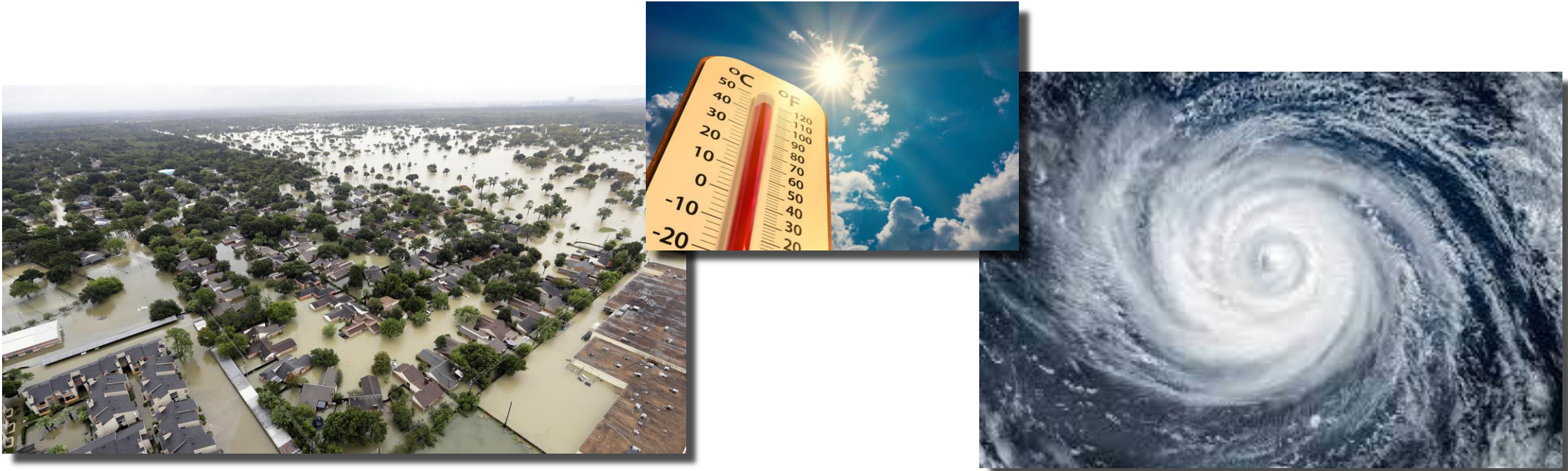


Climate, Climate Change and Extreme Weather: What Does Our Future Hold?



Warren Burggren
University Distinguished Research Professor
Department of Biological Sciences
University of North Texas



THIS TALK

- What is 'Climate'?
- What is 'Climate Change'?
- What Causes Climate Change?
- Climate vs. 'Weather'
- Actions That Can Be Taken



Ask Questions!

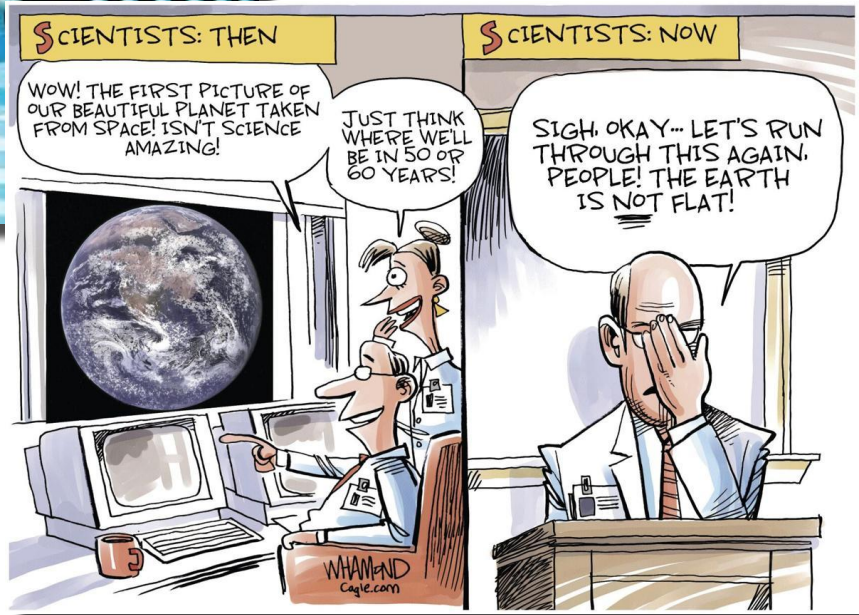


I'm not a Guru!!

or a White Knight!!!!



I AM a Scientist - Tough time for scientists



Science
and
Anti-



Are ALL Scientists Ethical/Competent/Honest?

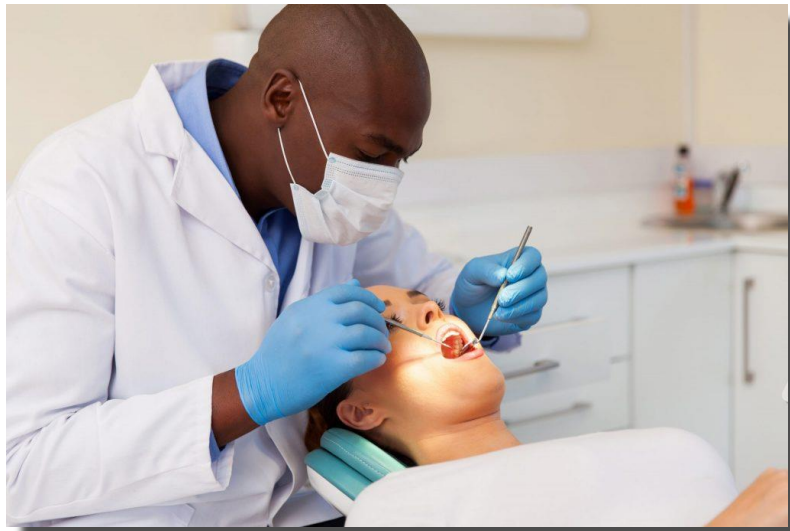
Not 100%, but.....

PRESS RELEASE

Grafton Dentist Sentenced to 54 months' imprisonment and ordered to pay over \$1 million in forfeiture

CRIME

Dentist Accused of Poisoning Wife Allegedly Drugged Her Years Ago, Had Pornography Addiction



Yet, we still trust our Dentist, don't we???

So let's trust our Scientists!!

My Goal is to Stimulate Thought and Educate,
Not Preach or Scare



A little bit about me....

A little bit about me.... NOT a “Climatologist”



NOT a “Tree Hugger”



I AM an Environmental Biologist!



Studying Fishes Involves

Laboratory work



Field Work



Studying Fishes Involves....

...CATCHING Fishes!



AHORA LA PESCA ES PARA TODOS

OUTDOOR BANDITS

Outdoor Bandits, una línea de artículos de equipamiento de pesca deportiva que desde el 2016, buscando desarrollar la pesca en Tabasco a través de la promoción de artículos y tours de pesca deportiva y recreativa. Los mejores precios y servicio al cliente. Su personal capacitado y experto en el ramo, ofrece y desarrolla para el turista de pesca en agua dulce y agua salada, con la finalidad de hacer que todos disfruten en una actividad y recreación saludable para compartir con la familia y amigos.

LAS MEJORES Y MÁS NUEVAS EMBARCACIONES

SALT WATER

OUTDOOR BANDITS

EN OUTDOOR BANDITS ENCUENTRAS:

- Boat
- Motor
- Life Jacket
- Snorkel
- Wetsuit
- Life Ring
- First Aid Kit
- Map
- Compass
- Binoculars
- Anchor
- Flotation Device
- Whistle
- Signal Flares
- Fire Extinguisher
- Tool Kit
- First Aid Kit
- Map
- Compass
- Binoculars
- Anchor
- Flotation Device
- Whistle
- Signal Flares
- Fire Extinguisher
- Tool Kit

Visita nuestra página para ver las ofertas.
TOURS EN MAR ABIERTO, RÍOS O LAGUNAS.
www.outdoorbandits.com

Puerto Villahermosa, entre el 310
Cuarto Intersección Calles
Paseo del Comercio #325
Municipio de Villahermosa, Tabasco

(993) 316 9680

Chavez Torres
@chavez_torres

Equipo de primera a la Vanguardia

Muestras instalaciones cuentan con todo el equipo necesario para la pesca deportiva y personal altamente capacitado.

El mejor equipo para el pescador

El mejor equipo para el pescador

El mejor equipo para el pescador

My Journey as a Biologist Started in Canada....



...and Has Taken Me All Over the World



Physiology – how they work!

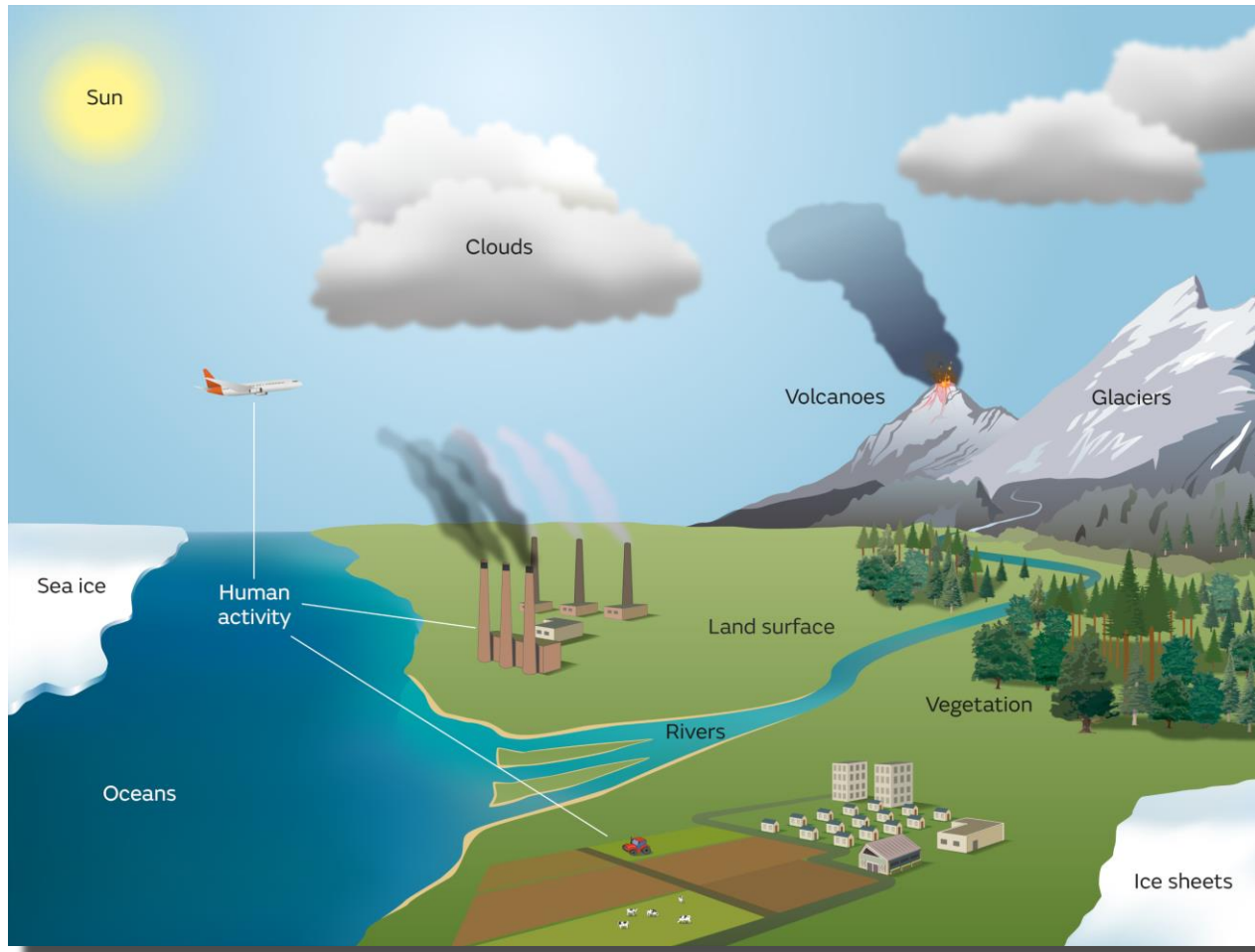


Organisms *stop working!*

So Why Do I Care About Climate Change??

WHAT IS 'CLIMATE'?

Definition of 'Climate'

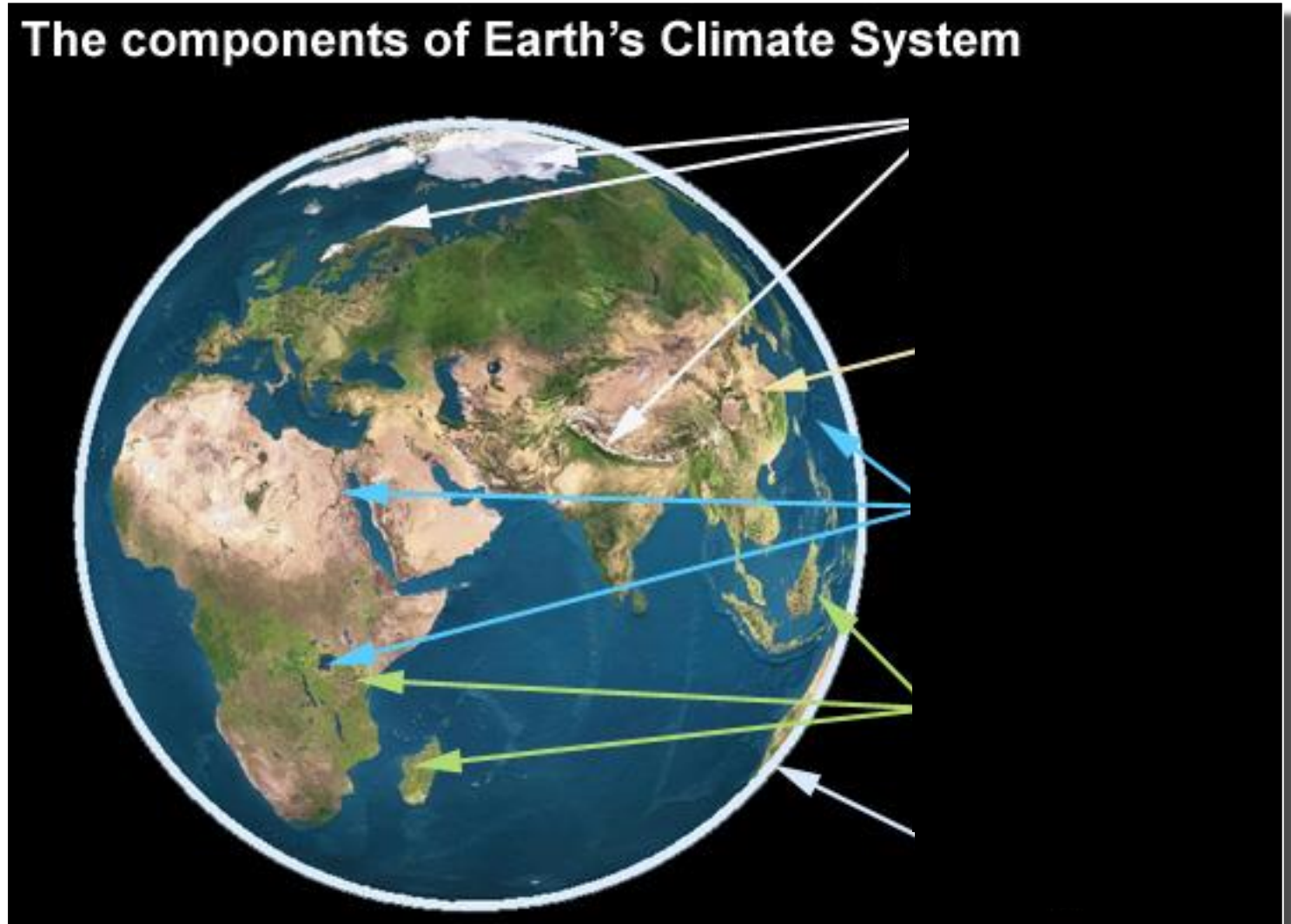


UK Met Office

- *Climate* is the **general weather over a long period**.
- Includes rainfall, temperature, snow or any other weather condition.
- Region's climate defined over of 30 year period.

