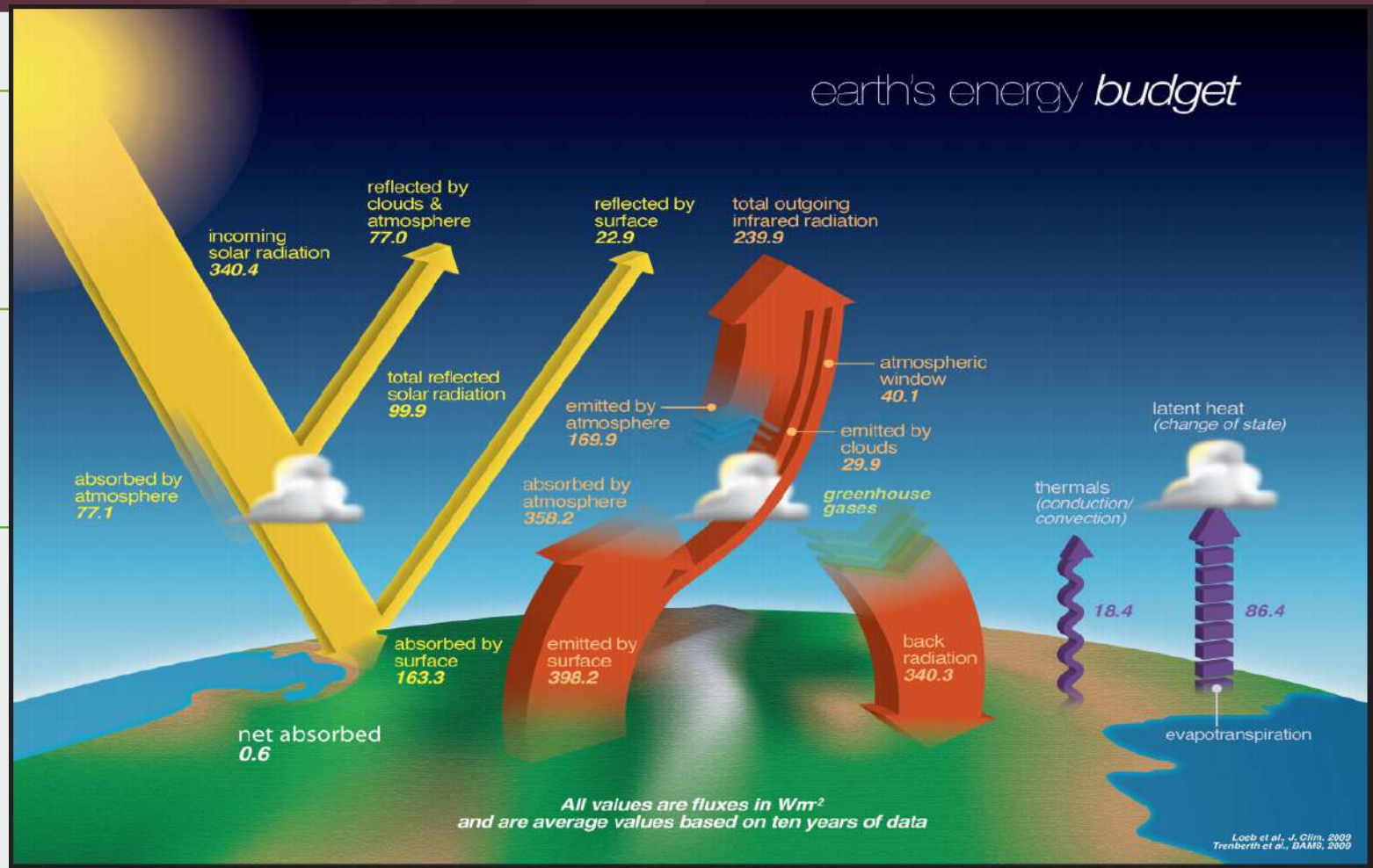
What happens to all that solar energy? We get a radiation budget!

The energy we receive from the sun is our currency. It's the energy that powers everything on Earth.

