

# GLOBAL WARMING

OR EUPHEMISTICALLY SPEAKING, 'CLIMATE CHANGE'

BY "GLOBAL WARMING" I MEAN:

**EARTH IS GETTING WARMER  
HUMAN ACTIONS ARE THE MAIN CAUSE**

**MARK WARREN, PE  
DIRECTOR OF COMMISSIONING  
ETHOS ENGINEERING**



OUTLINE

**THE SCIENCE**

**~~WE ARE LOSING THE BATTLE~~**

**~~THE IMPACTS~~**

**~~DON'T FALL FOR THE IGNORANCE~~**

**~~WHAT TO DO~~**

# THE SCIENCE

**THIS PRESENTATION WILL  
LOOK HEAVILY AT THE SCIENCE**

**WHY BOTHER TO LEARN THE SCIENCE?**

**IF YOU UNDERSTAND THE SCIENCE,  
YOU WILL LIKELY BE CONVINCED**

# THE SCIENCE

## THE BIGGEST FACTORS IN CHANGING MINDSETS ON GLOBAL WARMING

**47%: SCIENCE**

**29%: STEWARDSHIP & CARE FOR EARTH**

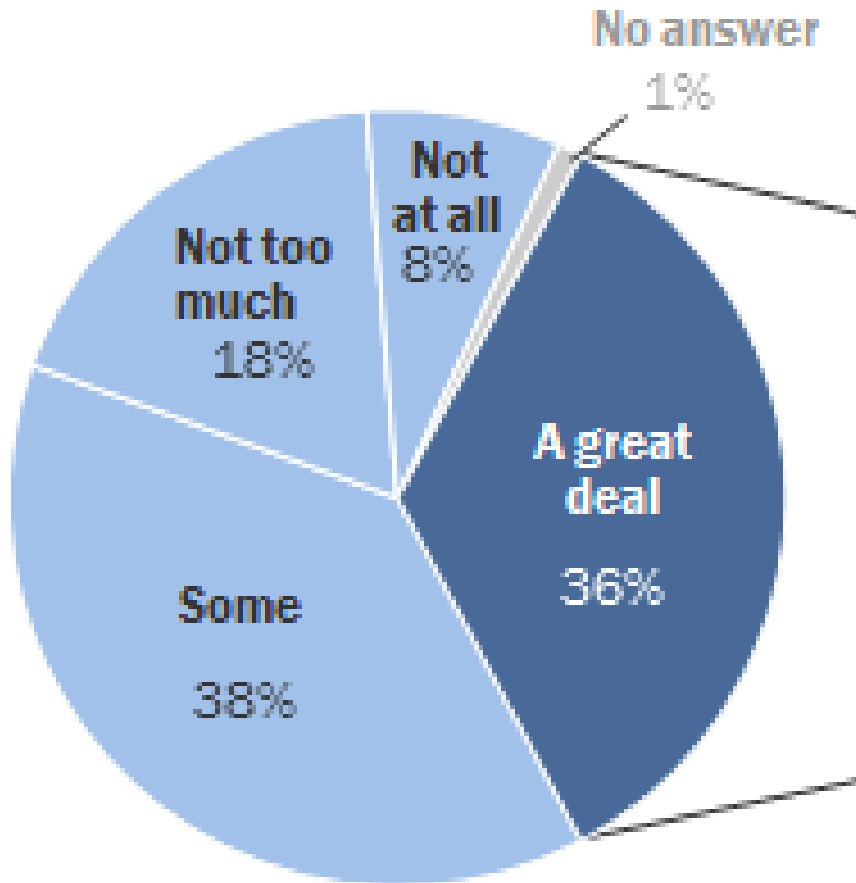
**21%: WEIRD, WARM, AND WILD WEATHER**

**17%: CLIMATE DENIERS SEEM UNTRUSTWORTHY**

FROM YALE CLIMATE CONNECTIONS

# THE SCIENCE

## WHO BELIEVES WHAT



Source: Pew Research Center, Sep 2016

## CONVINCED & CONCERNED

**±36%**

## BELIEVE & MILDLY CONCERNED

**±38%**

## AGNOSTIC

## NOT KNOWLEDGEABLE / APATHETIC

**±18%**

## DENIER / DISMISSIVE

**±8%**

# THE SCIENCE

## WHO BELIEVES WHAT



# THE SCIENCE

**CONVINCED & CONCERNED  
BELIEVE & MILDLY CONCERNED**

**No need to convince, but more motivation to act needed**

**AGNOSTIC  
NOT KNOWLEDGEABLE / APATHETIC**

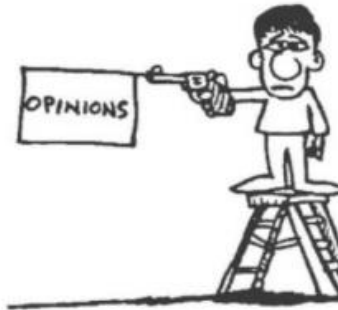
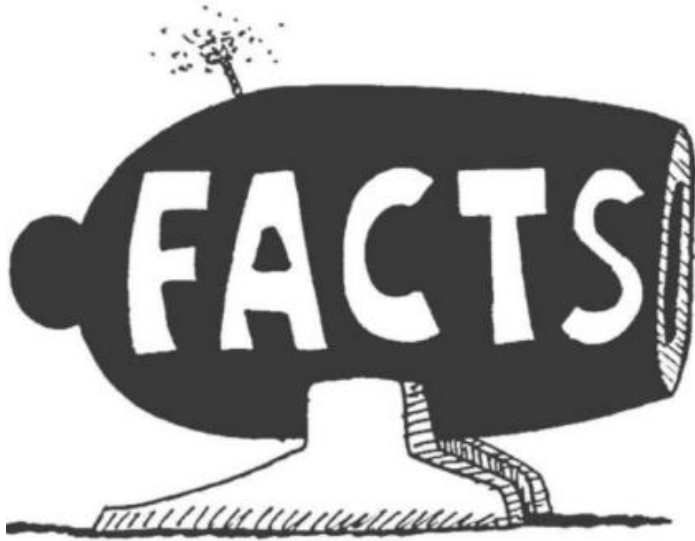
**Need to convince AND motivate**

**DENIER / DISMISSIVE**

**Facts do not matter at all**



# THE SCIENCE



## REASONS FOR DENIAL

**TRIBALISM**

(reps v. dems)

**HATRED OF GOVERNMENT**

(They will have to regulate us)

**FEAR OF IMPACT ON LIFESTYLE**

(I won't be able to drive my Hummer)

**RELIGION**

(God could not possibly allow this to happen)

**ASSUMED COST**

(reps v. dems)

**BELIEF IN CONSPIRACY THEORIES**

# THE SCIENCE

## THE SCIENCE IS INCONTROVERTIBLE:

- EARTH IS GETTING WARMER
- HUMAN ACTIONS ARE THE MAIN CAUSE
- THE IMPACT WILL BE VERY BAD

# THE SCIENCE

**WHY IS EARTH A NICE, COZY, RELATIVELY  
STABLE TEMPERATURE?**

**BECAUSE OUR ATMOSPHERE HAS NATURALLY  
OCCURRING GREENHOUSE GASES THAT RETAIN HEAT**

- EARTH'S AVERAGE TEMPERATURE IS ABOUT 57-59 DEG F.
- WITHOUT GREENHOUSE GASES, EARTH'S AVERAGE TEMPERATURE WOULD BE ABOUT 0 DEG F, AND LIFE WOULD NOT EXIST ON EARTH IN ITS PRESENT FORM.

# THE SCIENCE

## THE SCIENCE IS NOT NEW

- **1827:** JOSEPH FOURIER – CALCULATED EARTH SHOULD BE AROUND 0°F. HE PROPOSED THAT THE ATMOSPHERE TRAPPED HEAT, CAUSING EARTH TO BE WARMER
- **1860's:** JOHN TYNDAL – RAN EXPERIMENTS ON INFRARED ABSORPTION CAPACITY OF GASES; FOUND CO<sub>2</sub> AND WATER VAPOR ARE GOOD ABSORBERS.

# THE SCIENCE

## THE SCIENCE IS NOT NEW

- **1896:** NOBEL PRIZE WINNING CHEMIST SVANTE ARRHENIUS DISCOVERED THE PRINCIPLE OF HOW INFRARED ABSORPTION OF WATER VAPOR AND CO<sub>2</sub> KEEPS EARTH WARM.
- HE EVEN ACCURATELY CALCULATED THE IMPACT OF CO<sub>2</sub> ON WARMING – USING PENCIL & PAPER (CALCULATED A DOUBLING OF CO<sub>2</sub> WOULD RESULT IN 6° C RISE. CURRENT SCIENCE CALCULATES 3°± 1.5 °C .

