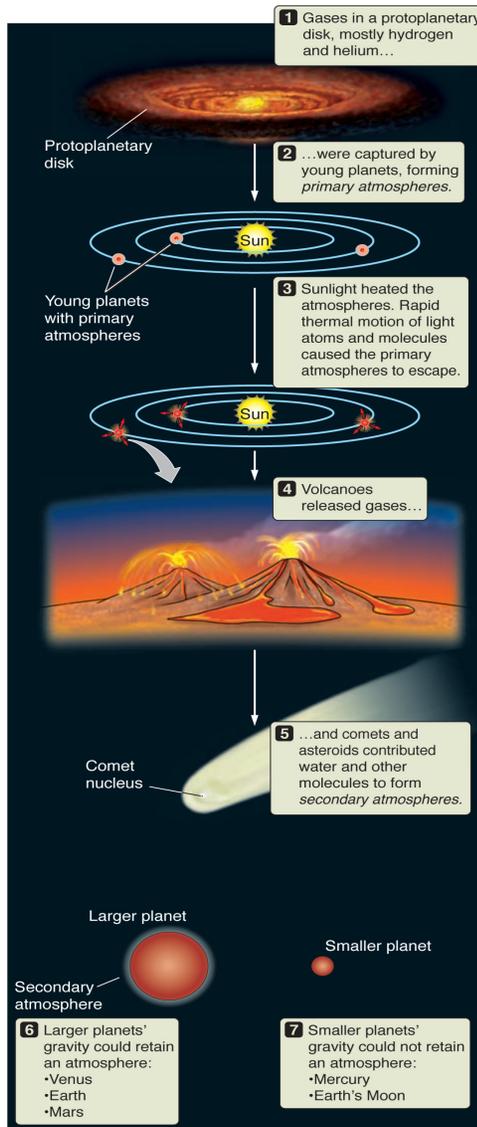


Balick's 101 climate slides

Earth's Atmosphere



- *Primary atmosphere* of Earth was **hot**. It quickly evaporated (H, He) or chemically evolved (“metals”)
- *Secondary atmospheres* were acquired or formed later by:
 - Accretion (but locked in the interior).
 - Volcanism & comet impacts (releasing the gas from the interior).

Atmospheres of other planets

- Secondary atmospheres
 - Probably from volcanic “outgasing”
 - low-mass or hot environments (mercury, Moon) could withstand evaporation. Atmospheres lost.
 - Mars has probably lost 99% of its secondary atmosphere. Pressure 1% Earth, 0.01% of Venus.
 - Venus held its secondary atmosphere. Pressure 100 times Earth. Holds heat.
 - Earth’s secondary atmosphere is largely chemically processed into limestone by chemical reactions in water: $\text{CO}_2 + \text{H}_2\text{O} \rightarrow$ carbonic acid, acid reacts with calcium or potassium to make precipitating rock.