Solar energy is reflected, absorbed, and reradiated

The radiation budget is in equilibrium when the energy Earth receives is equal to what is lost to space

(*Earth's Energy Budget* | *MyNASAData*, n.d.)



Radiation Budget is measured at different levels

The common method of measure is the Top of Atmosphere (TOA)

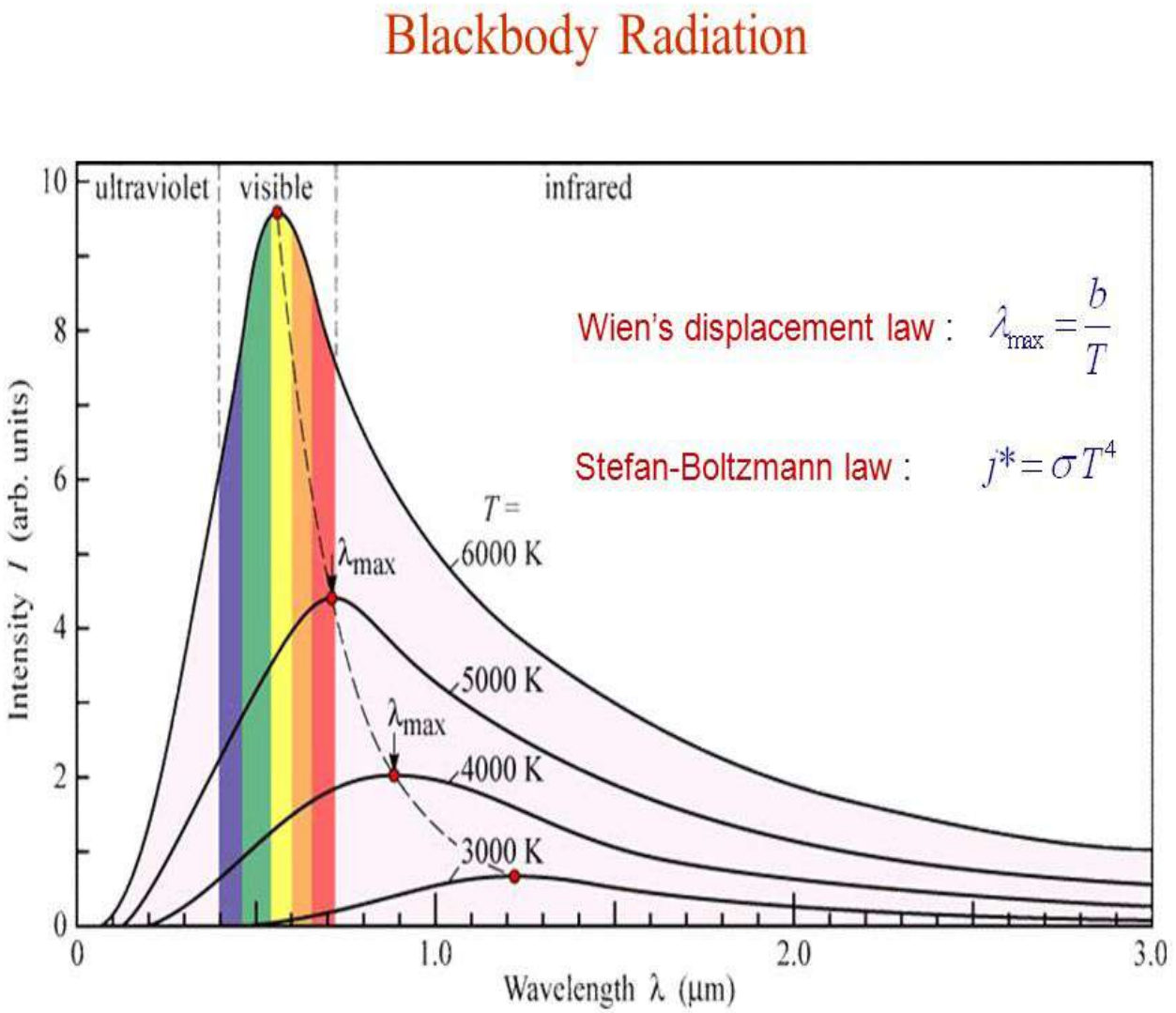
This method directly compares shortwave radiation reflected and longwave that's emitted from the top of Earth's atmosphere