# THE SCIENCE

## THE SCIENCE IS NOT NEW

- **1988: GLOBAL WARMING BROUGHT TO PROMINENT NATIONAL ATTENTION IN JUNE 1988.**
- **JAMES HANSEN / DIRECTOR NASA'S INSTITUTE FOR SPACE STUDIES, TESTIFIED BEFORE SENATE ENERGY & NATURAL RESOURCES COMMITTEE.**
- **DR. HANSEN TESTIFIED IT WAS 99% CERTAIN THAT OBSERVED WARMING WAS NOT A NATURAL VARIATION BUT WAS CAUSED BY BUILD-UP OF CO2 AND OTHER ARTIFICIAL GASES.**

# THE SCIENCE

# THE IPCC

**(INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE)**

**Established 1988 by the World Meteorological Organization (WMO)  
and the United Nations Environment Programme (UNEP)**

- THE PRE-EMINENT SOURCE OF EXPERTISE & INFORMATION ON GLOBAL WARMING**
- 195 MEMBER NATIONS, >2500 SCIENTIFIC EXPERT REVIEWERS, >800 CONTRIBUTING AUTHORS**

# THE SCIENCE

**IPCC: “WARMING OF THE CLIMATE SYSTEM IS UNEQUIVOCAL, AND SINCE THE 1950’s, MANY OF THE OBSERVED CHANGES ARE UNPRECEDENTED OVER DECADES TO MILLENNIA. THE ATMOSPHERE AND OCEAN HAVE WARMED, THE AMOUNTS OF SNOW AND ICE HAVE DIMINISHED, SEA LEVEL HAS RISEN, AND THE CONCENTRATIONS OF GREENHOUSE GASES HAVE INCREASED.”**



# THE SCIENCE

## **97% OF CLIMATE SCIENTISTS AGREE \***

- GLOBAL WARMING IS REAL
- IT'S CAUSED BY INCREASED GREENHOUSE GASES
- HUMAN ACTIVITY IS CAUSING ALMOST ALL THE INCREASE

\* From NASA - <https://climate.nasa.gov/scientific-consensus/>

“ACTIVELY PUBLISHING CLIMATE SCIENTISTS” ... “IN ADDITION, MOST OF THE LEADING SCIENTIFIC ORGANIZATIONS WORLDWIDE HAVE ISSUED PUBLIC STATEMENTS ENDORSING THIS POSITION.”

# THE SCIENCE

FROM NASA <https://climate.nasa.gov/scientific-consensus/>

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

AMERICAN CHEMICAL SOCIETY

AMERICAN GEOPHYSICAL UNION

AMERICAN MEDICAL ASSOCIATION

AMERICAN METEOROLOGICAL SOCIETY

AMERICAN PHYSICAL SOCIETY

THE GEOLOGICAL SOCIETY OF AMERICA

U.S. NATIONAL ACADEMY OF SCIENCES

U.S. GLOBAL CHANGE RESEARCH PROGRAM

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

MORE: LIST OF NEARLY 200 WORLDWIDE SCIENTIFIC ORGANIZATIONS THAT HOLD THE POSITION THAT CLIMATE CHANGE HAS BEEN CAUSED BY HUMAN ACTION.

[HTTP://WWW.OPR.CA.GOV/FACTS/LIST-OF-SCIENTIFIC-ORGANIZATIONS.HTML](http://www.opr.ca.gov/facts/list-of-scientific-organizations.html)

# THE SCIENCE

IN SUM

---

**THE SCIENCE IS ESTABLISHED**

---

**WE HAVE KNOWN THE WORLD IS  
WARMING DUE TO MAN'S ACTIVITIES  
FOR MORE THAN 40 YEARS**

---

**BUT HAVE FAILED TO DO  
ANYTHING ABOUT IT**

# THE SCIENCE

## PLAYING THE ODDS

80 – 90 – 95 – 97 ??

WHO CARES?

THE AGREEMENT IS OVERWHELMING

# THE SCIENCE

## ELECTROMAGNETIC RADIATION - EMR

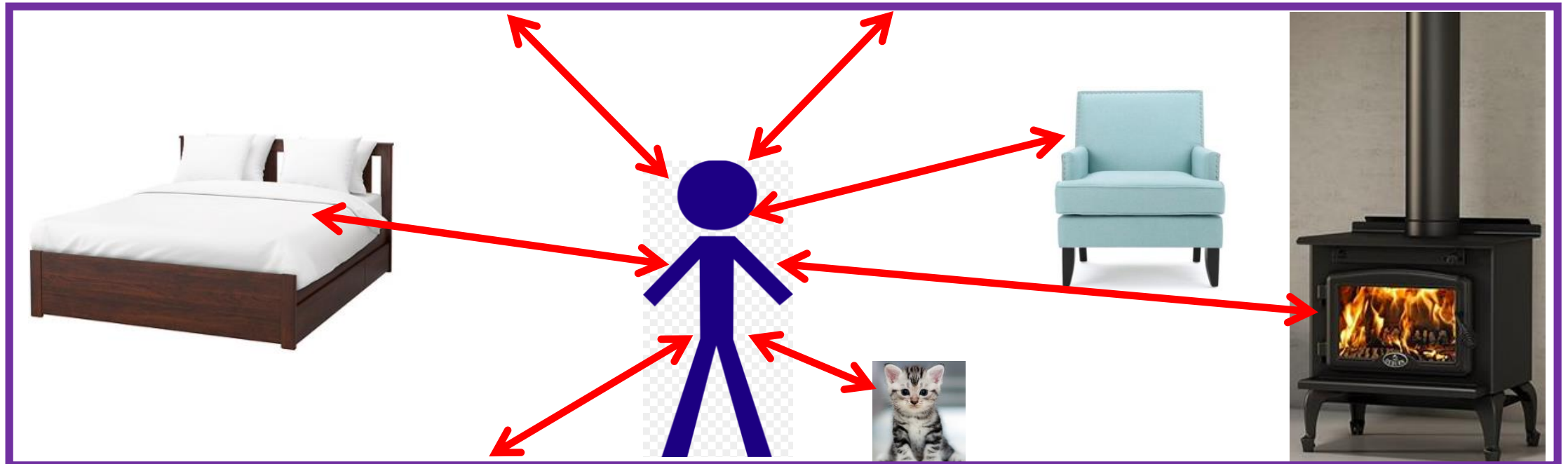
UNDERSTANDING BASICS OF EMR IS  
KEY TO UNDERSTANDING GLOBAL WARMING

- EMR IS MERELY ENERGY TRANSMITTED IN WAVES
- EVERYTHING WITH A TEMPERATURE ABOVE ABSOLUTE ZERO EMITS EMR

**ABSOLUTE ZERO = -459.7 deg F / -273.2 deg C**

# THE SCIENCE

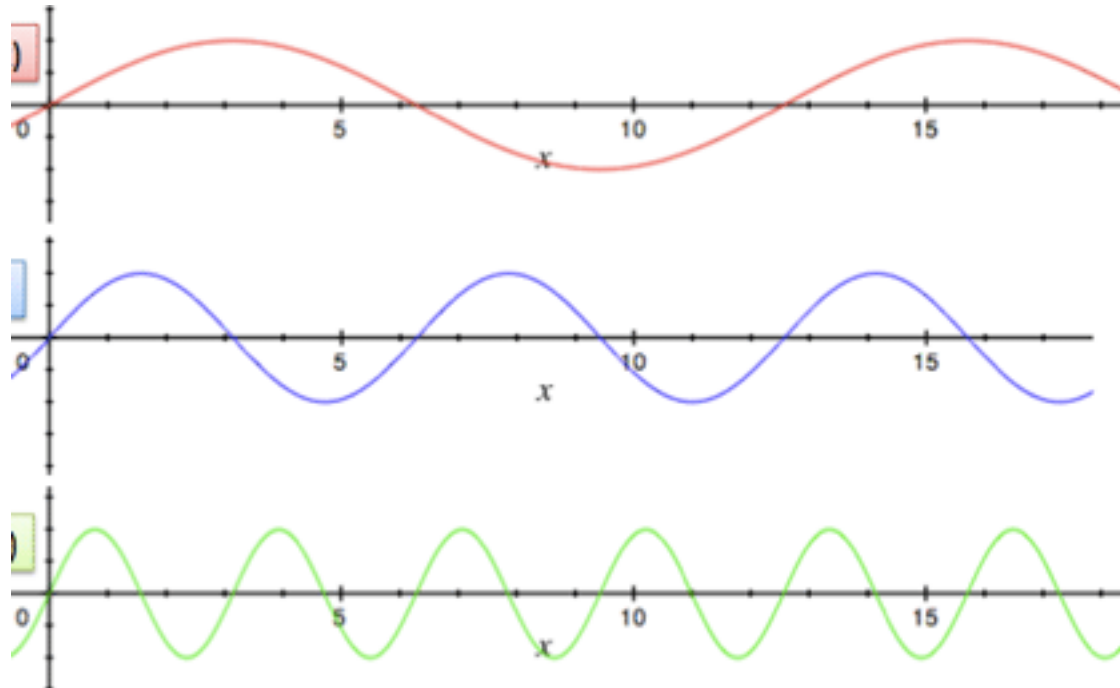
**EVERYTHING WITH A TEMPERATURE IS  
EXCHANGING EMR WITH EVERYTHING  
ELSE THAT IT CAN 'SEE' ALL THE TIME**