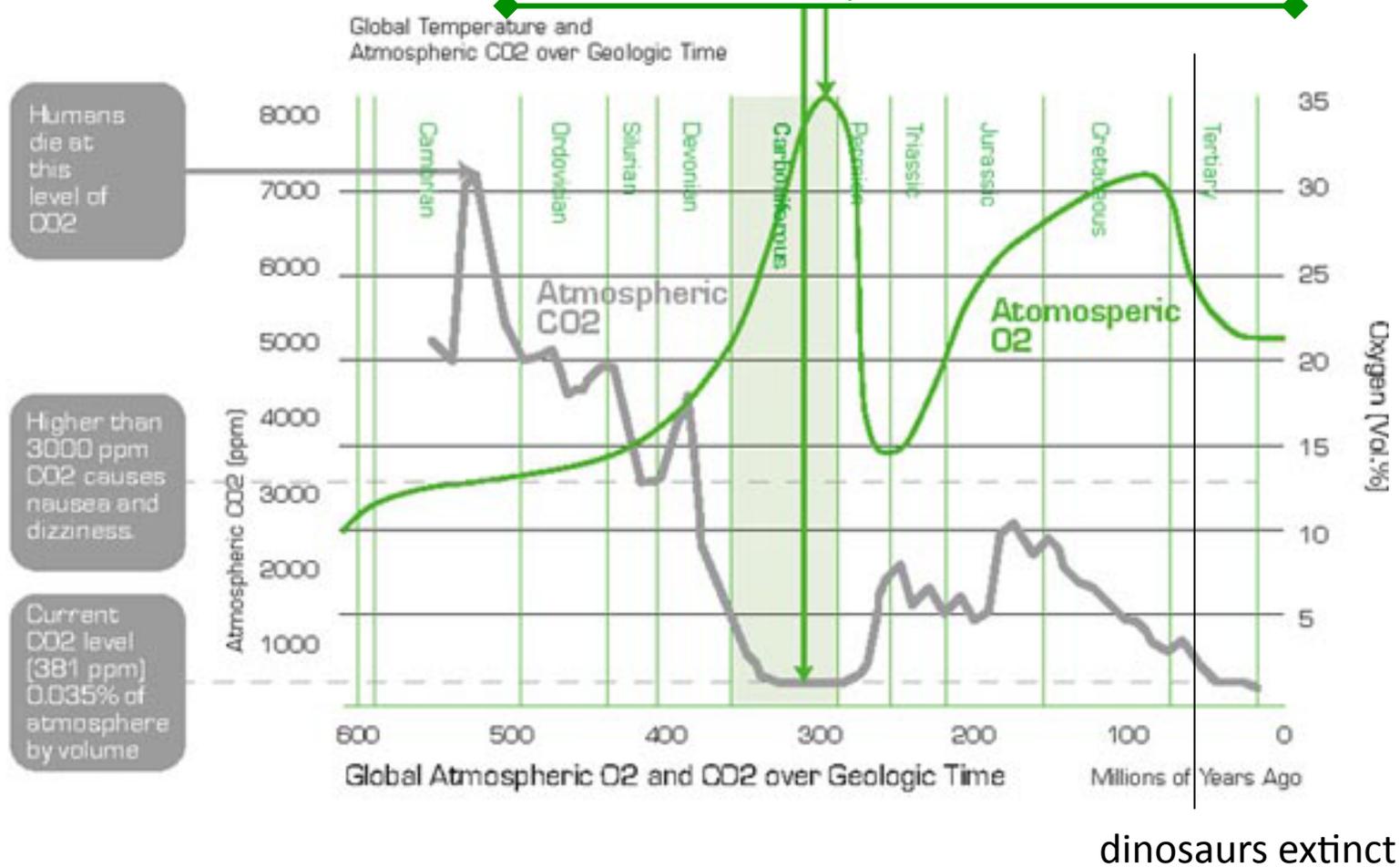
Modern Atmosphere of Earth

- Secondary atmospheres

- Earth's secondary atmosphere is largely chemically processed into limestone by chemical reactions in water:
 - $\text{CO}_2 + \text{H}_2\text{O} \rightarrow$ carbonic acid, acid reacts with calcium or potassium to make precipitating rock.
- Plants have transformed the rest of the atmosphere, converting residual CO_2 into food and oxygen.
- Oxygen (a poison for plants) is used by animals for energy + CO_2 .
- Plants/animals: “symbiosis” maintains balance of O_2 and CO_2 (until start of industrial revolution)

Modern Atmosphere of Earth

Various forms of animal life appear.
Breathe O₂ and respire CO₂.



Greenhouse Effect

Q: Why does your car's interior become hot when you park in the Sun?

A: Greenhouse effect. (What's that?)

