



CLIMATE CHANGE IN NEW JERSEY

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GREAT SWAMP WATERSHED ASSOCIATION
THE PASSAIC RIVER WATERKEEPER® ALLIANCE AFFILIATE

CLIMATE VS. WEATHER

- CLIMATE IS

- AVERAGE OVER LONG TIME
- YOUR PERSONALITY
- THE STOCK MOVING AVERAGE

- WEATHER IS

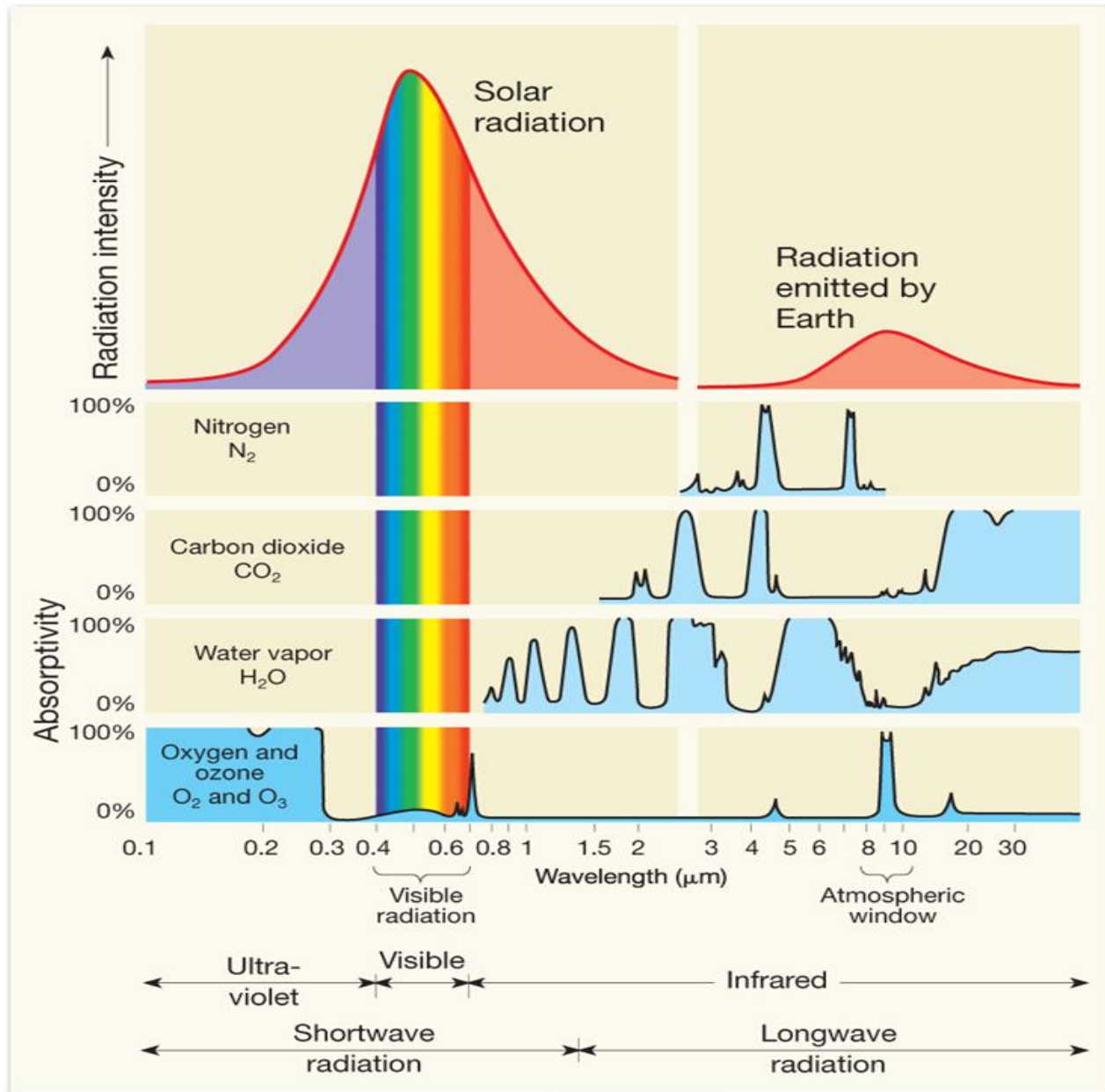
- CURRENT CONDITIONS
- YOUR MOOD
- THE CURRENT STOCK PRICE



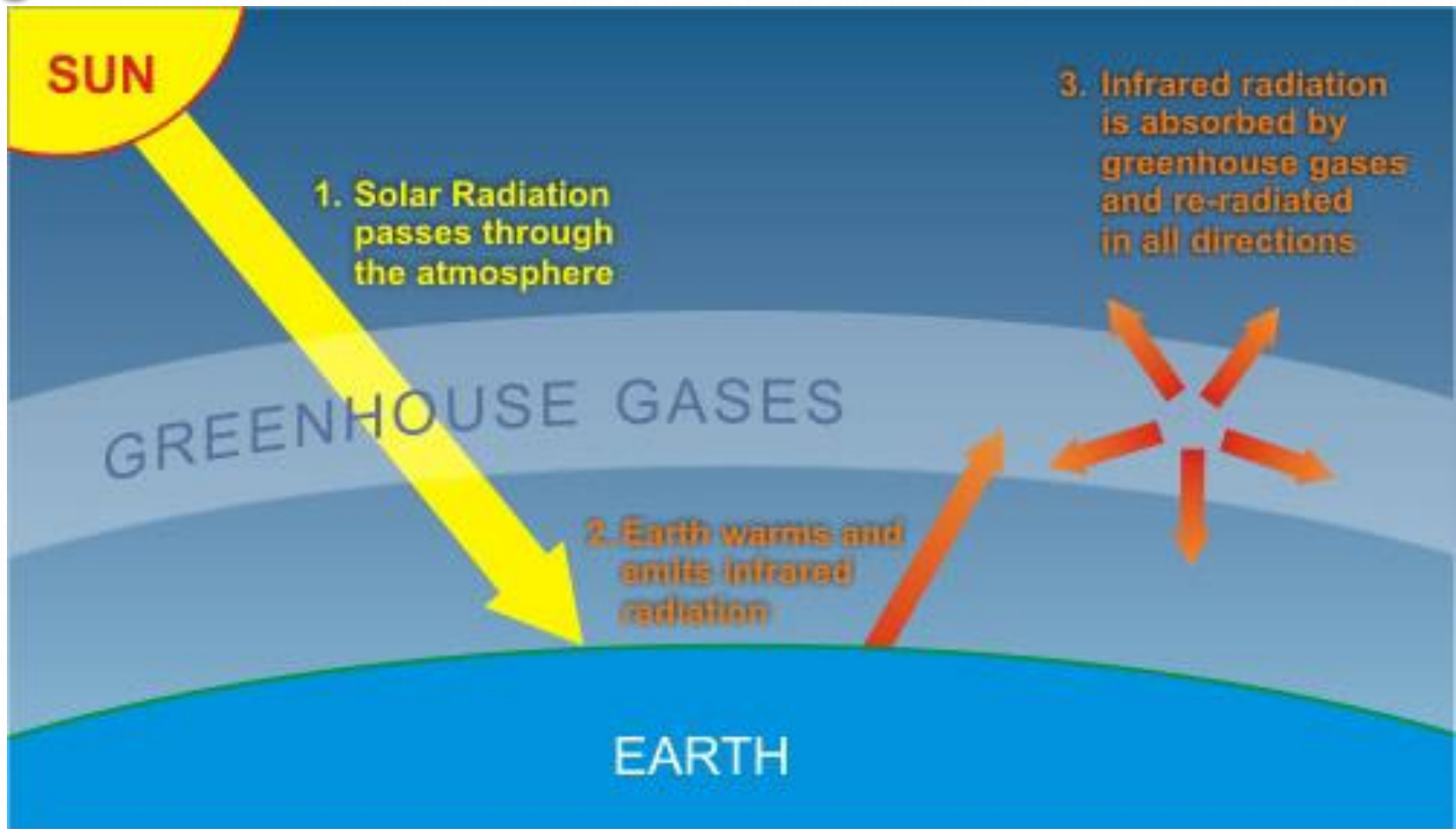
CAUSES OF CLIMATE CHANGES

- NATURAL
 - PLATE TECTONICS
 - VOLCANIC ERUPTIONS
 - OCEAN CURRENTS
 - EARTH'S ORBITAL CHANGES
 - SOLAR VARIATIONS
- ANTHROPOGENIC
 - USE OF FUELS
 - ELECTRICITY GENERATION, HEATING, TRANSPORT
 - AGRICULTURE
 - CH₄ EMISSIONS BY LIVESTOCK AND MANURE
 - NO_x EMISSIONS FROM FERTILIZERS
 - DEFORESTATION