# THE SCIENCE

**EMR VARIES IN FREQUENCY**

**WAVE LENGTH VARIES - SHORT TO LONG**



**MULTIPLE WAVELENGTHS ARE  
EMITTED SIMULTANEOUSLY**

# THE SCIENCE

## **WHAT DETERMINES THE NATURE OF THE EMR WAVES?**

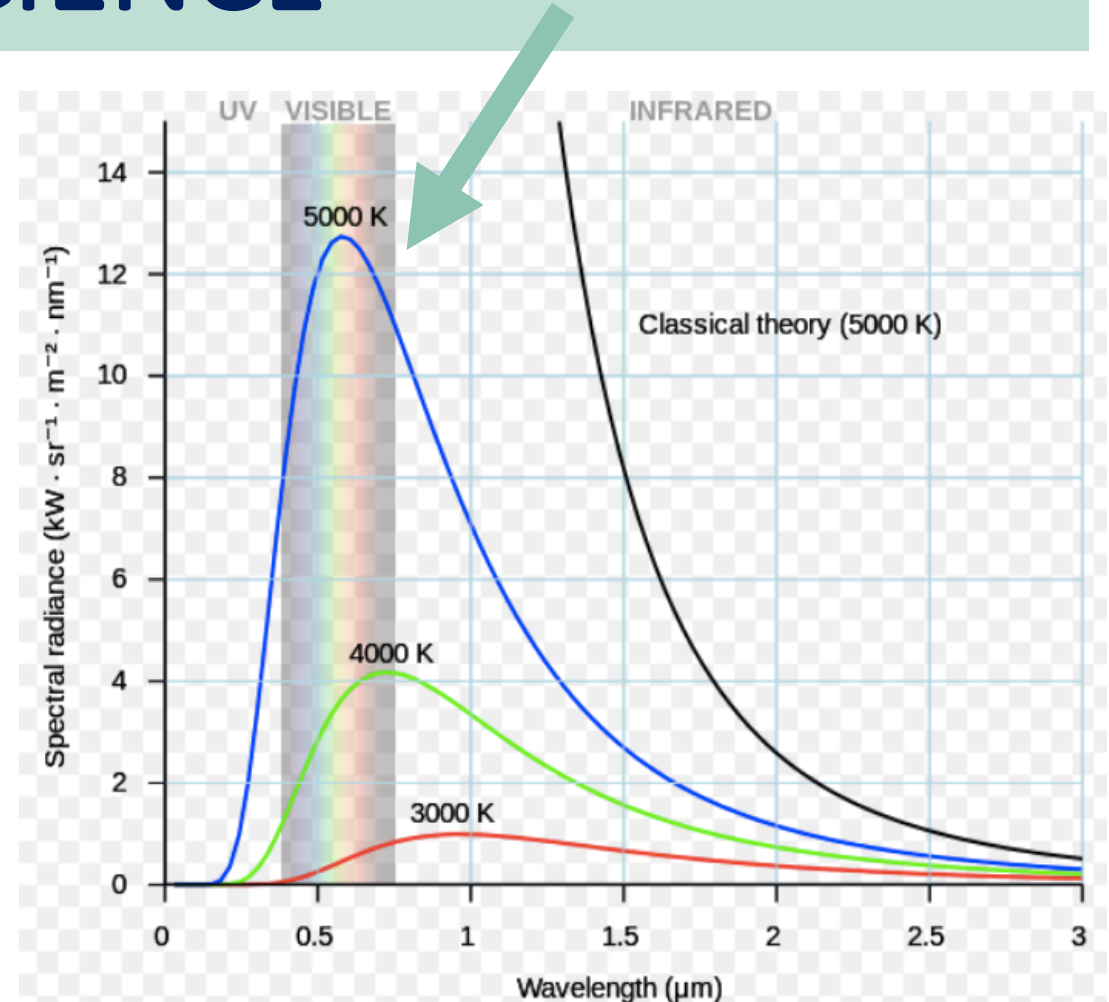
**THE FREQUENCY DISTRIBUTION OF AN EMR WAVE  
IS RELATED TO TEMPERATURE OF THE SOURCE**



# THE SCIENCE

- SUN'S SURFACE IS  $\pm 10,000$  DEG F (5800K) (vs 27million deg F interior)
- EARTH'S AVERAGE TEMPERATURE IS 57F ( $\pm 300$ K)

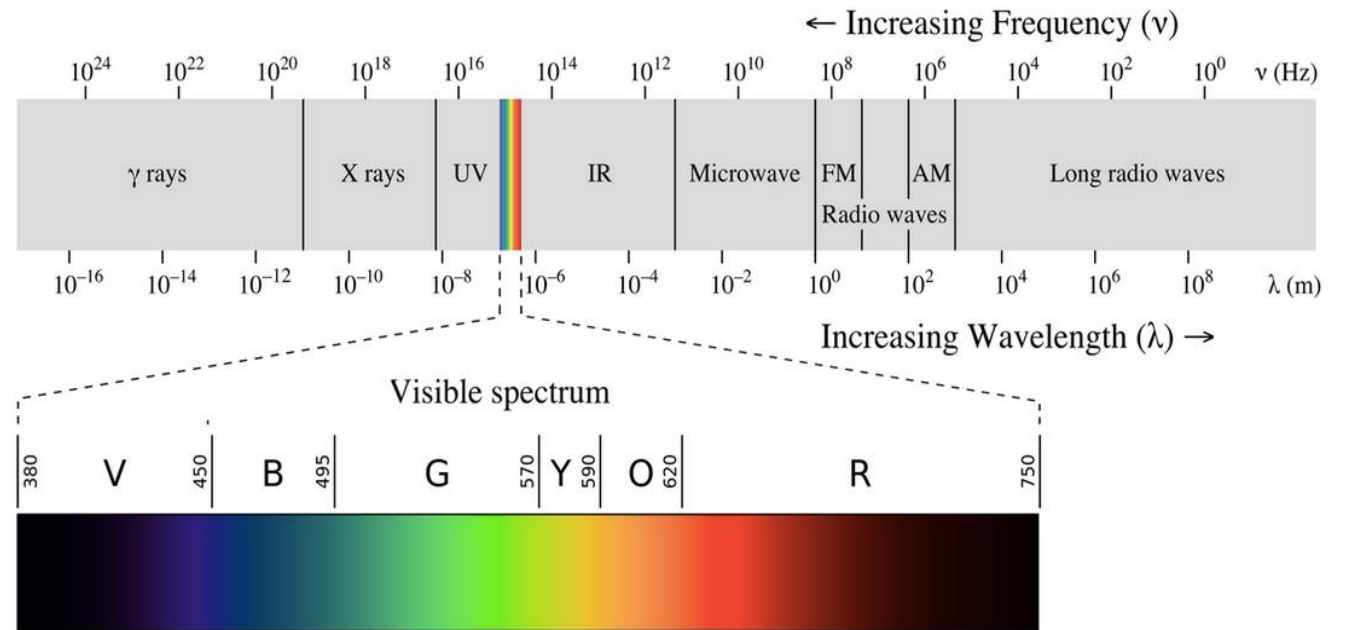
**EMR EMITTED BY SUN AND EARTH IS THEREFORE VERY DIFFERENT**



