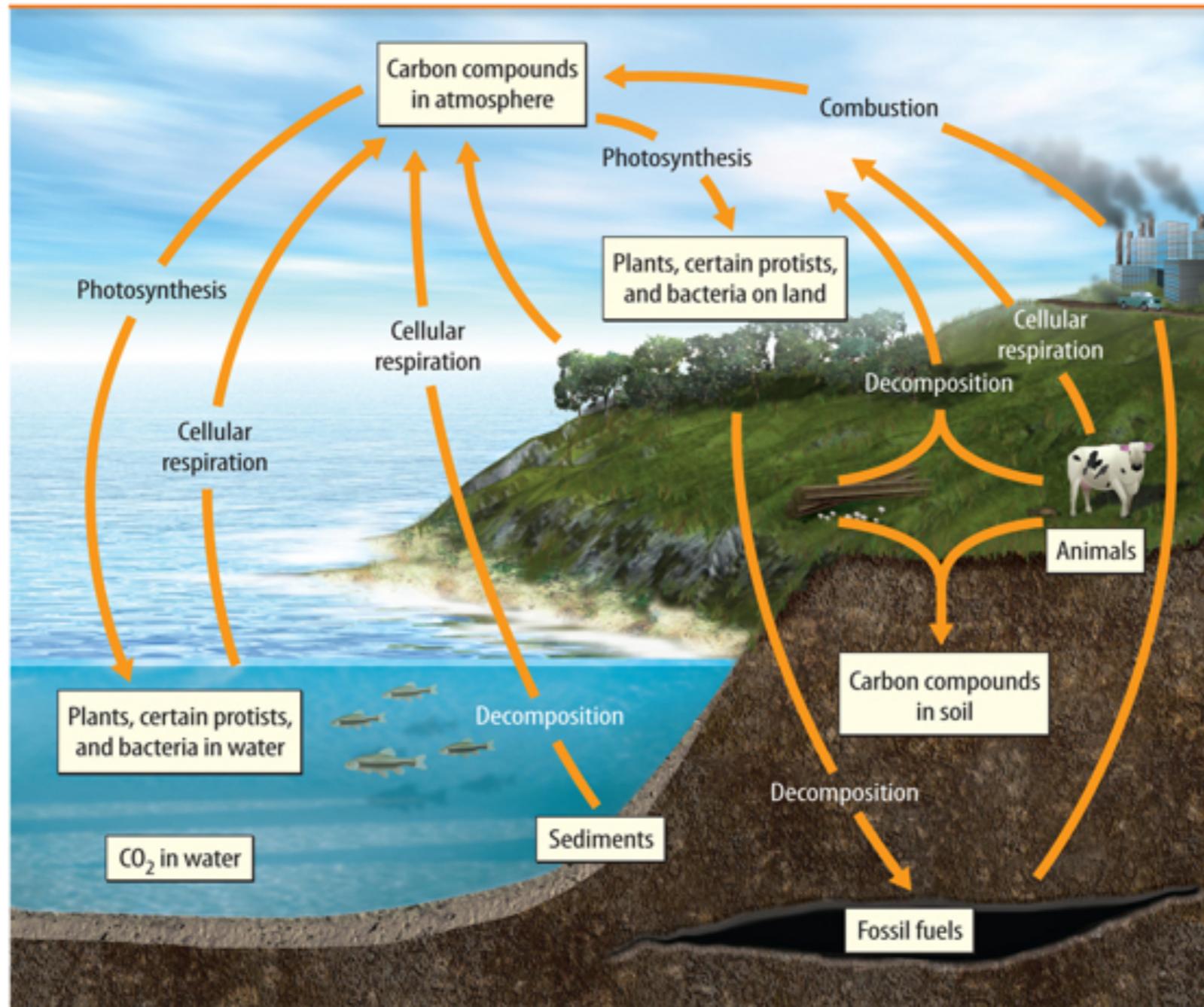


Carbon Cycling

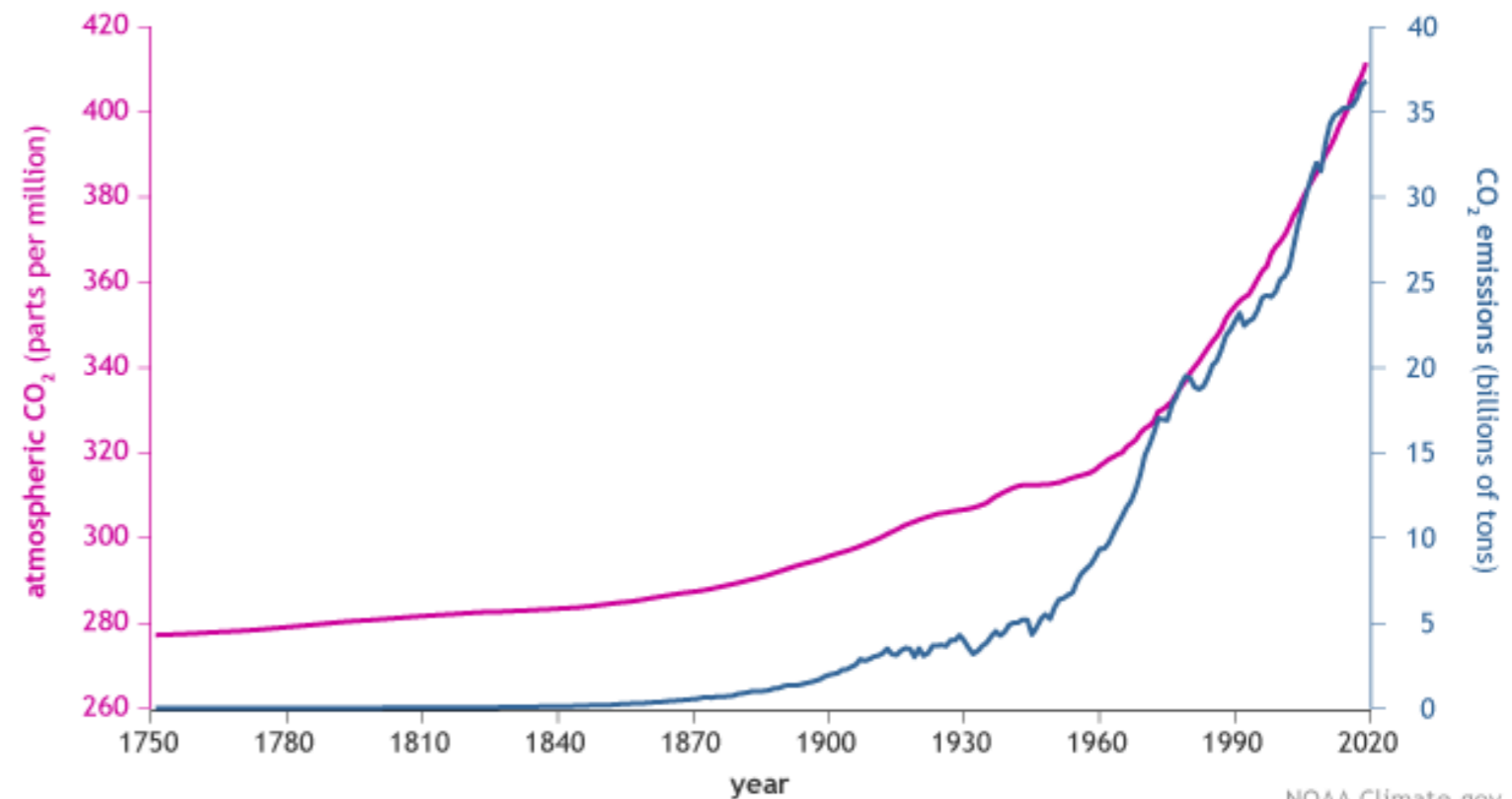
4.3



Carbon Fixation

- commonly called carbon capture
- conversion of atmospheric CO₂ into
 - carbohydrates
 - lipids
 - calcium carbonate
- $\approx 0.04\%$ of air is CO₂ (and growing)
- areas with photosynthesis, it's lower (eg. Rain forest)