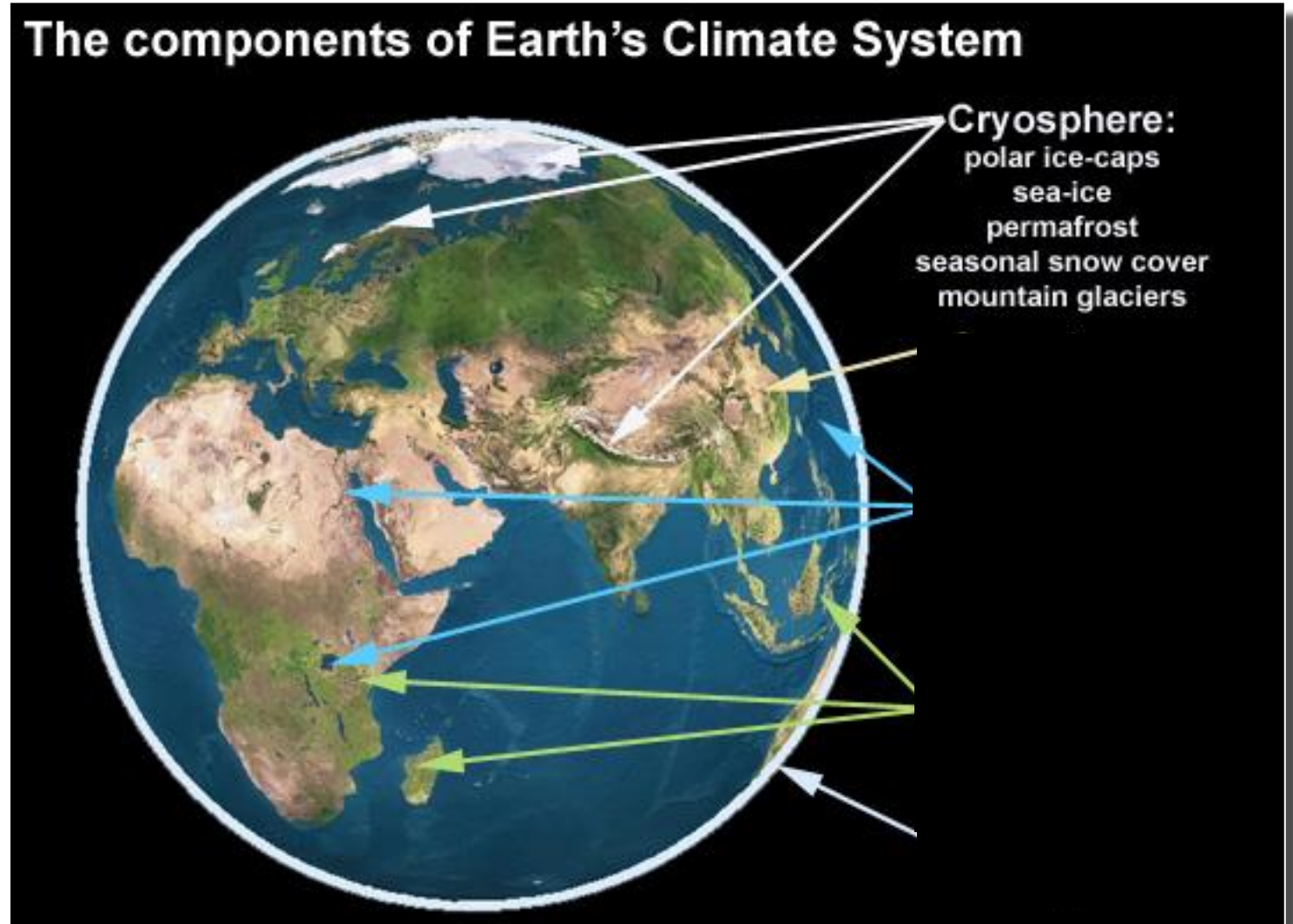
Components of Global 'Climate' System

- 5 Components

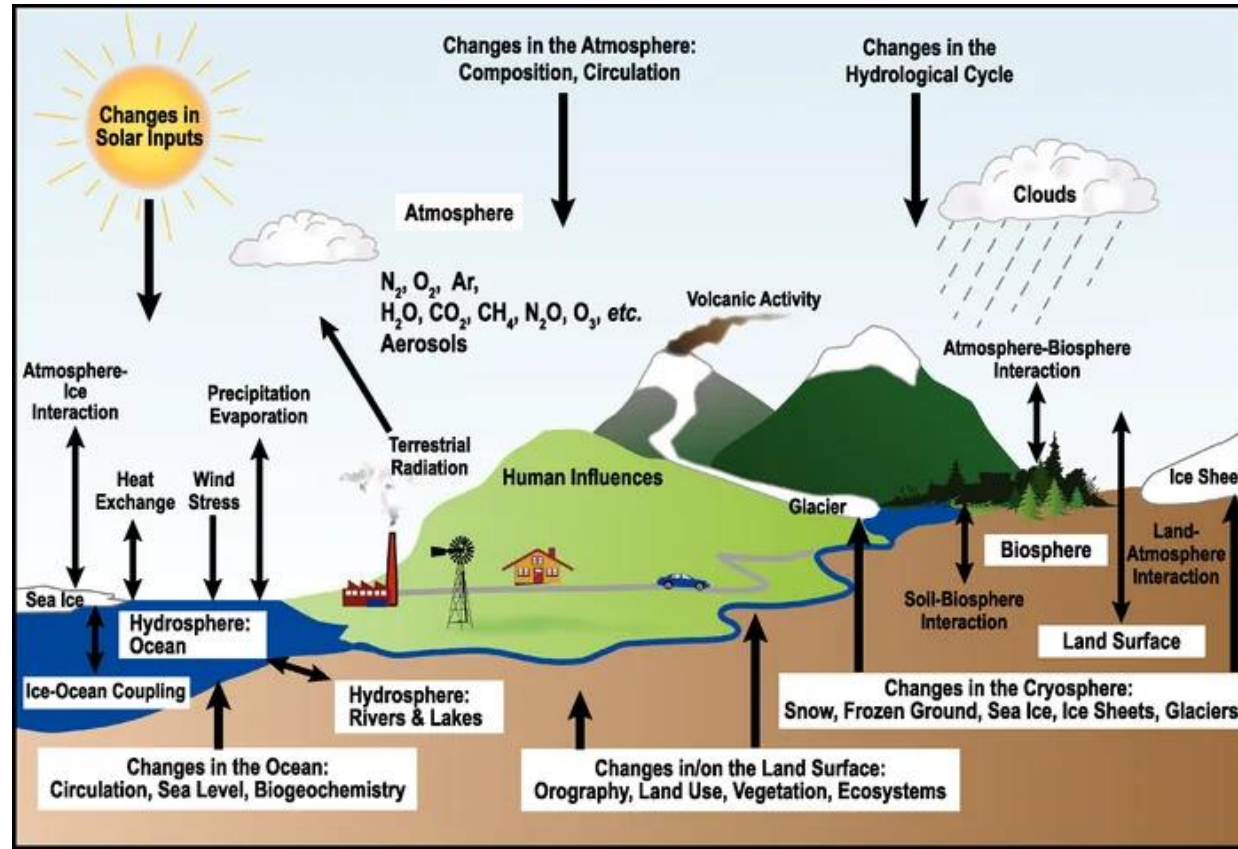


Components of Global 'Climate' System

- 5 Components



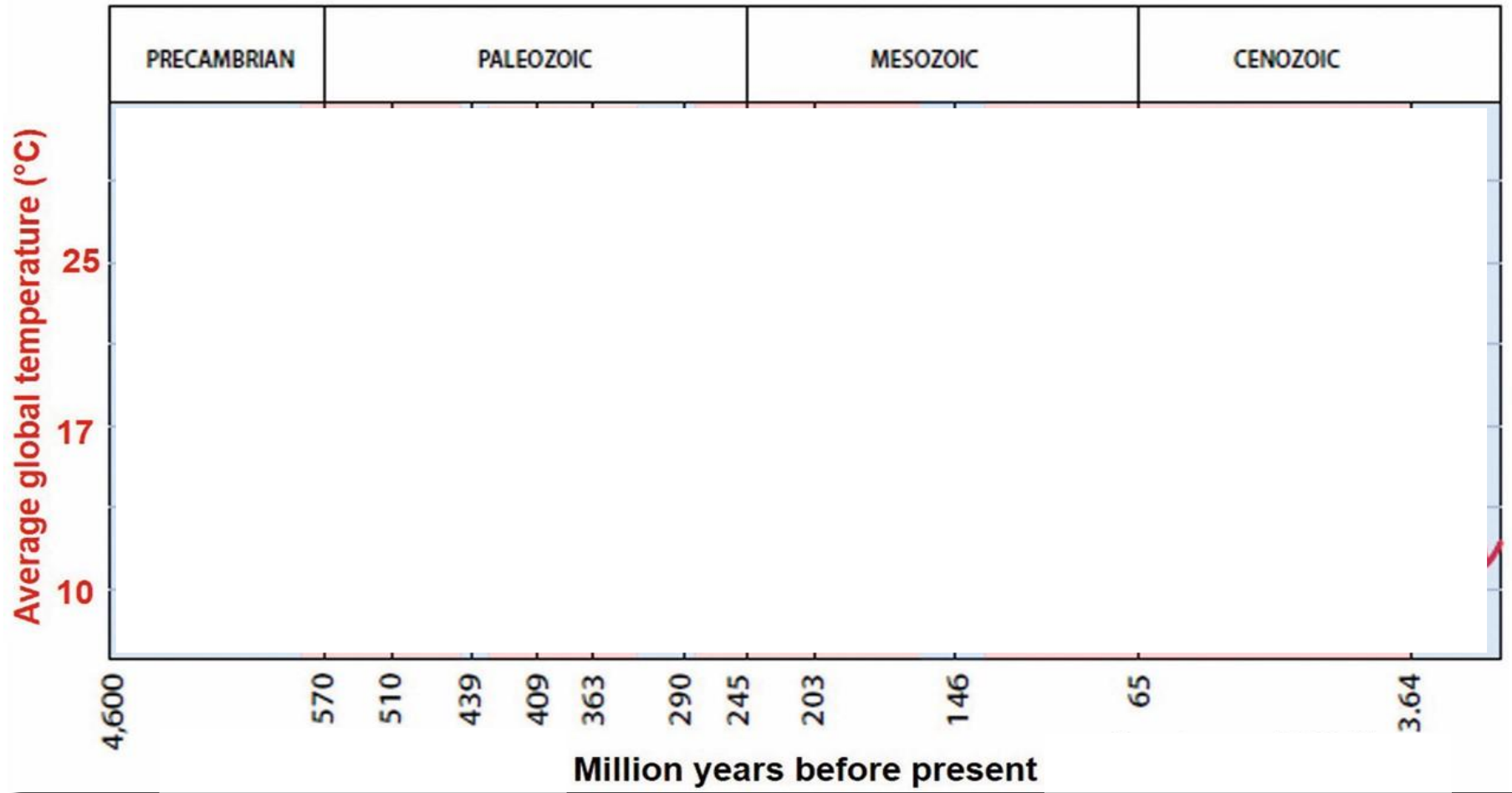
Would That 'Climate' Be So Simple....



- Highly complex interactions
- Not fully understood!

WHAT IS CLIMATE CHANGE AND WHAT CAUSES IT?

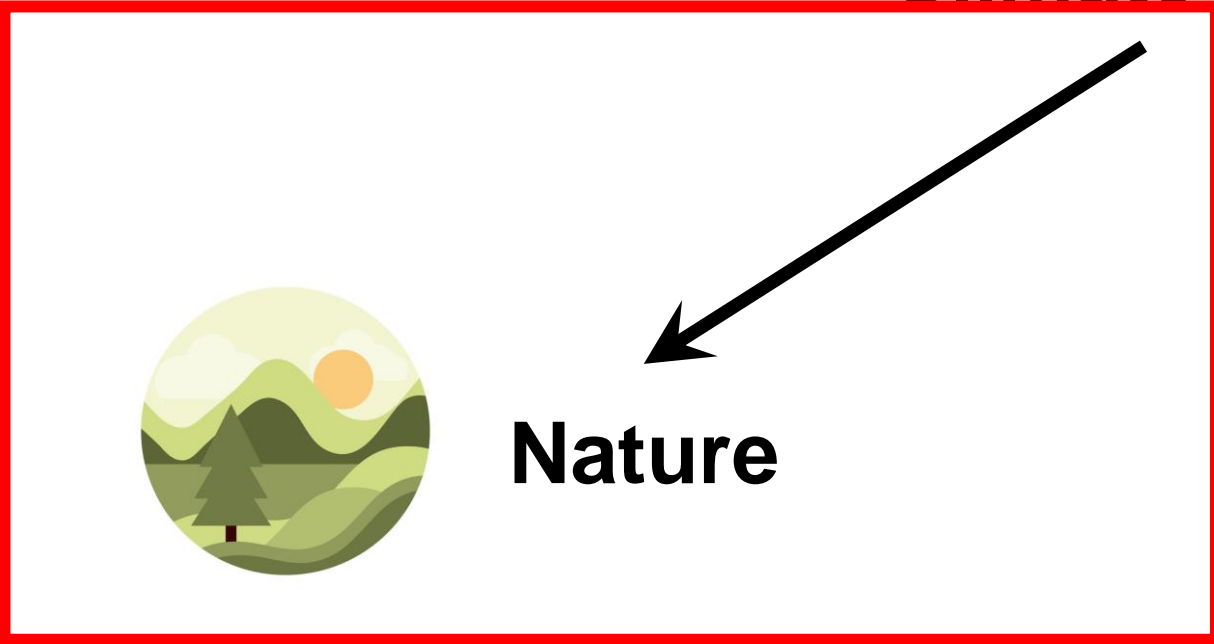
We've Always had 'Climate Change'



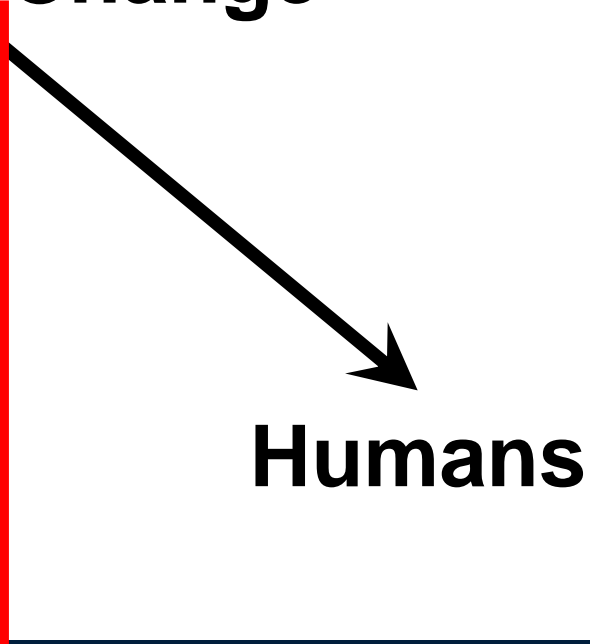
Climate Change Has Many Causes



Climate Change

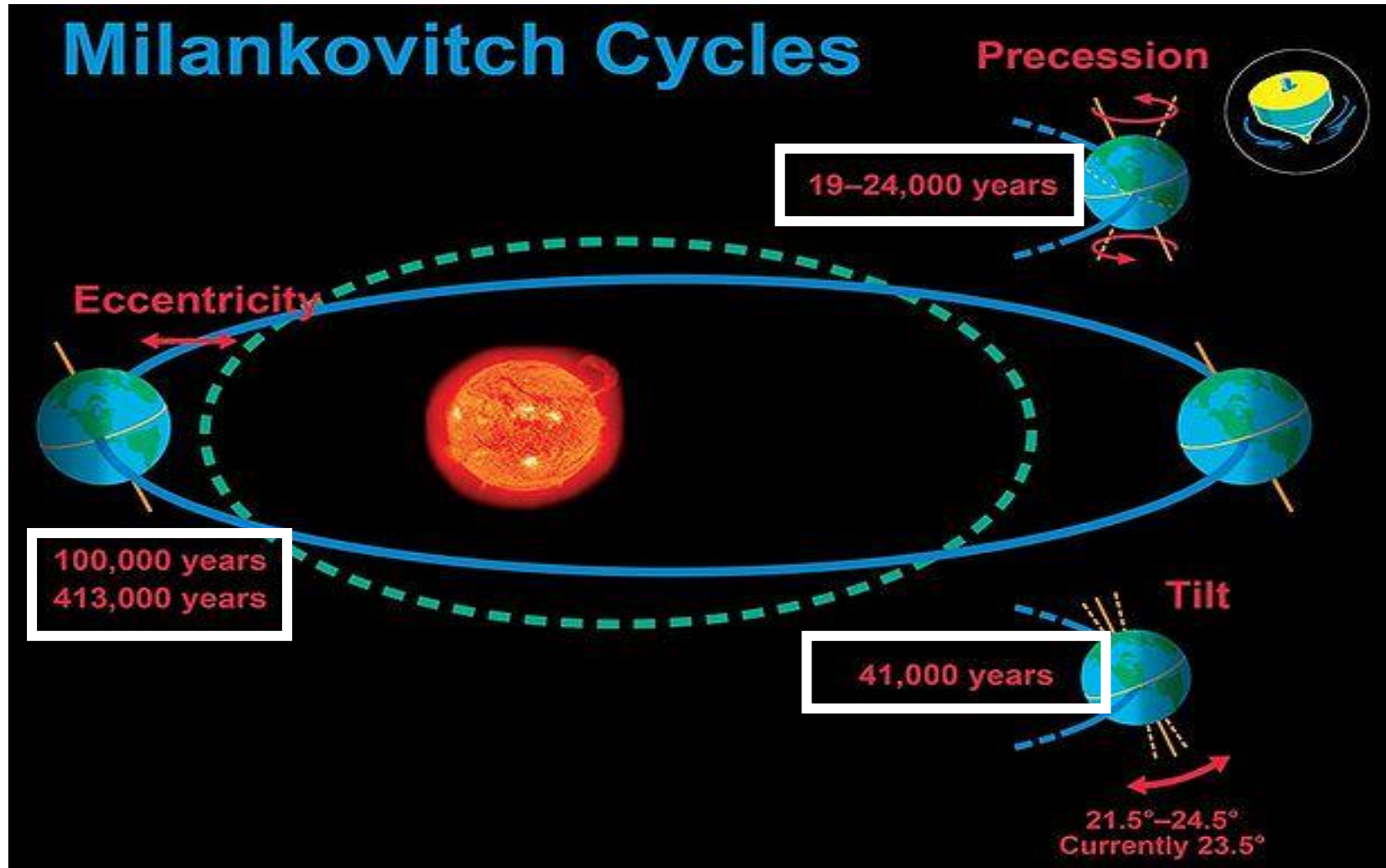


Nature

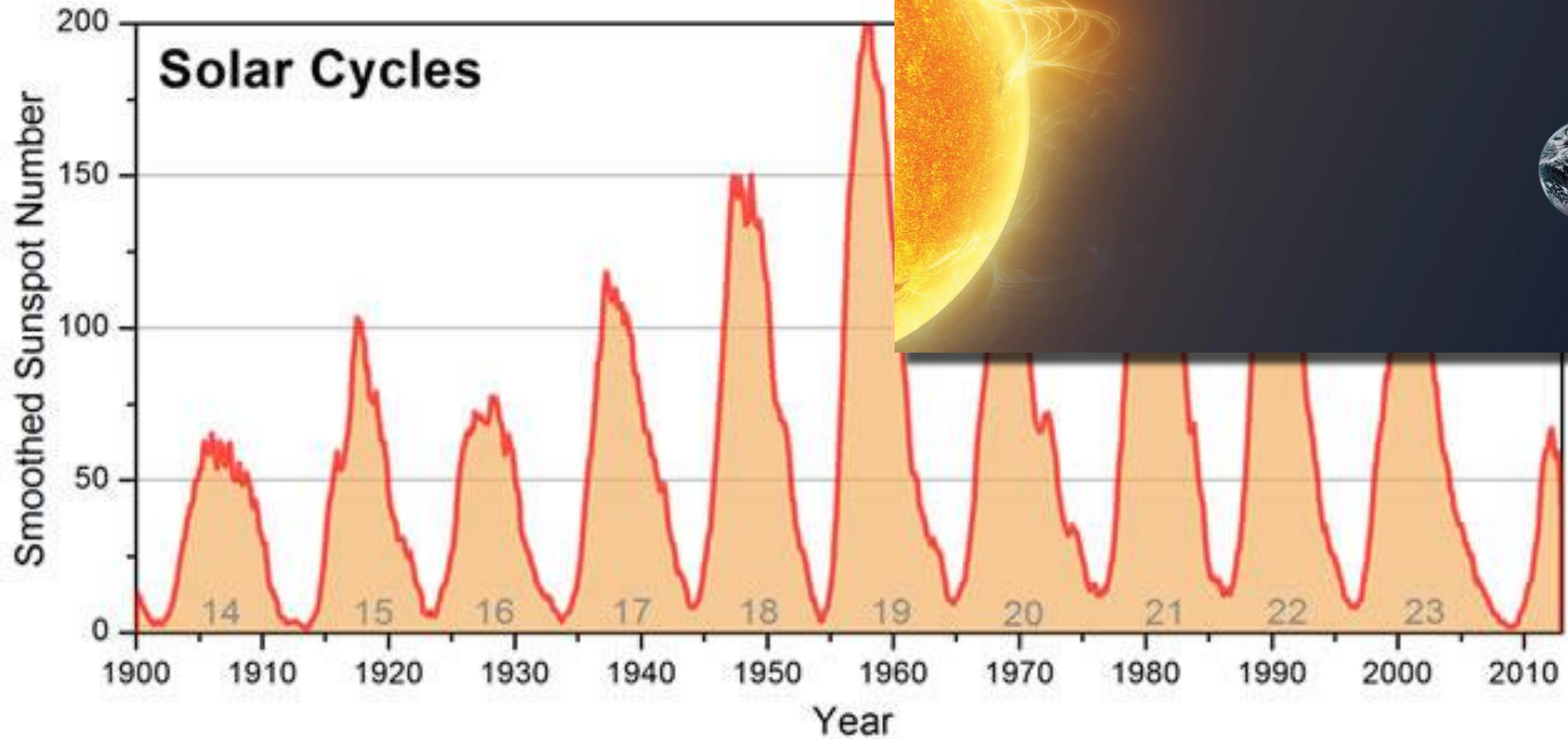
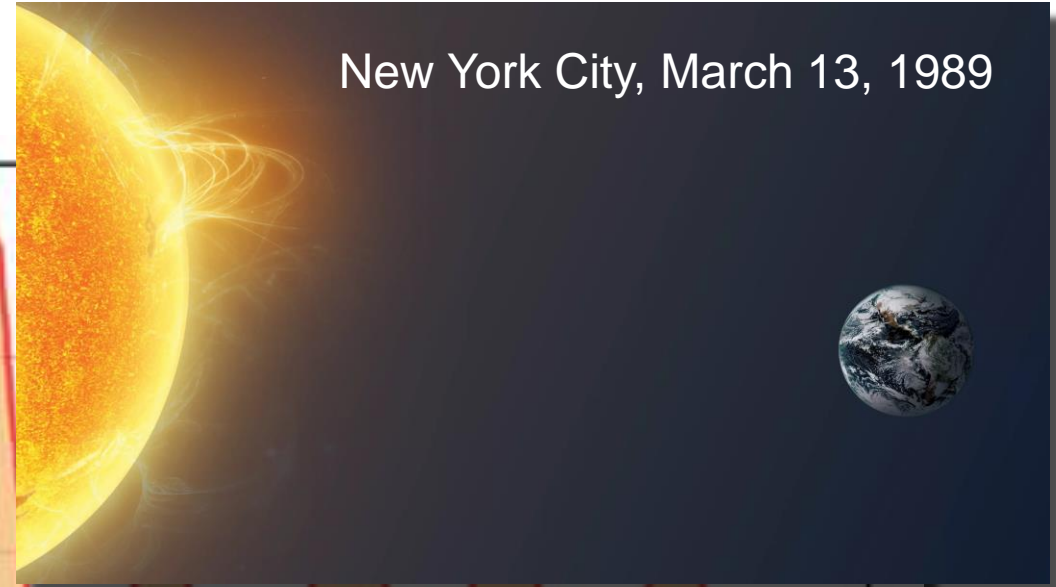


Humans

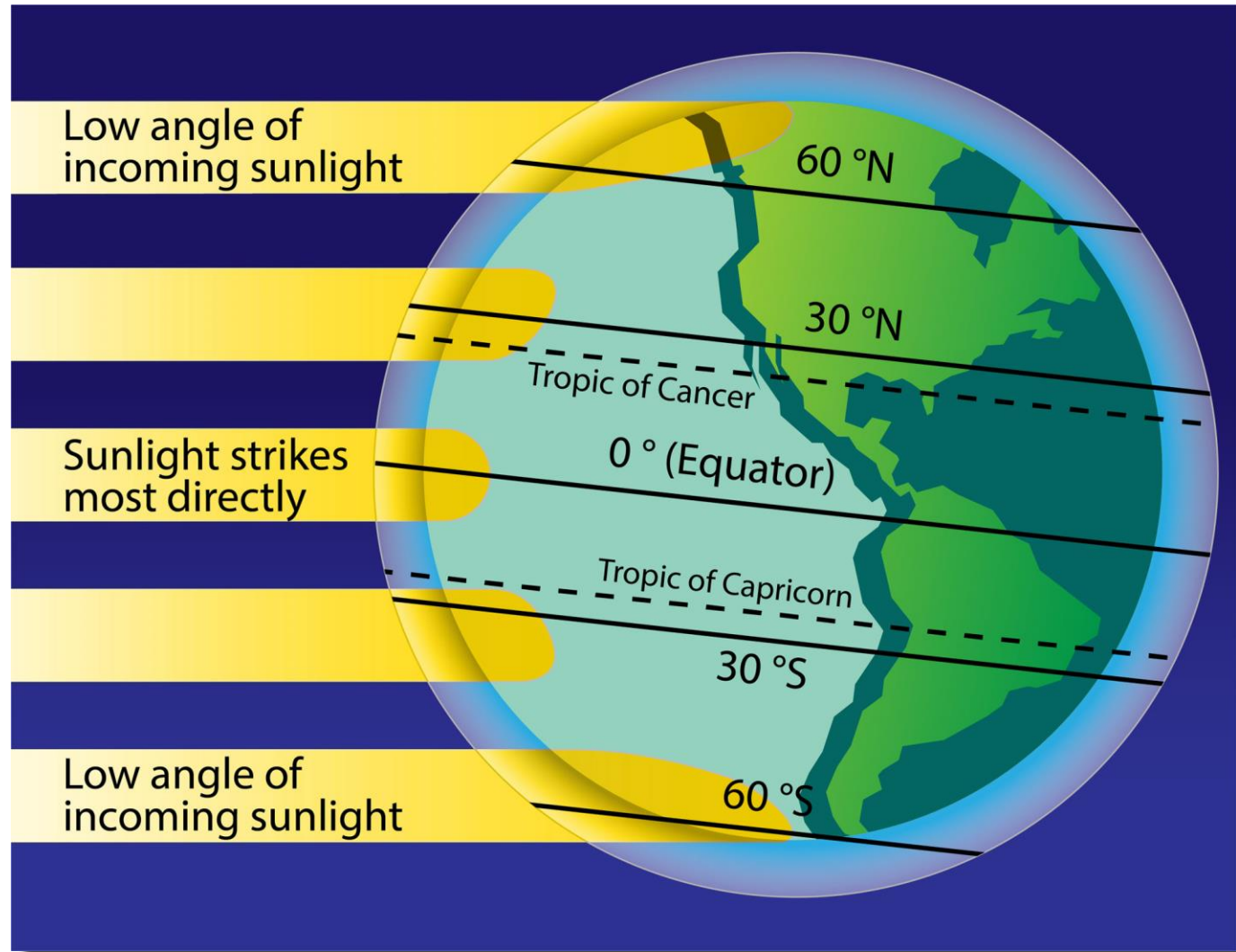
Changes in the Earth's Orbit and Rotation