NASA CERES Satellites collects this data

CERES: Clouds and Earth's Radiant Energy System

How the Atmosphere Traps Heat

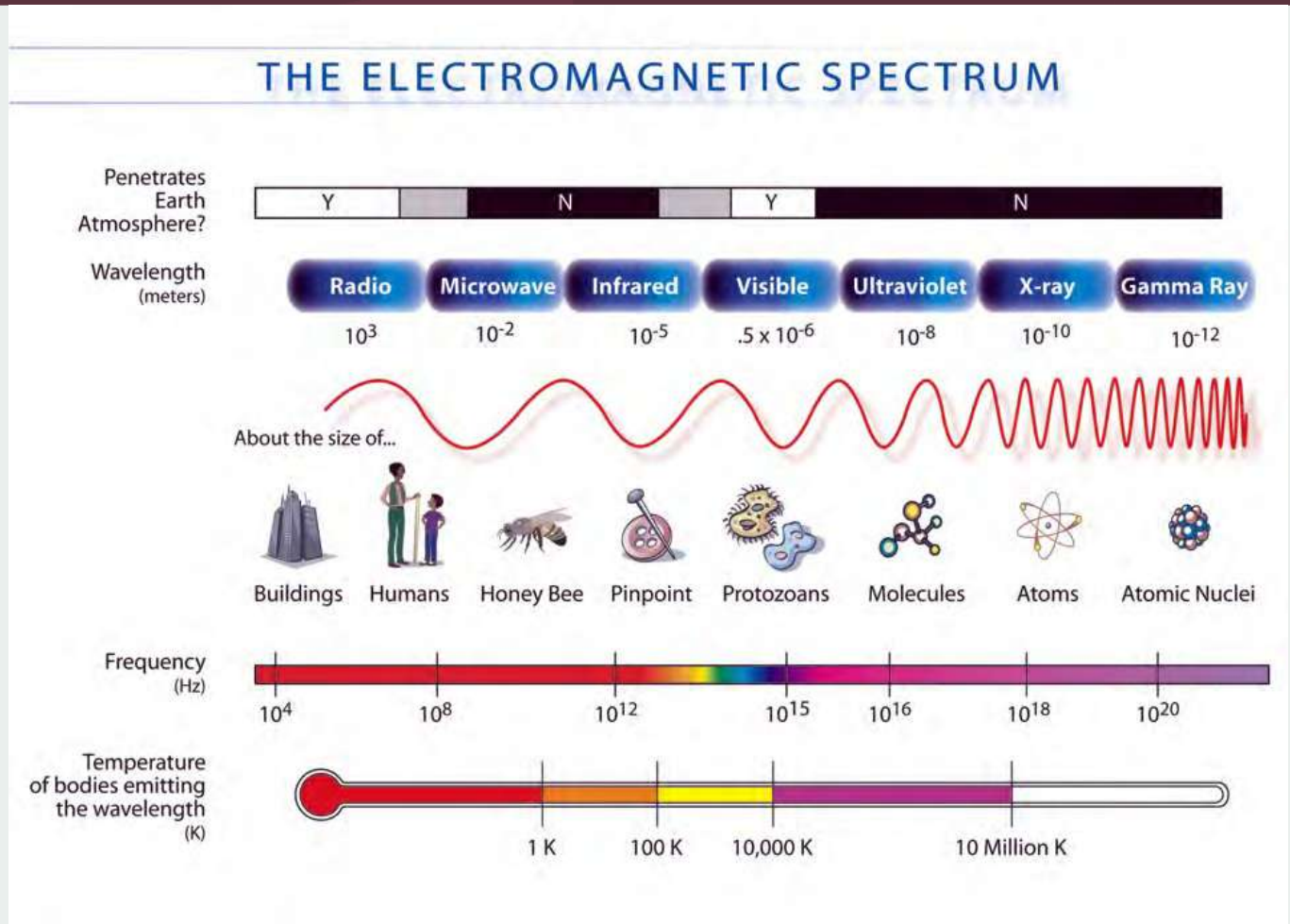
- Weins displacement law states with an increase in Kelvin temperature radiation emissions will be shorter in wavelength
- Remember shorter wavelengths are more highly energized



(*Blackbody Radiation Wien's Displacement Law*, n.d.)