# THE SCIENCE

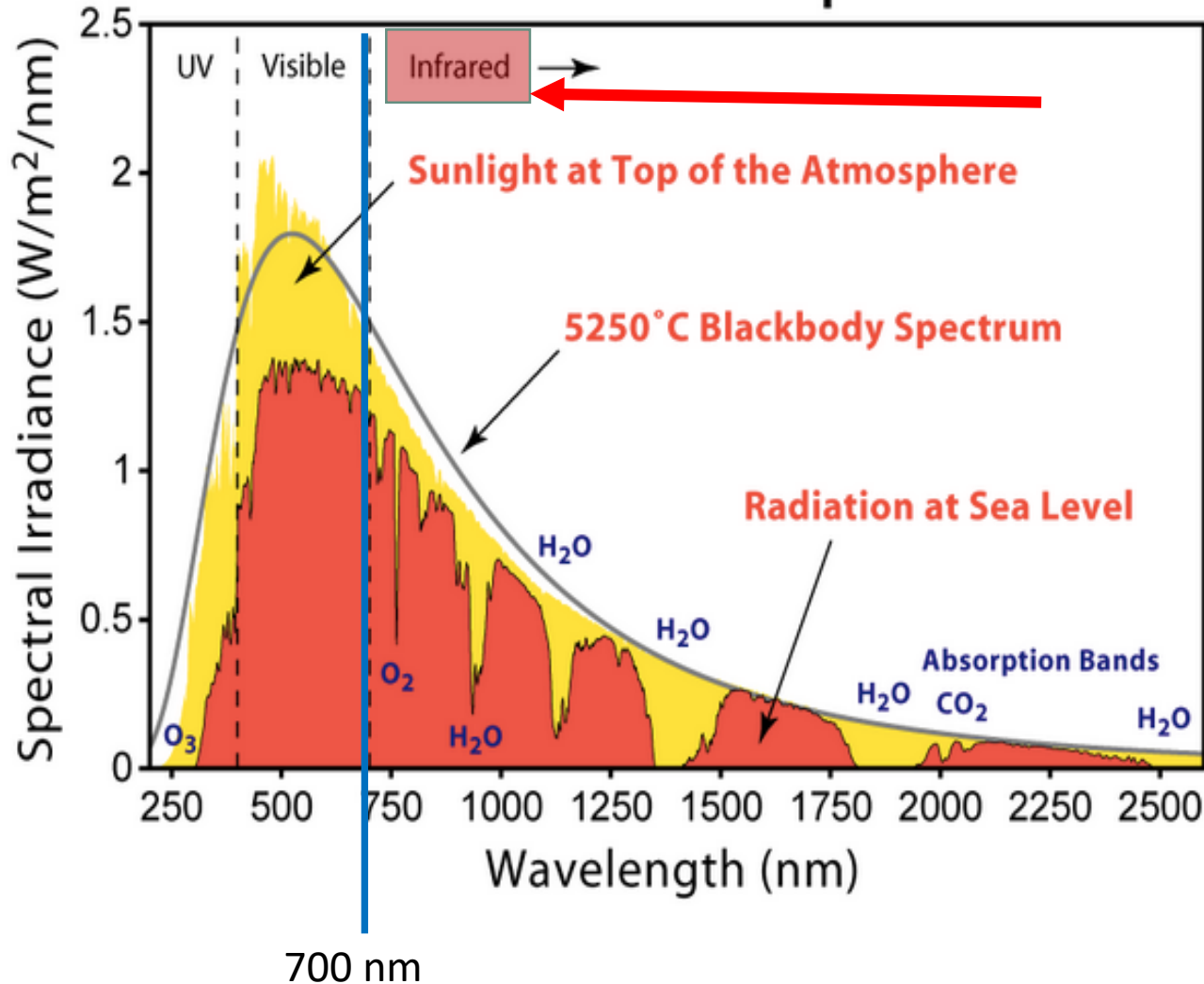
**SUNLIGHT IS THE EMR BEST KNOWN TO YOU**

**YOU HAVE  
HEARD OF, BUT  
ARE PHYSICALLY  
UNAWARE OF,  
MOST OF THE  
SOLAR EMR  
SPECTRUM**



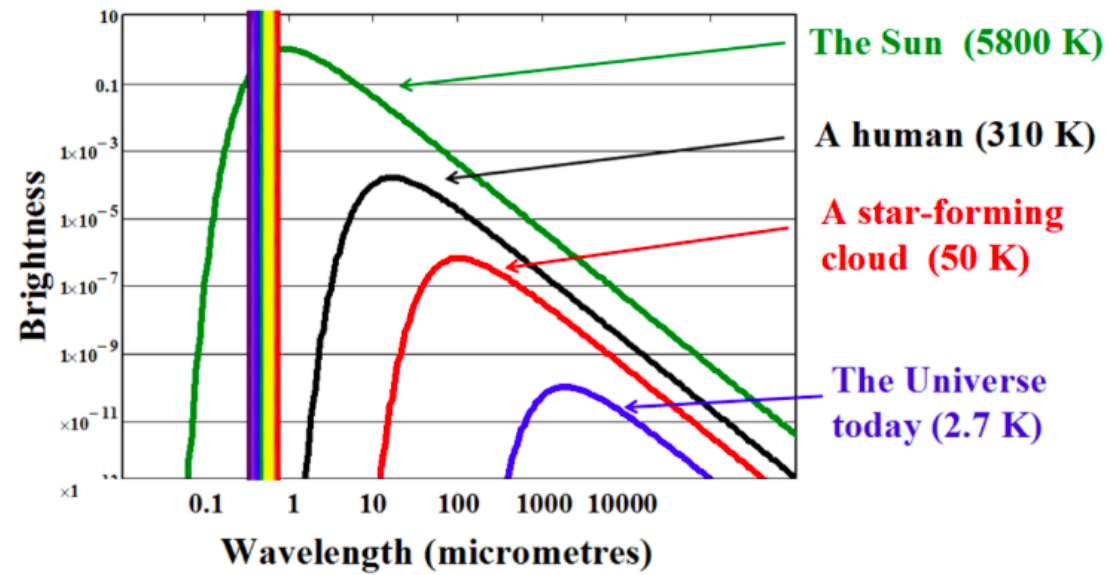
# THE SCIENCE

## Solar Radiation Spectrum

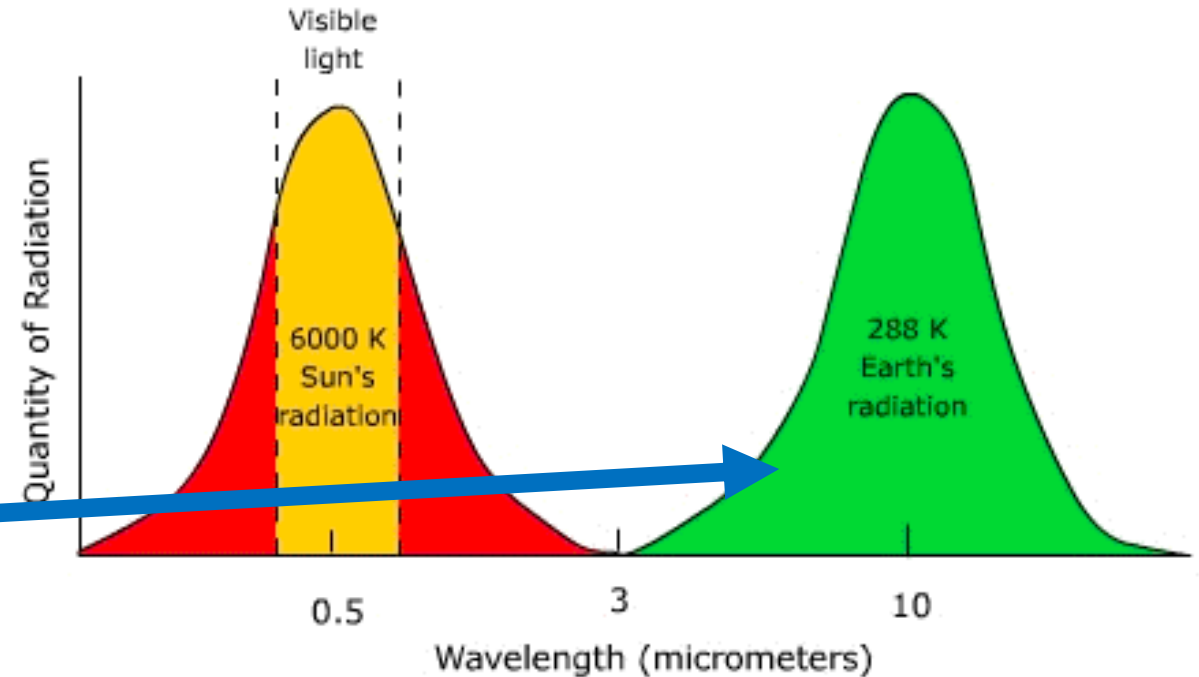


Sunlight hitting Earth's surface is 52 to 55 percent infrared (above 700nm), 42 to 43 percent visible (400 to 700 nm), and 3 to 5 percent ultraviolet (below 400 nm).