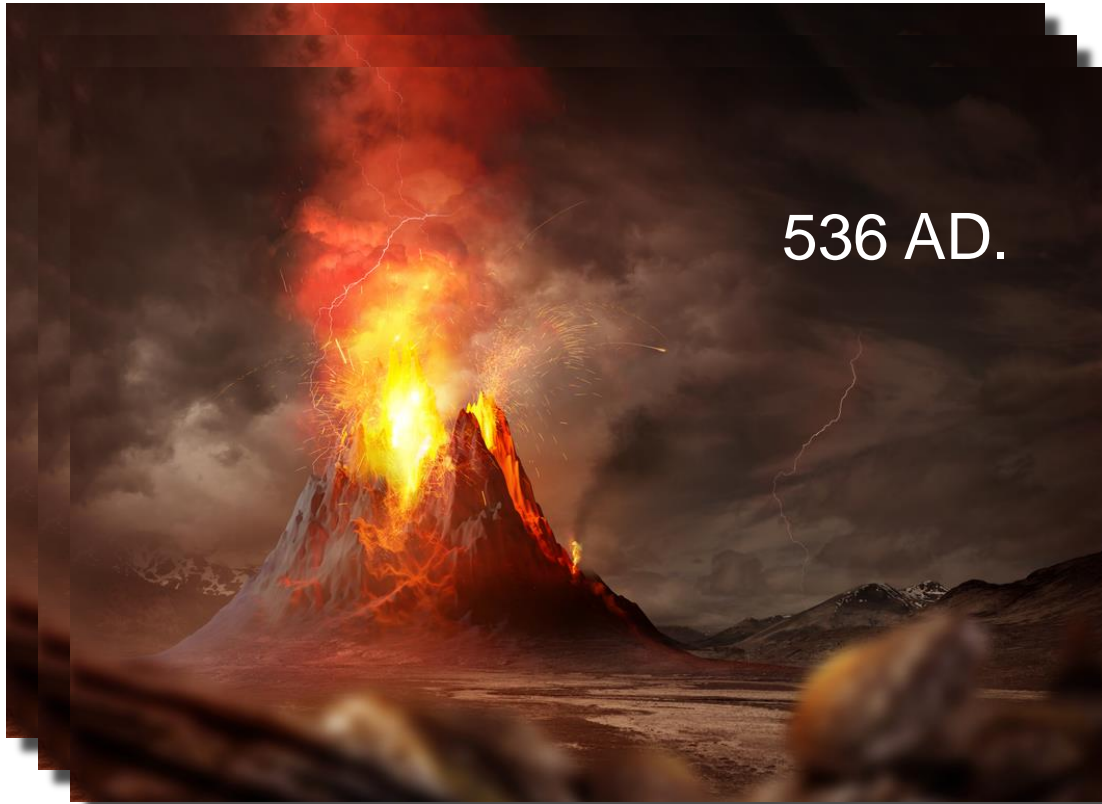
Variations in Solar Activity



Changes in the Earth's Reflectivity

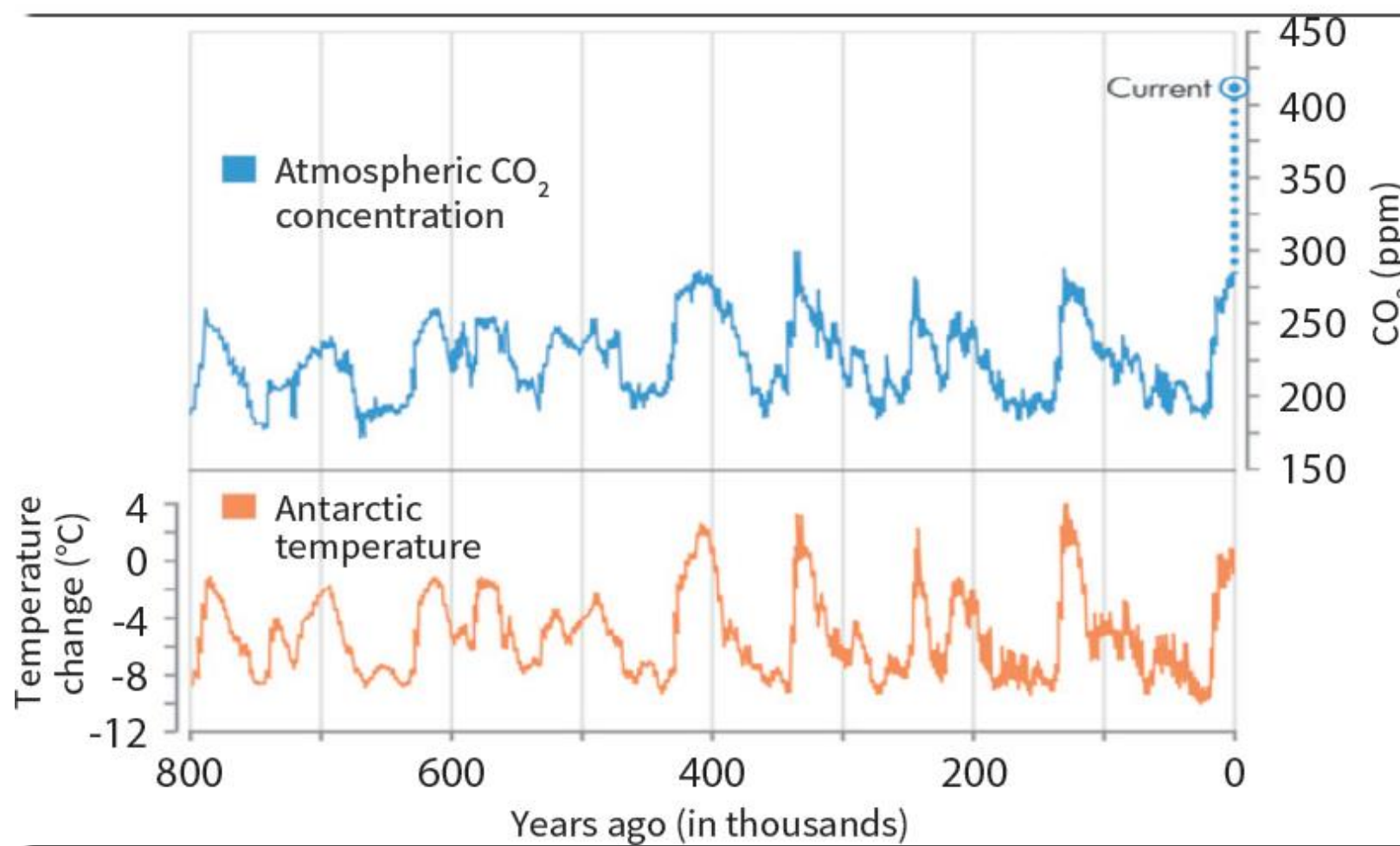


Volcanic Activity



- Ancient Roman scholar Cassiodorus reported “*a winter without storms, spring without mildness, and summer without heat.*”
- Procopius wrote “*the sun gave forth its light without brightness...like the sun in eclipse.*”
- 12th-century scholar Michael the Syrian said that “*the sun shone feebly for a year and a half.*”
- Others described lower temperatures, harvest failure, famine, and disease from Europe to the Middle East.

Naturally Occurring Changes in Carbon Dioxide Concentrations



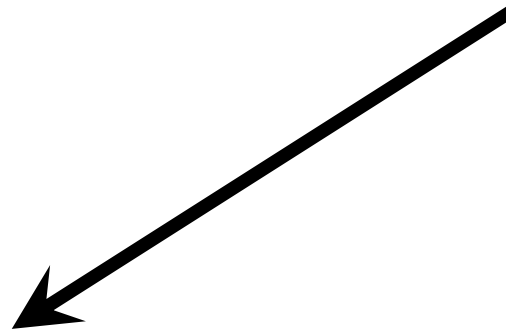
Climate Change Has Many Natural Causes



Climate Change



Nature



**Whew!
Not our fault!!**

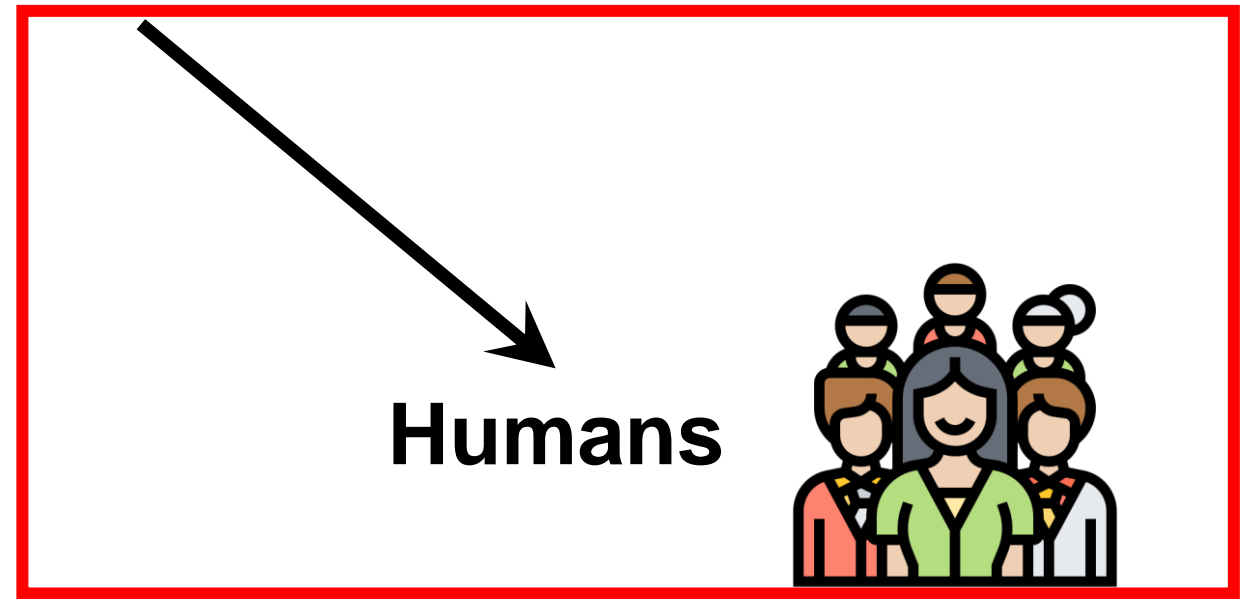
Climate Change Has Many 'Culprits'



Not so fast!!



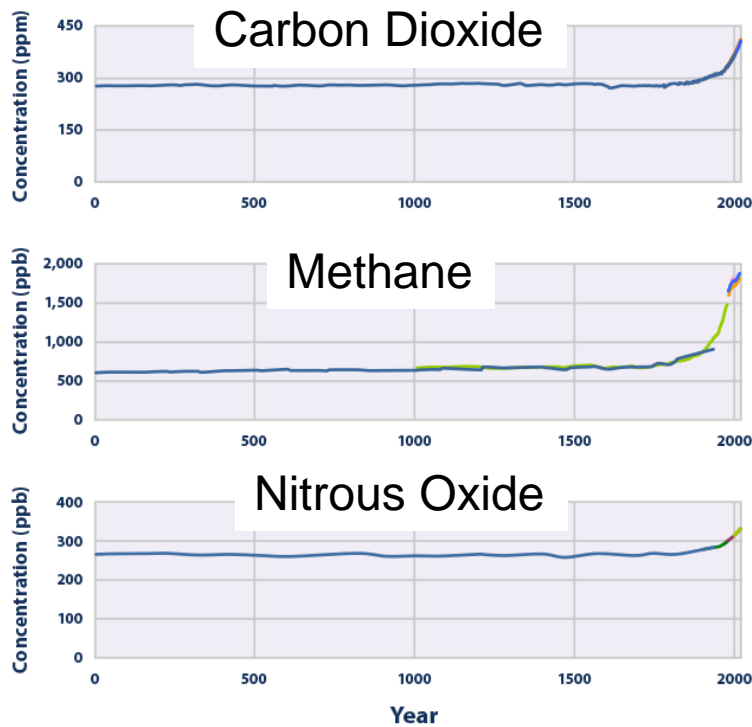
Climate Change



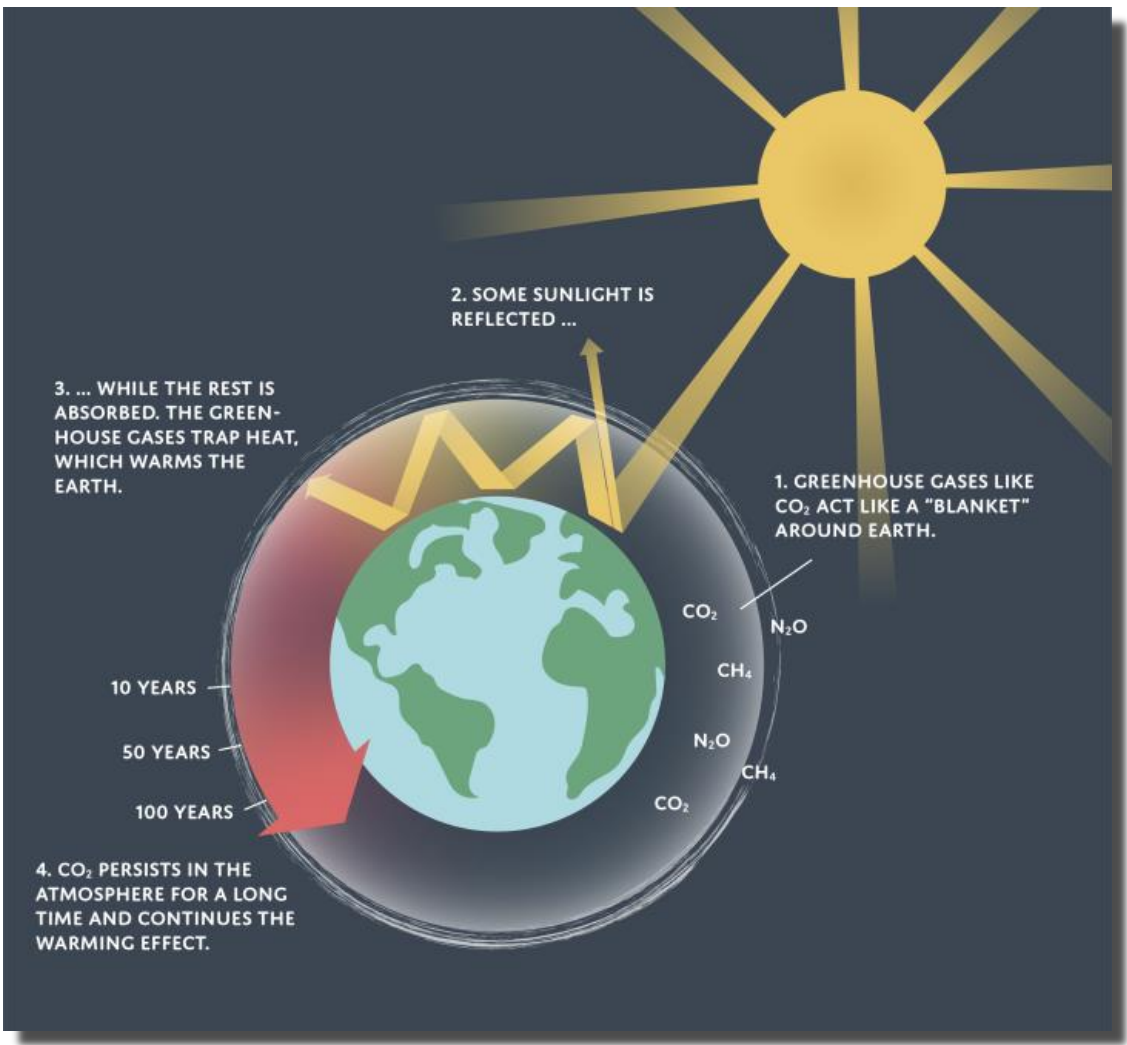
Greenhouse Gas Emissions

“Greenhouse Gases = gases that trap Earth’s heat, rather than let it escape to Space

Global Atmospheric Greenhouse Gas Concentrations Over Time

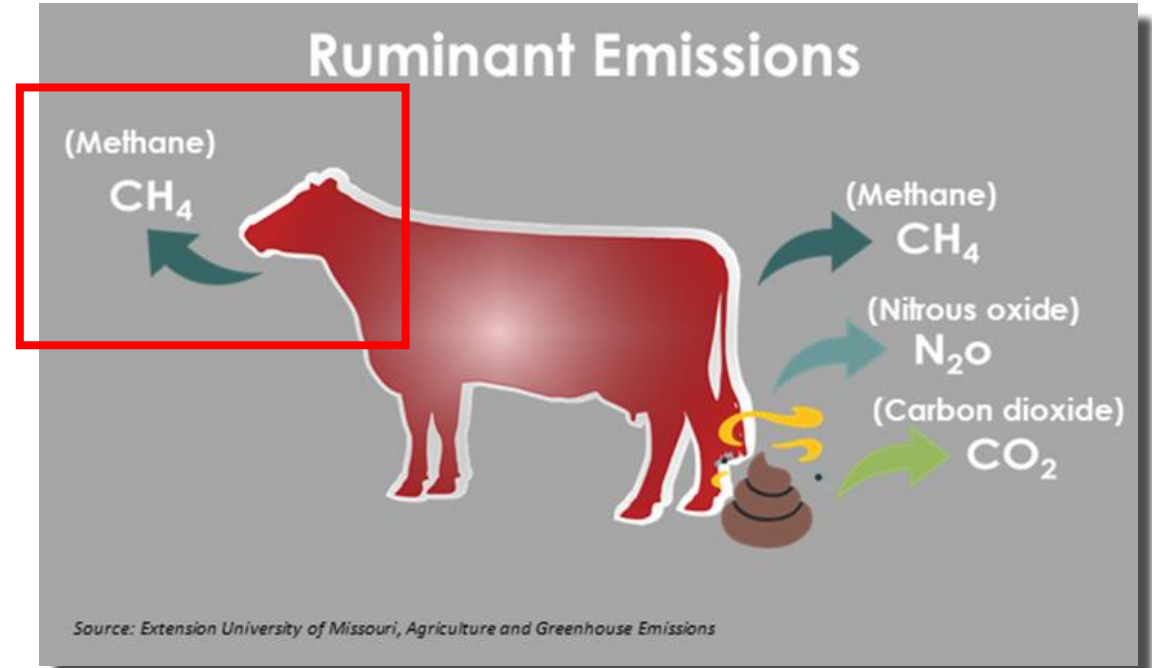
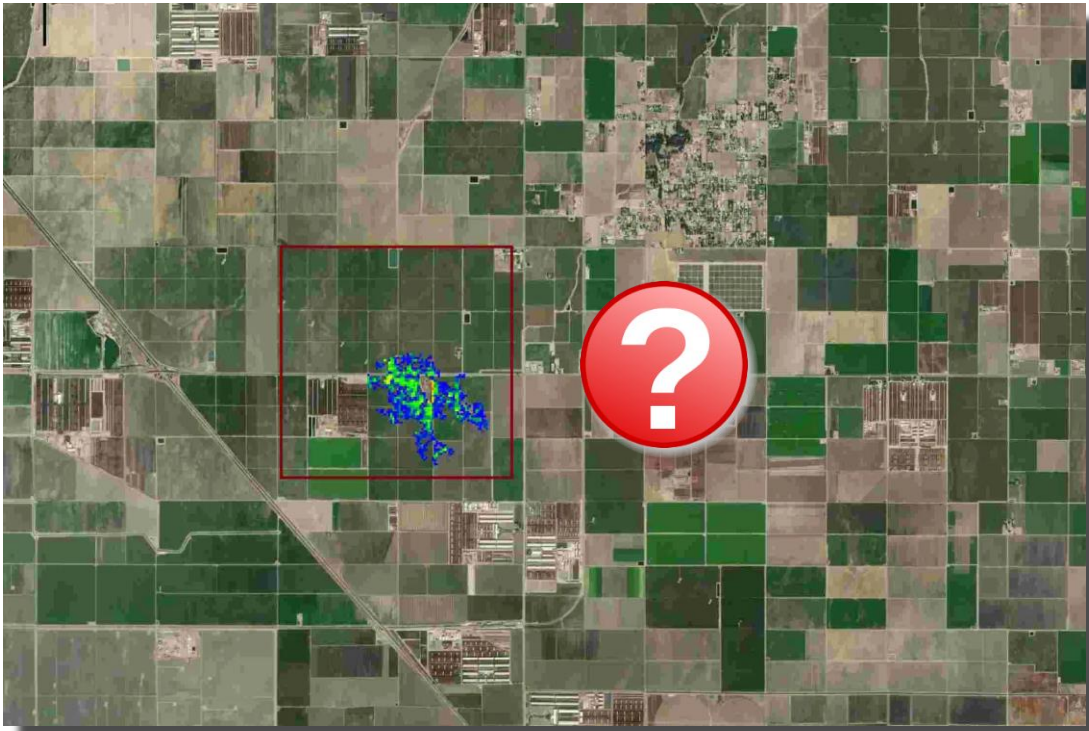


Greenhouse Gas Effect



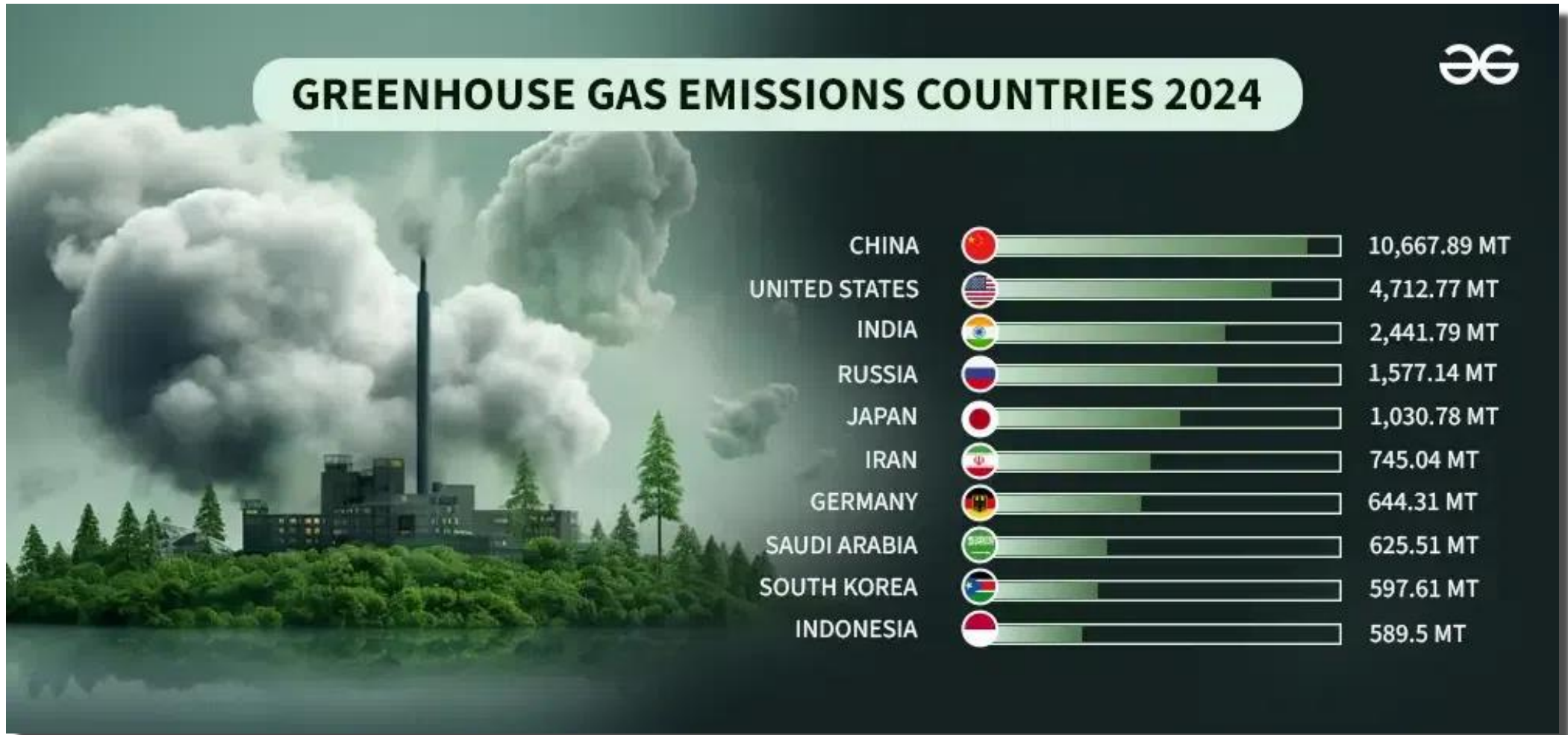
Greenhouse Gas Emissions

Unusual 'Suspects'....