Greenhouse Effect

- The Sun's emitted energy is disproportionately in short wavelengths
- Earth's emitted energy is disproportionately long wavelengths
- Greenhouse gases block the loss of thermal longwave radiation emitted from Earth trapping heat at the surface



(*Earth's Energy Budget* | *MyNASAData*, n.d.)

The Greenhouse Gases

The big four are:

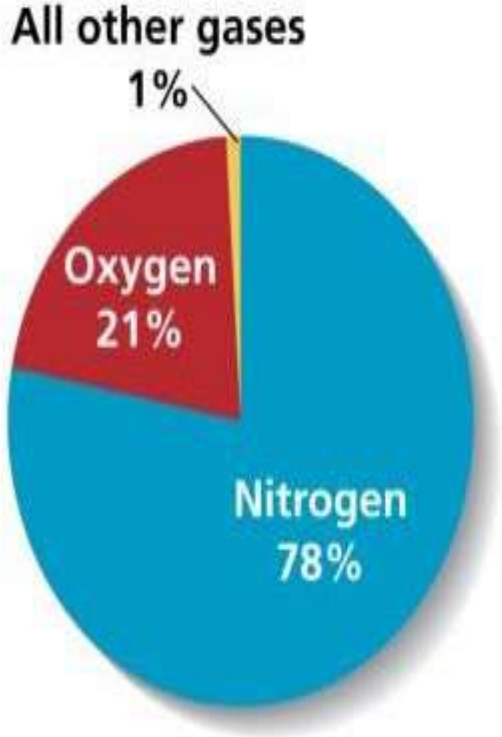
Water Vapor

Carbon Dioxide

Methane

Nitrous Oxide

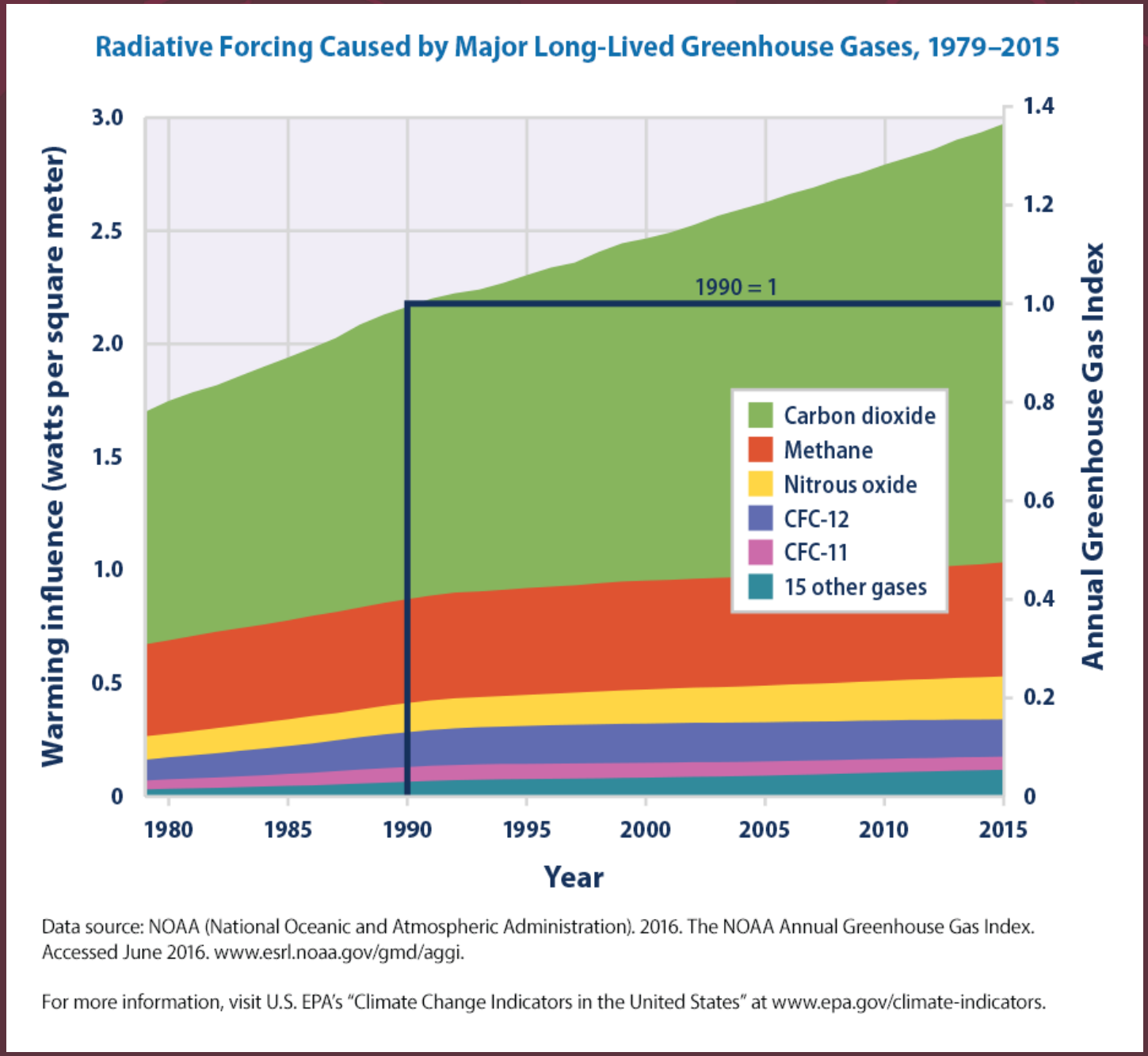
Pay attention to how small the concentration of CO2 is!



Gas	Percentage by Volume
Nitrogen (N_2)	78.084
Oxygen (O_2)	20.946
Argon (Ar)	0.934
Carbon dioxide (CO_2)	0.037
Neon (Ne)	0.00182
Helium (He)	0.00052
Methane (CH_4)	0.00015
Krypton (Kr)	0.00011

(davina, 2014)

- Co2 is mighty at trapping heat
- Radiative Forcing is how the balance to the radiation budget has changed



Why is the Greenhouse Effect important?

It raises Earth's surface temperature by 15 degrees Celsius!

That's 30 degrees warmer then if we didn't have an atmosphere

The greenhouse effect raises the surface temperature enough so that Earth's climate is habitable for humankind