Each year about 37 babies and toddlers die when they are accidentally left strapped in car safety seats or become trapped in vehicles that rapidly heat up. –parenting.com

**DON'T COOK
YOUR DOG!**

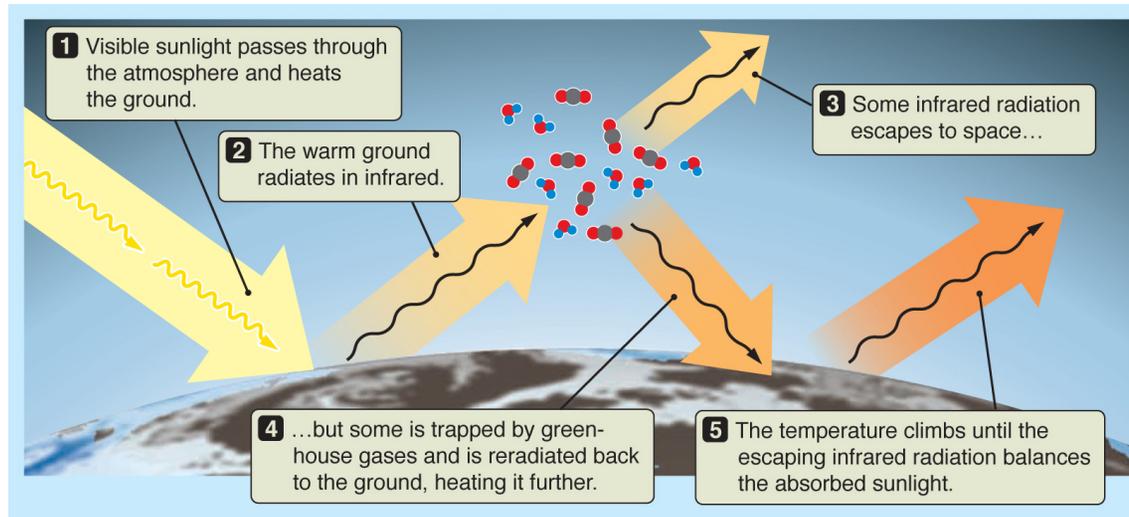


DOGS DIE EVERY SUMMER
even with the windows down,
in **minutes** cars turn into coffins

DOGS for info go to dogstodaymagazine.co.uk
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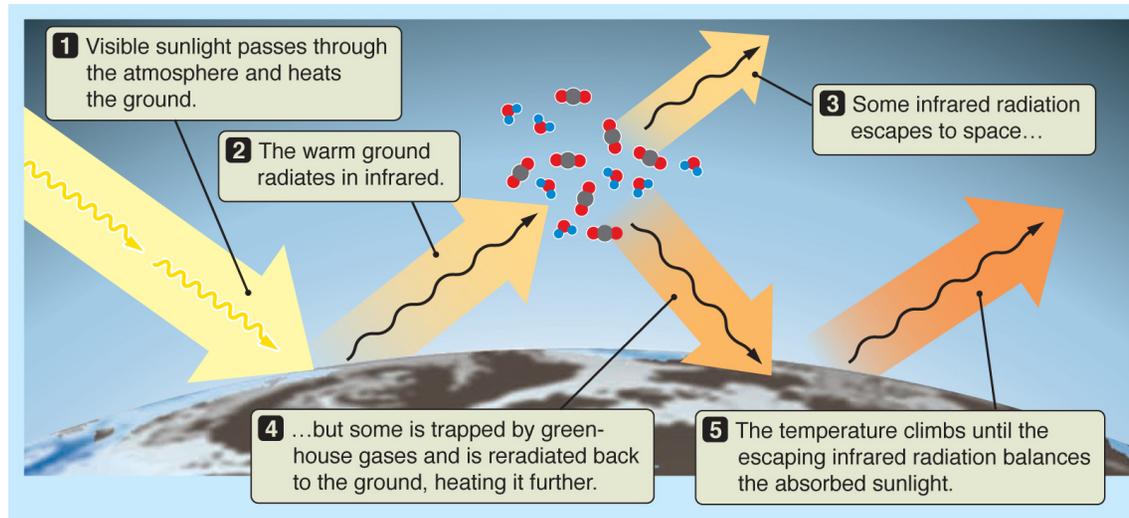