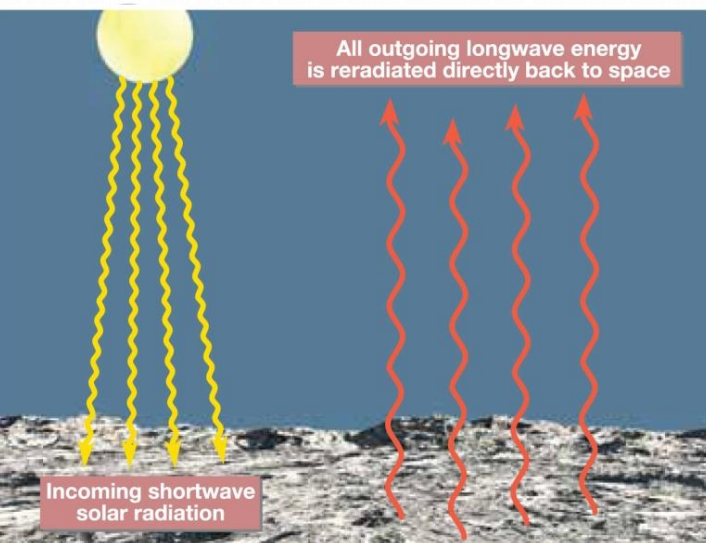
THE GREENHOUSE EFFECT



THE GREENHOUSE EFFECT

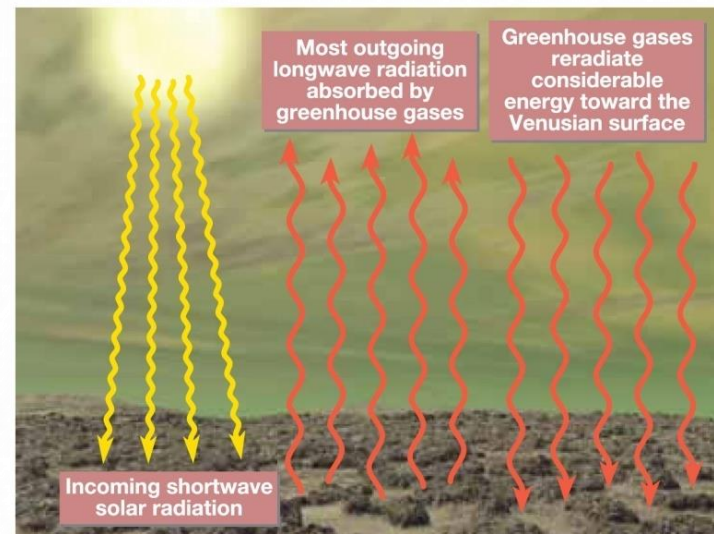


THREE-EARTHS SCENARIO

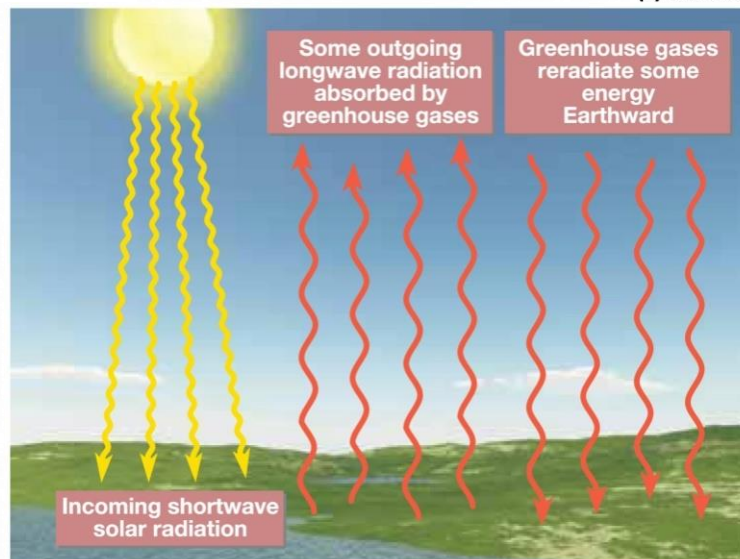


(a) Airless bodies like the Moon

WE ARE IN THE
GOLDILOCKS ZONE

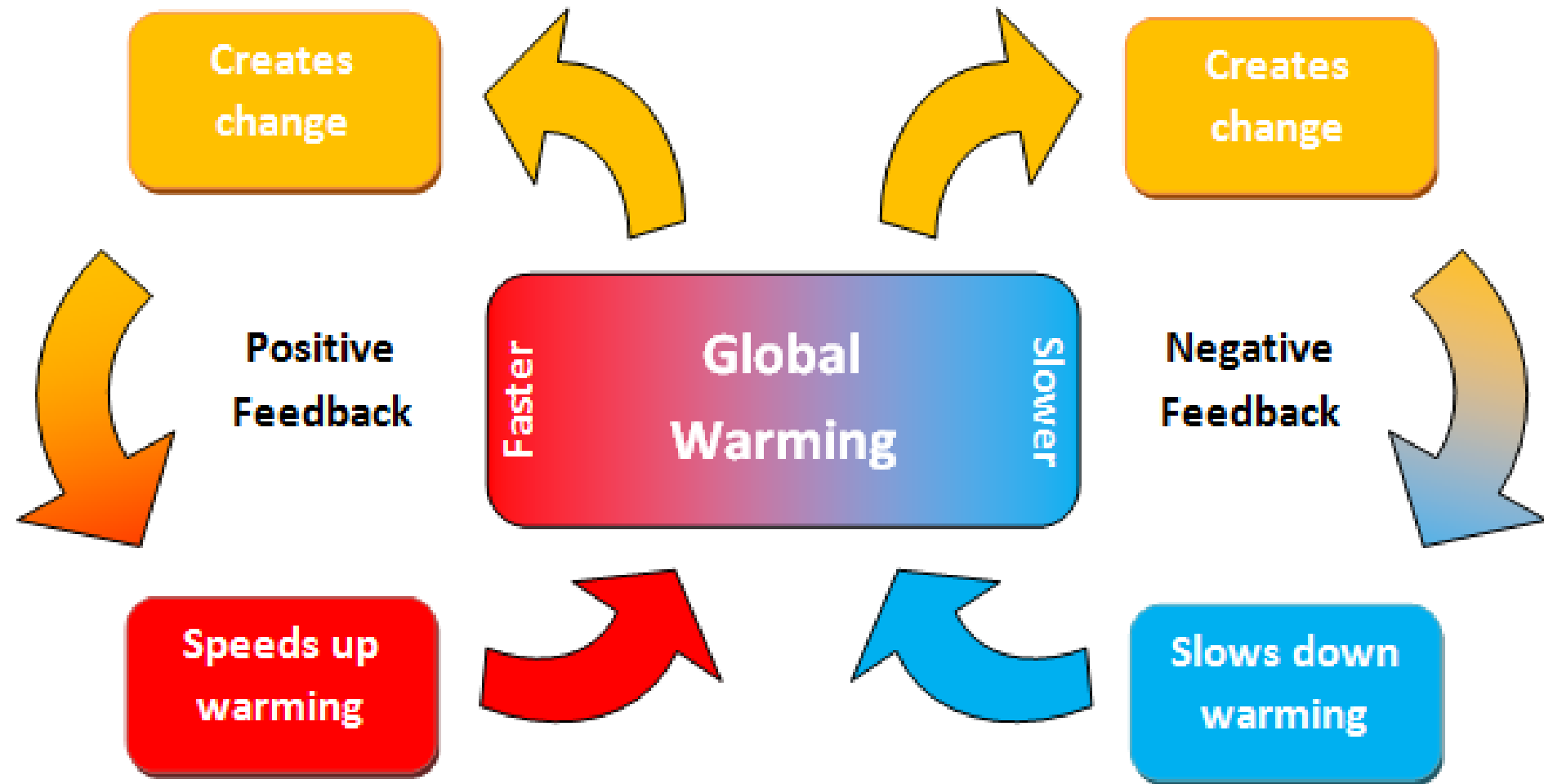


(c) Bodies with abundant greenhouse gases like Venus