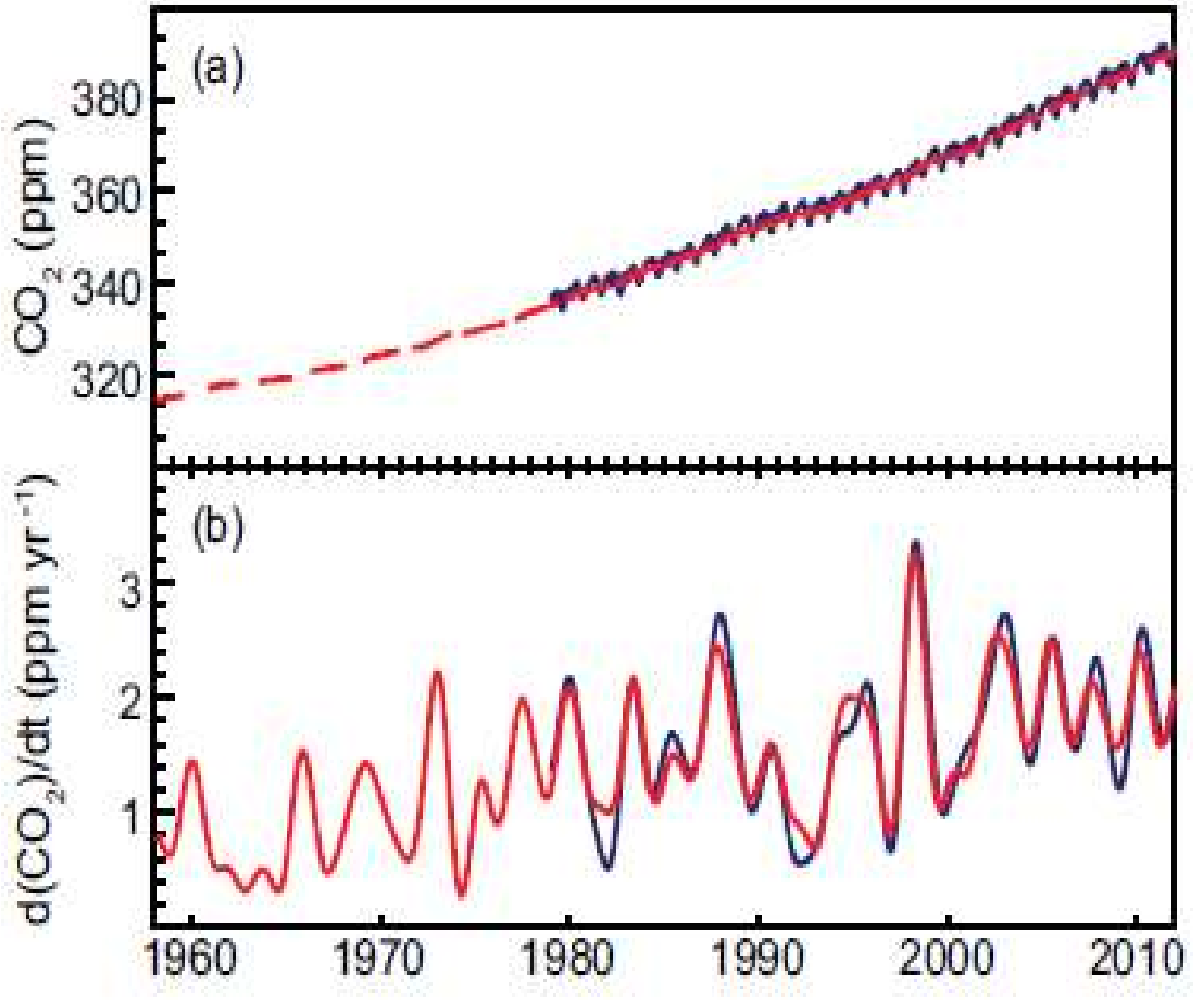
Carbon Dioxide is increasing

This increase is anthropogenically caused from fossil fuel combustion

From 1980 to 2011 the average