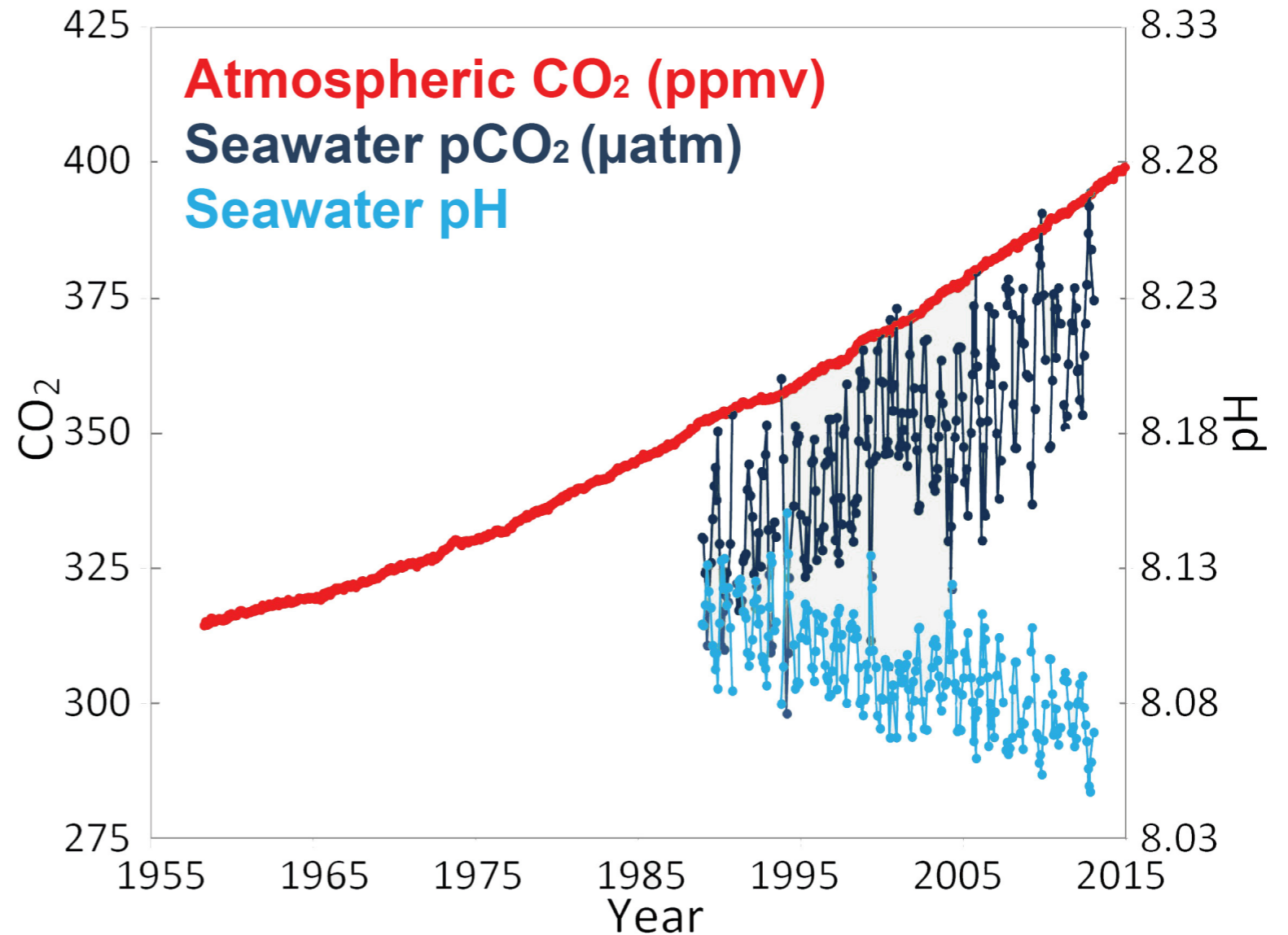
CO₂ in the atmosphere and annual emissions (1750-2019)