(b) Bodies with modest amounts of greenhouse gases like Earth

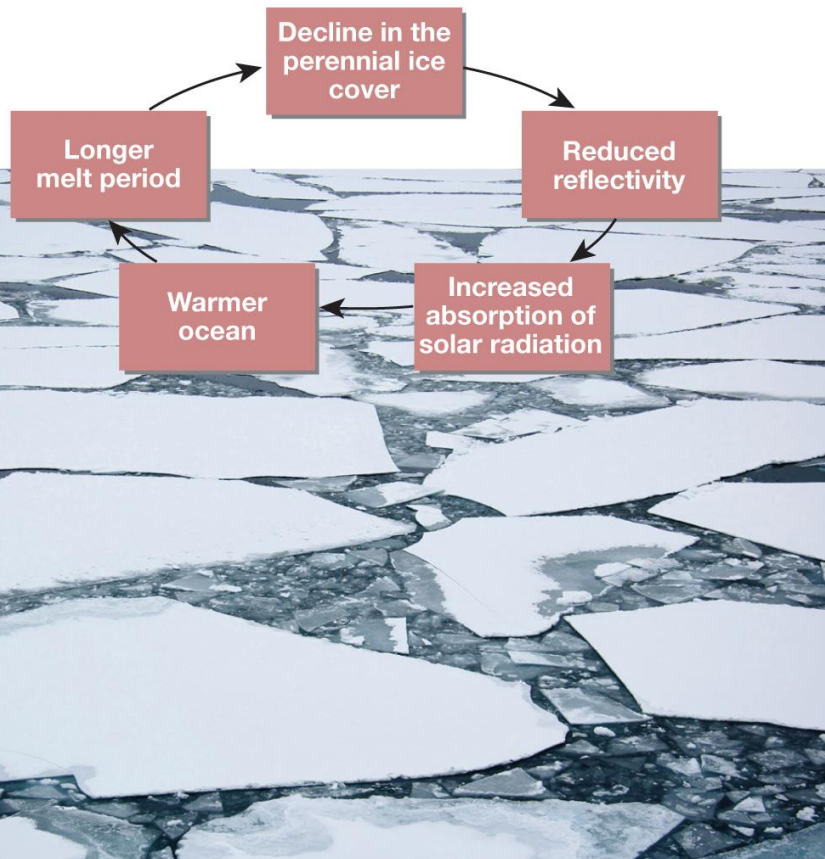
FEEDBACK MECHANISMS



FEEDBACK MECHANISMS

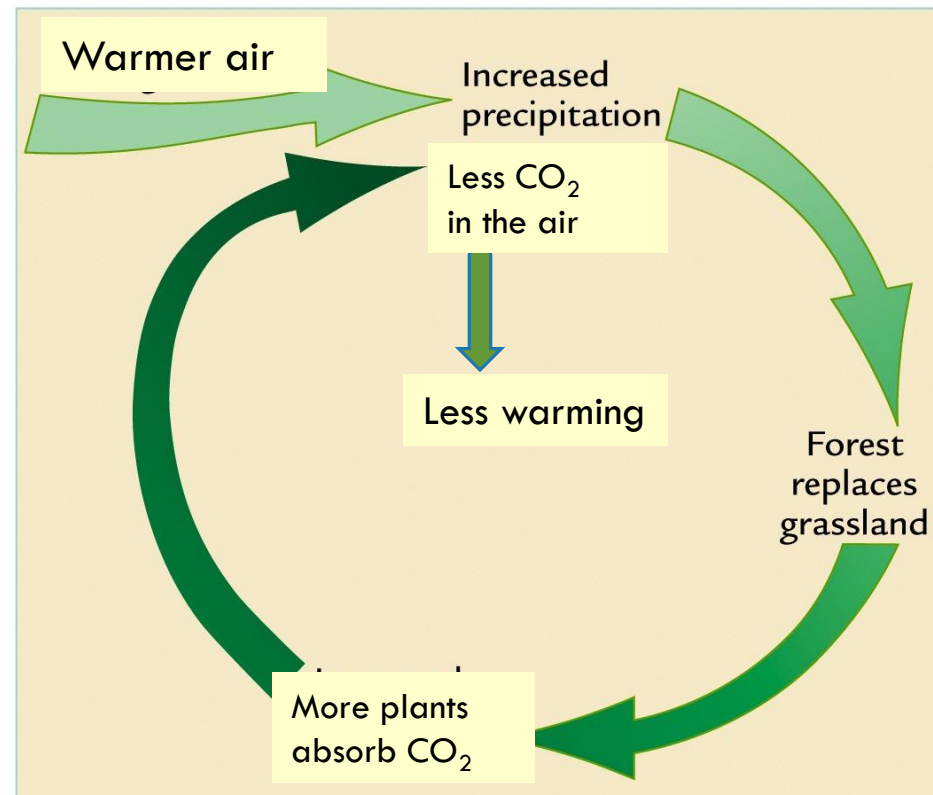
- POSITIVE FEEDBACK

- Ice-albedo feedback example

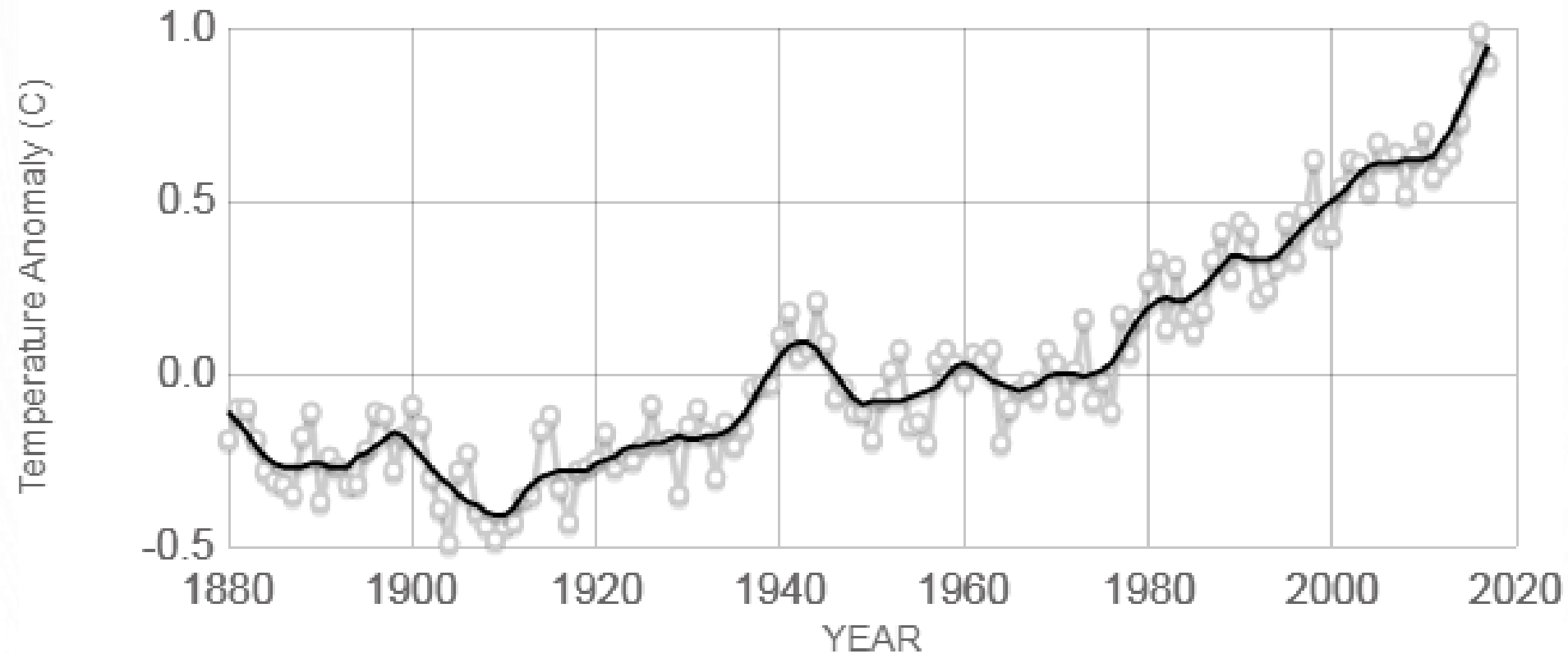


- NEGATIVE FEEDBACK

- Precipitation feedback example



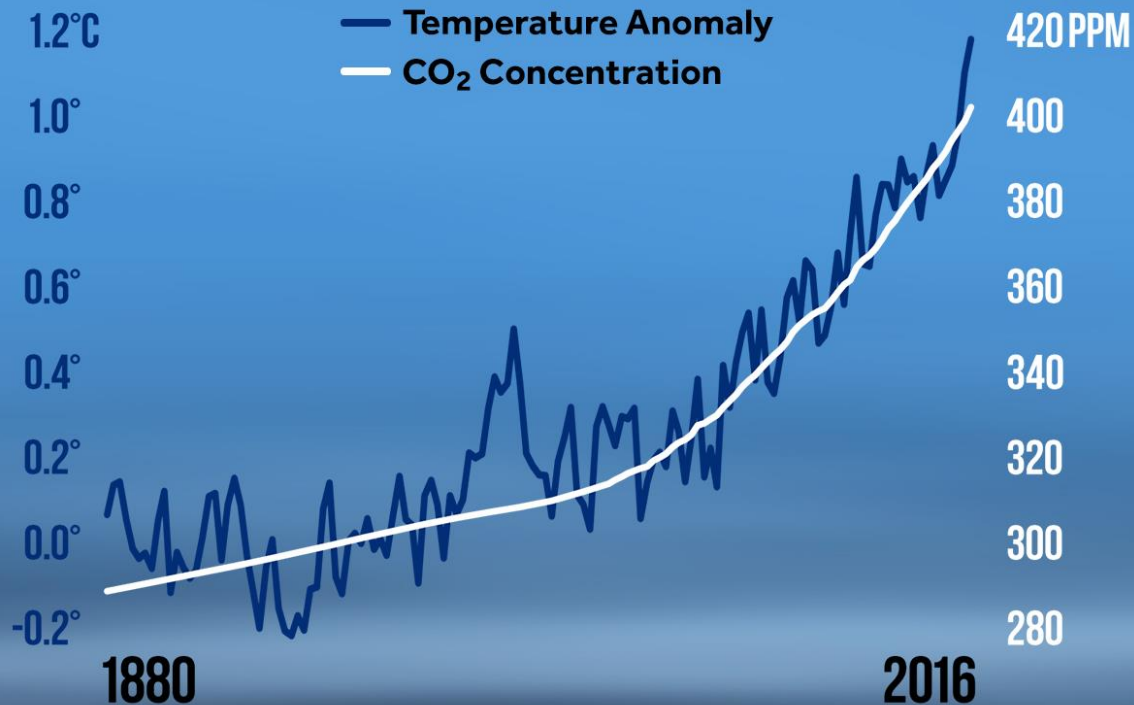
TEMPERATURE DATA – SINCE 1880