# THE SCIENCE



Comparison of Solar and Earth Radiation Spectra



EARTH, BEING A  
COLD 57°F, EMITS  
ONLY INFRARED EMR

# THE SCIENCE

**REMEMBER: RAT**

**(or TAR or ART or TRA)**

**REFLECT**

**ABSORB**

**TRANSMIT**

# THE SCIENCE

## HOW INCOMING SOLAR EMR INTERACTS WITH EARTH'S ATMOSPHERE

**REFLECT: 17%**

**ABSORB: 35%**

**TRANSMIT: 48%**

# THE SCIENCE

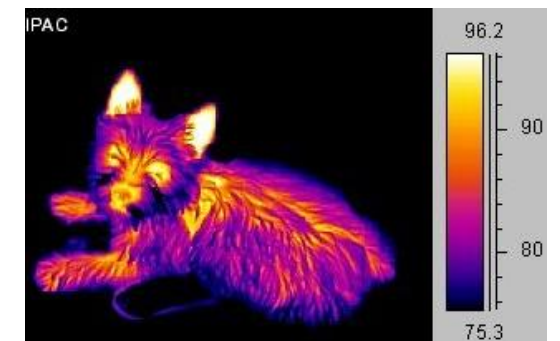
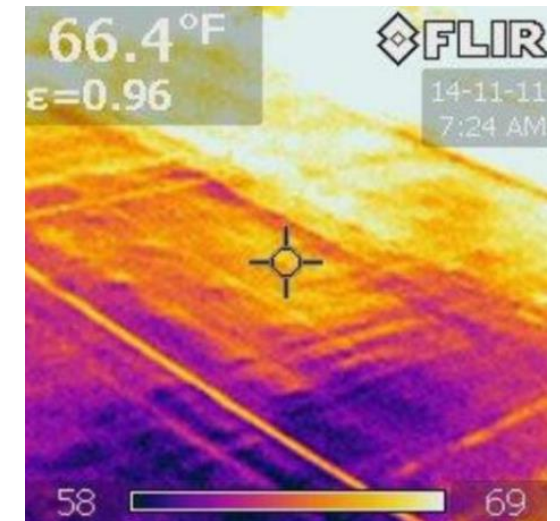
## HOW OUTGOING INFRARED EMR INTERACTS WITH EARTH'S ATMOSPHERE

COMPLICATED DUE TO HUNDREDS OF FACTORS SUCH AS ATMOSPHERIC CHEMISTRY, VARYING SURFACE TEMPERATURES, CLOUDS AND WATER VAPOR, EARTH'S ROTATION, ETC. BUT - SCIENTISTS:

- MEASURE THE ULTIMATE EMR WITH GREAT ACCURACY.
- CONSTRUCT MODELS THAT VERY ACCURATELY PREDICT THE PROCESSES.

# THE SCIENCE

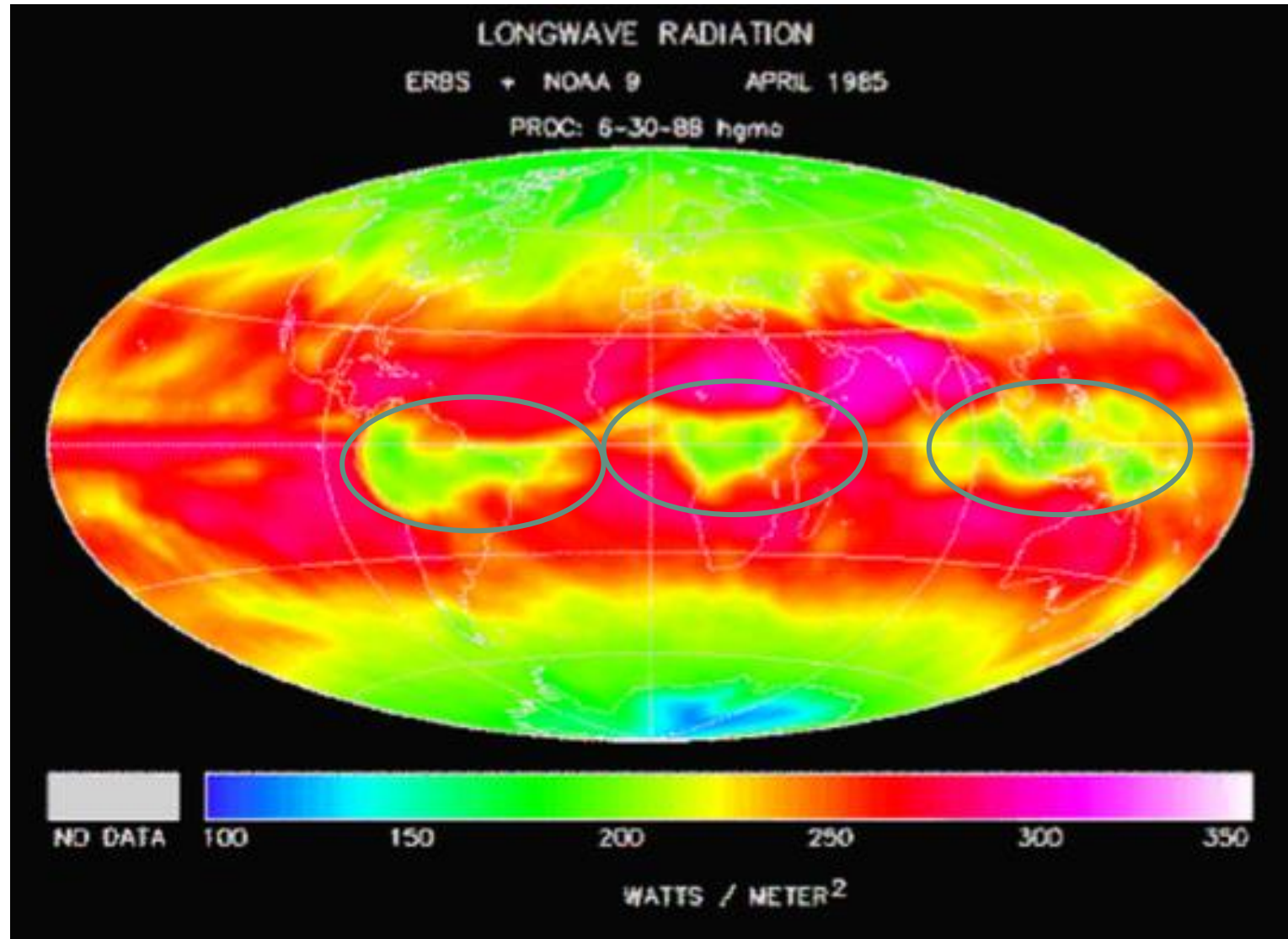
- INFRARED RADIATION





# THE SCIENCE

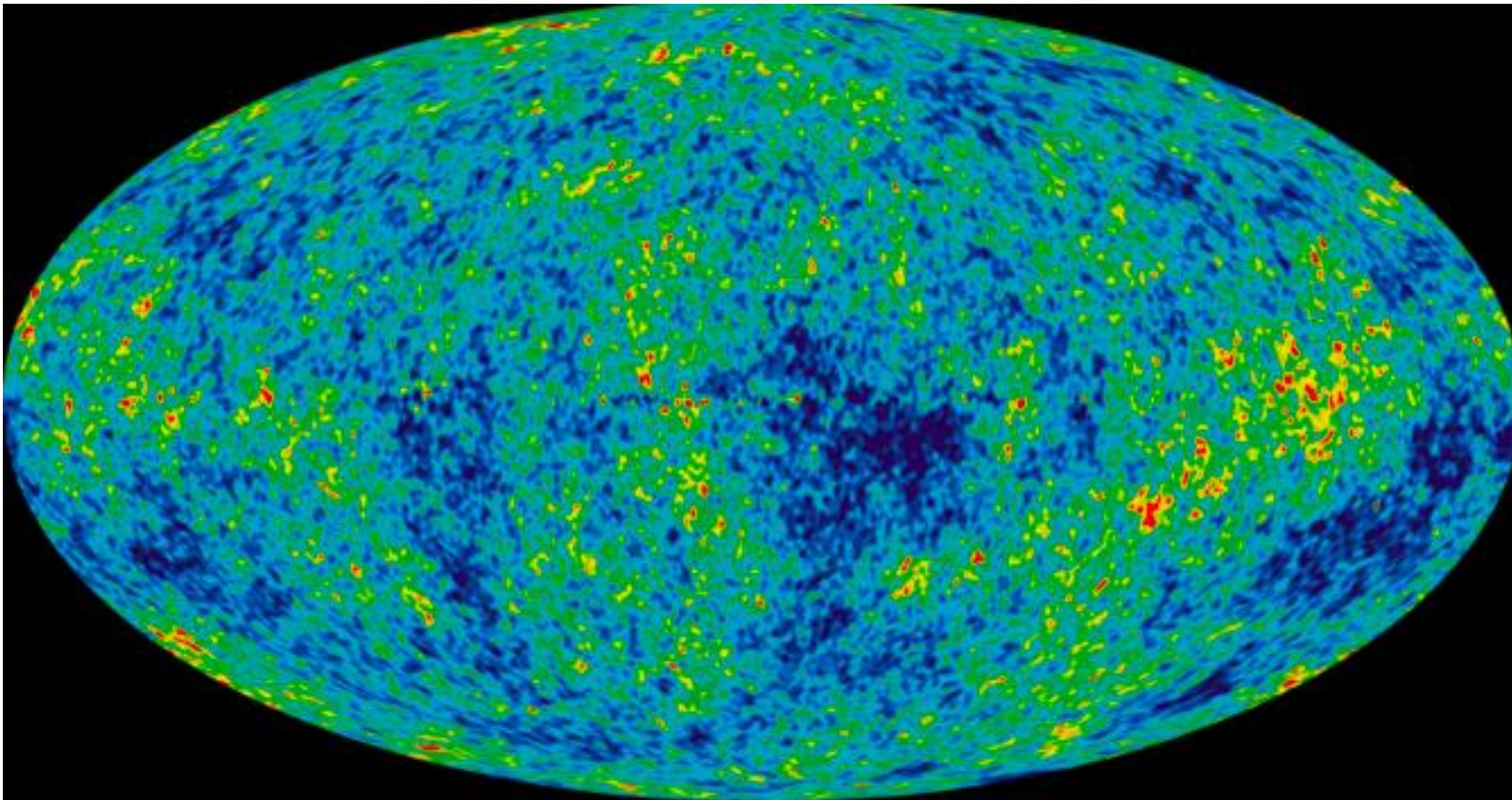
EARTH'S  
LONGWAVE  
RADIATION  
INTENSITY  
FROM CLOUDS,  
ATMOSPHERE,  
GROUND