Greenhouse Effect



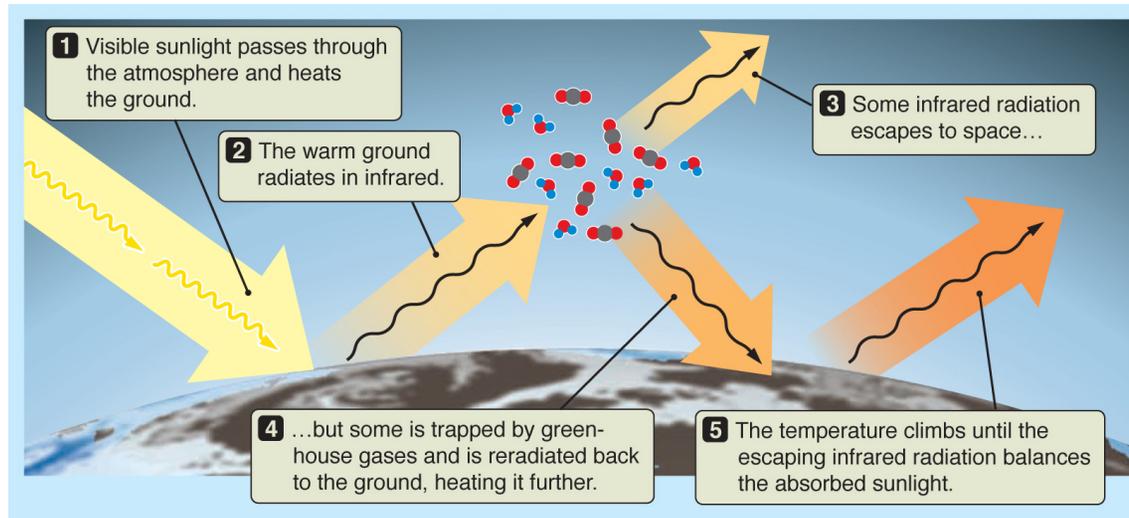
- Incoming sunlight heats the planet.
- Outgoing infrared radiation cools the planet.
- Some gases, especially CO₂ and water vapor, block some infrared radiation, preventing the planet from cooling.