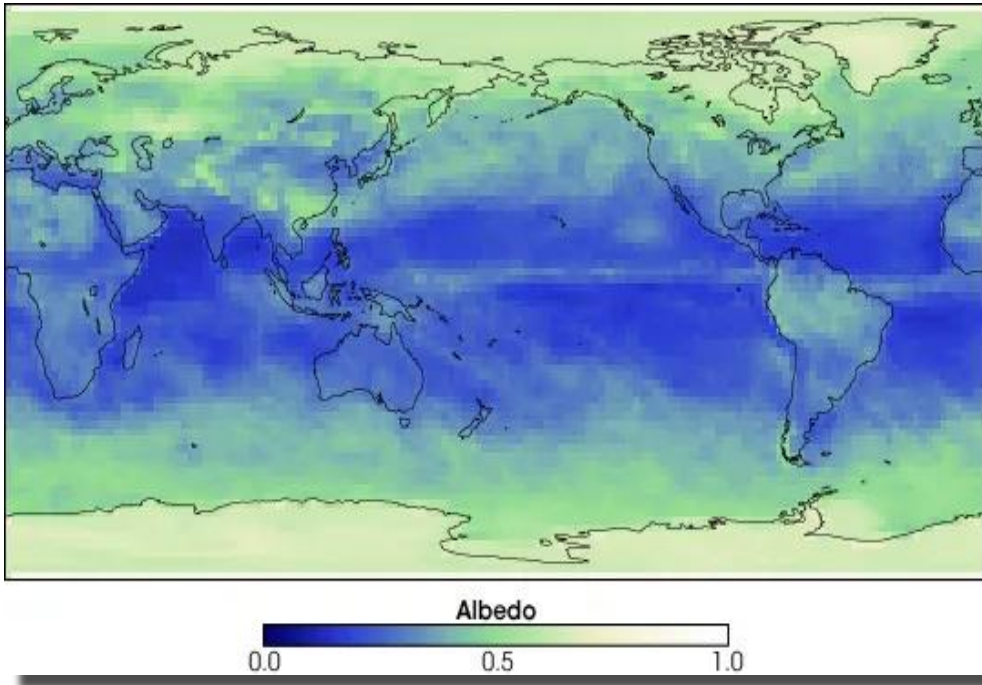


Cattle = #1 Methane Producer in the US!! – 10%!!

Greenhouse Gas Emissions



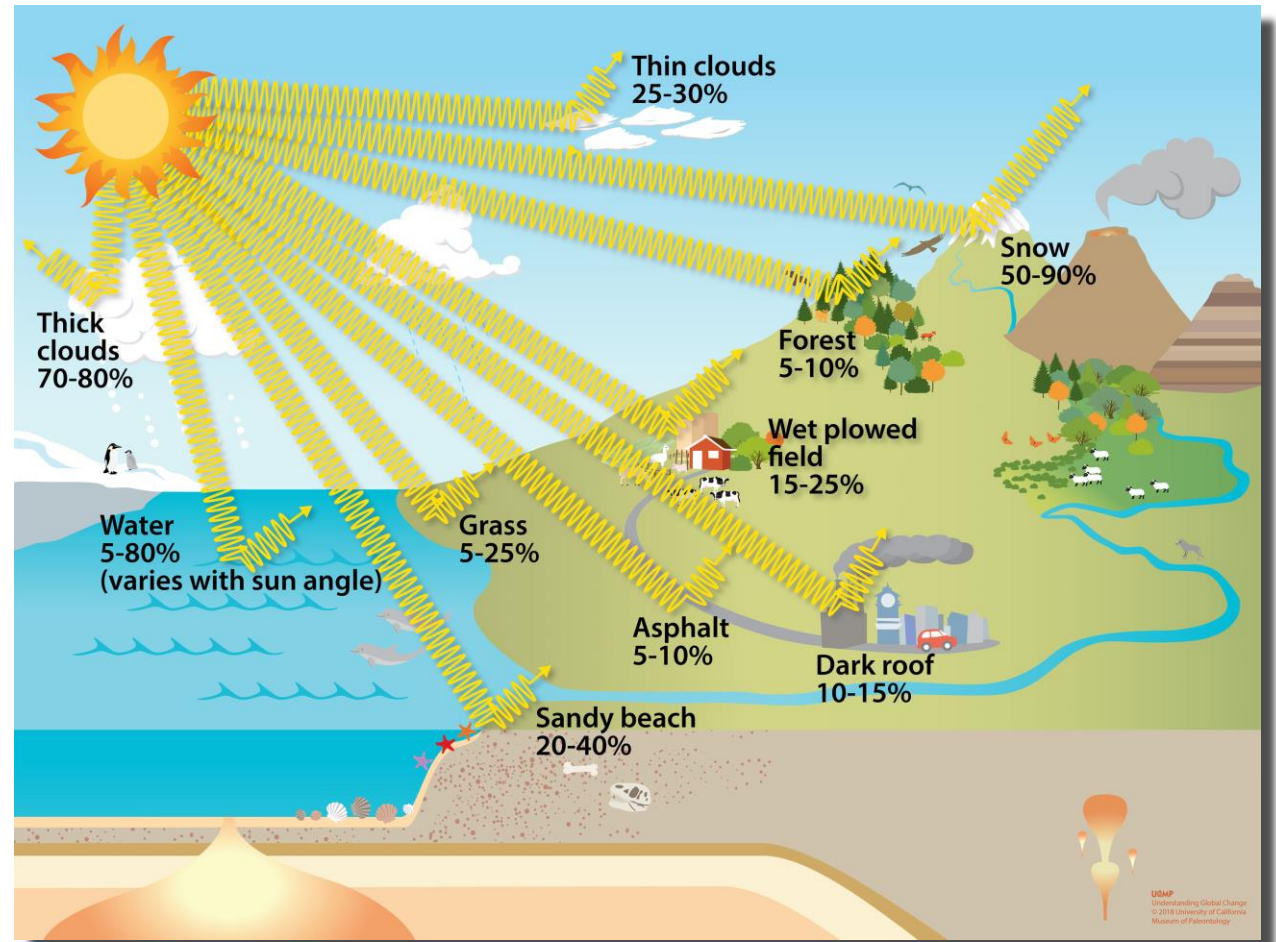
Reflectivity ('Albedo')



Low Reflectivity

High Reflectivity

Depends on angle of Sun's rays!

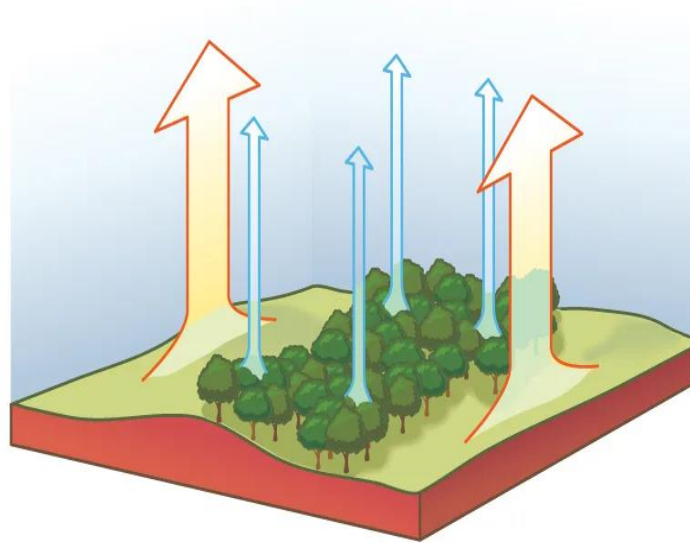


Land Use Changes

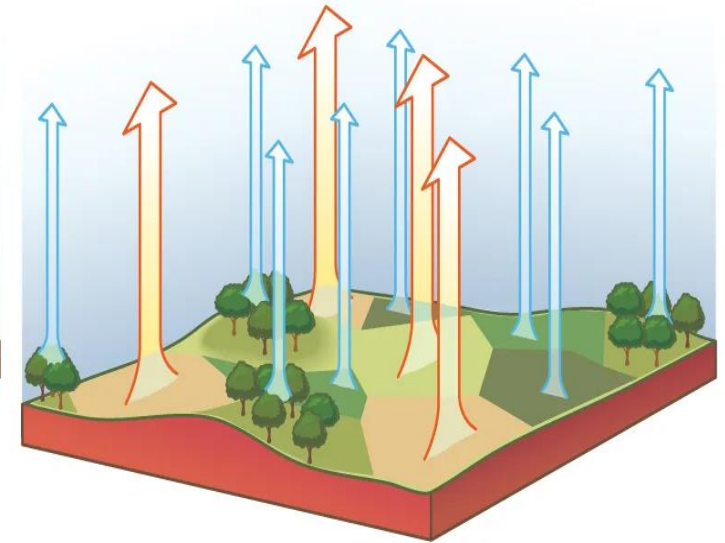
Human-driven changes in land use and land cover: deforestation, urbanization, and shifts in vegetation patterns



Pre-agricultural landscape



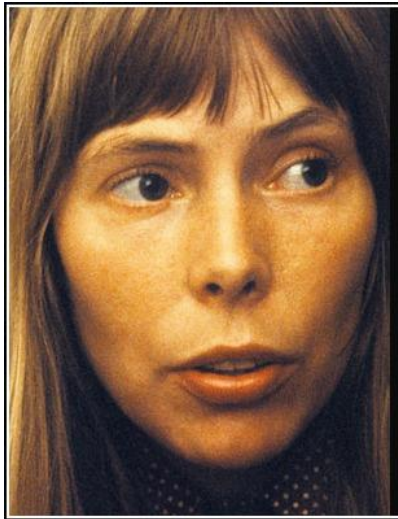
Modern agricultural landscape



- ⇨ Land cover with lower surface albedo
- ⇨ Land cover with higher surface albedo

© Encyclopædia Britannica, Inc.

Land Use Changes



They paved paradise and put up a parking lot.

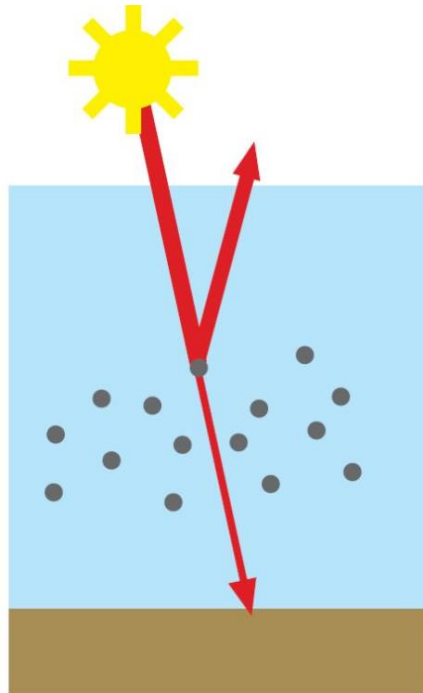
— *Joni Mitchell* —

AZ QUOTES

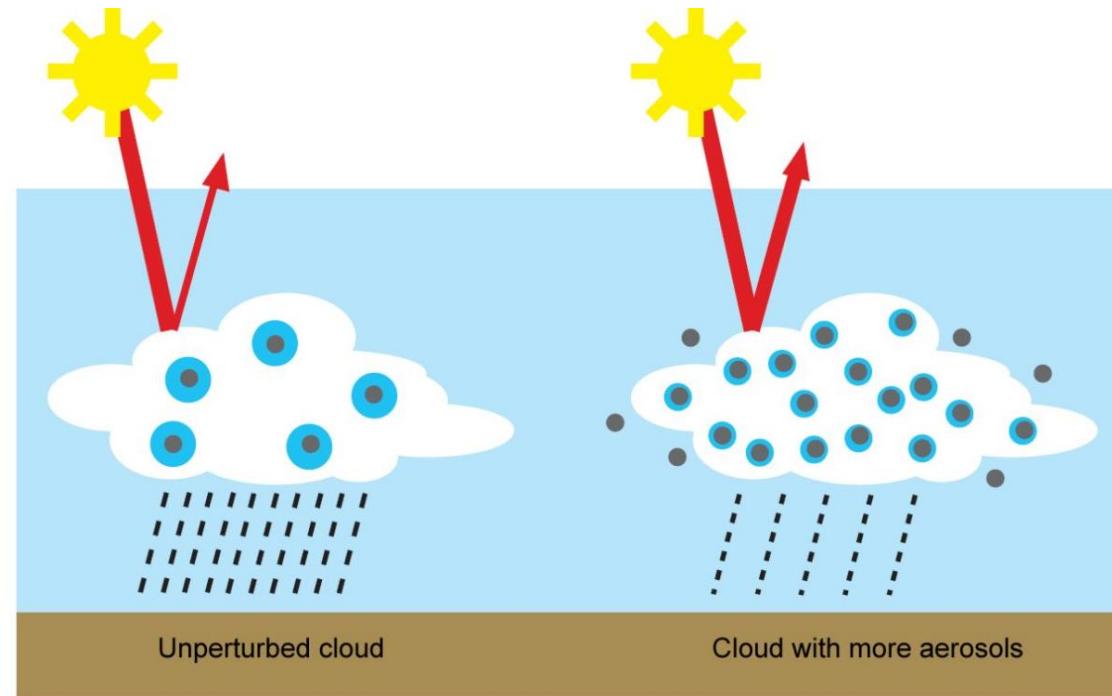


Aerosols and Other Pollutants

Atmospheric aerosols containing sulfur compounds, organic compounds, and black carbon - both warming and cooling effects on climate.



Aerosol direct effect
Scattering and absorption
of solar radiation



Unperturbed cloud

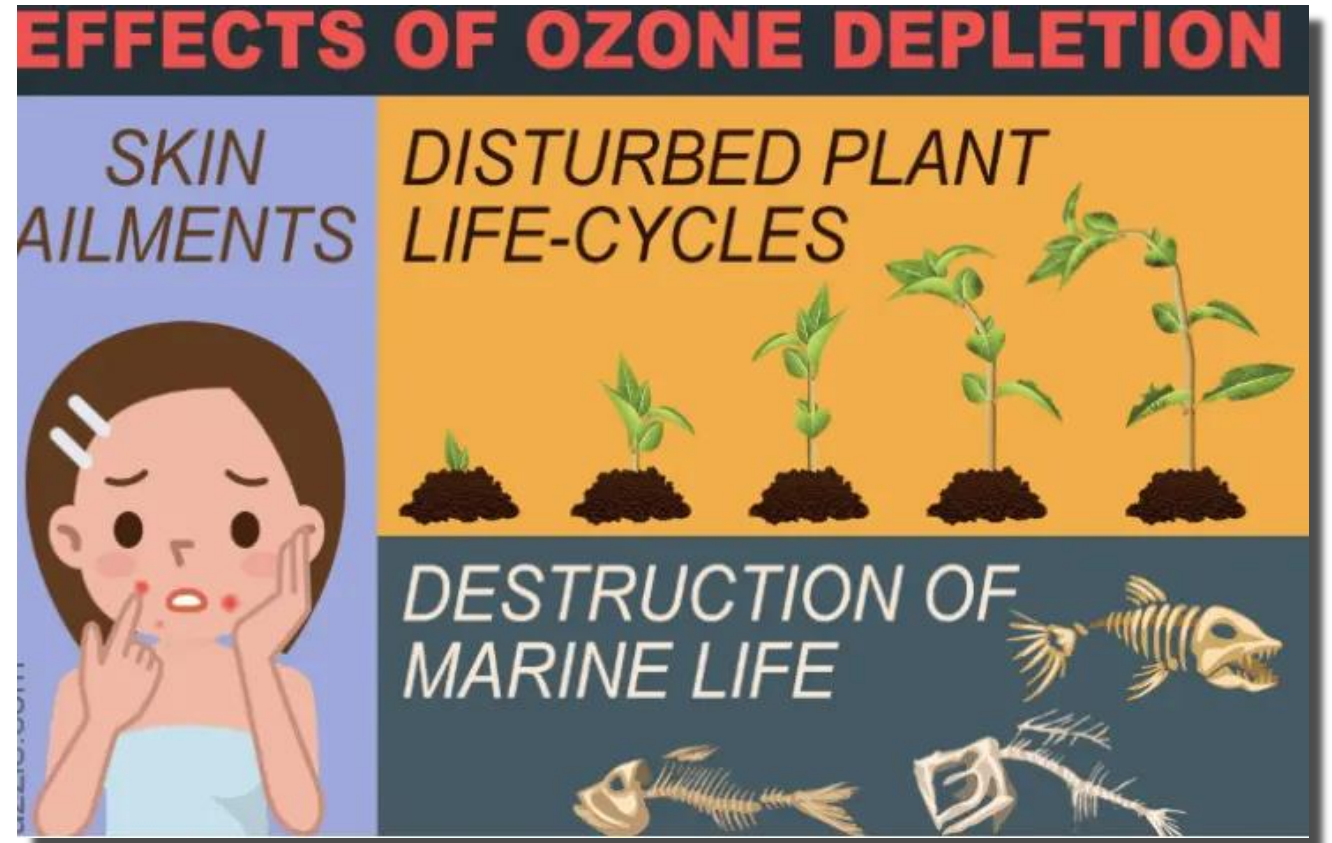
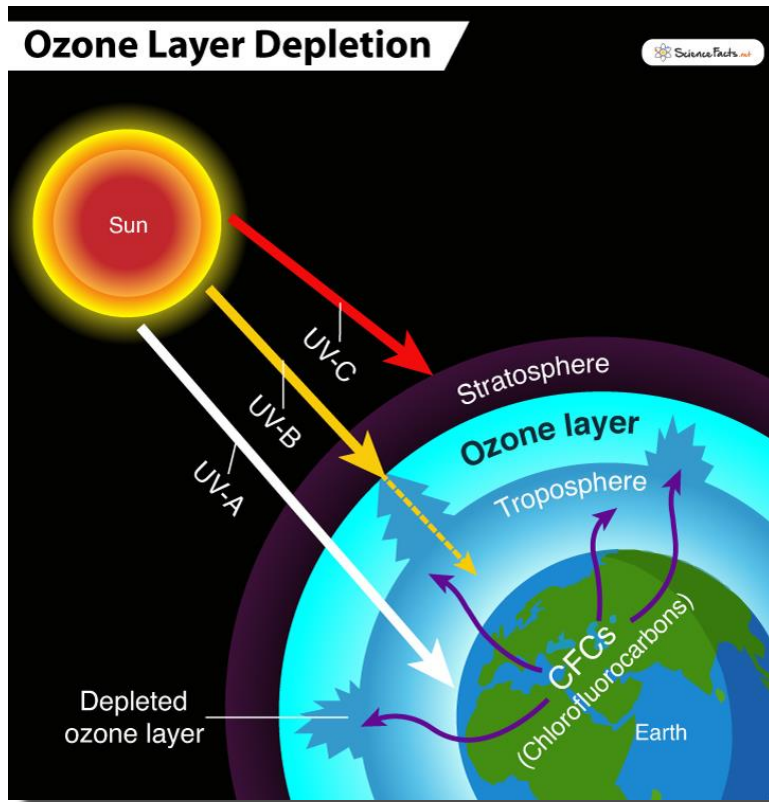
Cloud with more aerosols

Aerosol indirect effect

Decrease of cloud droplet size, increase of droplet number,
increased scattering of solar radiation, decrease of precipitation

Ozone Depletion

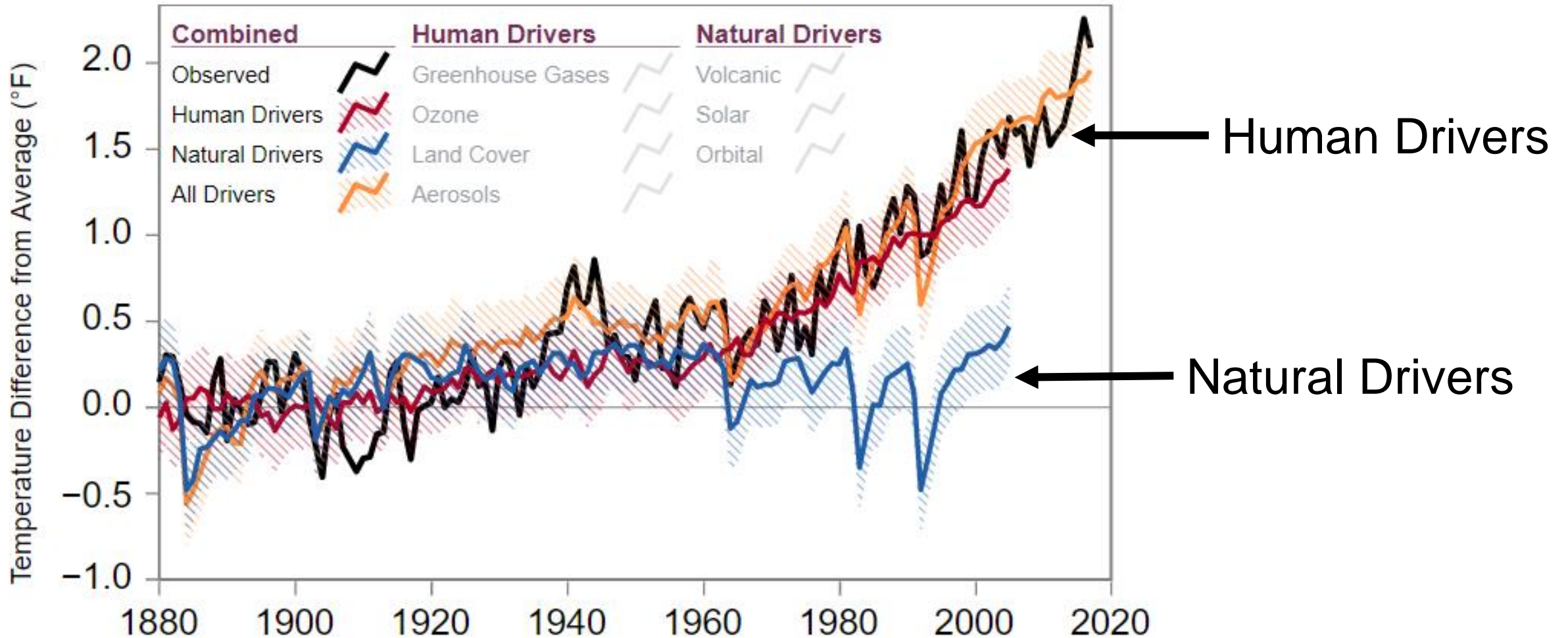
Human-produced halocarbon gases, like chlorofluorocarbons (CFCs), cause depletion of ozone layer in stratosphere, which protects Earth from harmful ultraviolet radiation.