Source: climate.nasa.gov

THE CO₂ CONNECTION – SINCE 1880

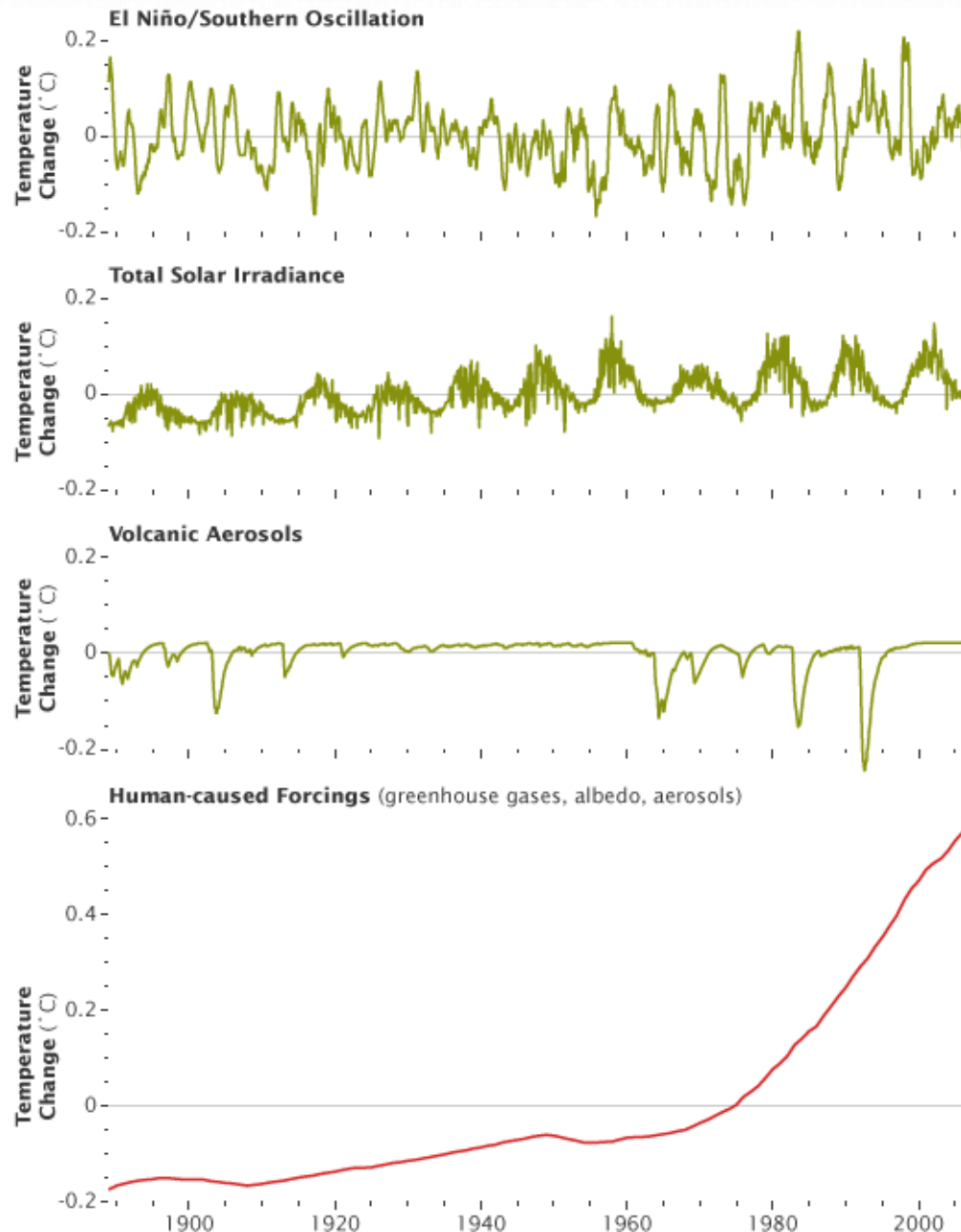
Global Temperature and Carbon Dioxide



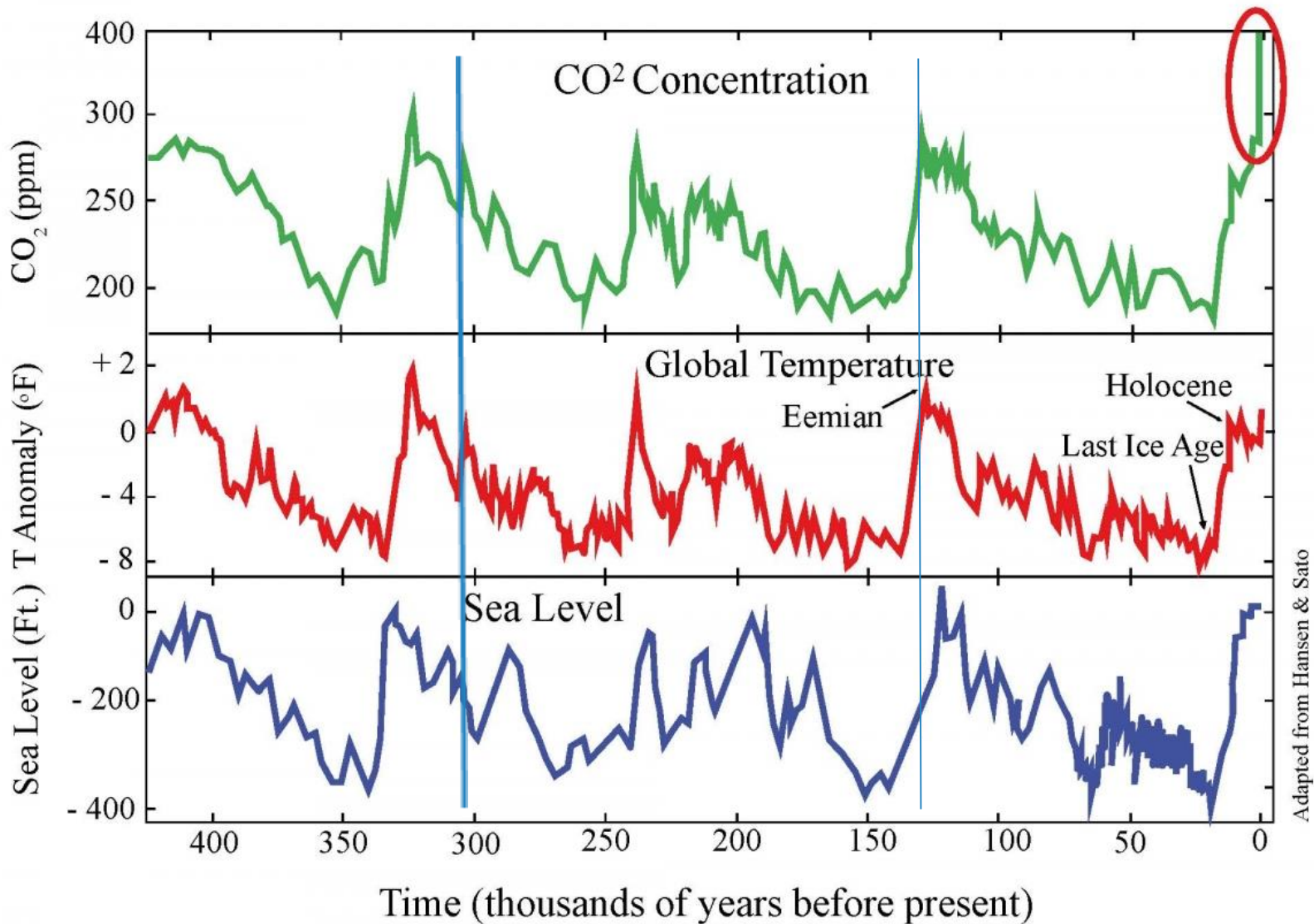
Global temperature data averaged and adjusted to early industrial baseline (1881-1910).
Source: NASA GISS, NOAA NCEI, ESRL

CLIMATE  CENTRAL

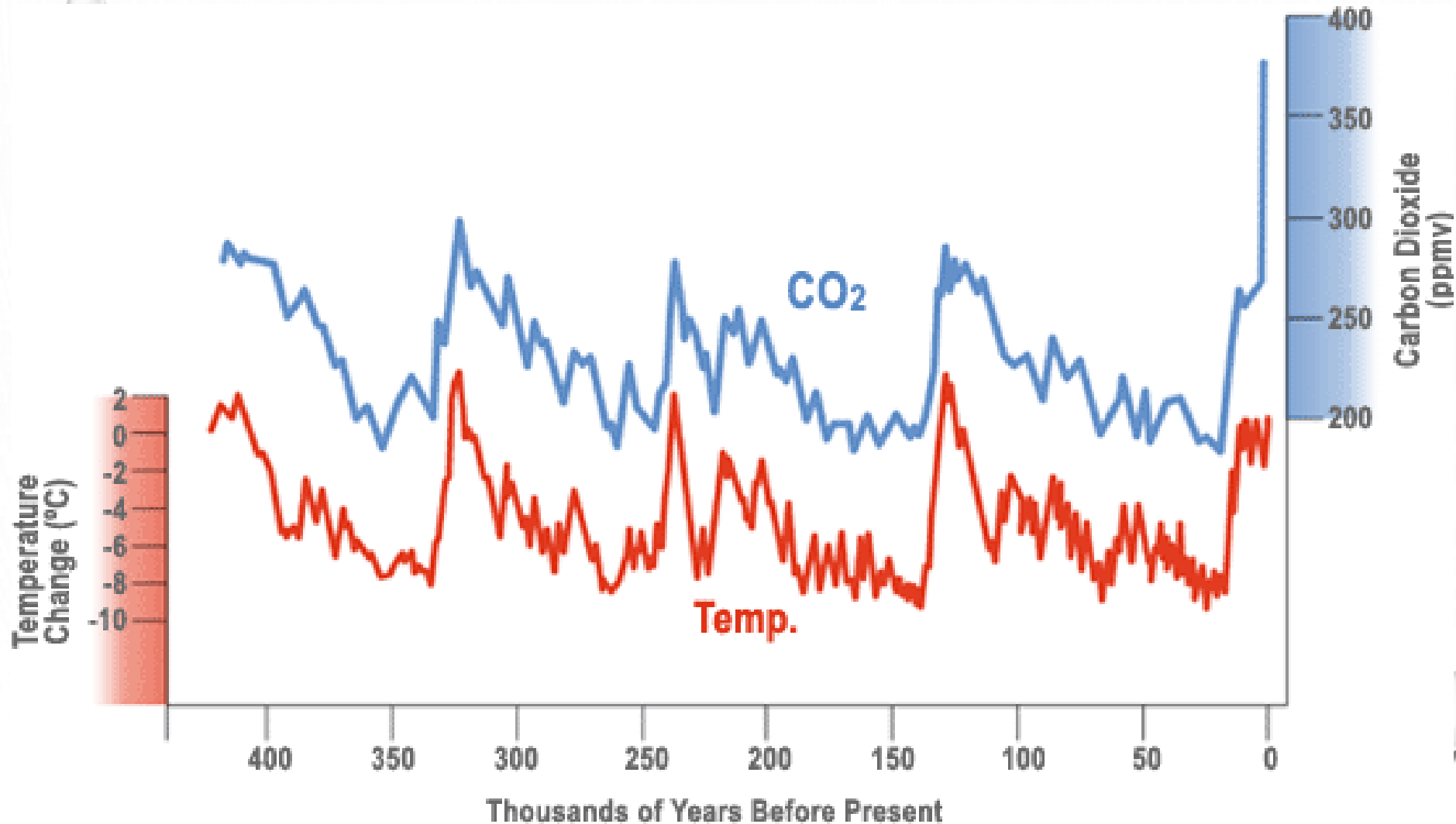
ANTHROPOGENIC OR NATURAL?