Greenhouse Effect



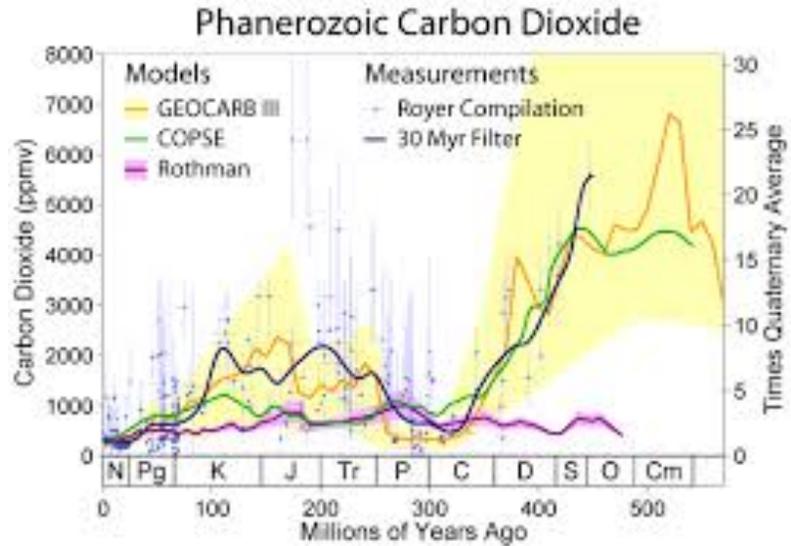
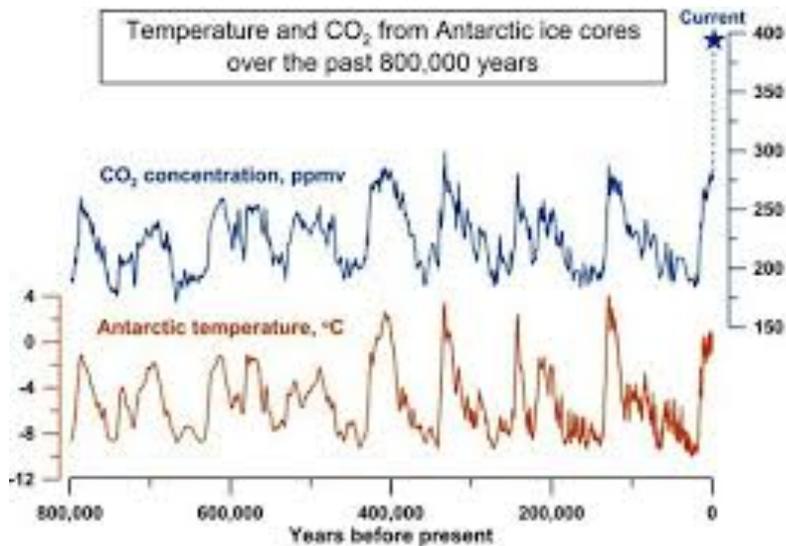
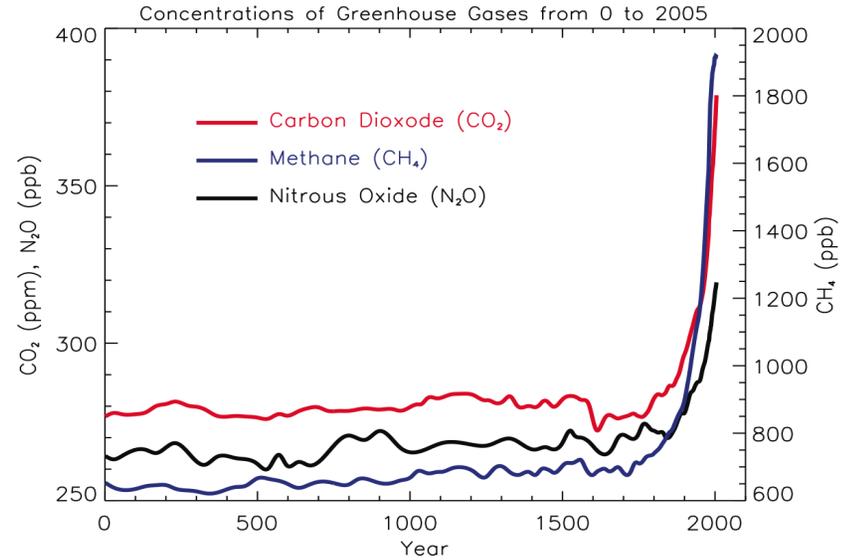
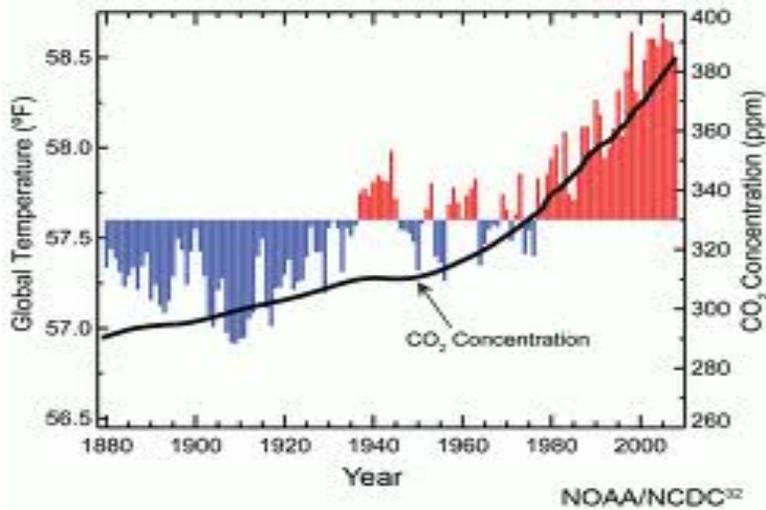
- The heated atmosphere will then also warm the ground.
- This *greenhouse effect* means the planet is at a *higher temperature* due to the extra energy needed to be in equilibrium with the sunlight.