Human and Natural Influences on Global Temperature

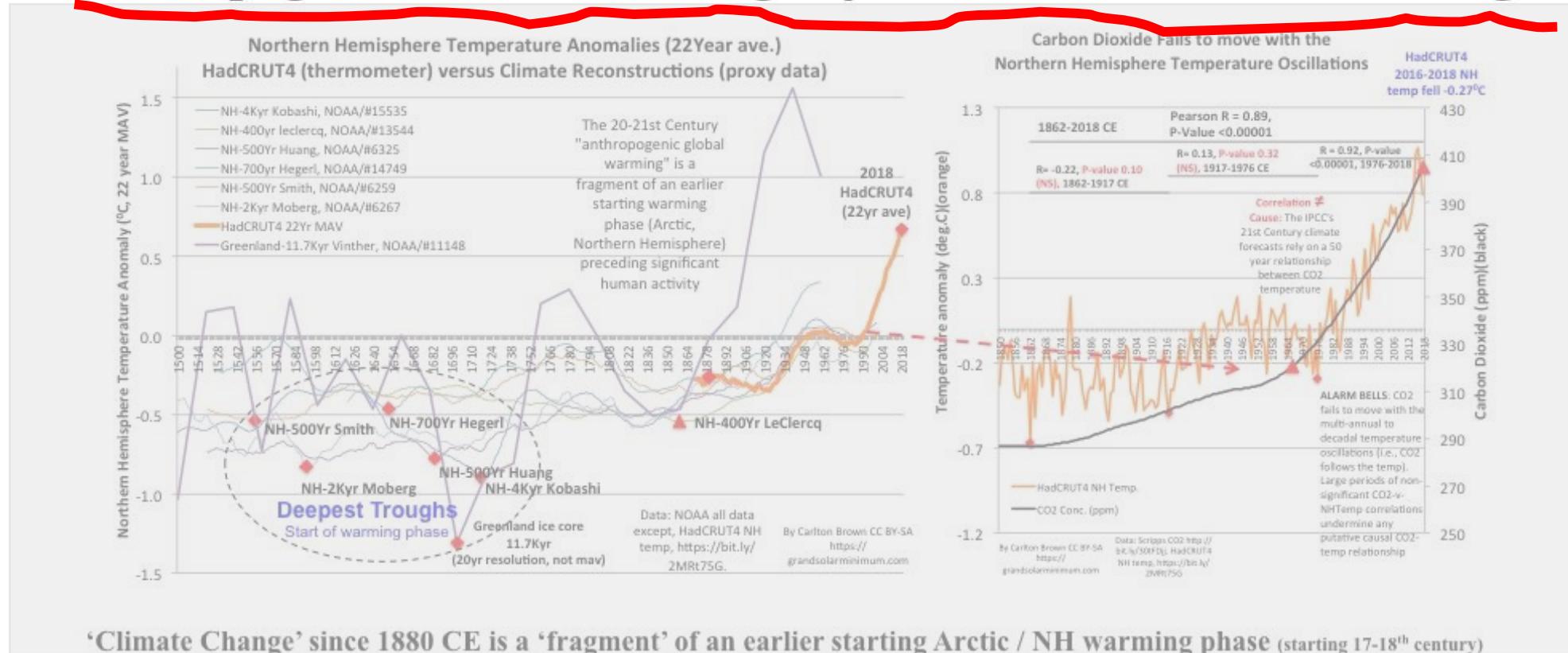


Human and Natural Influences on Global Temperature



Anthropogenic (Human-Caused) Climate Change

Anthropogenic Global Warming Hijacked Natural Climate Change



'Climate Change' since 1880 CE is a 'fragment' of an earlier starting Arctic / NH warming phase (starting 17-18th century)

6/11/19

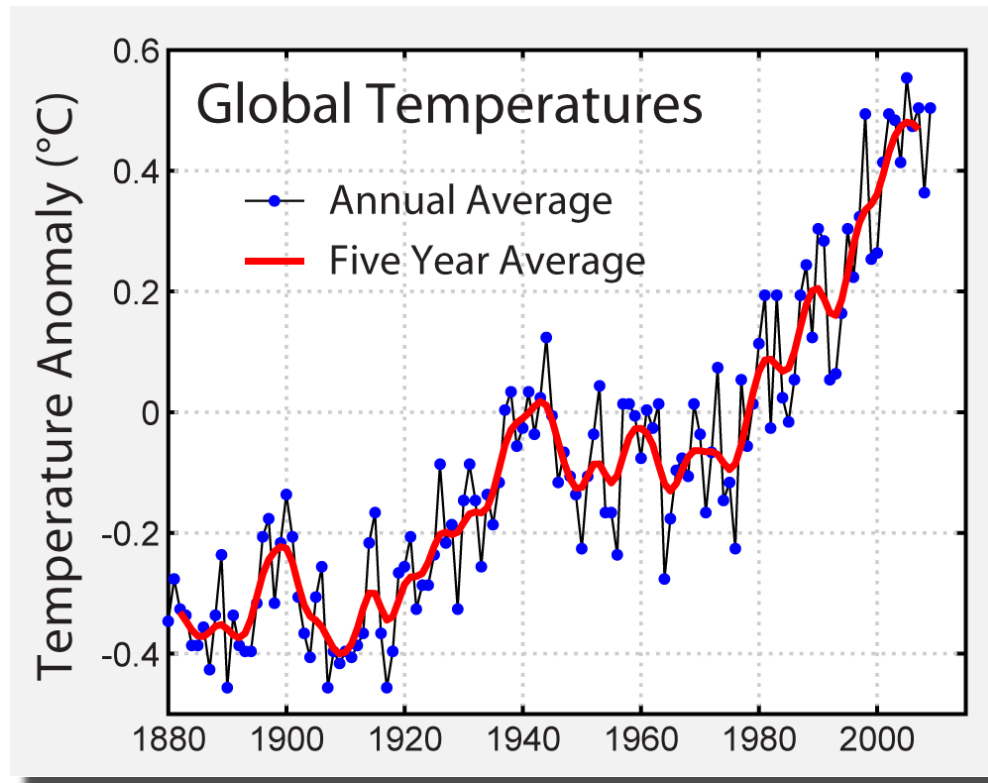
Carlton B. Brown, <https://grandsolarminimum.com>, CC BY-SA 4.0

9

CONSEQUENCES OF CLIMATE CHANGE

Rise in Average Global Temperature

Aquatic and Marine environments (and the animals living in them) will be highly susceptible to Climate Change – especially temperature rise!!



Warmer Ocean Surface Temperatures



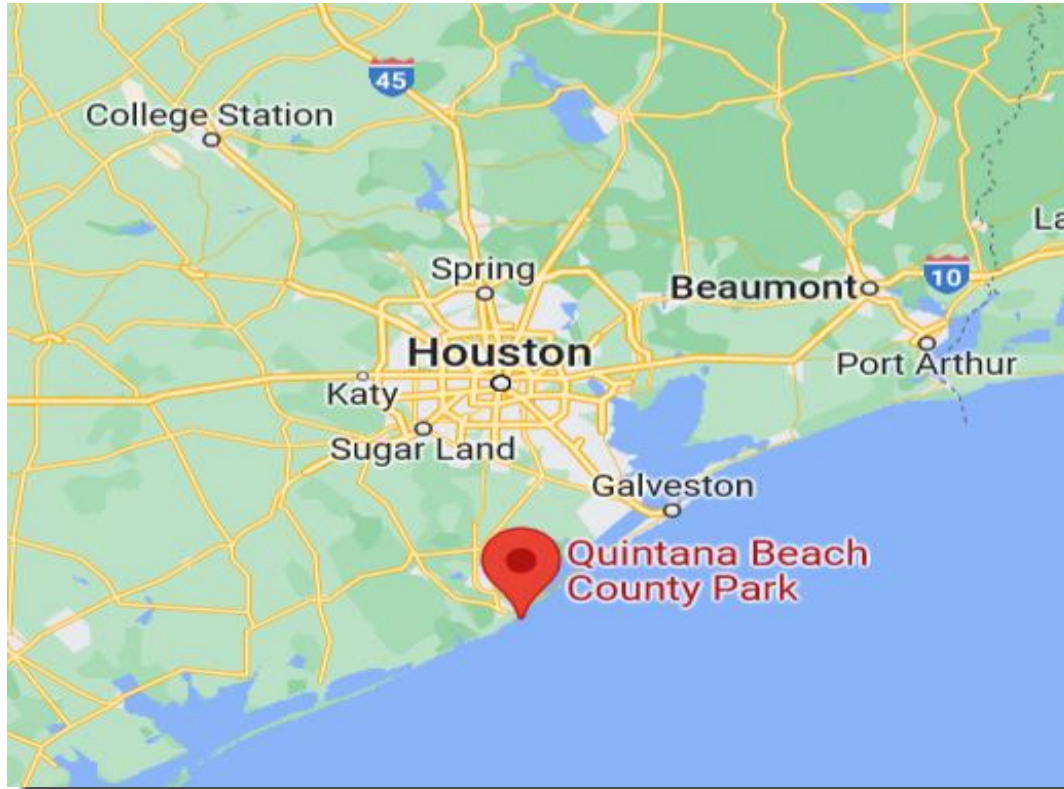
☰ **CNN** Weather Video Climate

This hurricane season is confounding experts and defying forecasts. What the heck is going on?

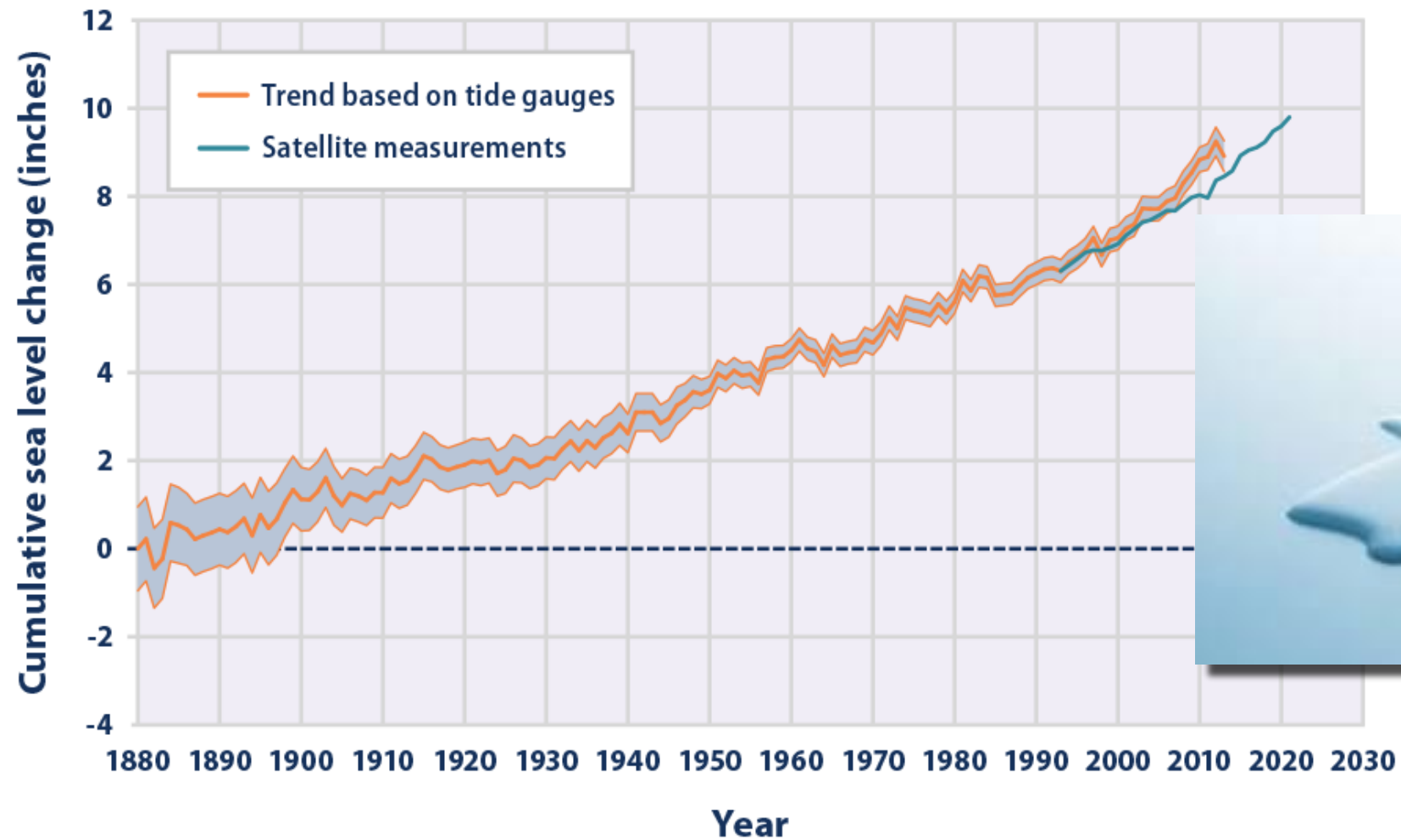
By Mary Gilbert, CNN Meteorologist
🕒 5 minute read · Updated 12:53 PM EDT, Fri September 6, 2024

Sept. 6, 2024

Rise in Local Temperatures



Temperature Rise = Sea Level Rise



Where is the World's Ice?



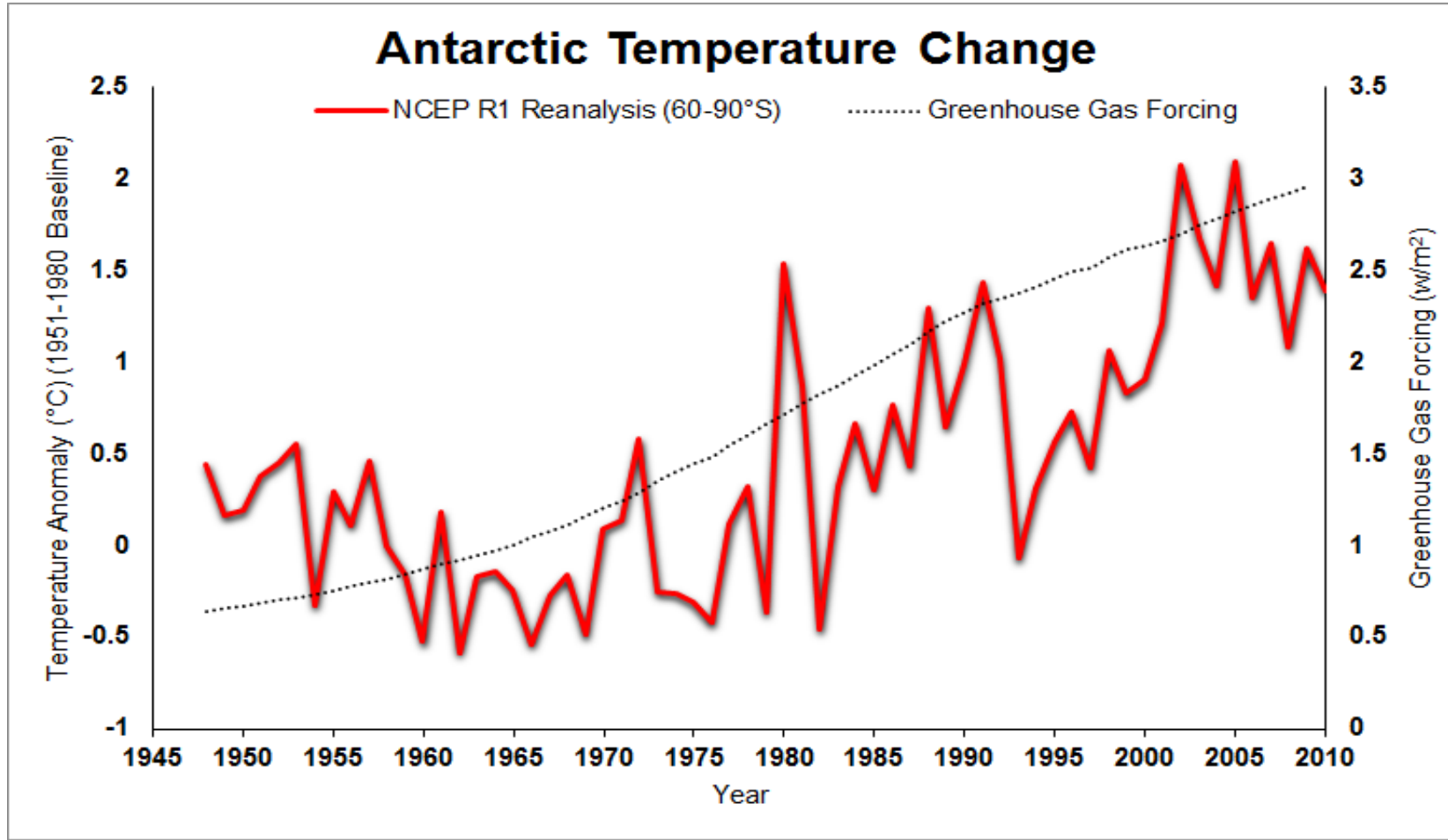
Antarctica!!!

Antarctica is enormous!!!

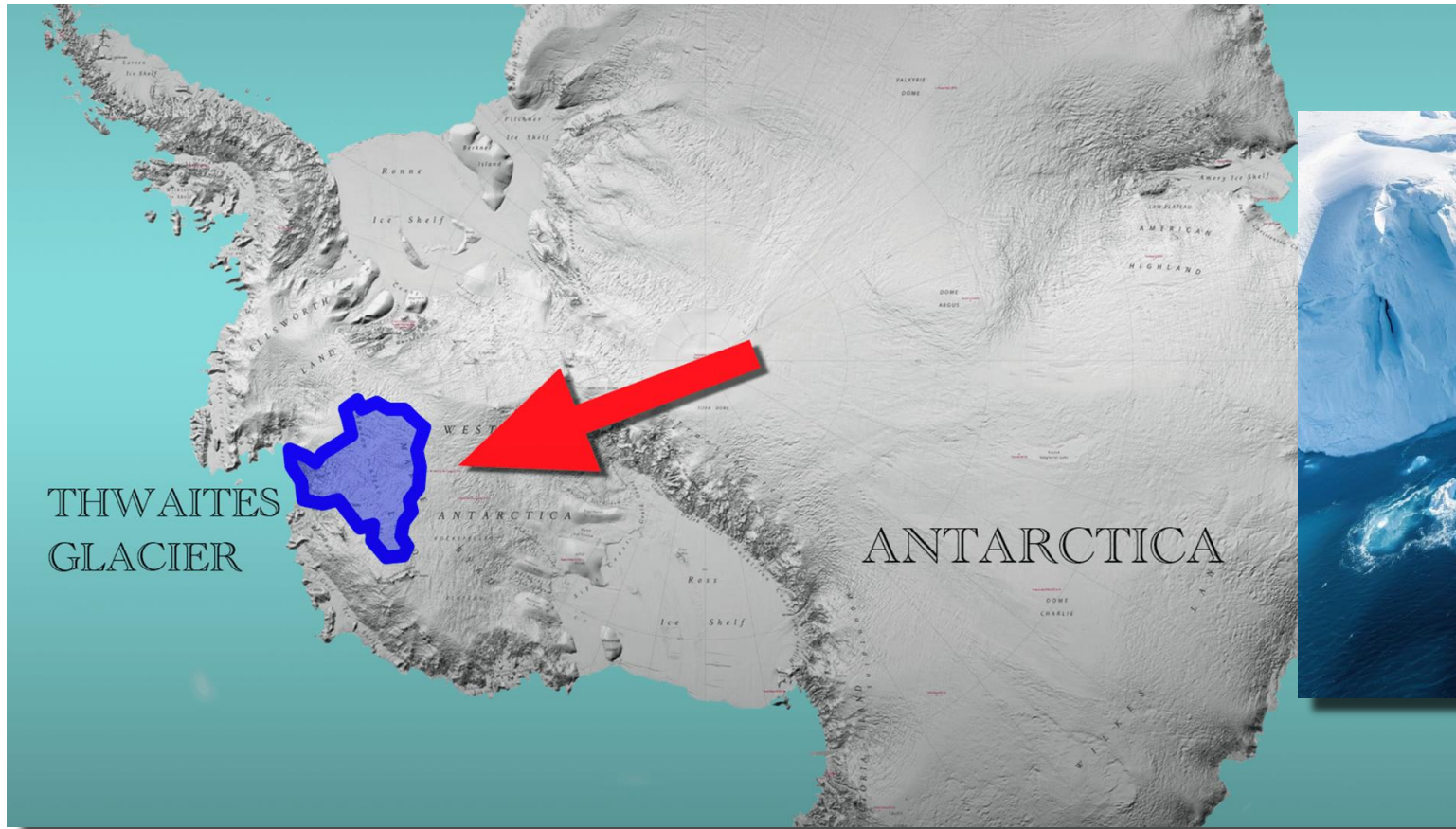
A comparison of the size of Antarctica and the USA