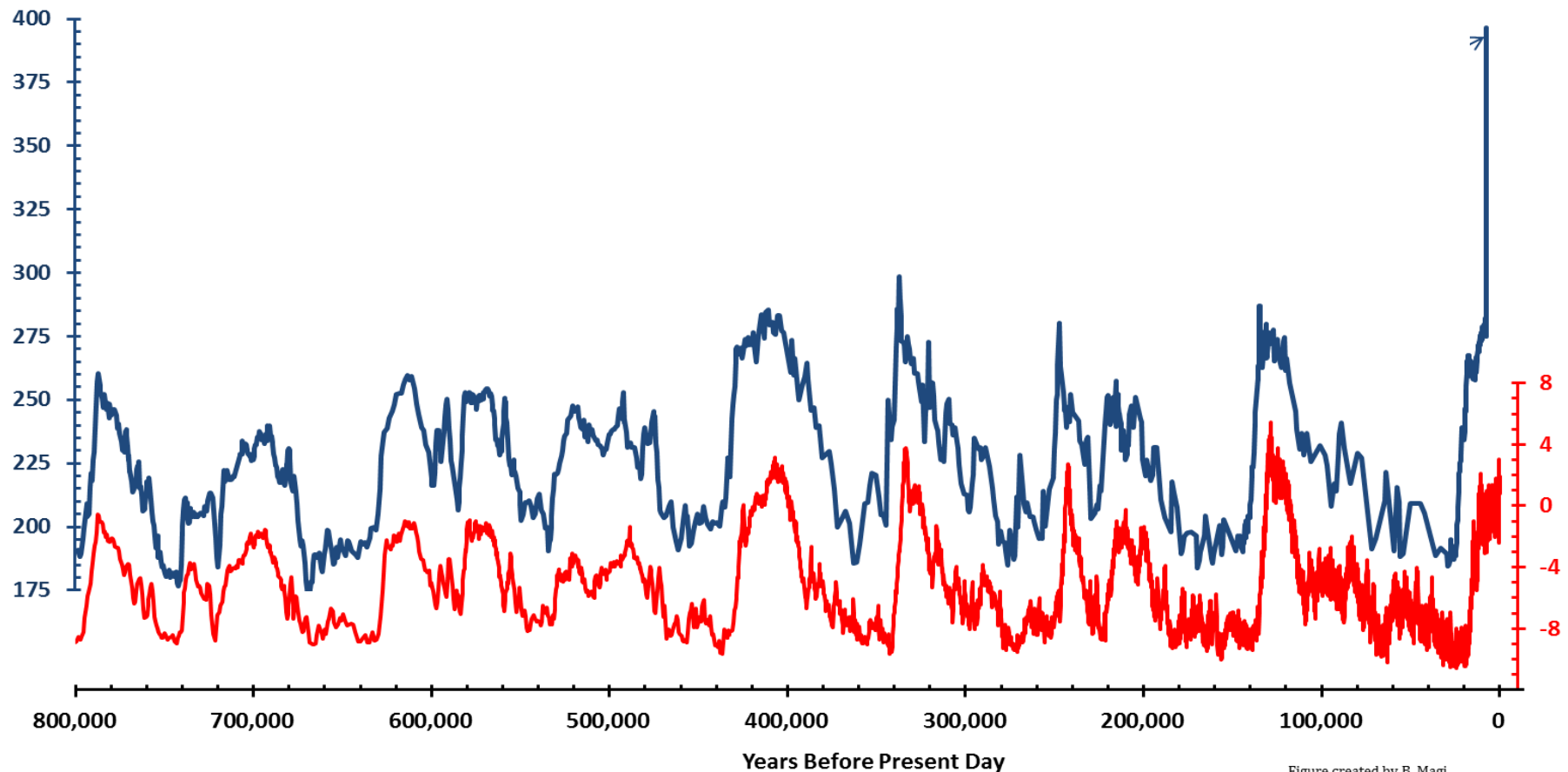
THE CO₂ CONNECTION – LAST 400,000 YRS



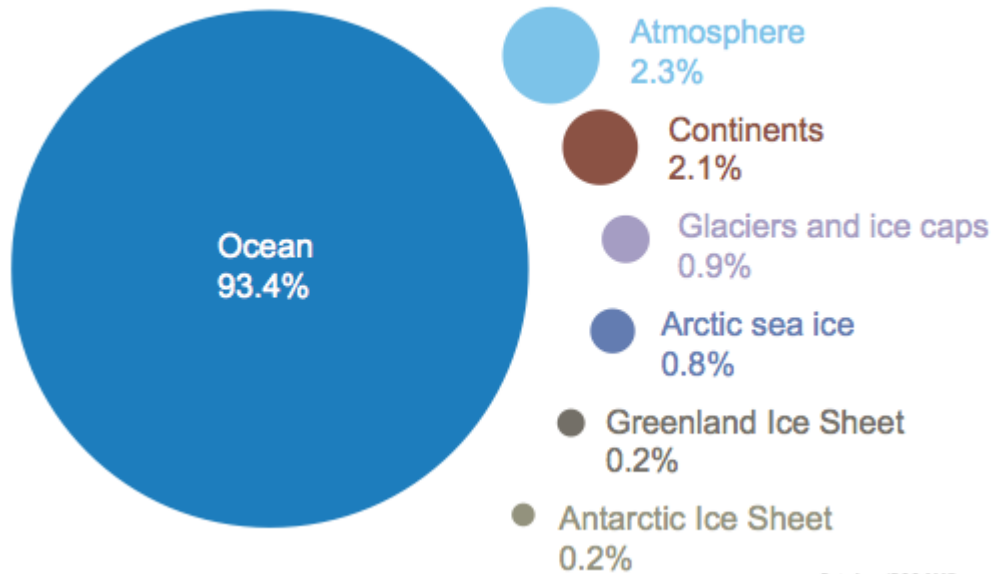
THE CO₂ CONNECTION – LAST 400,000 YEARS



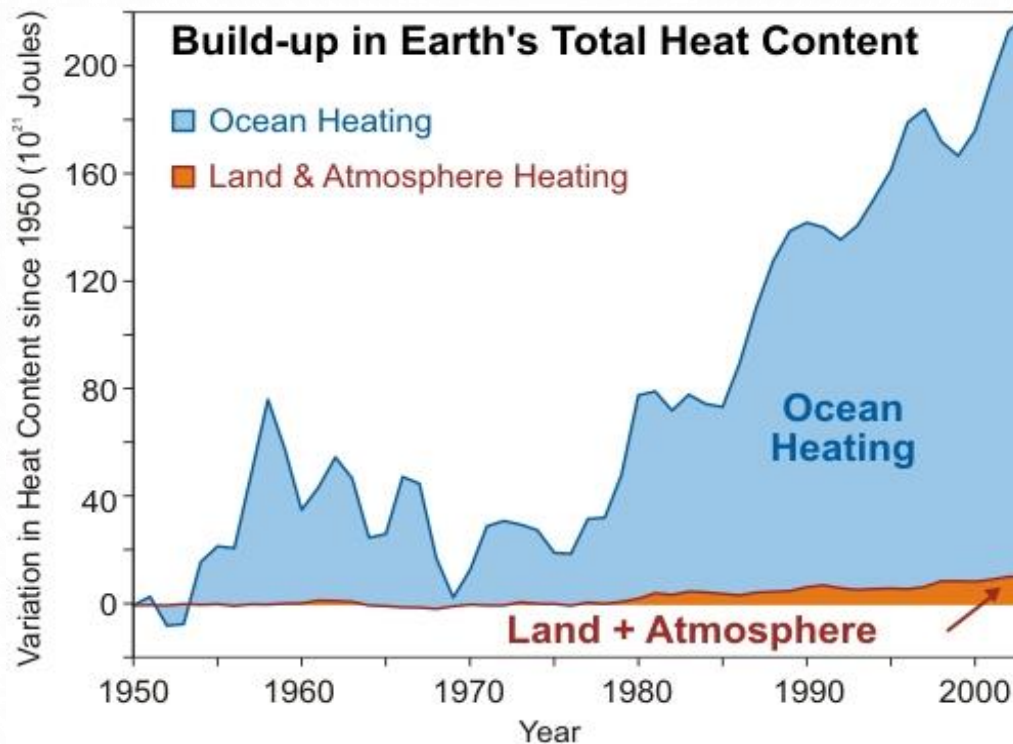
THE CO₂ CONNECTION – LAST 800,000 YEARS



Where is global warming going?

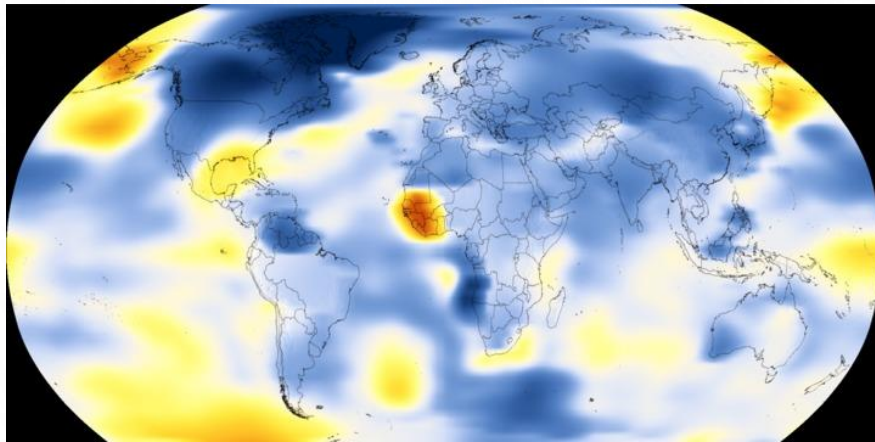


Data from IPCC 2007

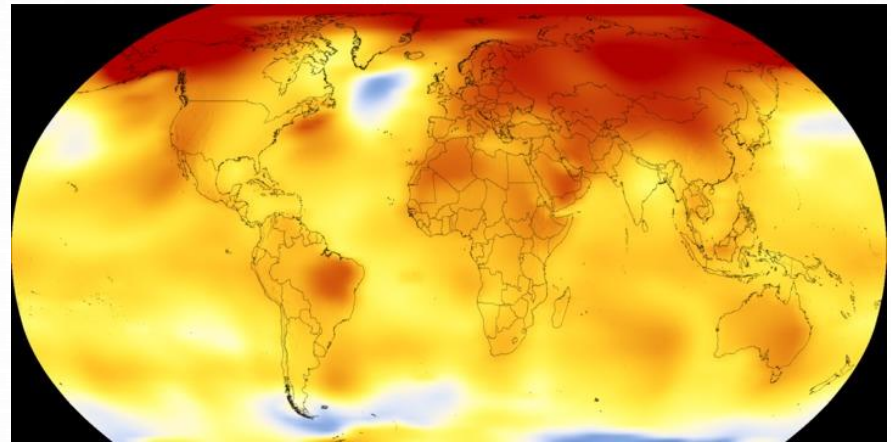


GLOBAL SURFACE TEMPERATURES

- 1884



- 2017

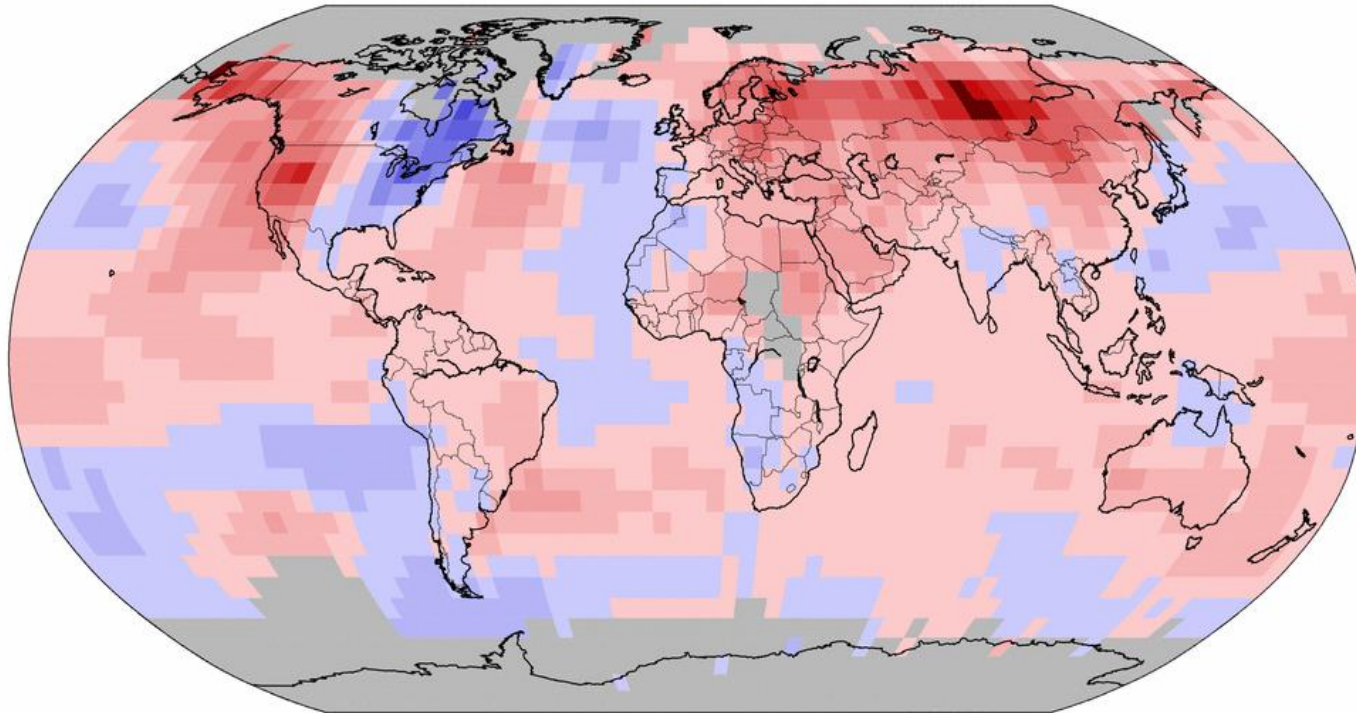


Blue: areas cooler than 1951-80 average. Red: areas warmer than average.