NOAA Climate.gov
Data: NOAA, ETHZ, Our World in Data

Carbon Fixation

- commonly called carbon capture
- conversion of atmospheric CO₂ into
 - carbohydrates
 - lipids
 - proteins
- $\approx 0.04\%$ of air is CO₂ (and growing)
- areas with photosynthesis, it's lower (eg. Rain forest)



Time series of carbon dioxide and ocean pH at Mauna Loa, Hawaii

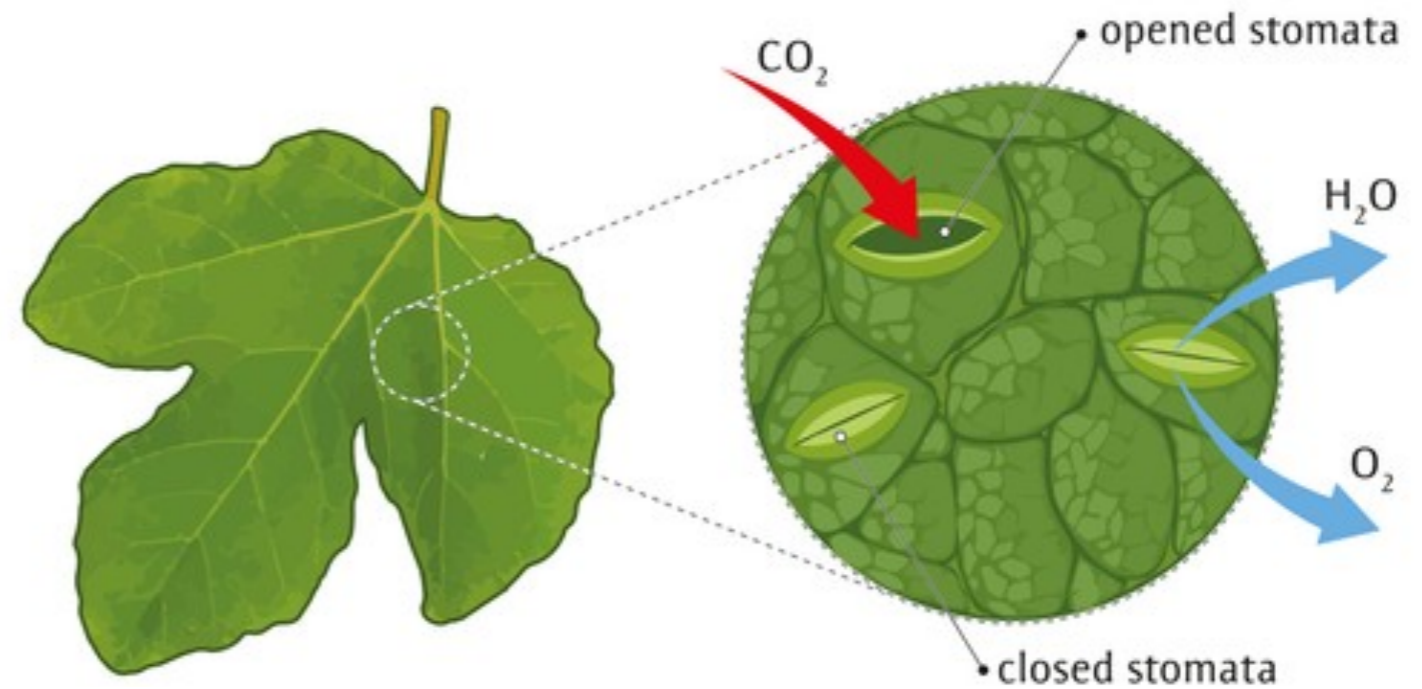
CO2 Sinks

- Water acts as a CO₂ collection sink
- CO₂ dissolves in water well
 - remain as a dissolved gas
 - combine to form carbonic acid (H₂CO₃)
- Both algae and aquatic plants can capture the CO₂ or HCO₃⁻ ions
- is a major contributor to atmospheric O₂