Temperature Rise in Antarctica

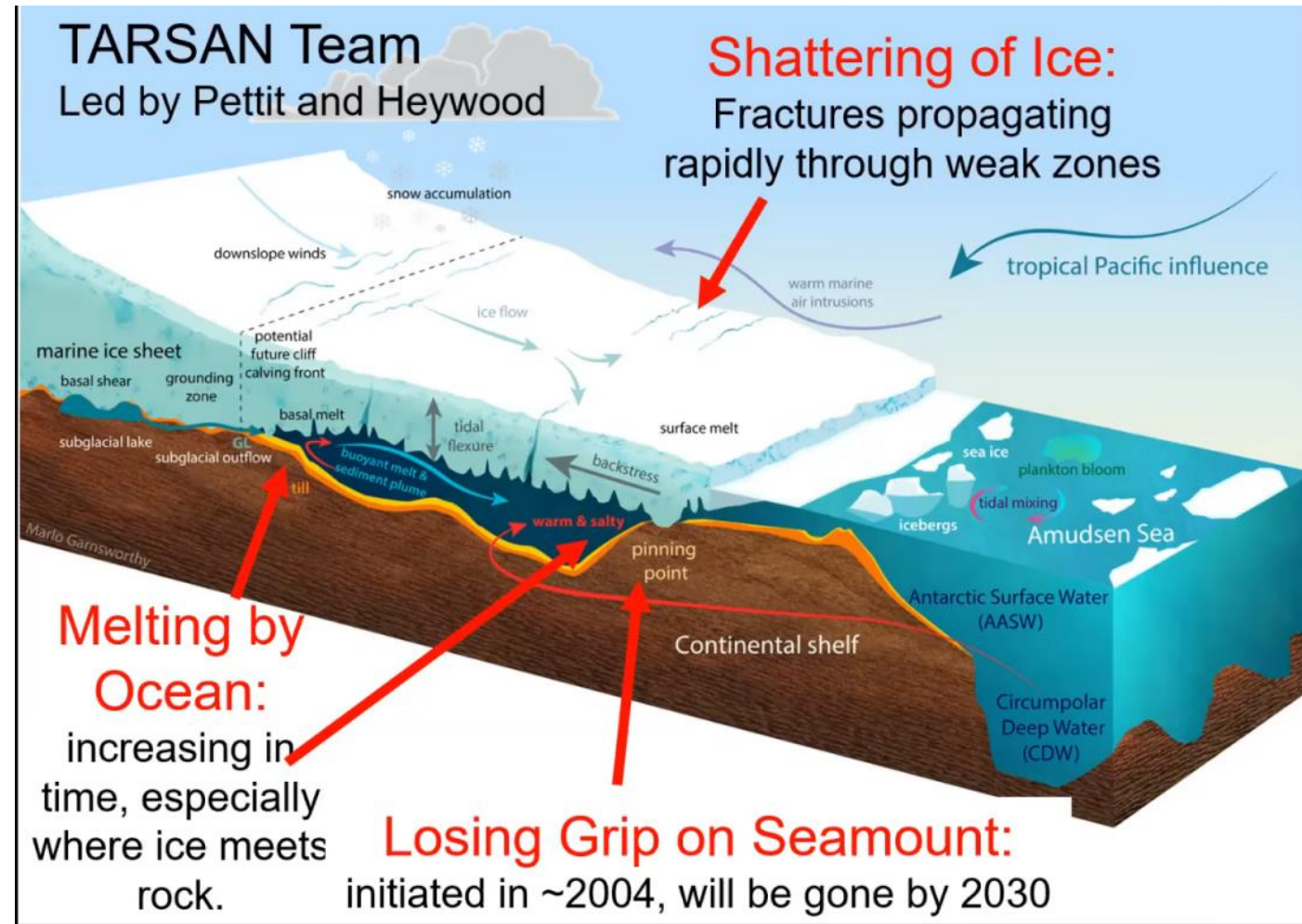


Thwaite Glacier = Sea Level Rise



Thwaite Glacier = Sea Level Rise

Three 'Drivers' for collapse of Thwaite's Eastern Ice Shelf by 2030



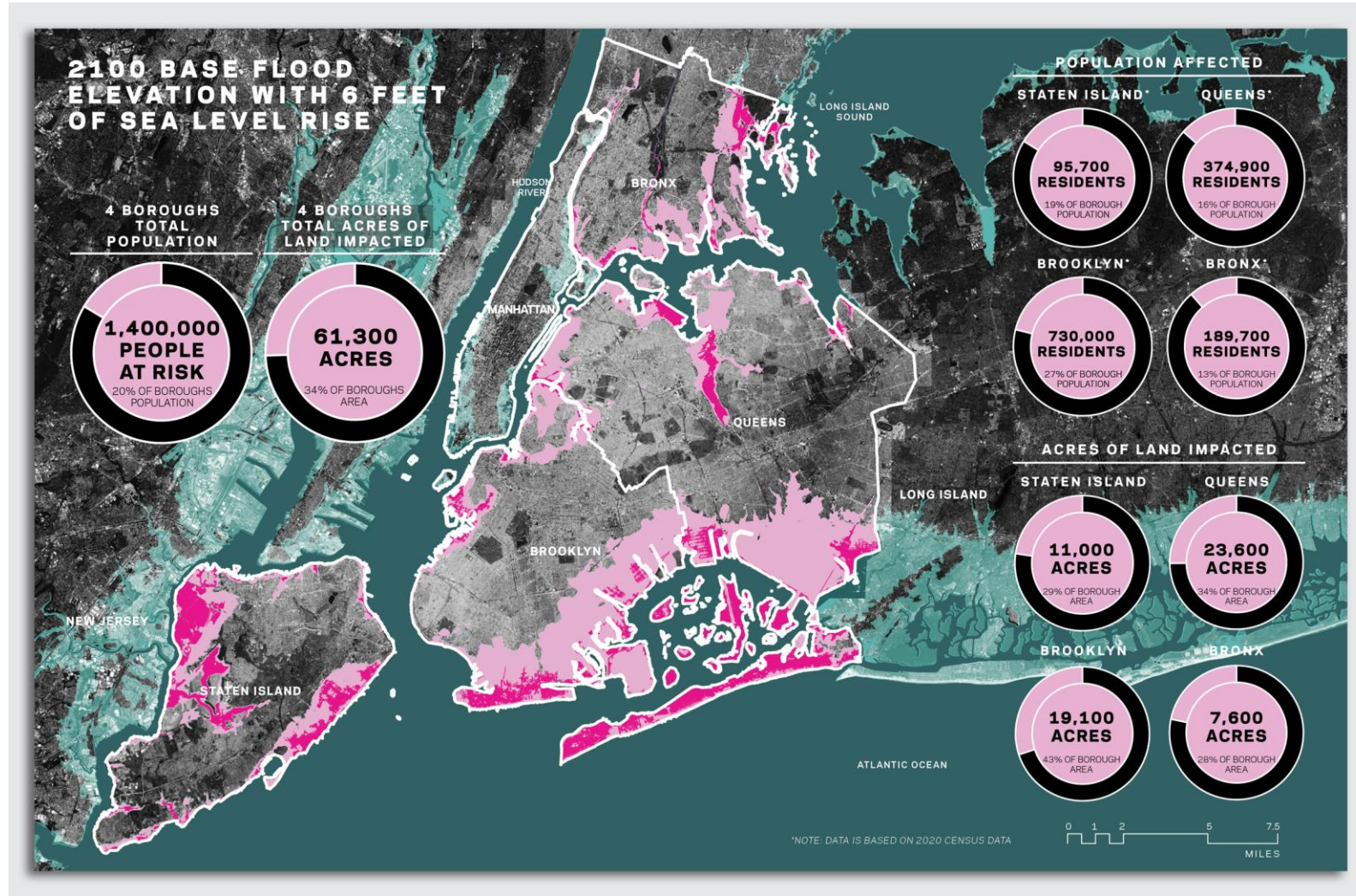
Sea Level Rise from Thwaites (and other) Glaciers

2-10' of sea level rise!

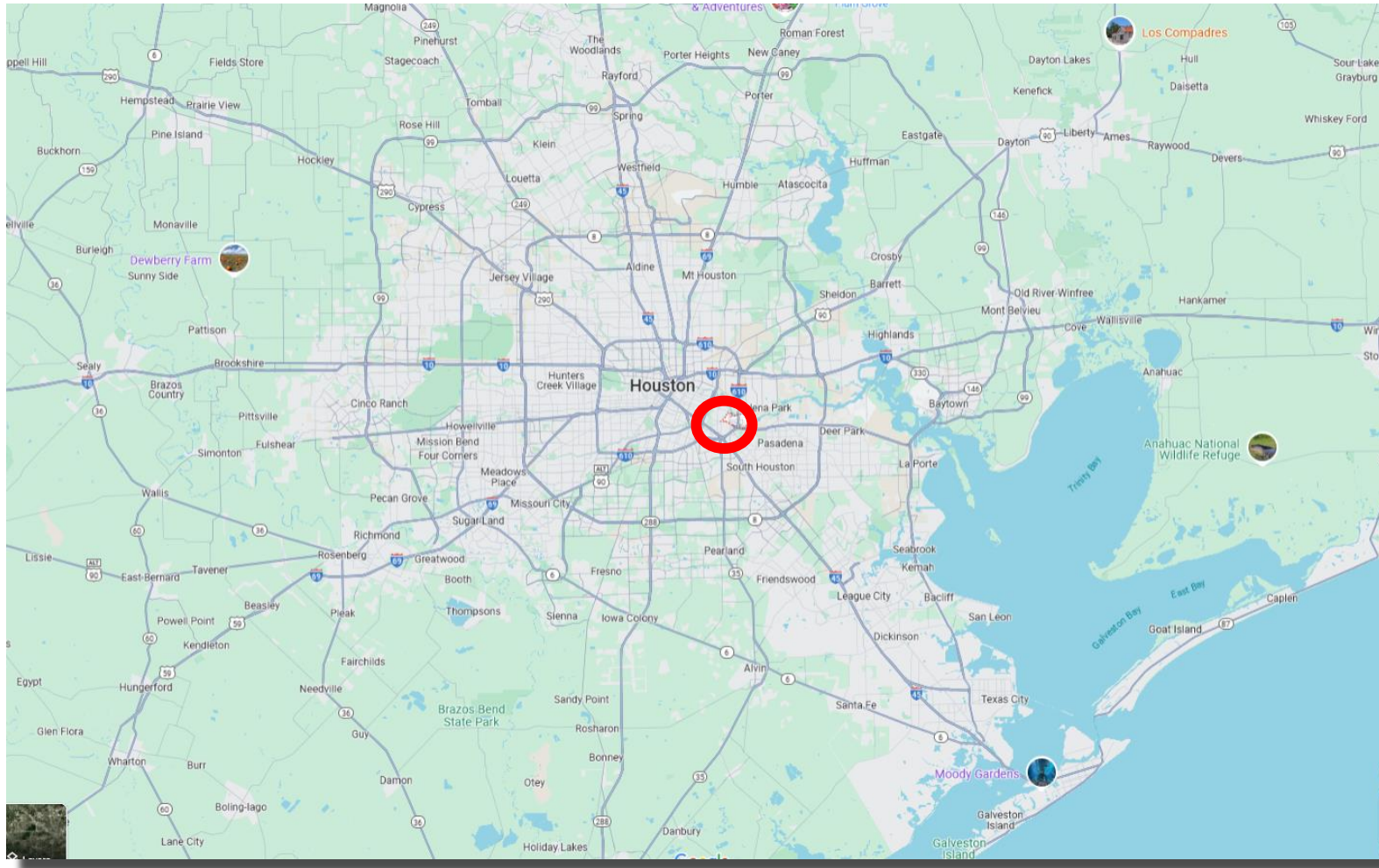
*'Hell's Kitchen',
Manhattan*



Sea Level Rise – New York City

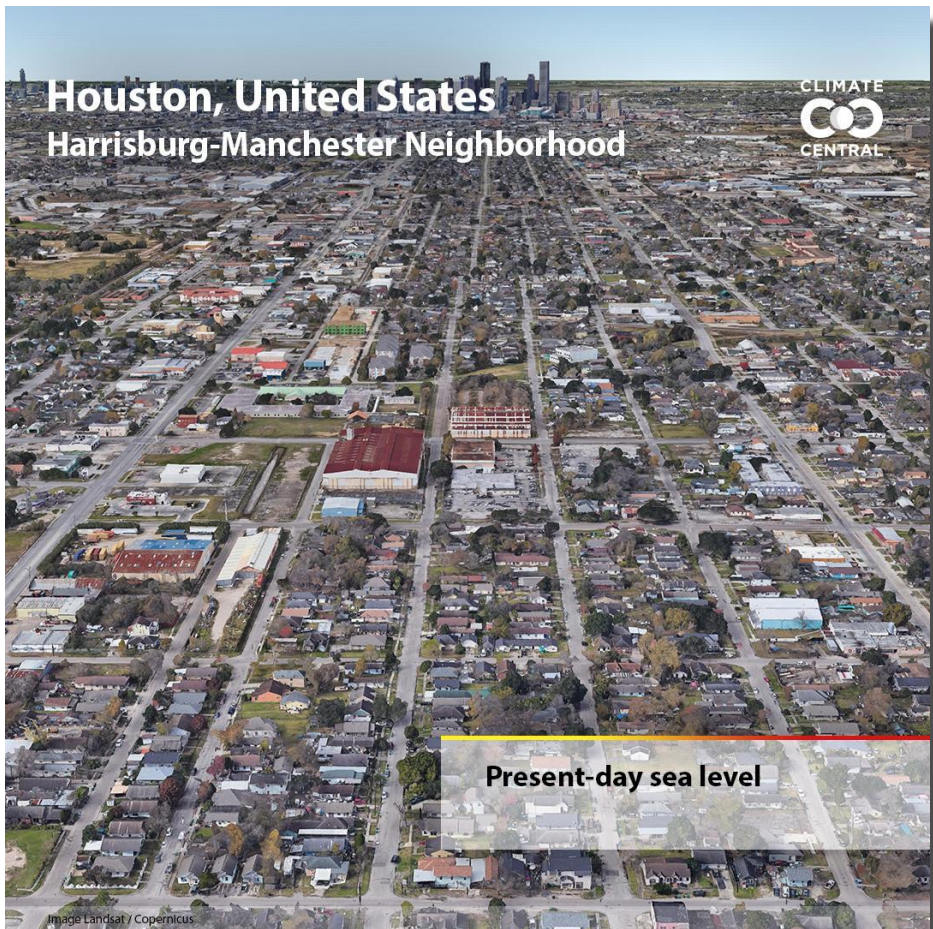


Sea Level Rise – Close to Home

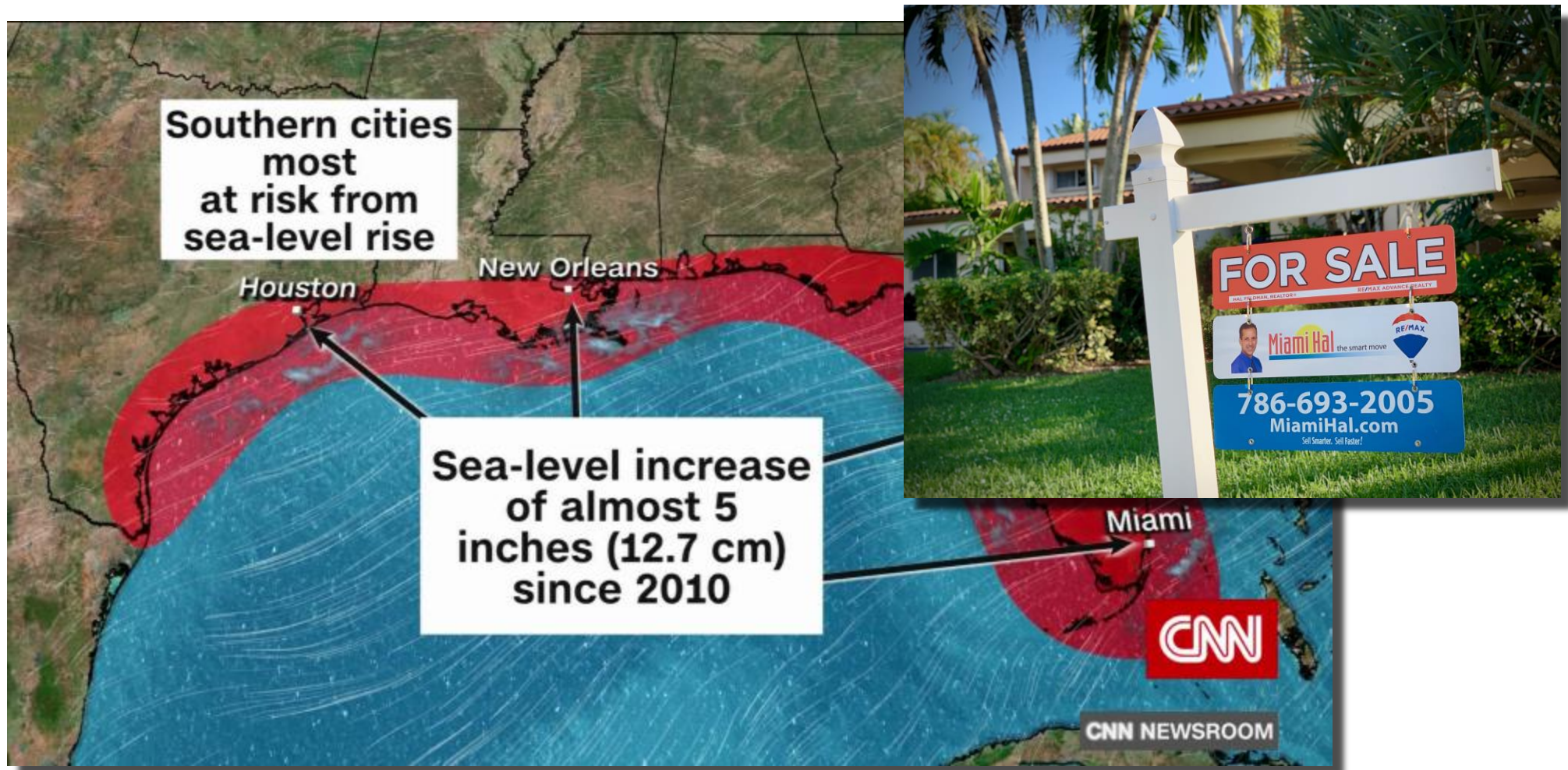


**Harrisburg-Manchester
Neighborhood**

Sea Level Rise – Close to Home



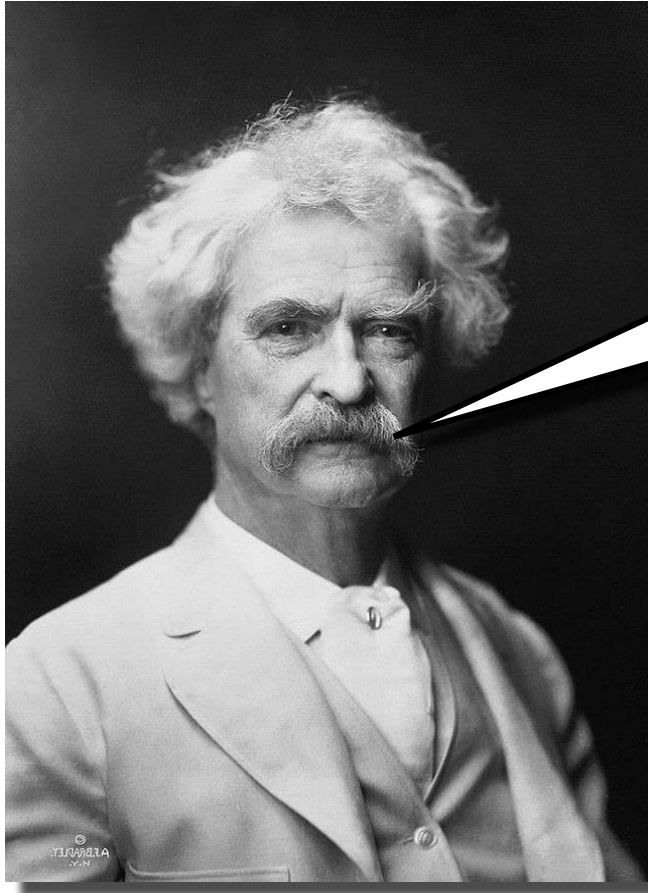
Sea Level Rise



WEATHER AND CLIMATE CHANGE

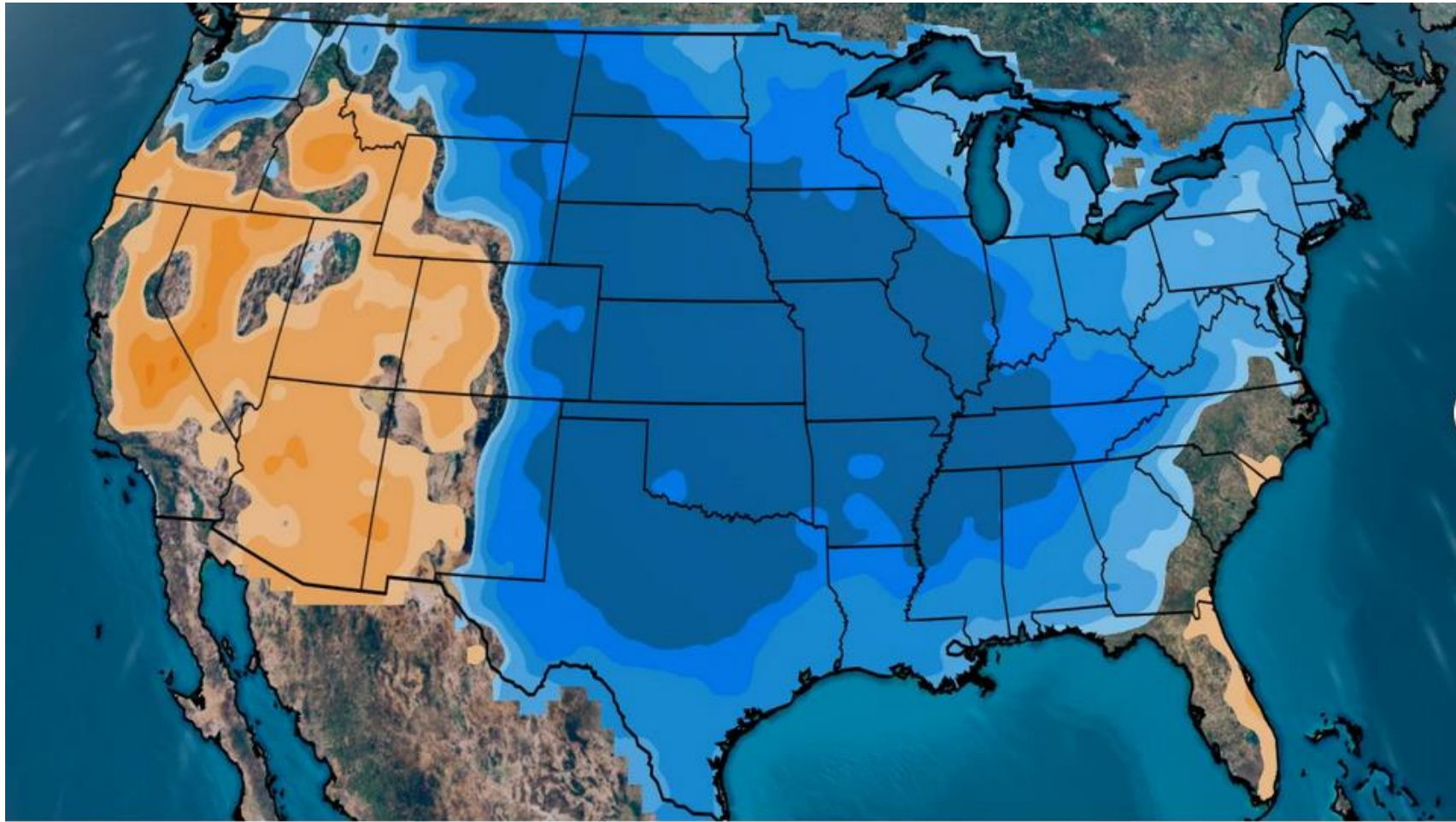
Climate Change Extreme → Weather Events

Climate Change ≠ Weather



*“Climate is what we expect:
Weather is what we get”
Mark Twain*

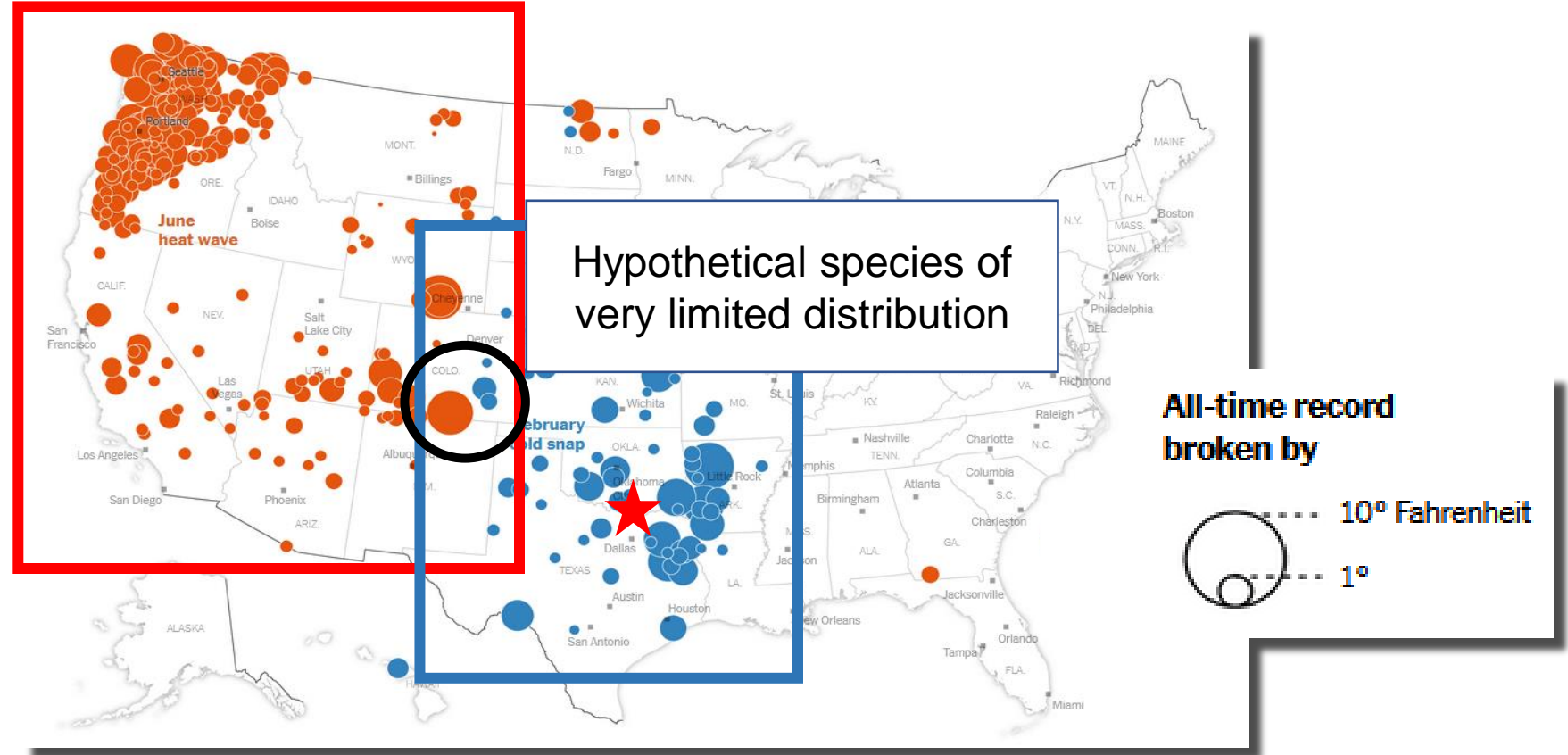
Extreme Temperature Excursions – Climate vs. Weather



January 19-24, 2021

Extreme Temperature Excursions – Climate vs. Weather

February, 2021
Continental USA

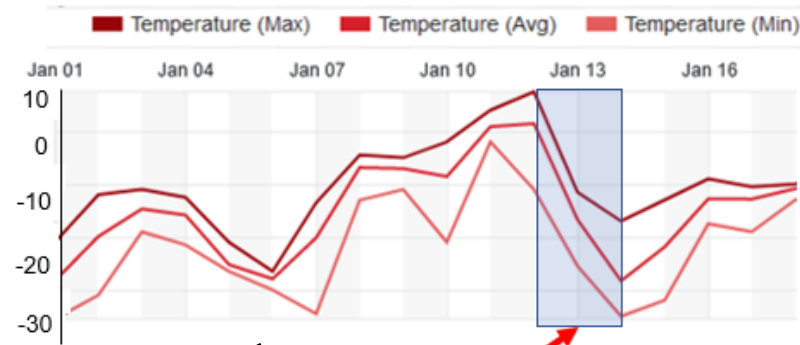


- The freeze was Texas' largest ever insurance event (>> worst hurricane)!!
- All-time heat records were set at 8.3% of all weather stations in US!!