# THE SCIENCE

## THE UNIVERSE

2-3°C > absolute zero



# THE SCIENCE

EVERY MOLECULE IN OUR ATMOSPHERE  
INTERACTS UNIQUELY TO VARYING  
WAVELENGTHS OF EMR

REMEMBER

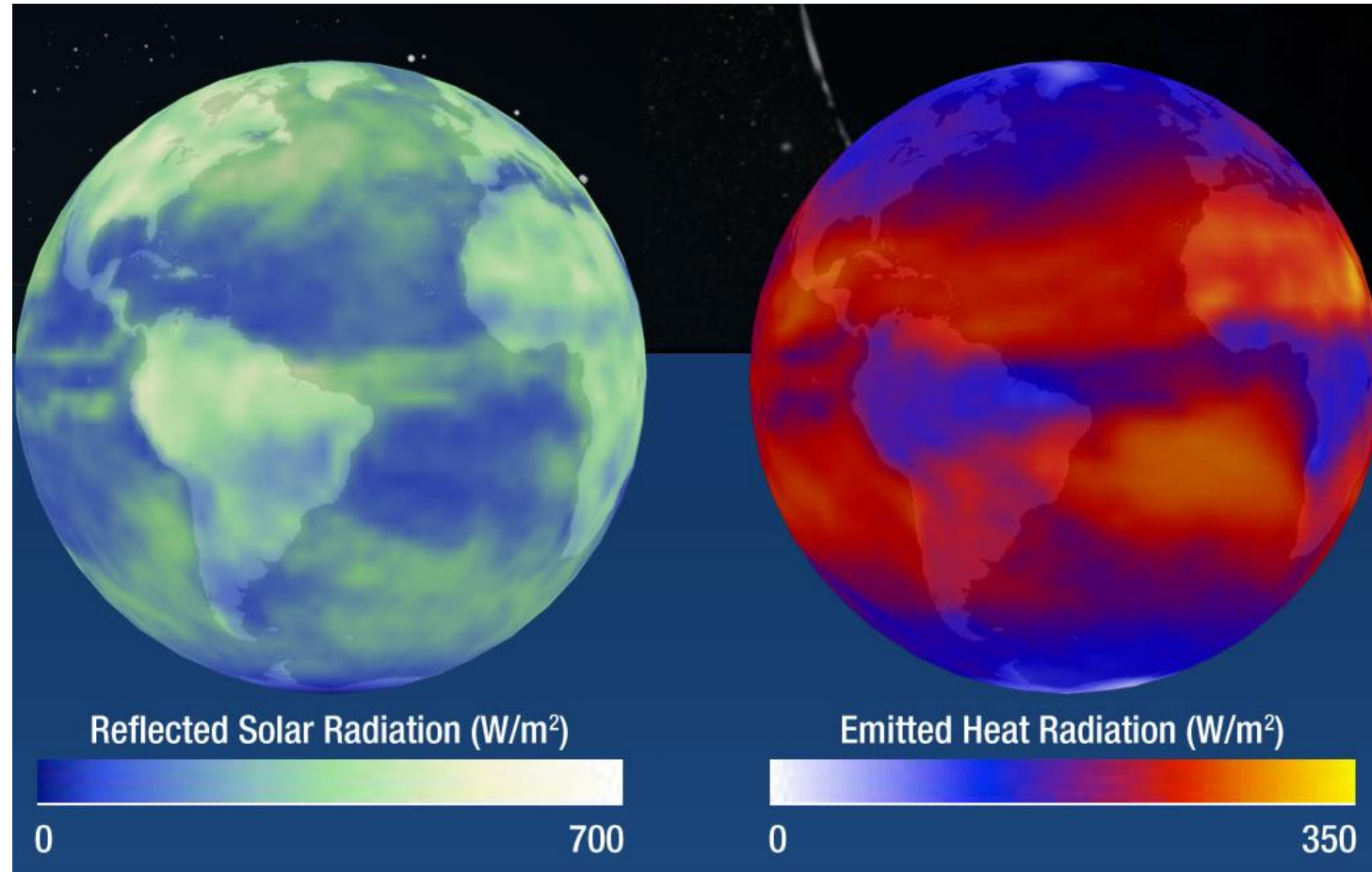
**RAT**

EXAMPLES:

NITROGEN --- OXYGEN(O<sub>2</sub>) --- WATER VAPOR --- OZONE (O<sub>3</sub>) --- ARGON  
CO<sub>2</sub> --- CFC's --- AEROSOLS --- TRACE GASES (METHANE, NO<sub>2</sub>, ETC.)

# THE SCIENCE

## REFLECTED VS. EMITTED





# THE SCIENCE

## DYNAMIC EQUILIBRIUM



WHY DOESN'T YOUR CAR  
KEEP GETTING HOTTER AND  
HOTTER SITTING IN THE SUN?  
IT ULTIMATELY REACHES AN  
EQUILIBRIUM POINT –  
INCOMING AND OUTGOING  
HEAT EQUALIZE