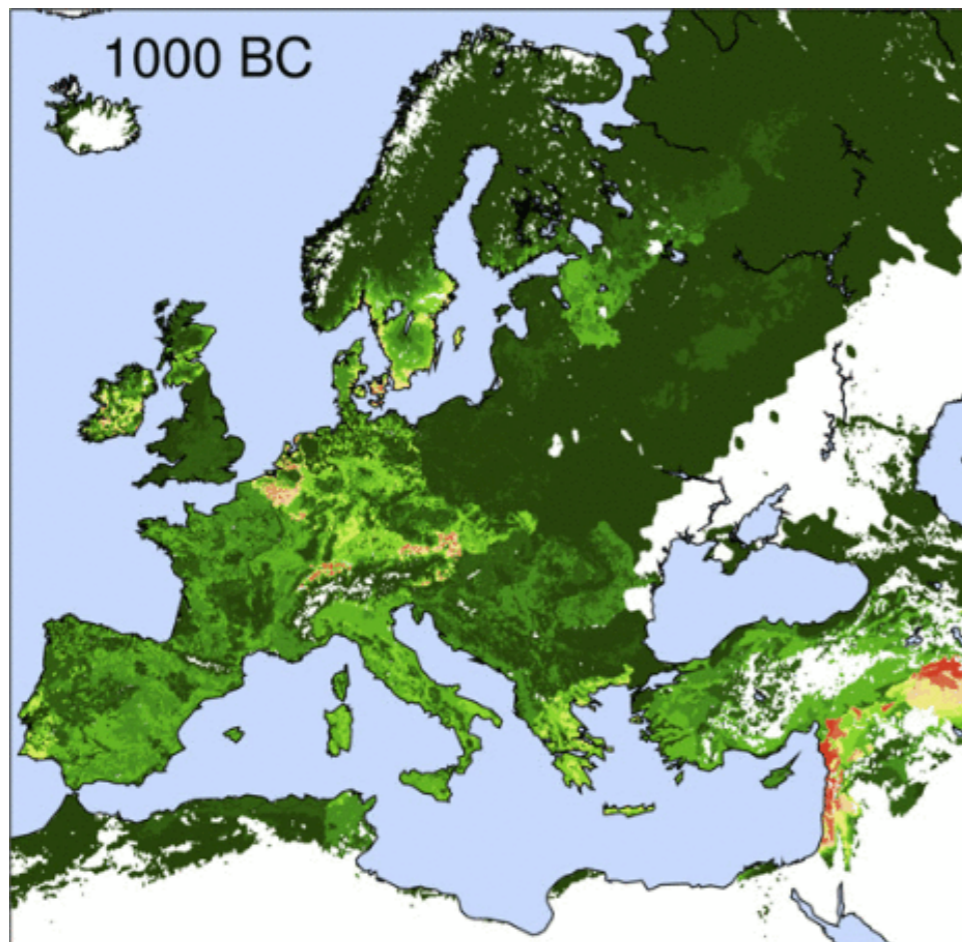


CO2 sinks

- Terrestrial autotroph provide a second sink CO2
- Absorption occurs through Stomata into leaves
 - forms plant structures and carbohydrate production