Extreme Temperature Excursions – Climate vs. Weather



January 2018, Saranac Lake, upstate New York, USA



72°F!!

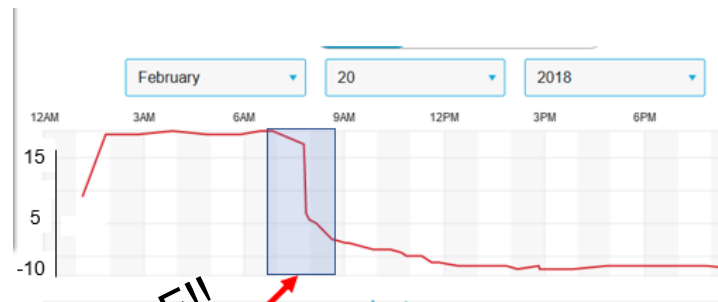
48°C temperature drop in <36 hours!!!!



Temperature increases as or more extreme!



February 2018, Oklahoma City, Oklahoma, USA



27°F!!

12°C temperature drop.....
....in 240 seconds!!!!

Extreme Temperature Excursions – Climate vs. Weather

- US cities with same day Record Highs and Lows

LOCATION	HIGH TEMP	LOW TEMP	DATE	SPREAD
Alamosa, Colorado	87°	30°	Aug. 25, 2002	57°
"	88°	31°	Aug. 26, 2002	57°
Astoria, Oregon	61°	28°	March 15, 1988	33°
Austin, Texas	102°	66°	July 21, 2000	36°
Bakersfield, California	75°	23°	Jan. 3, 1930	52°
Coalville, Utah	100°	37°	July 10, 2003	63°
Corpus Christi, Texas	100°	71°	July 29, 2014	29°
Delta, Utah	107°	42°	July 10, 2003	65°
Deeth, Nevada	87°	12°	Sept. 21, 1954	75°
Eureka, California	61°	28°	March 15, 1988	33°
Grand Canyon, Arizona	95°	39°	July 31, 2008	56°
Hilo, Hawaii	91°	60°	May 25, 2003	31°
"	88°	60°	May 26, 2003	28°
Juneau, Alaska	56°	25°	April 16, 2001	31°
Kansas City, Missouri	76°	11°	Nov. 11, 1911	65°

LOCATION	HIGH TEMP	LOW TEMP	DATE	SPREAD
Miami, Florida	96°	70°	Aug. 11, 1984	26°
Melbourne, Florida	97°	68°	May 22, 1998	29°
Napa, California	63°	25°	Jan. 1, 2014	38°
"	70°	24°	Jan. 5, 2014	46°
Oklahoma City, Oklahoma	83°	17°	Nov. 11, 1911	66°
Olympia, Washington	67°	25°	March 14, 2005	42°
Park City, Utah	87°	36°	Aug. 11, 2002	61°
"	89°	39°	Aug. 15, 2002	60°
Paso Robles, California	74°	21°	Jan. 9, 1999	53°
"	73°	22°	Dec. 13, 2017	51°
Pine Valley, Nevada	97°	30°	July 30, 1989	67°
Pueblo, Colorado	101°	52°	July 15, 1993	49°
Safford, Arizona	105°	52°	Aug. 25, 2002	53°
Sioux City, Iowa	91°	33°	May 16, 1997	58°
Springfield, Missouri	80°	13°	Nov. 11, 1911	67°
Vero Beach, Florida	92°	70°	Sept. 14, 2005	22°

Weather Extremes a Global Phenomenon – not just the US!

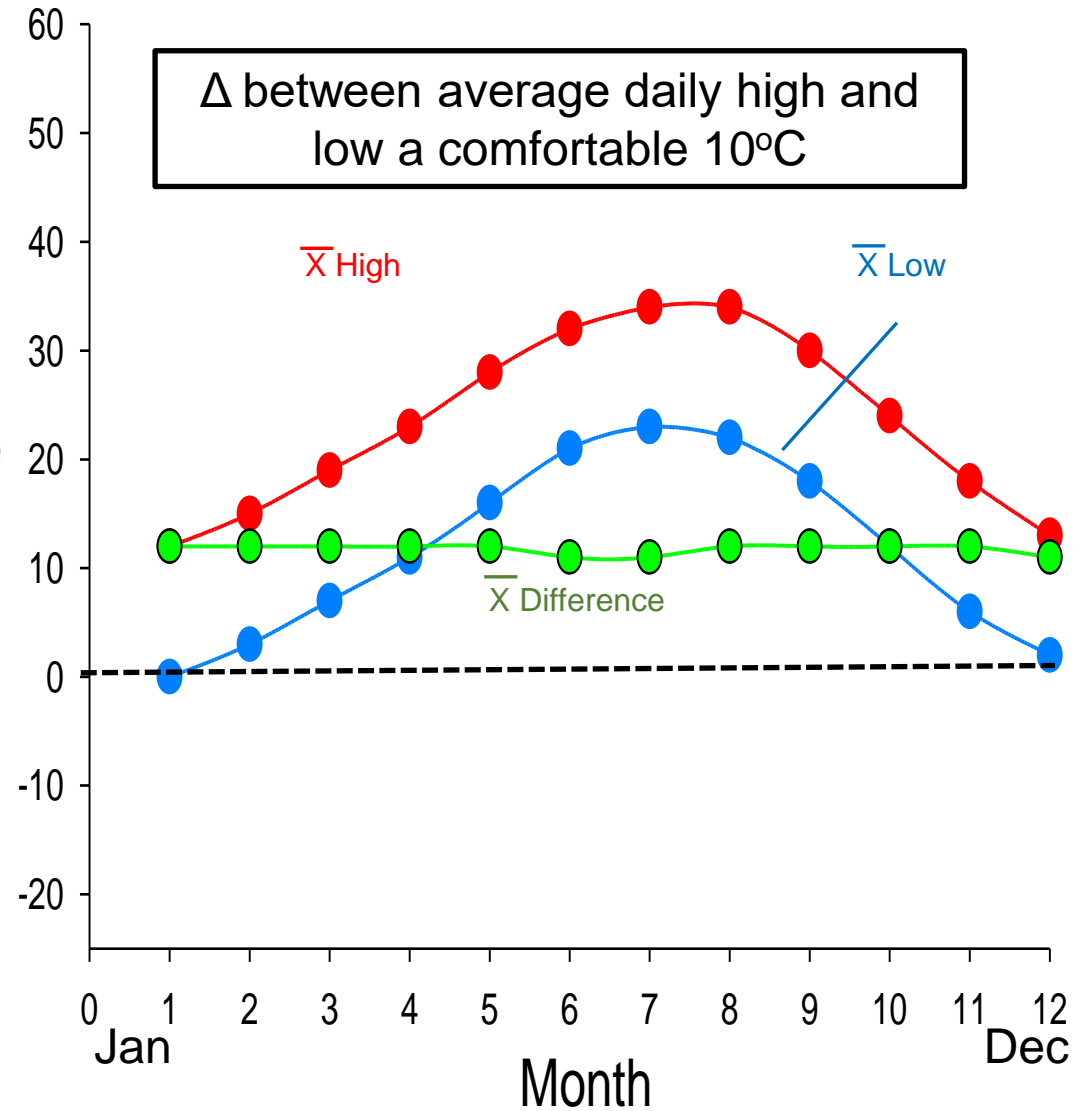
Variation in Temper



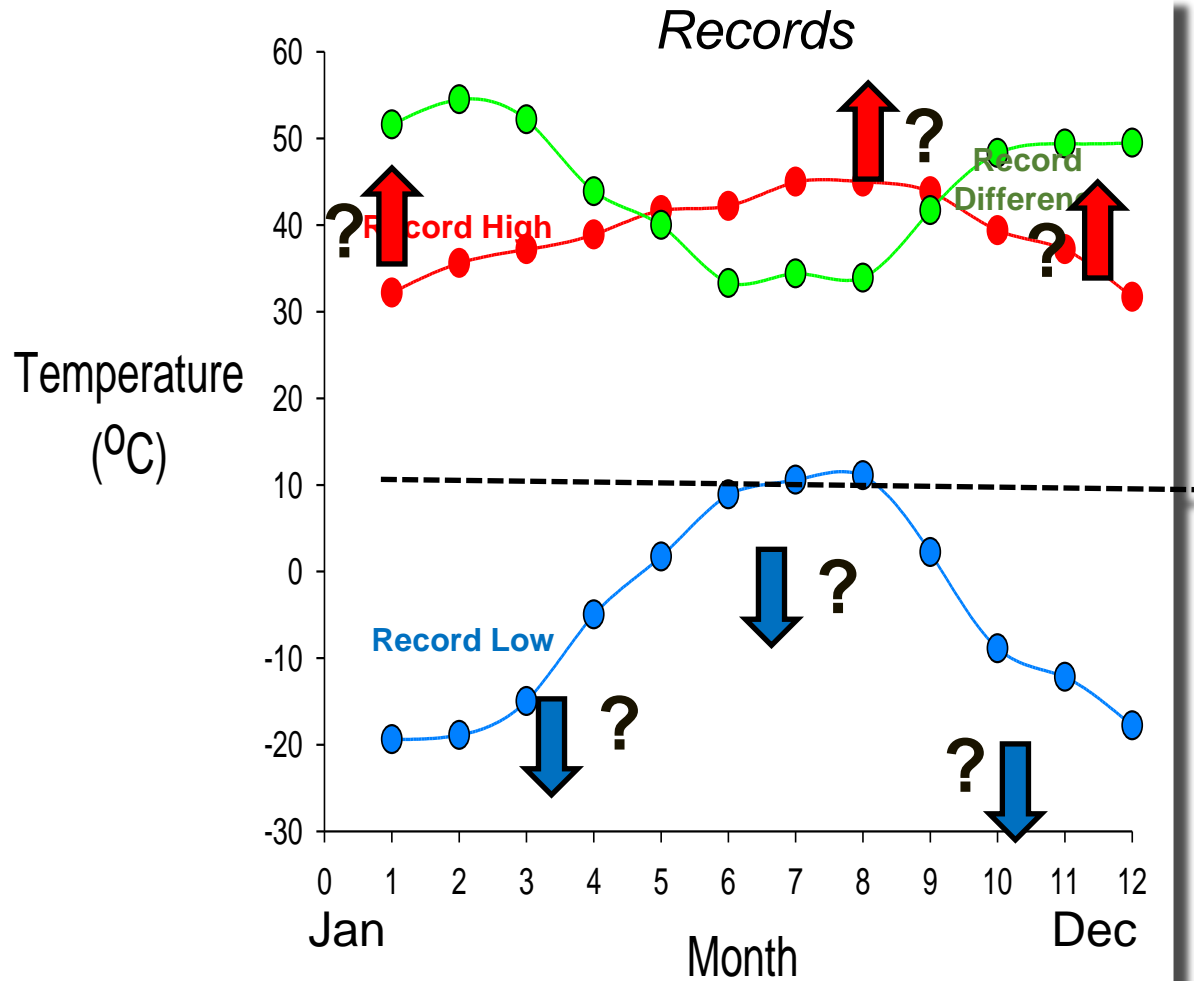
Denton TX Average
Highs and Lows

Nice, temperate climate
(if a bit warm), right??

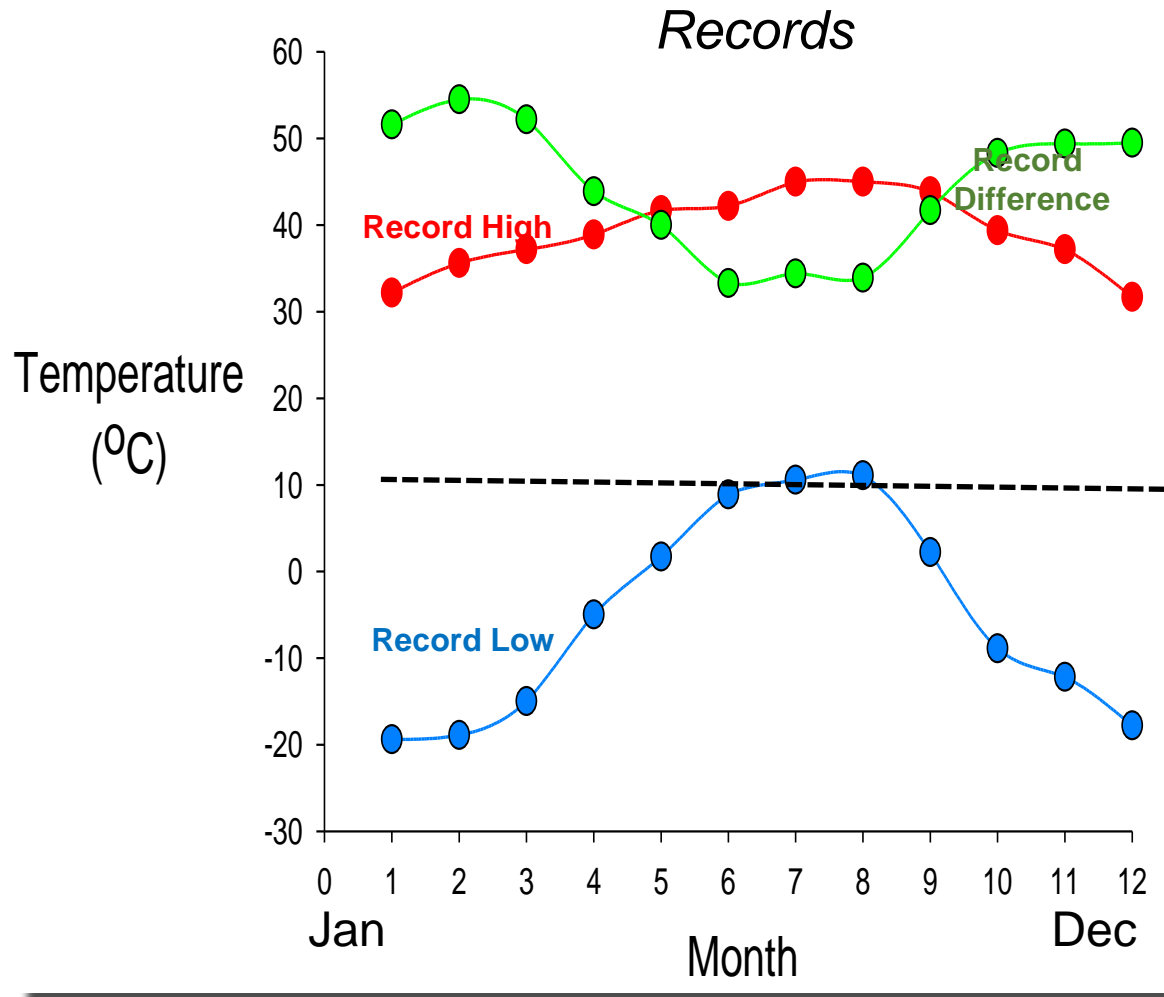
Temperature
(°C)



What About Largest Temperature Excursions?



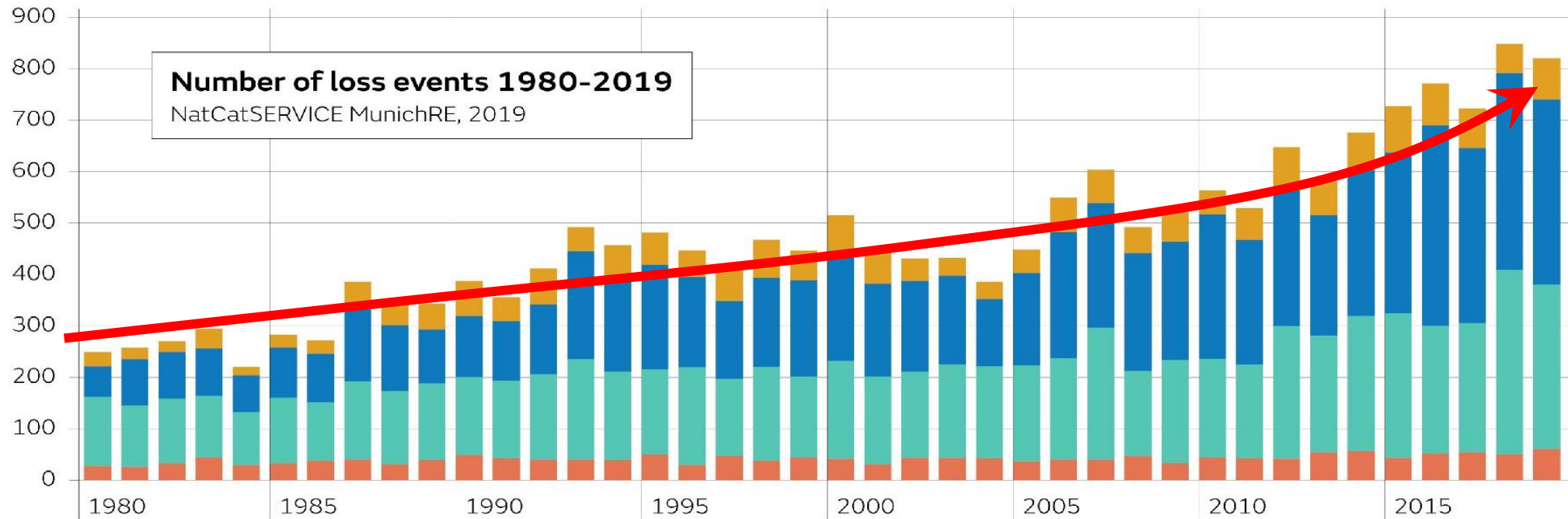
What About Largest Temperature Excursions?



What will happen with more variable weather giving *higher highs* and *lower lows*?



Extreme Weather Events Accelerating



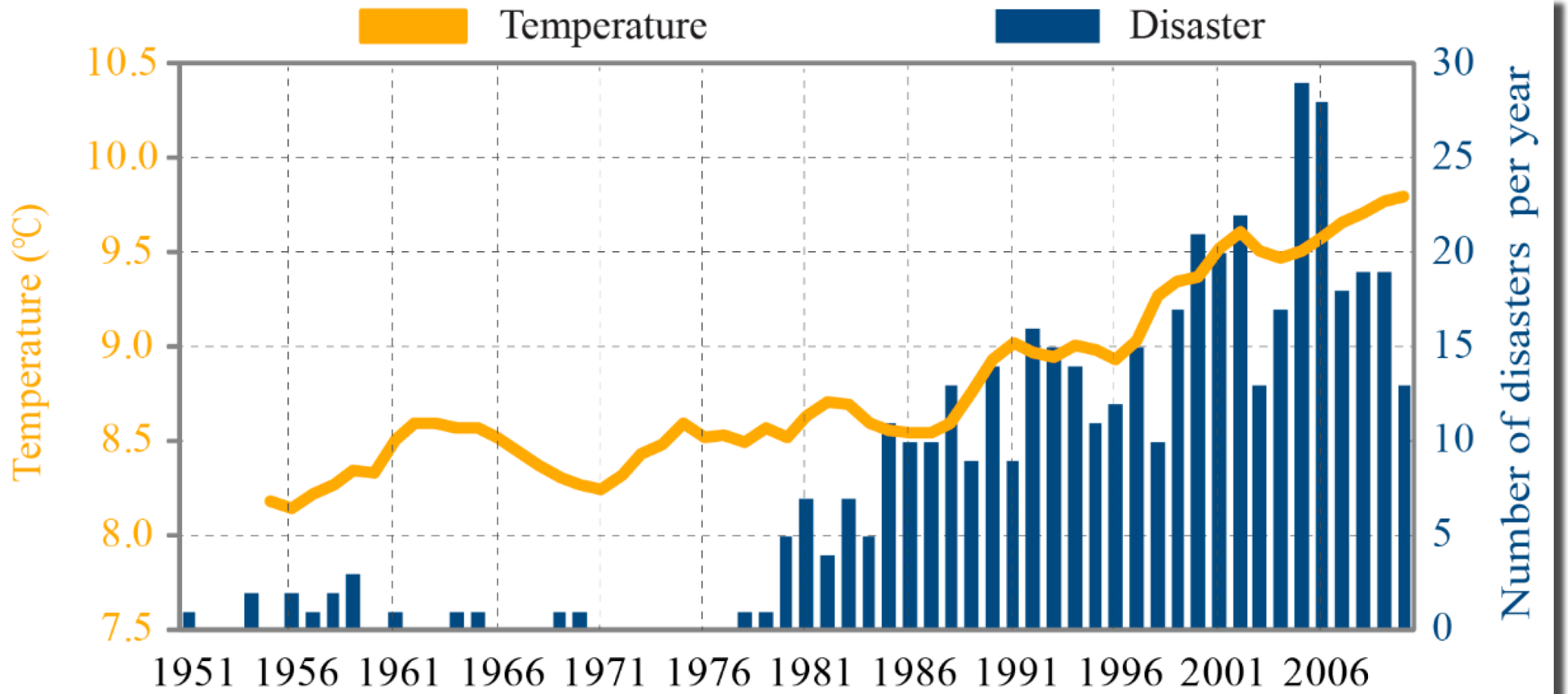
Geophysical events
Earthquakes, tsunamis,
volcanic activity

Meteorological events
Tropical storm, extratropical storm,
convective storm, local storm.