TEMPERATURE ANOMALIES

Land & Ocean Temperature Departure from Average Dec 2014–Feb 2015
(with respect to a 1981–2010 base period)

Data Source: GHCN–M version 3.2.2 & ERSST version 3b



NOAA's National Climatic Data Center
Sun Mar 15 19:53:31 EDT 2015

Degrees Celsius

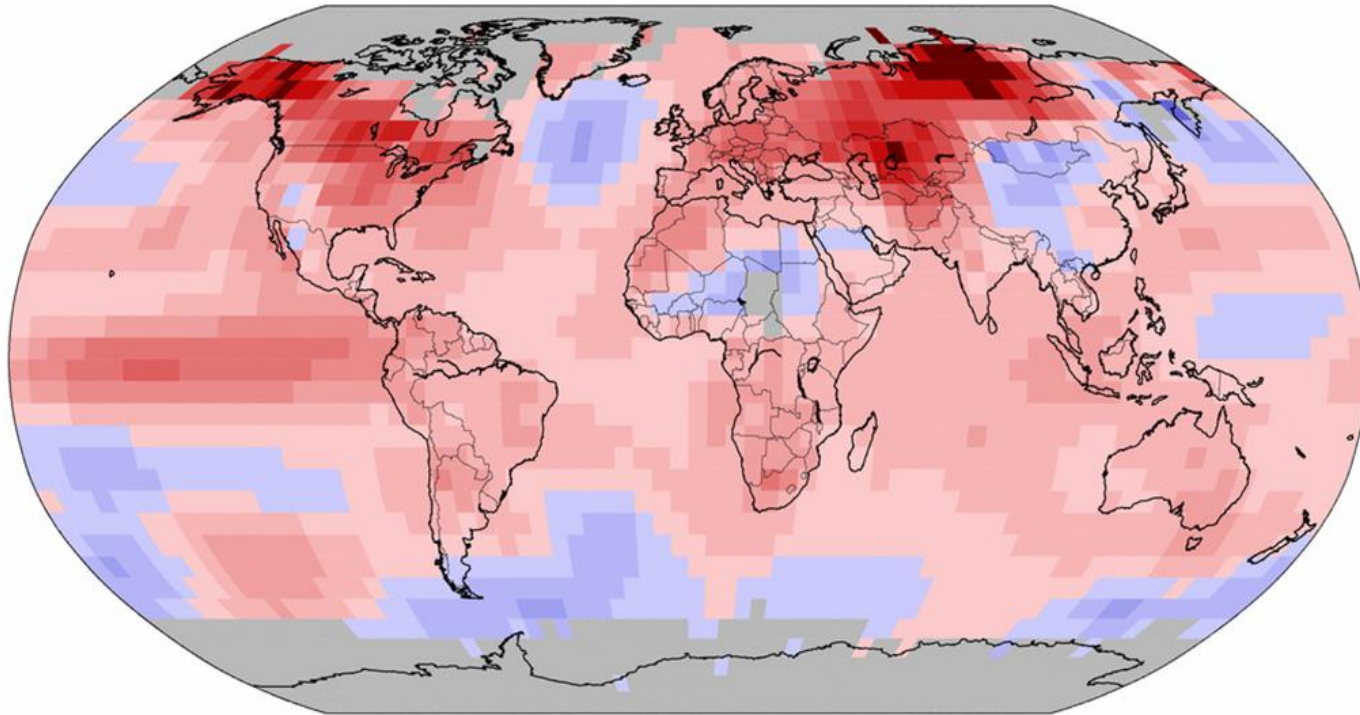
Please Note: Gray areas represent missing data
Map Projection: Robinson

[https://www.ncdc.noaa.gov/temp-and-precip/global-maps/201614?products\[\]=map-blended-mntp#global-maps-select](https://www.ncdc.noaa.gov/temp-and-precip/global-maps/201614?products[]=map-blended-mntp#global-maps-select)

TEMPERATURE ANOMALIES

Land & Ocean Temperature Departure from Average Dec 2015–Feb 2016
(with respect to a 1981–2010 base period)

Data Source: GHCN–M version 3.3.0 & ERSST version 4.0.0

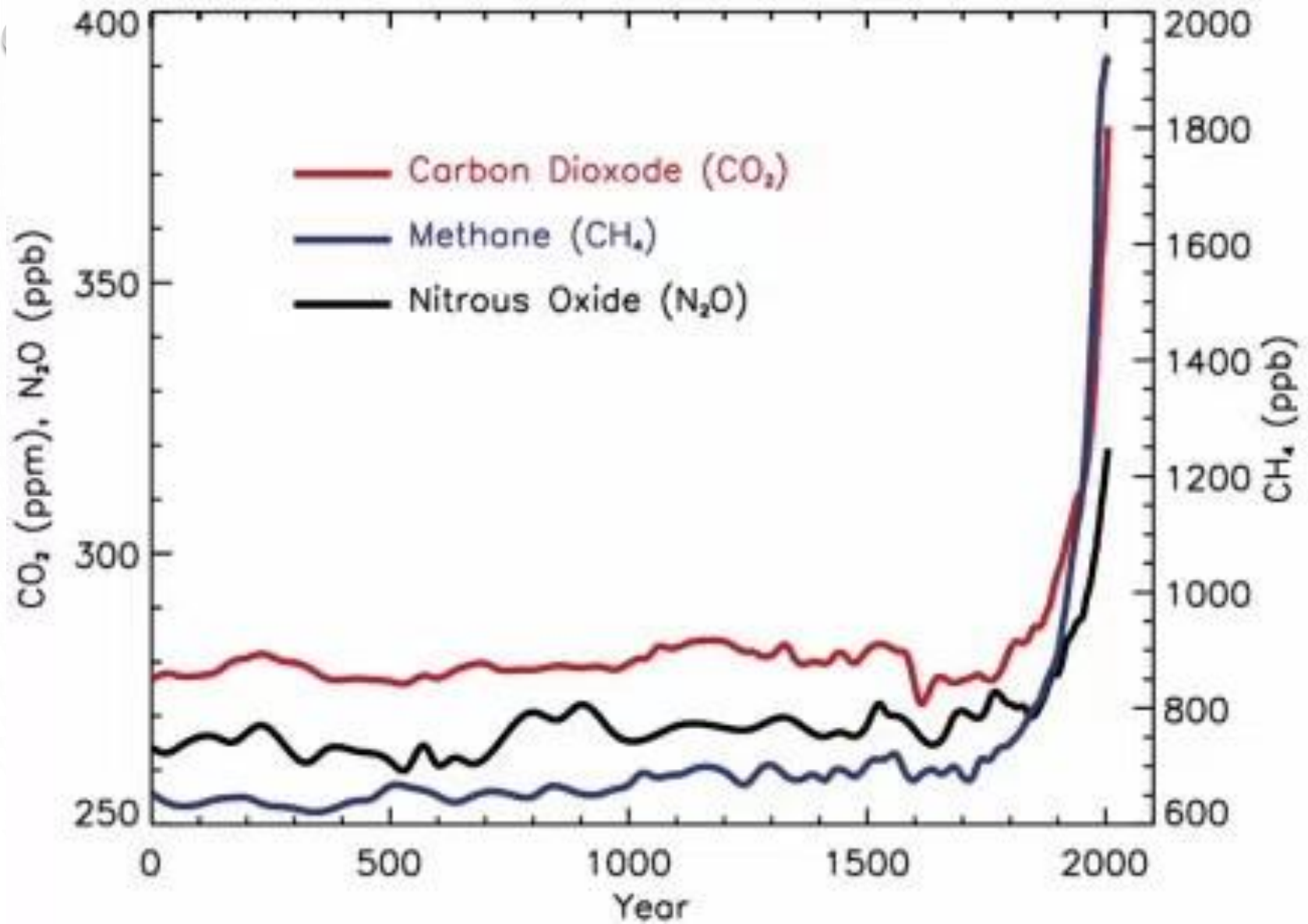


National Centers for Environmental Information
Mon Mar 14 07:22:03 EDT 2016

Degrees Celsius

Please Note: Gray areas represent missing data
Map Projection: Robinson

THE OTHER GREENHOUSE GASES



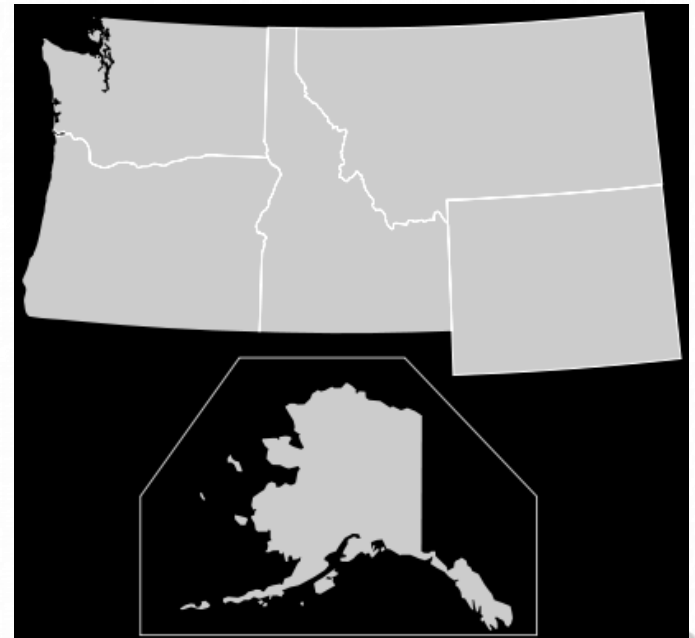
EFFECTS IN THE EASTERN USA

- MORE FREQUENT HEAT WAVES
- MORE FREQUENT EXTREME WEATHER
- HEAVY DOWNPOURS
- SEA LEVEL RISE
- CHANGES IN FISHERIES AND ECOSYSTEMS
- INSECT OUTBREAKS, VIRUS OUTBREAKS
- TREE DISEASES, CHANGES IN GROWING SEASONS
- DECREASE IN WATER SUPPLIES IN SOUTHEAST REGIONS



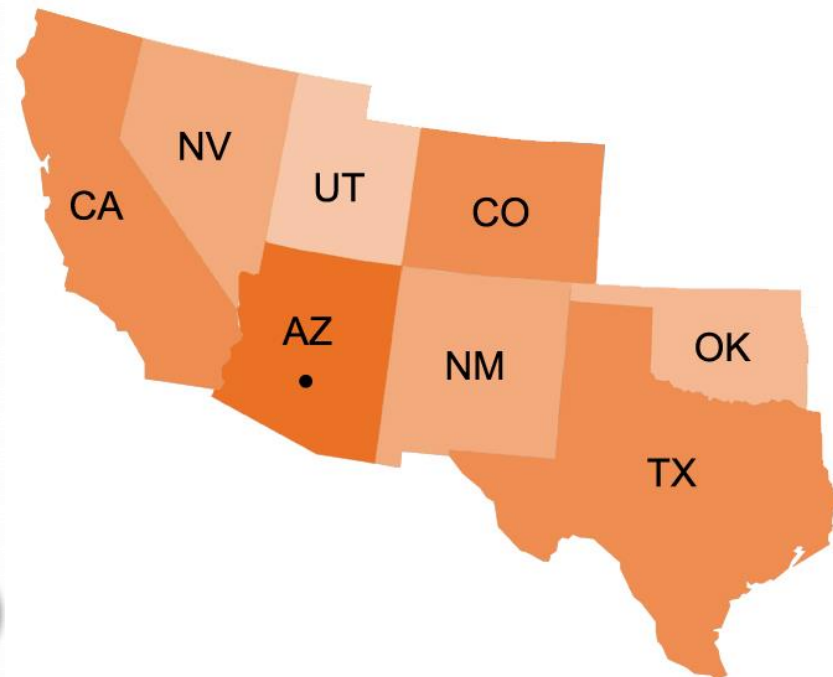
EFFECTS IN THE NORTHWEST USA

- CHANGES IN TIMING OF STREAM FLOW
- REDUCED WATER SUPPLIES
- SEA LEVEL RISE
- EROSION
- INSECT OUTBREAKS
- TREE DISEASES
- INUNDATION (FLOOD WATERS)
- INCREASING OCEAN ACIDITY
- INCREASING WILDFIRES



EFFECTS IN THE SOUTHWEST USA

- INCREASED HEAT, DROUGHT, AND INSECT OUTBREAKS
- HEALTH IMPACTS IN CITIES DUE TO HEAT
- FLOODING AND EROSION IN COASTAL AREAS
- DECLINING WATER SUPPLIES
- REDUCED AGRICULTURAL YIELDS
- INCREASED WILDFIRES