Tree cover loss in South America 2001-2019



Source: Global Forest Watch

CO₂ Sinks

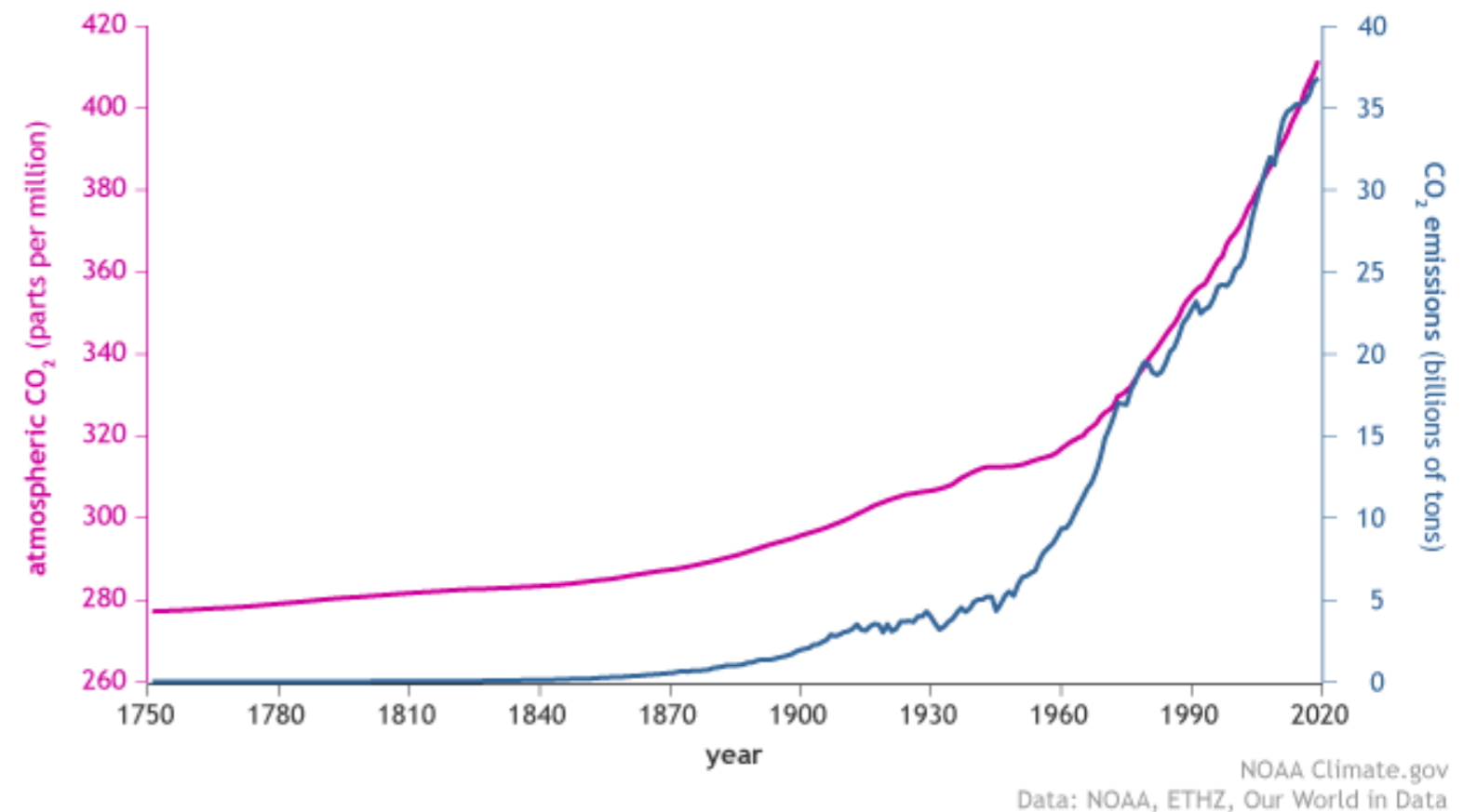
- Limestone
 - Hard parts of coral, molluscs, and small protists fix CO₂ in as their shells (CaCO₃)
 - Death over time deposits and produces limestone
 - 10% of rock of the earth is limestone



Carbon Release into the Atmosphere

- Cellular respiration
 - mitochondria of consumers
- Methanogenesis (CH₄)
 - Archaea (anaerobic prokaryotes release of carbon)
 - Associated with livestock farming
 - $\text{CO}_2 + 4\text{H}_2 \rightarrow \text{CH}_4 + 2\text{H}_2\text{O}$
 - $\text{CH}_3\text{COOH} \rightarrow \text{CH}_4 + \text{CO}_2$
 - Can be used as a fuel
- Decomposition
- Combustion

CO₂ in the atmosphere and annual emissions (1750-2019)



Carbon fluxes

Process		Flux/gigatonnes a year
Photosynthesis	-	120
Cell respiration	+	119.6
Ocean uptake	-	92.8
Ocean loss	+	90
Deforestation and land use changes	+	1.6
Burial in marine sediments	-	0.2
Combustion of fossil fuels	+	6.4

Net total = (+4.6)

Algae Carbon Fixation



Algae Carbon Fixation