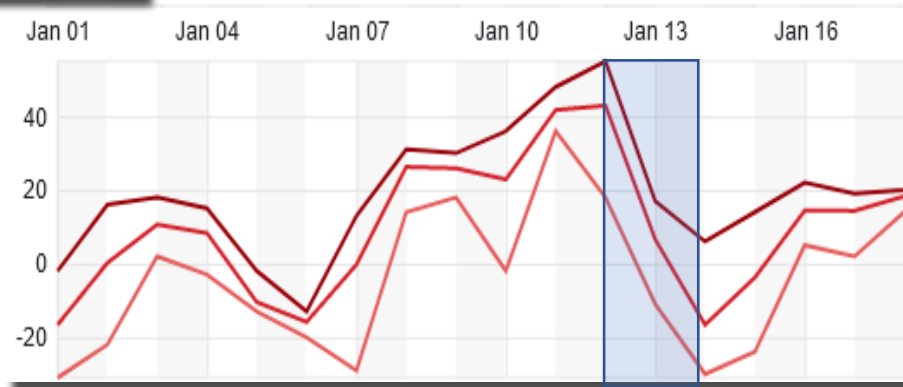
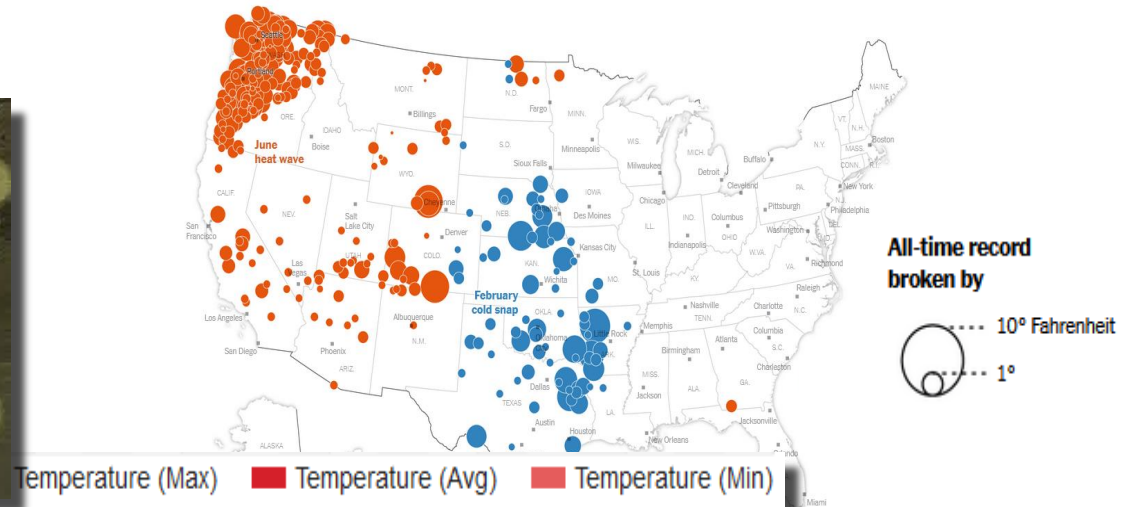
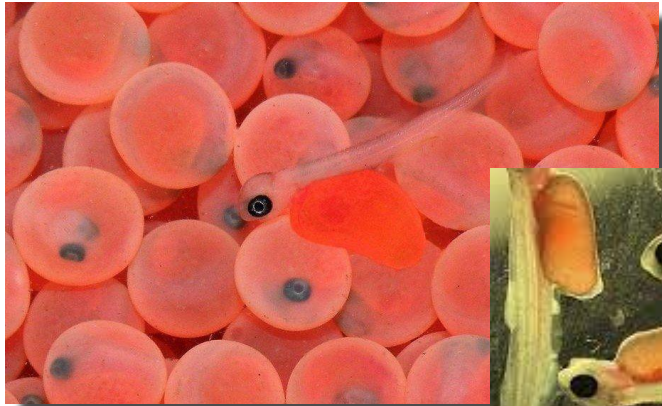
Hydrological events
Flood, mass movement.

Climatological events
Extreme temperature,
drought, wildfire.

Climate Change-Related Natural Disasters



Not Trivial - Potential Extinction Events!



Cold Weather Doesn't Mean Climate Change and Global Warming is Fake!



**CASIE
CLOSED**

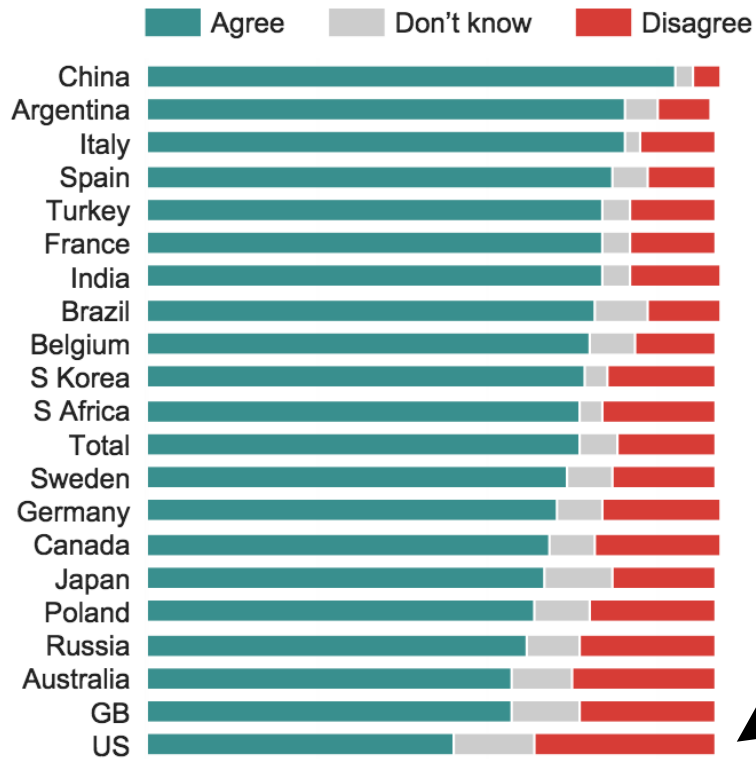
It can be hotter or colder where you are, but it is colder or hotter where someone else is!

Climate Change predicts:

- greater weather variability
- overall global warming

Climate Change Deniers

To what extent do you agree or disagree? The climate change we are currently seeing is largely the result of human activity

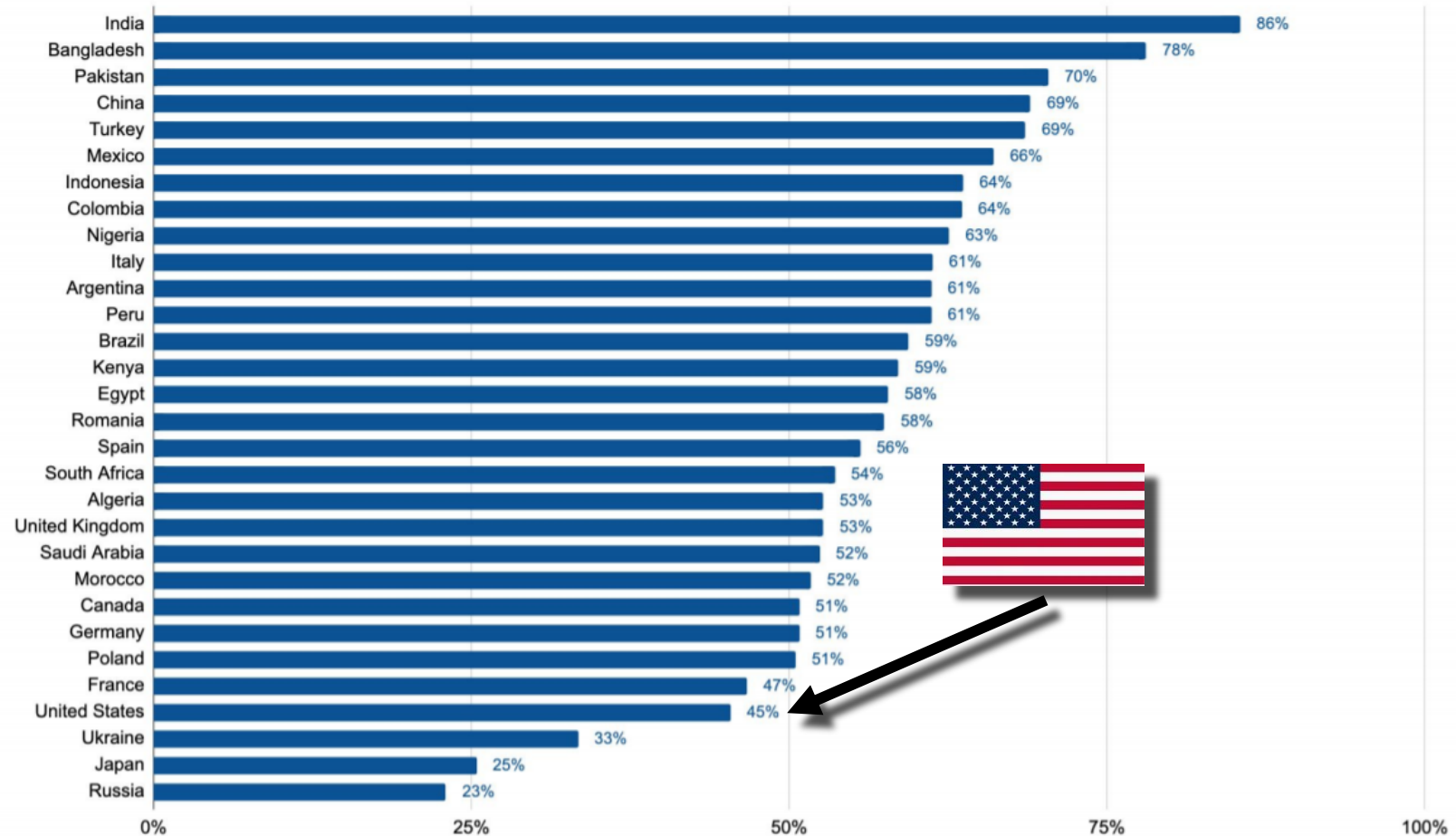


Climate Change Deniers

QUESTION

How much do you trust what scientists say about the environment?

Percentage saying "a great deal" or "a lot"





WHAT CAN PEOPLE DO?

Getting Educated on Climate Change

- Coming to Discussions like this one!
- Reading, Watching
- Keeping an open mind

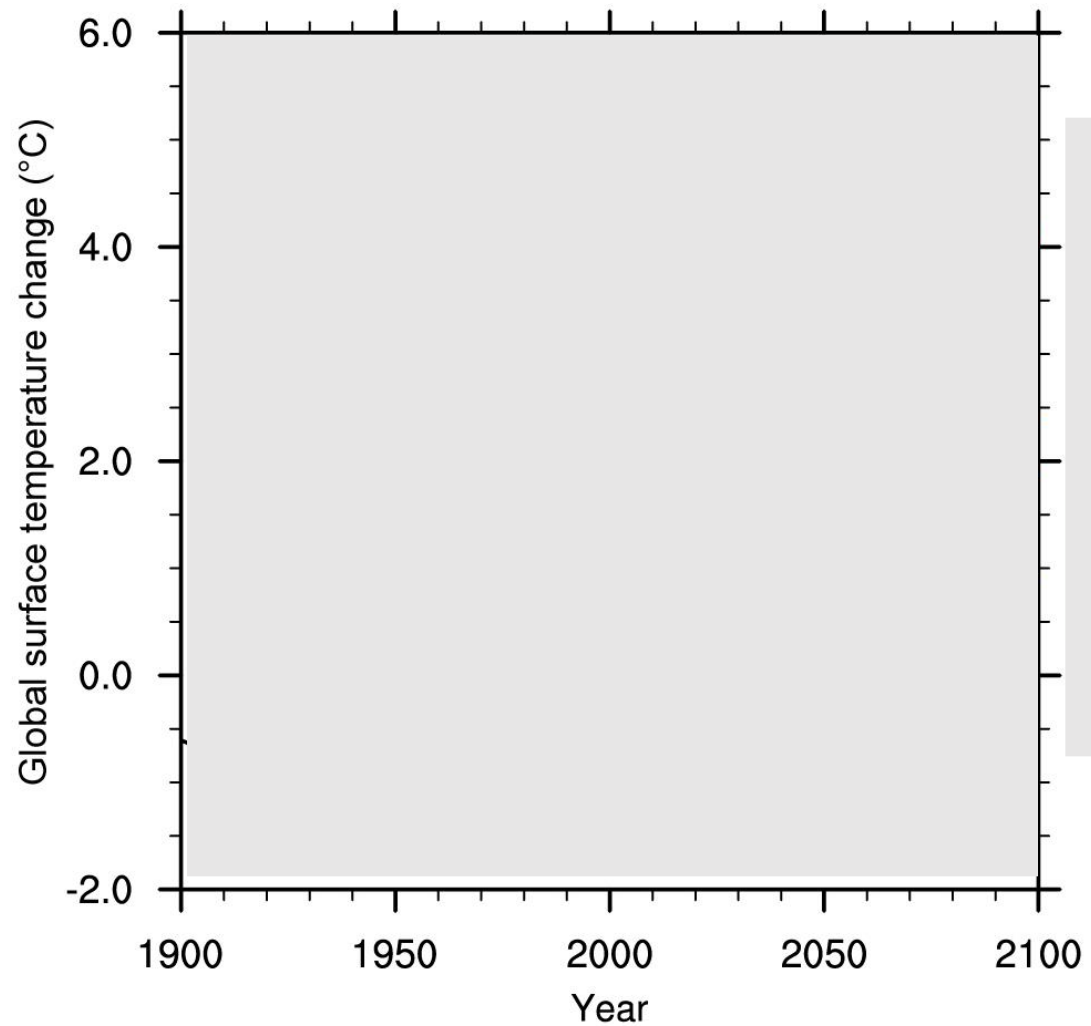


Actions People Can Take About Climate Change

- ✓ • Make your voice heard by those in power. ...
- ✓ • Eat less meat and dairy...
- ~~• Cut back on flying. ...~~
- ~~• Leave the car at home. ...~~
- ✓ • Reduce your energy use, and bills. ...
- ✓ • Respect and protect green spaces. ...
- ~~• Bank and invest your money responsibly. ...~~
- ✓ • Cut consumption and waste....
- ✓ • Talk about the changes you made.

Pick a few!!!

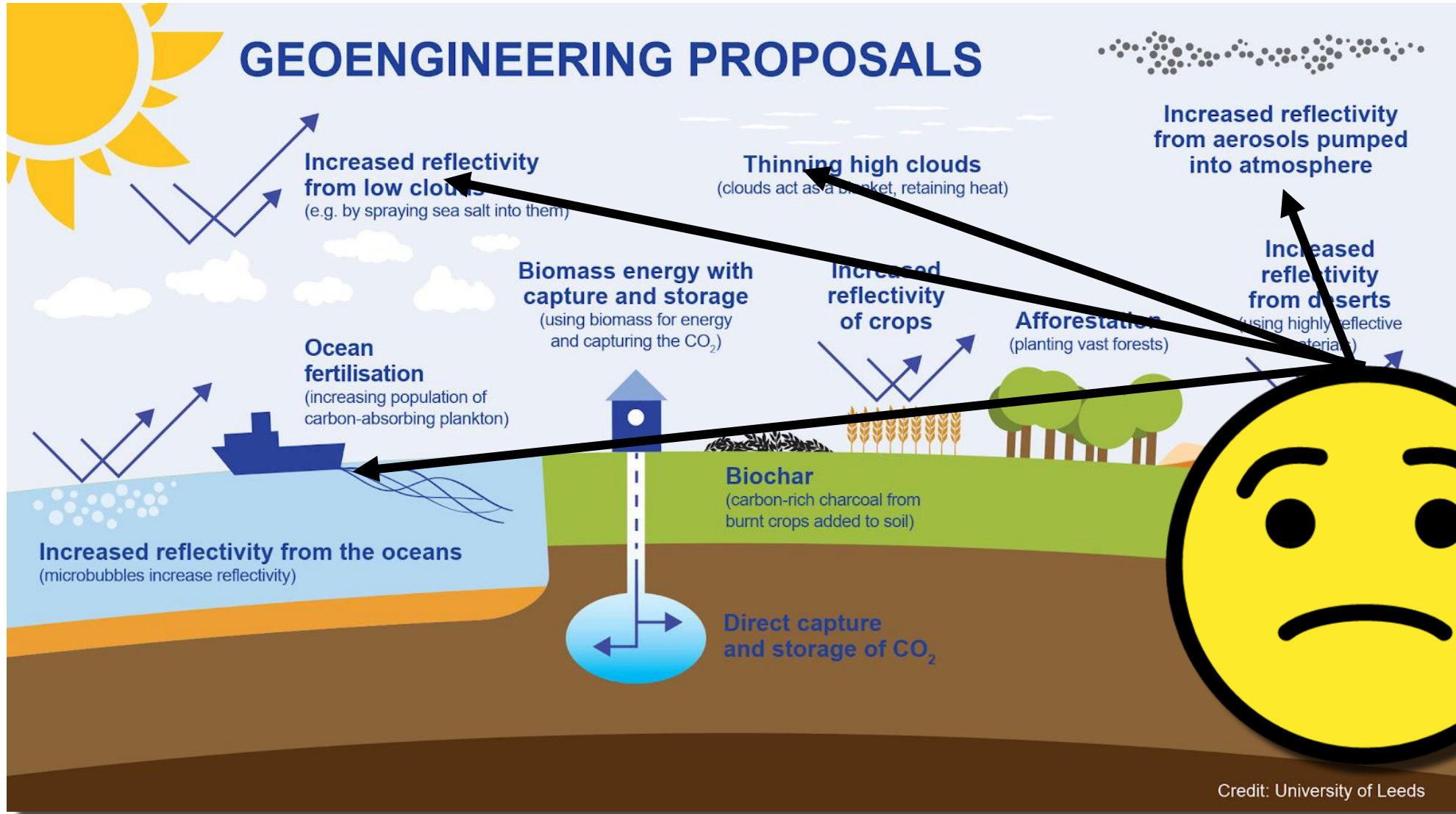
The Future of Climate Change??



Who Cares Who/What's to Blame – Let's FIX it!!!



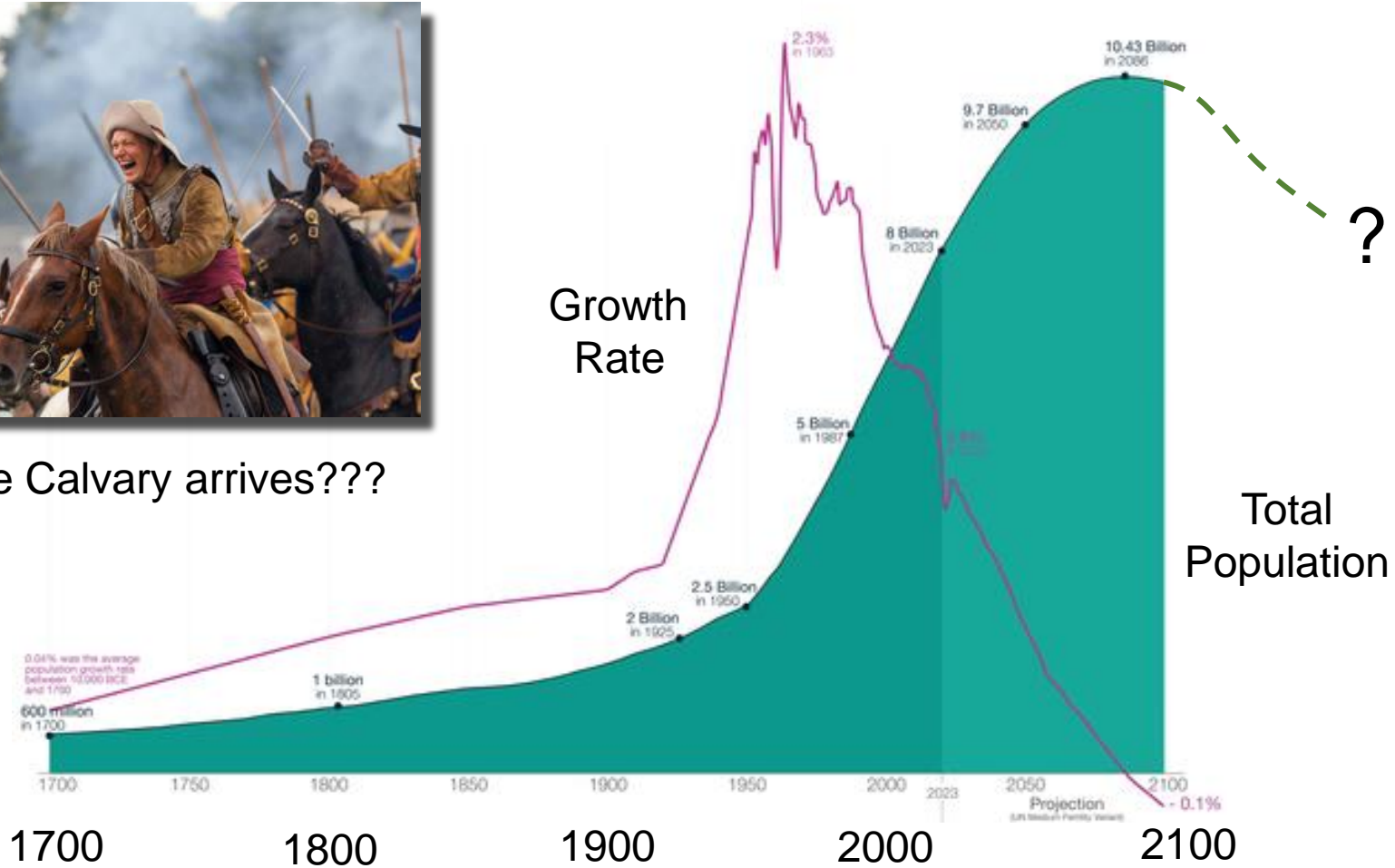
GeoEngineering Proposals to Reduce GreenHouse Effects



World Population Growth, 1700-2100



The Calvary arrives???





TAKEAWAYS

- ‘Climate’ is a complex combination of factors
- ‘Climate Change’ has long occurred
- ‘Climate Change has both natural and human causes
- Climate vs. ‘Weather’ – Weather may be biggest concern
- We aren’t helpless - Actions can be taken!



QUESTIONS?