global increase to CO2 was 1.7 ppm each year

CO2 isn't the only greenhouse gas that's increasing

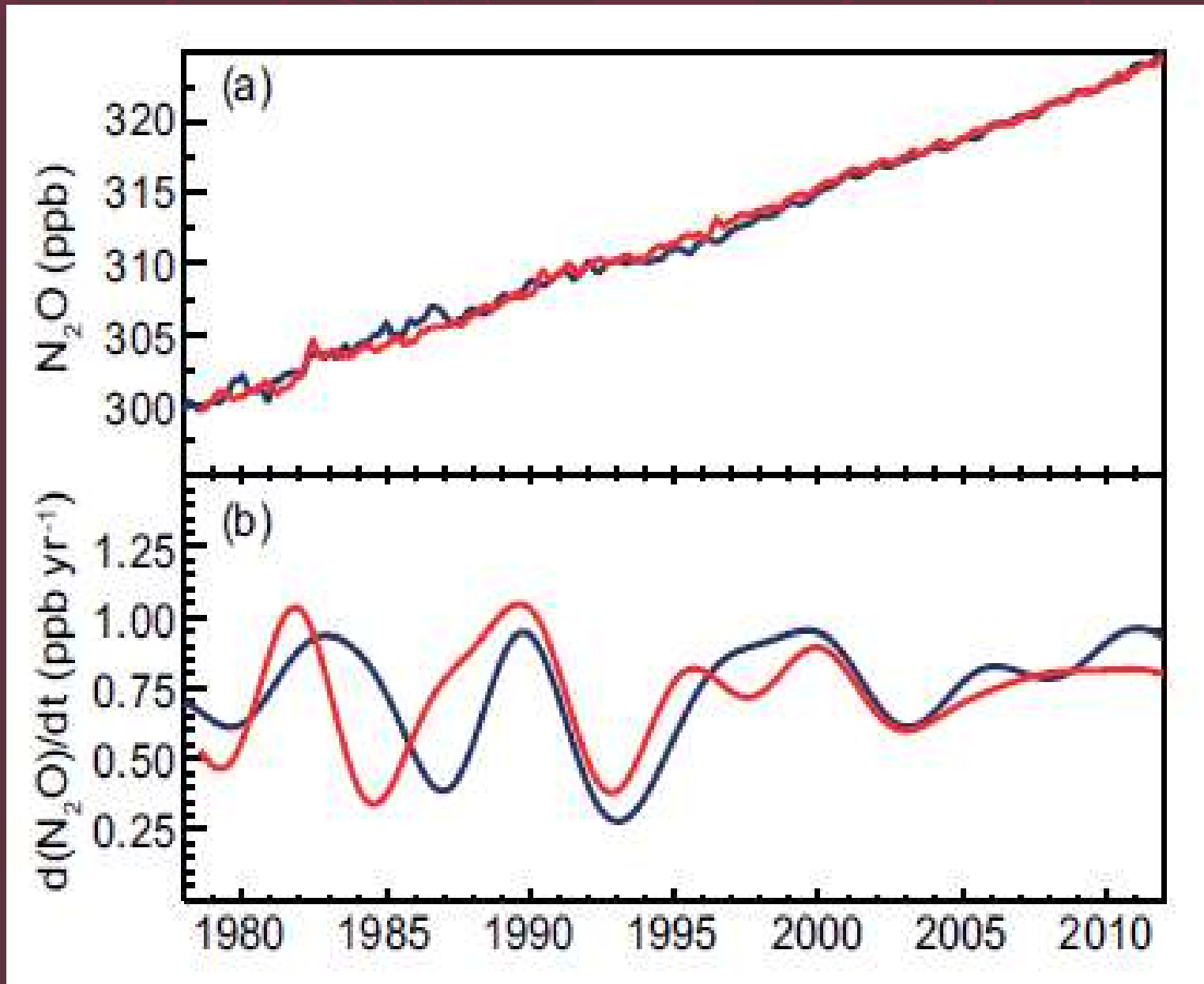
(*AR5 Climate Change 2013*, n.d.)