Greenhouse Effect

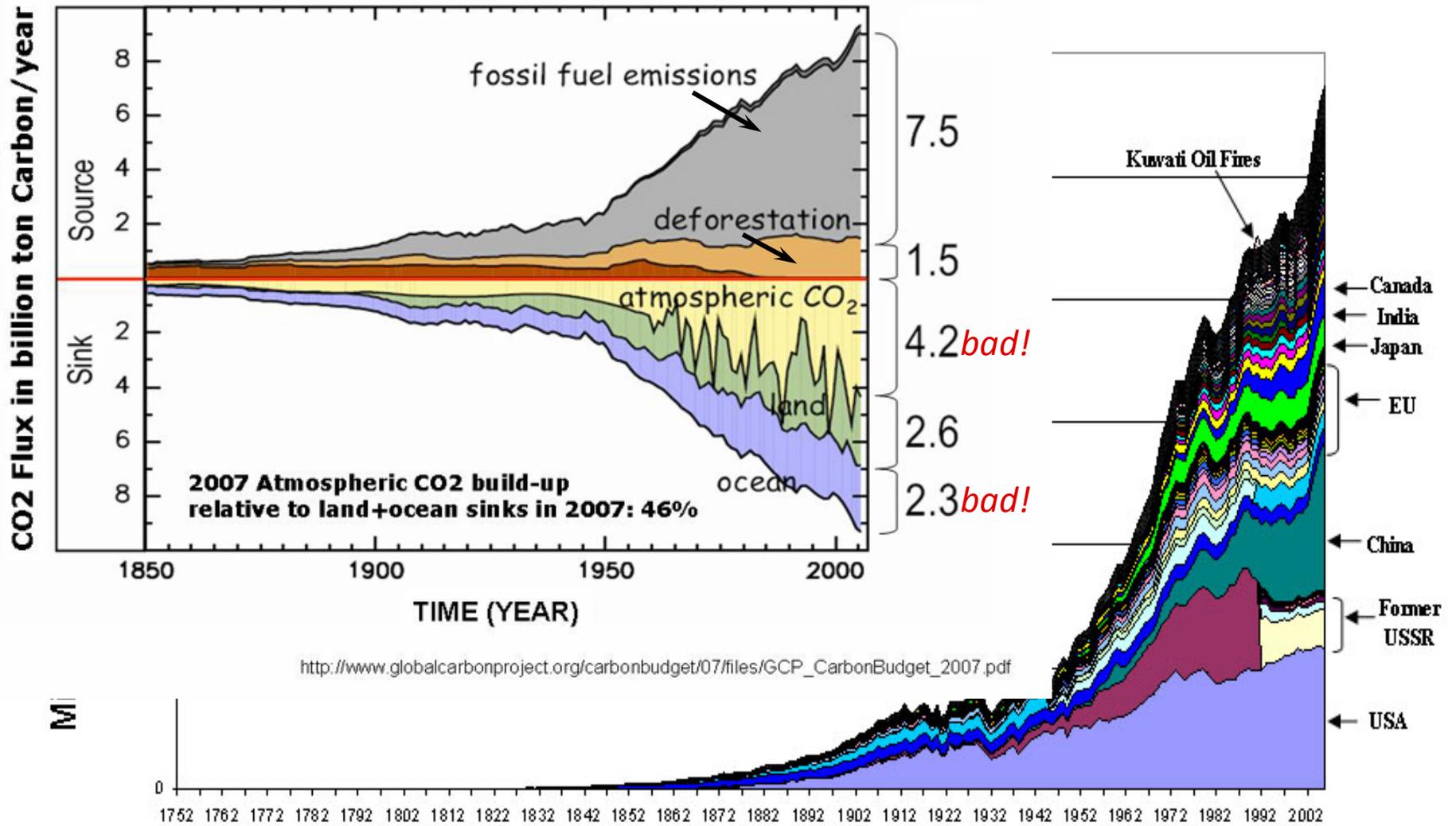


- Earth would freeze without this!
- While Earth is 33 K warmer because of it, a runaway effect makes Venus 730 K. No