CLIMATE CHANGE EFFECTS IN NJ - FISHING

- FISH MOVING NORTH (TO COOLER WATERS)
 - Loss of fishing grounds to New England states
- HIGHER OCEAN ACIDITY
 - Damage to scallops, clams
 - Account for 65% of fishing revenue
- INCREASED ACIDITY IN ESTUARIES
 - Damage to crabs and other hard-shell fish
 - Account for 15% of fishing revenue

CLIMATE CHANGE EFFECTS IN NJ - FARMS

- MORE HOT DAYS AND DROUGHTS
 - May reduce crop yields
 - May turn NJ into a bigger wine producer
- MORE FLOODING AND WETTER SPRINGS
 - May delay planting dates
- LONGER GROWING SEASON
 - May be beneficial

EFFECTS IN NJ – HEALTH CARE

- Increasing heat-related ER visits and hospitalizations
 - Most vulnerable: seniors, disabled, poor...
- Increasing respiratory illnesses, heatstroke, dehydration
- Increasing ground-level ozone
- Increasing length and severity of the pollen season
- Increasing risk of some diseases carried by insects
 - Ticks (lime disease)
 - Mosquitos (West Nile, Zika)

EFFECTS IN NJ – SEA LEVEL RISE

- SEA LEVEL IS RISING
 - In Atlantic city, sea level has risen about 1.5” per decade since 1912
 - Expected rise of 1’ to 4’ in the next century
- LOWEST DRY LANDS WILL BE SUBMERGED
- MANY WETLANDS WILL BE SUBMERGED
 - Salt marshes b/w Cape May and Meadowlands will be lost if sea level rises 3’
 - Wetlands along Delaware Bay are likely to be lost if sea rises 2’
 - Tidal flats are also likely to become open water
- BEACH EROSION
 - Barrier islands will be broken up or lost if sea level rises 3’.
 - Bay beaches may be eliminated in some areas

IF ALL ICE MELTED...

Sea Level Rise effects in NJ



1 INCH OF WATER ...



EFFECTS IN NJ – CHANGING PRECIPITATION PATTERNS

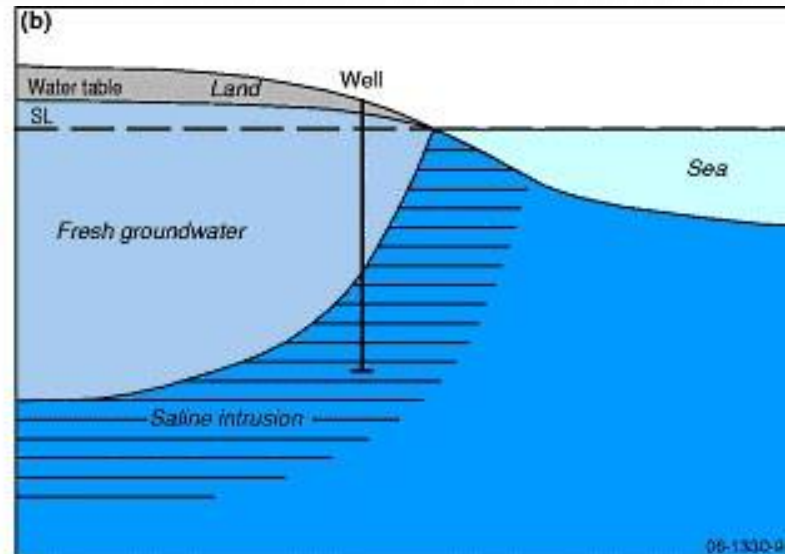
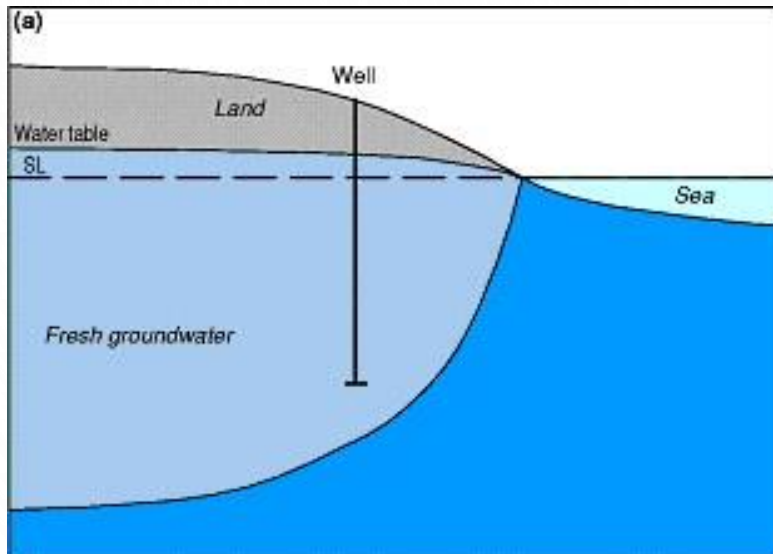
- AVERAGE ANNUAL PRECIPITATION INCREASED 5-10% IN THE 20TH CENTURY
 - Precipitation from heavy storms increased 70% since 1958
- PRECIPITATION LIKELY TO INCREASE DURING WINTER/SPRING BUT NOT CHANGE DURING SUMMER/FALL
 - Flooding during winter/spring, and drought during summer/fall
- MORE VIOLENT COASTAL STORMS EXPECTED TO BECOME MORE DESTRUCTIVE
 - Power outages will become the new normal
- LONGER PERIODS W/O RAINFALL DURING LONGER GROWING SEASONS
 - Drier growing season, especially during the summer months
 - Exacerbated by reduced recharge from spring snowmelt

EFFECTS IN NJ – STORMS AND INFRASTRUCTURE

- Redrawing Flood Maps
- Higher storm surges, more coastal erosion
- Washed-out roads, inundated rail tunnels
- Risks for power grids
- Risks for wastewater management
- Tropical storms coming to NJ are likely to increase
- Increasing winds
- Flood insurance rates will increase
- Higher deductibles for wind damage in home ins. policies
- Changes in housing in coastal and flood areas

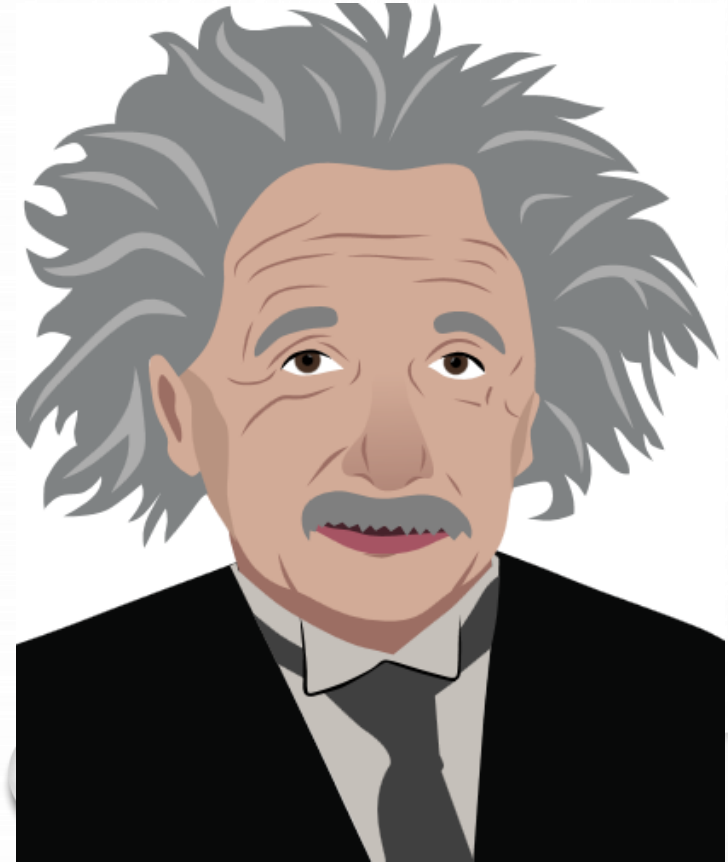
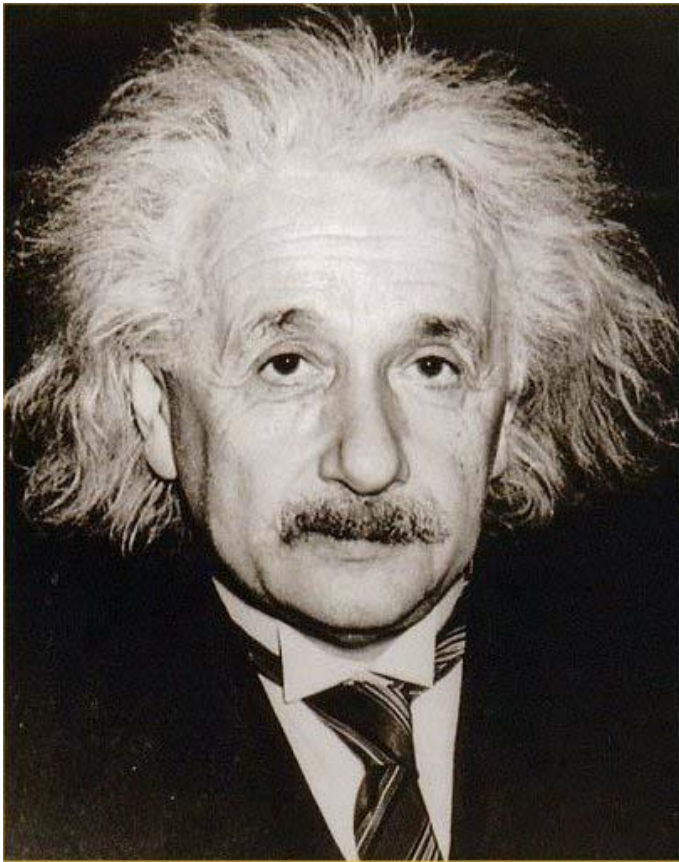
EFFECTS IN NJ – SALT WATER INTRUSION

- Salt water mixing farther inland or upstream
- Salt water intruding into aquifers near the coast
- Salty Soils for crops and trees in low-lying areas



CLIMATE FORECASTS

THE DEVIL IS IN THE DETAILS



WHAT CAN WE DO?

MITIGATION

Slow down (or stop) the warming of the atmosphere by stabilizing greenhouse gas emissions.

ADAPTATION

Build defenses and prepare for the consequences of climate change.