# THE SCIENCE

## DYNAMIC EQUILIBRIUM



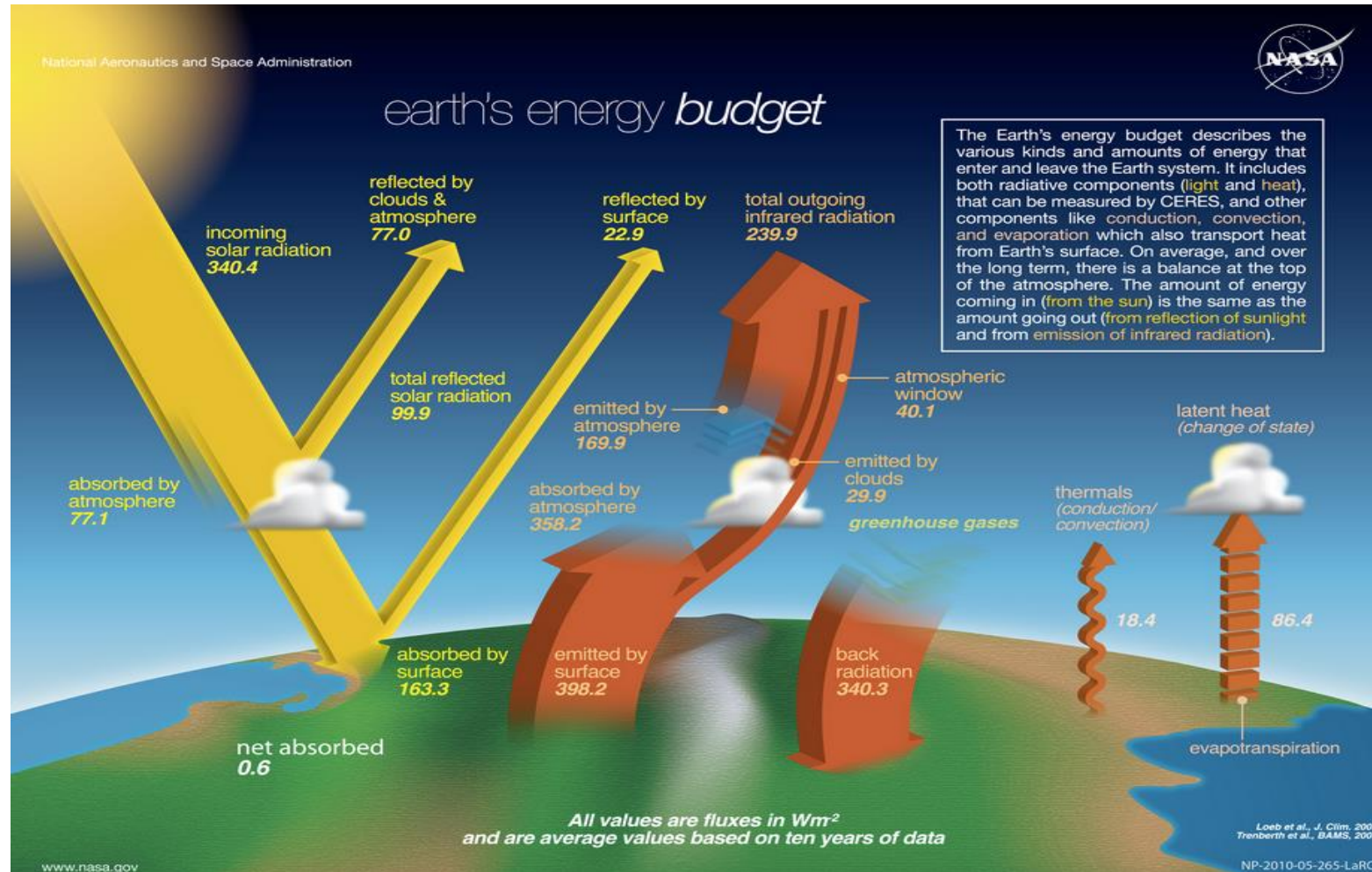
CONDITIONS ARE ALWAYS CHANGING

CHANGED CONDITIONS RESULT IN A  
NEW EQUILIBRIUM POINT

E.G., A BLACK CAR WILL REACH EQUILIBRIUM AT A HIGHER  
TEMPERATURE THAN A LIGHT COLORED MORE REFLECTIVE CAR

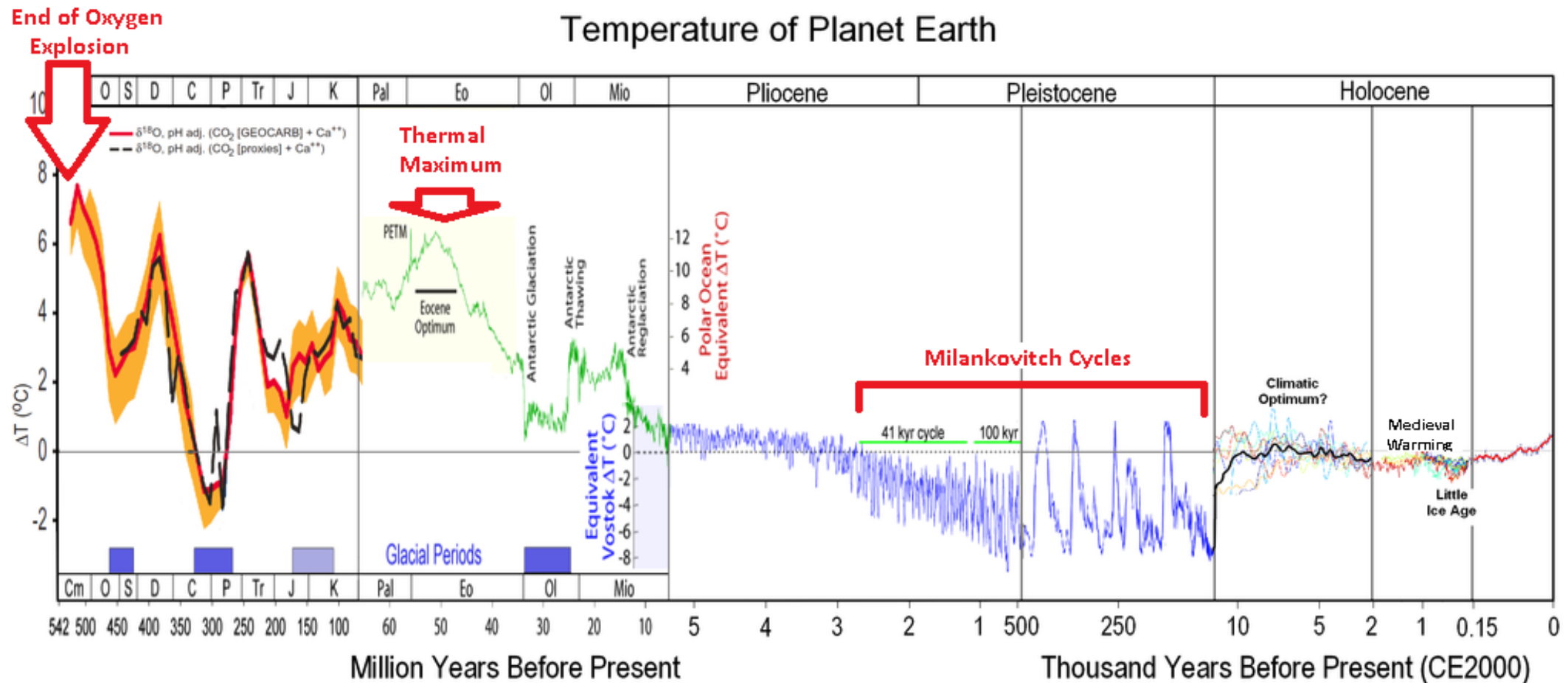
# THE SCIENCE

## EARTH'S DYNAMIC EQUILIBRIUM



# THE SCIENCE

EARTH IS ALWAYS IN DYNAMIC EQUILIBRIUM WHERE  
A 'TYPICAL' TEMPERATURE RANGE IS MAINTAINED





# THE SCIENCE

## THE 'TYPICAL' TEMPERATURE RANGE CHANGES OVER TIME / WITH CHANGING CONDITIONS

- The Oxygen Explosion (2.5 billion – 500 million years ago) due to cyanobacteria
- 500 – 250 million years ago – earth cools to temperatures 'similar' to today's
- Animal life, CO2 increase
- "Thermal Maximum" - Massive warming of 5-8 deg C in just 20,000 years (MOST LIKELY DUE TO CO2 INCREASE AND/OR METHANE [ICE CLATHRATES])
- THE ICE AGE STARTING 35 MILLION YEARS AGO (ICE ON THE POLES OF EARTH. WE ARE STILL IN AN ICE AGE.)

# THE SCIENCE

## FOR THE PAST 10 MILLION YEARS

- ❖ EARTH'S TEMPERATURE HAS BEEN ASTOUNDINGLY STABLE
- ❖ IT HAS NOT BEEN EVEN 1 DEG C WARMER THAN IT IS TODAY
- ❖ IT HAS BEEN COLDER BY UP 2+ DEG C (MILANKOVITCH CYCLES)
  - **Orbit Eccentricity** – more spherical to more elliptical ~95,000-100,000 years cycle
  - **Axis Tilt** – 22.1-24.3° (now @23.45°) over a ~41,000 year cycle
  - **Wobble** – 19,000-24,000 year cycle



# THE SCIENCE

**HUMANS ARE VERY RAPIDLY CHANGING THE  
DYNAMIC EQUILIBRIUM CONDITIONS OF  
EARTH BY EMITTING GREENHOUSE GASES**

**IF MORE OF THE INFRARED ENERGY LEAVING EARTH  
IS BLOCKED, EARTH'S TEMPERATURE WILL RISE  
UNTIL NEW EQUILIBRIUM IS REACHED**