water. Carbon bonds break: no carbon life.
- Mars is warmed only about 5 K. No liquids.

Greenhouse History

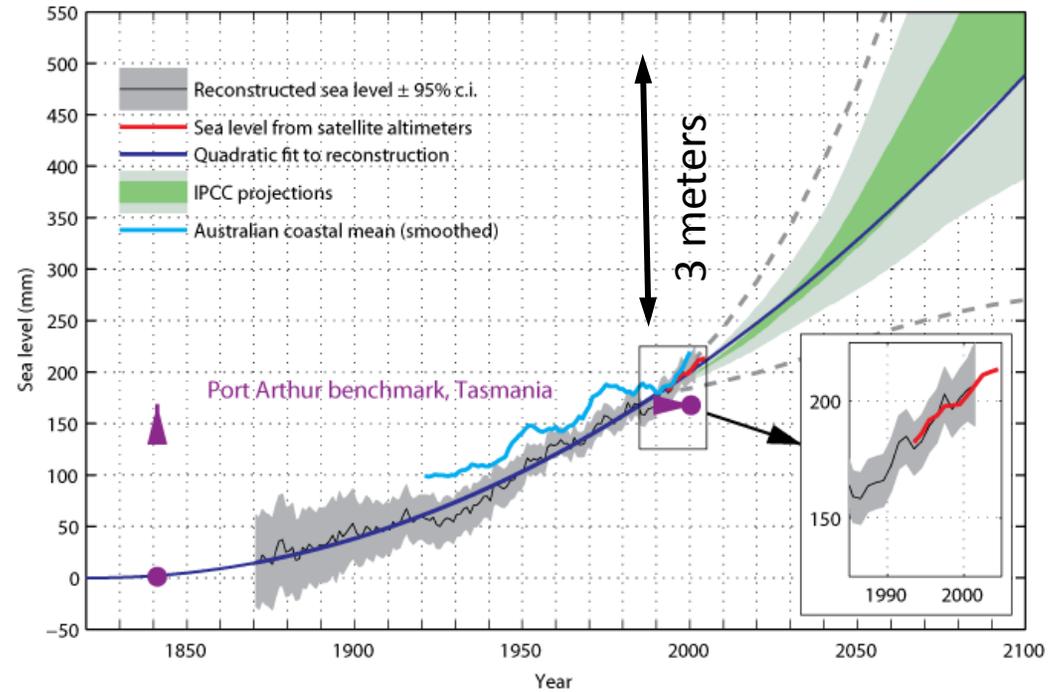
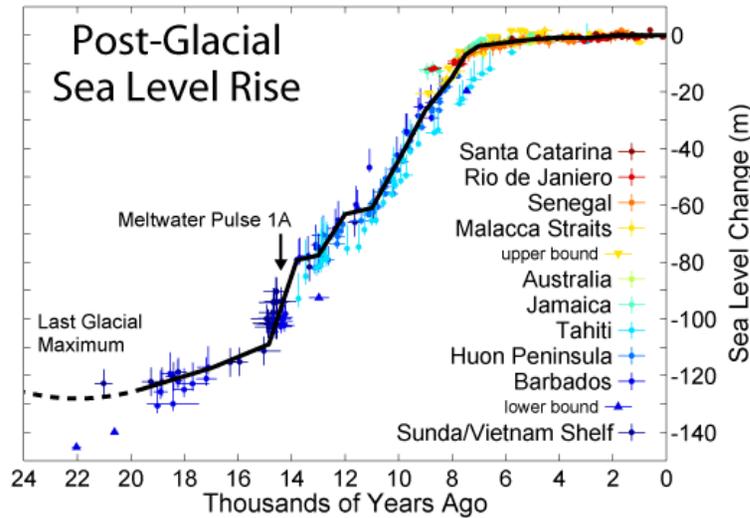