Nitrous Oxide is also increasing

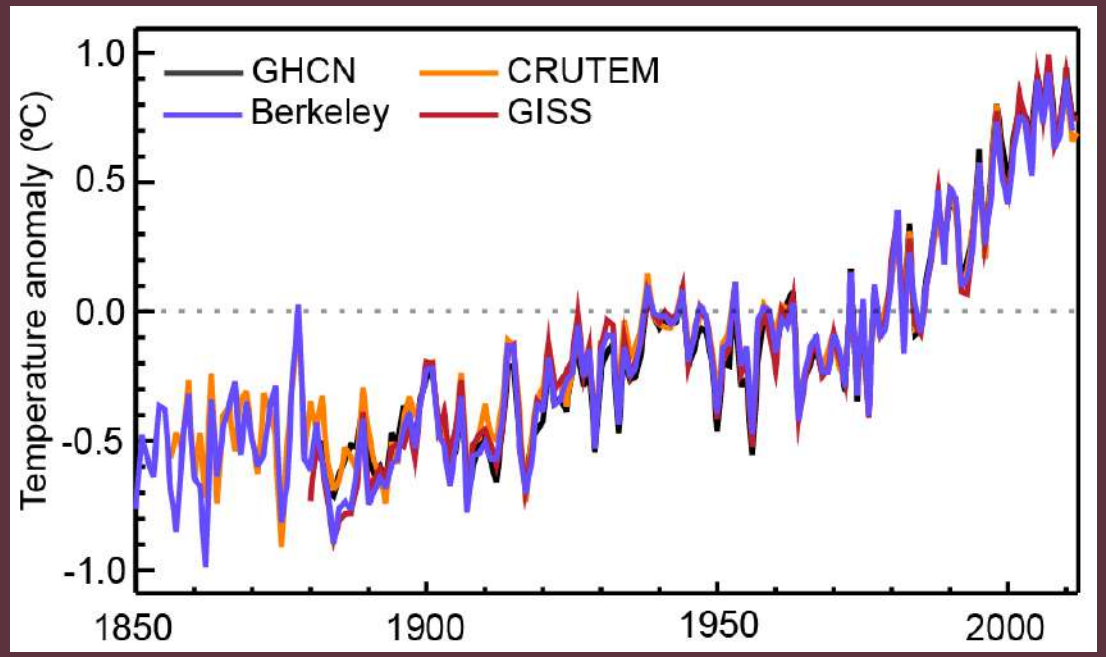
The increase is likely from the use of nitrogen fertilizers in agriculture

Since systematic testing started in the 1970's N2O has increased nearly .75 ppb each year

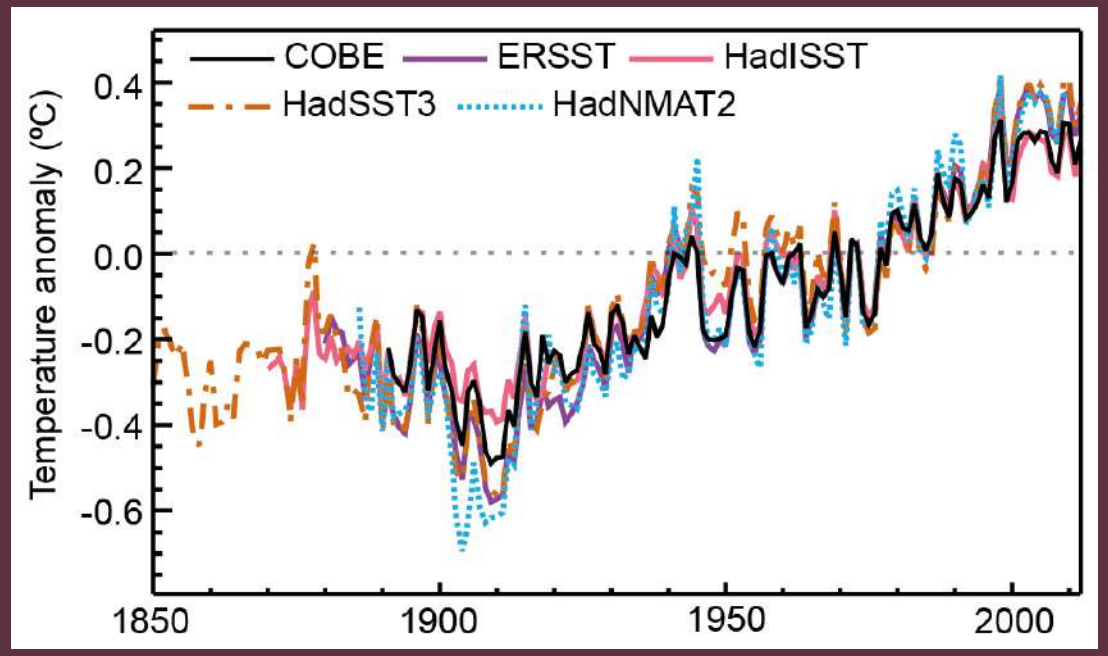


(*AR5 Climate Change 2013*, n.d.)

As Greenhouse Gases Increase What Happens to Temperature on Land and in Oceans?



Land surface air temperature record



Sea surface temperature and oceanic air temperature

(*AR5 Climate Change 2013*, n.d.)

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