MITIGATION

- REDUCE EMISSIONS AND STABILIZE LEVELS OF GREENHOUSE GASES
 - Reduce sources
 - Increase “sinks” of greenhouse gases
 - Stabilize emissions to allow ecosystems to adapt naturally

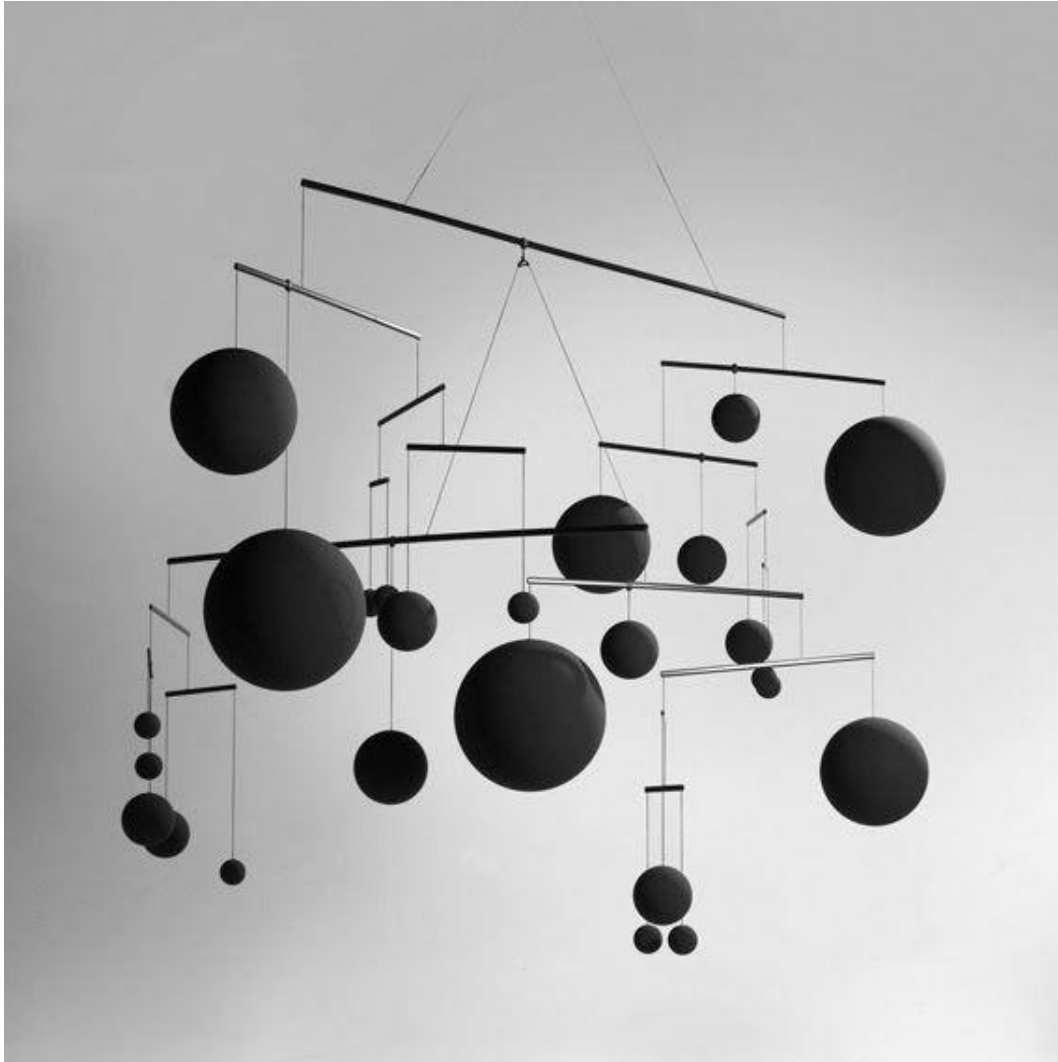


ADAPTATION

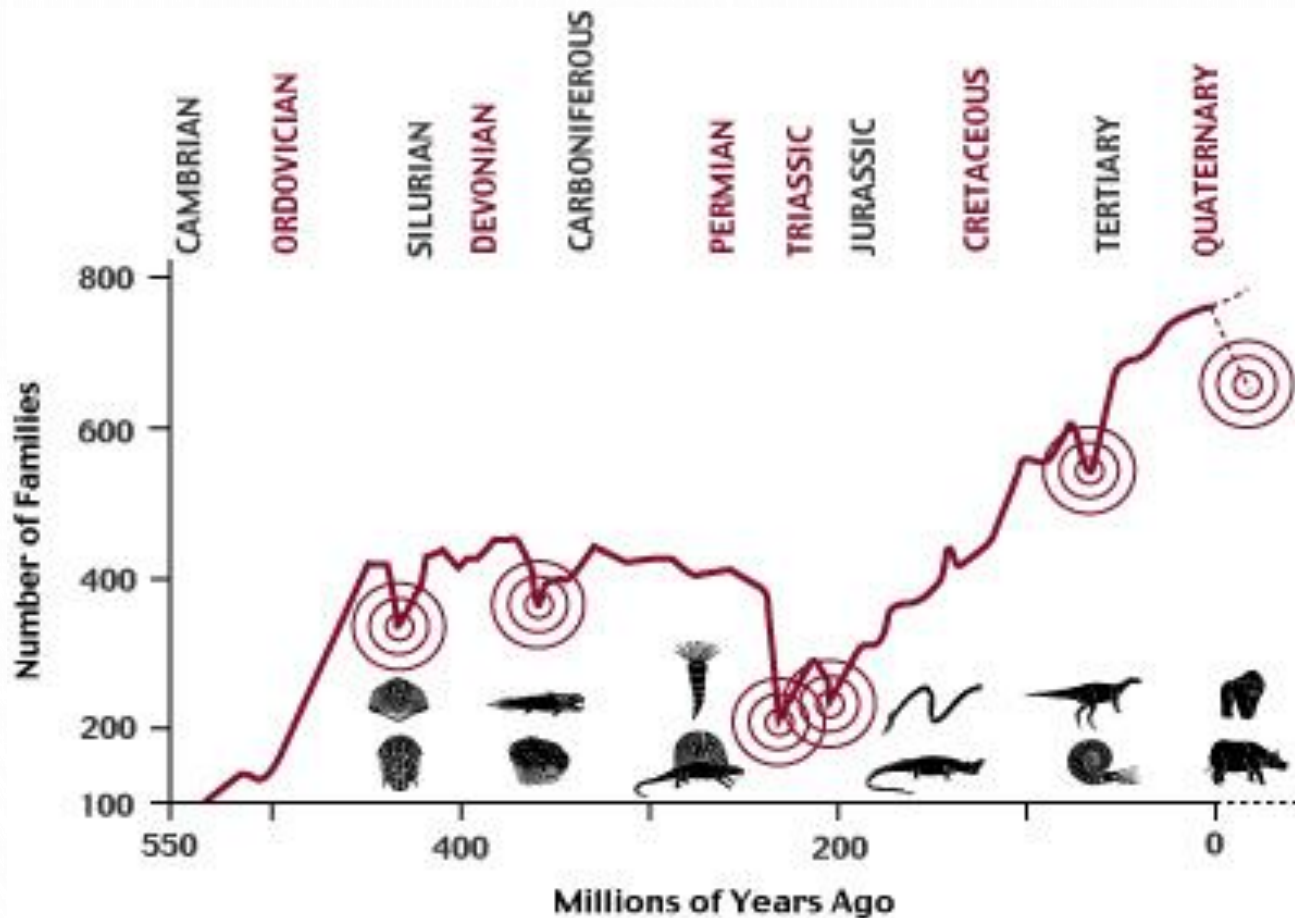
ADAPT TO THE CLIMATE CHANGE ALREADY IN THE PIPELINE

- Prepare for excessive floods
 - Build flood defenses
 - Develop storm-water management
- Limit or stop development in exposed locations
 - Relocate at risk communities
 - Clear protocol for timely evacuation of vulnerable communities
- Plan for heat waves and higher temperatures
- Plan for higher winds (tall buildings, building codes)
- Improve water storage and use
- Make the most of any potential benefits

CLIMATE IS A BALANCE OF MANY FACTORS...



WHY SHOULD WE CARE?



Climate change is an opportunity!

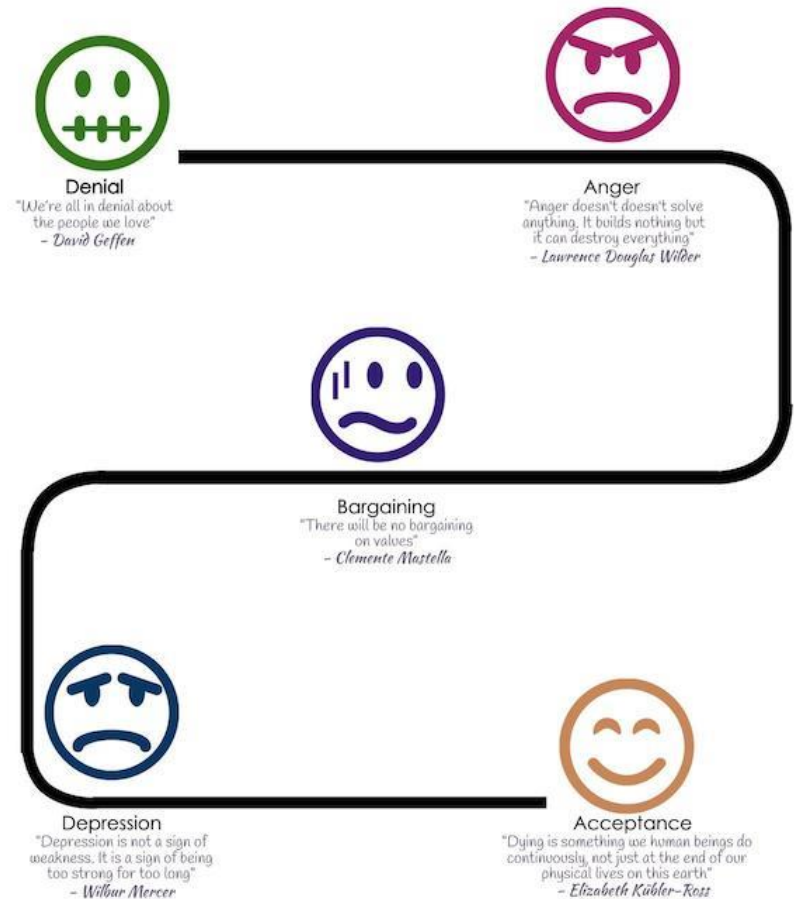
THE HUMAN ELEMENT...

- DENIAL
- ANGER
- BARGAINING ←
- DEPRESSION
- ACCEPTANCE

5 Stages of Grief

by eClosure

Kübler-Ross Theory



FOR FURTHER EXPLORATION

- TOWARD A CLIMATE-READY PHILADELPHIA:

<https://beta.phila.gov/media/20160504162056/Growing-Stronger-Toward-a-Climate-Ready-Philadelphia.pdf>

- CAPE MAY STUDY – VULNERABILITY TO SEA LEVEL RISE:

<http://www.int-res.com/articles/cr2002/22/c022p255.pdf>

- NJADAPT: A PROJECT FOR NJ CLIMATE CHANGE RESILIENCE:

<http://www.njadapt.org/home.html>

- CLIMATE CHANGE IMPACTS AND RESPONSES FROM NJADAPT:

<http://njadapt.rutgers.edu/resources/videos/new-jersey-and-climate-change-impacts-and-responses>



Any Questions?

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