Greenhouse History



The ethics of managing CO₂: what problem? what's a fair way of controlling production?

Greenhouse Consequences

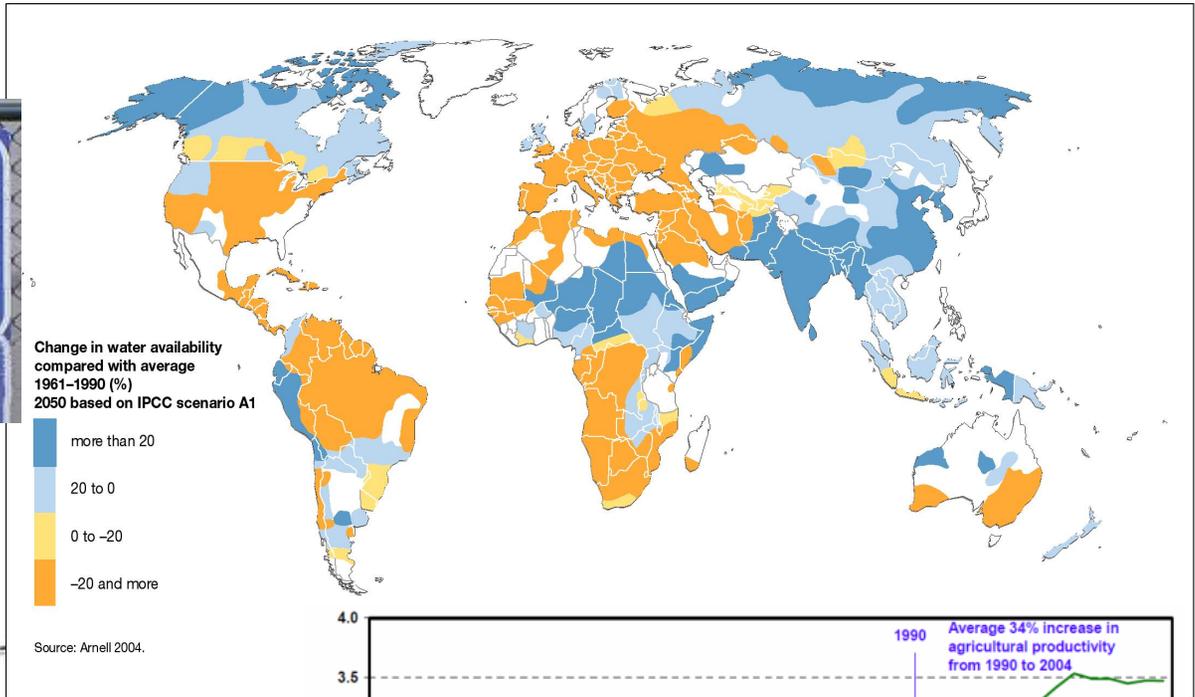


← altitude <10 meters

← altitude <5 meters

(Sandy storm surge = 1.5 meters)

Greenhouse Consequences



Days Over 100°F