# THE SCIENCE

## GREENHOUSE GASES

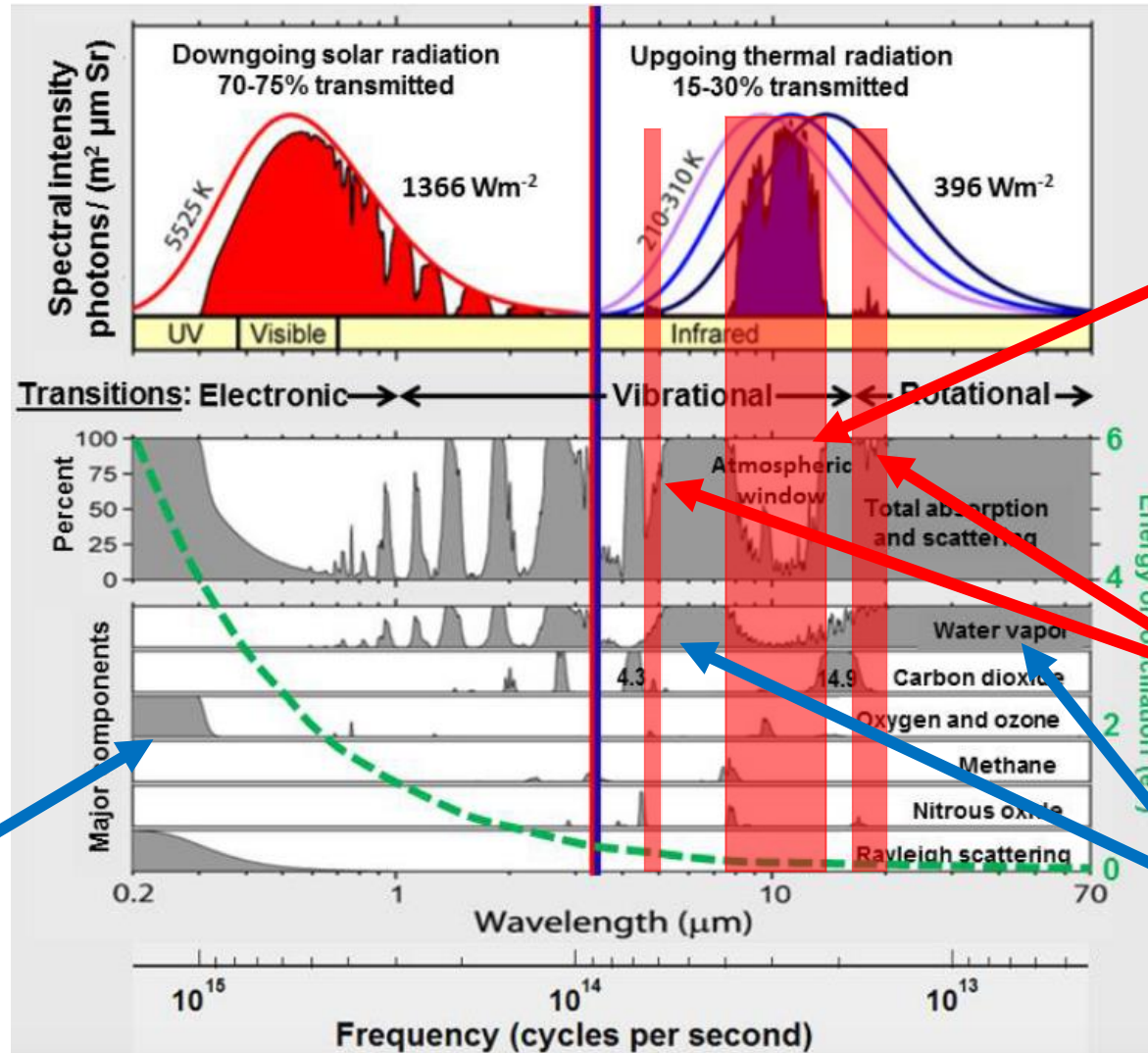
MOLECULES ABSORB INCOMING SOLAR ENERGY, AND INCREASE THEIR TEMPERATURE ACCORDINGLY. THEN RE-RADIATE HEAT TO THEIR SURROUNDINGS.

- When a greenhouse gas is abundant, the absorption lines for which it is active are said to become saturated - most of the available IR will have been absorbed by the molecules of that gas. Adding more of that gas will not absorb more IR in the proportion of the addition.
- Many of carbon dioxide's absorption lines are fairly well saturated. This is the fundamental reason that the 30 percent increase in carbon dioxide since the industrial revolution has not increased the background greenhouse effect by 30 percent.

# THE SCIENCE

## THE “A” IN RAT

### INCOMING SOLAR



### OUTGOING INFRARED

NON-SATURATED “WINDOW” WHERE MOST OF EARTH’S INFRARED HEAT IS SENT BACK INTO SPACE

SMALLER, SLIGHTLY MORE SATURATED BANDS WHERE A BIT MORE HEAT ESCAPES

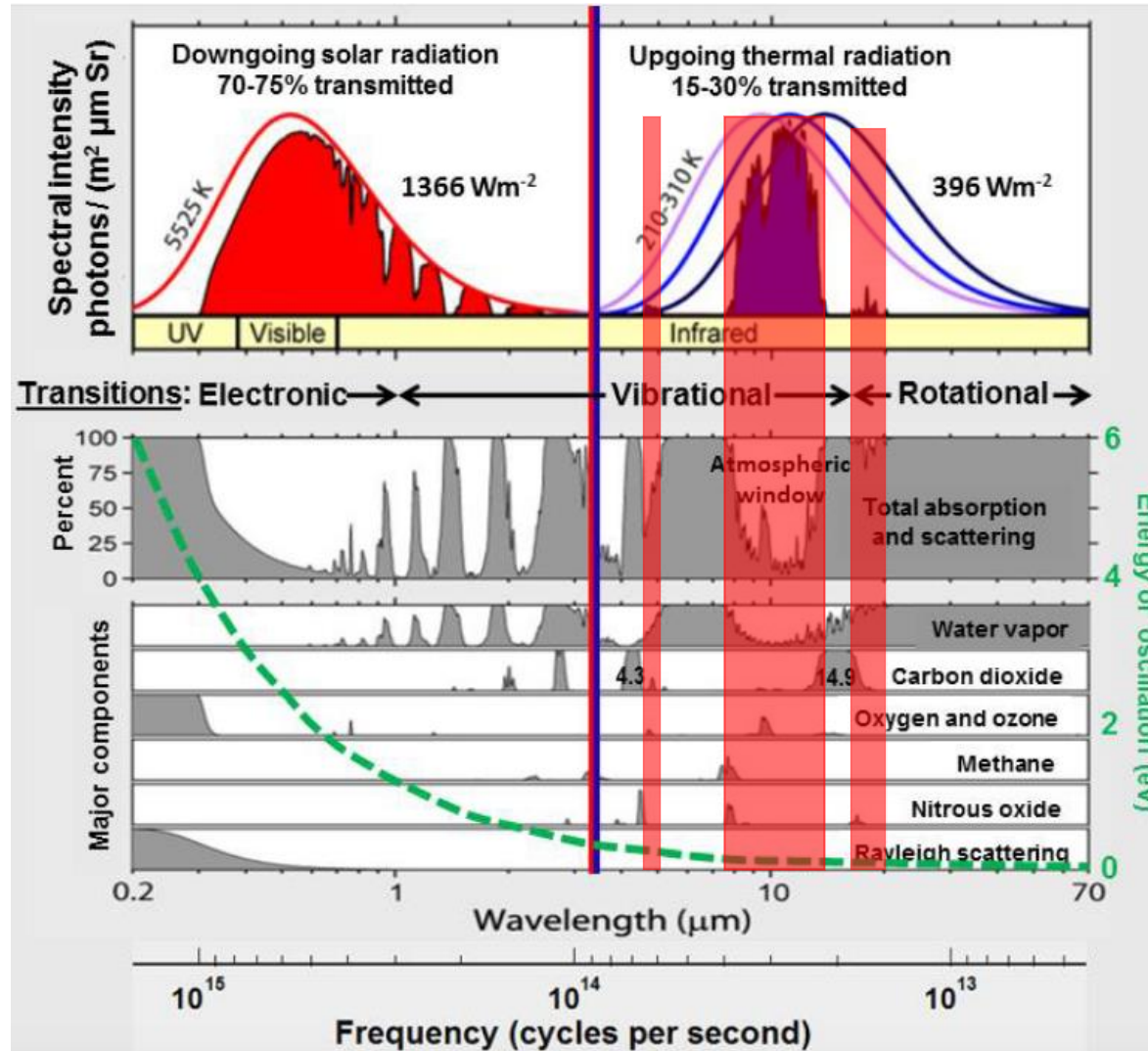
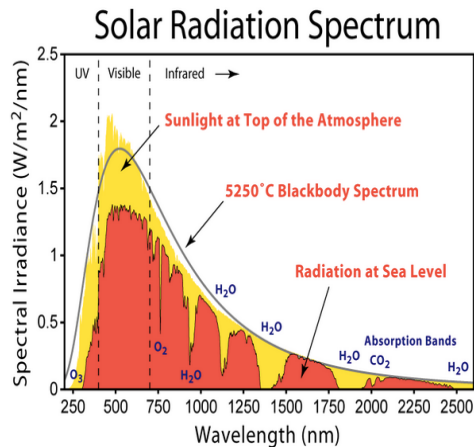
LOOK HOW POWERFUL WATER VAPOR IS IN THE LOWER FREQUENCY RANGE

AND LOOK AT HOW IMPORTANT OZONE IS IN THE UV RANGE

# THE SCIENCE

## THE “A” IN RAT

### INCOMING SOLAR



### OUTGOING INFRARED

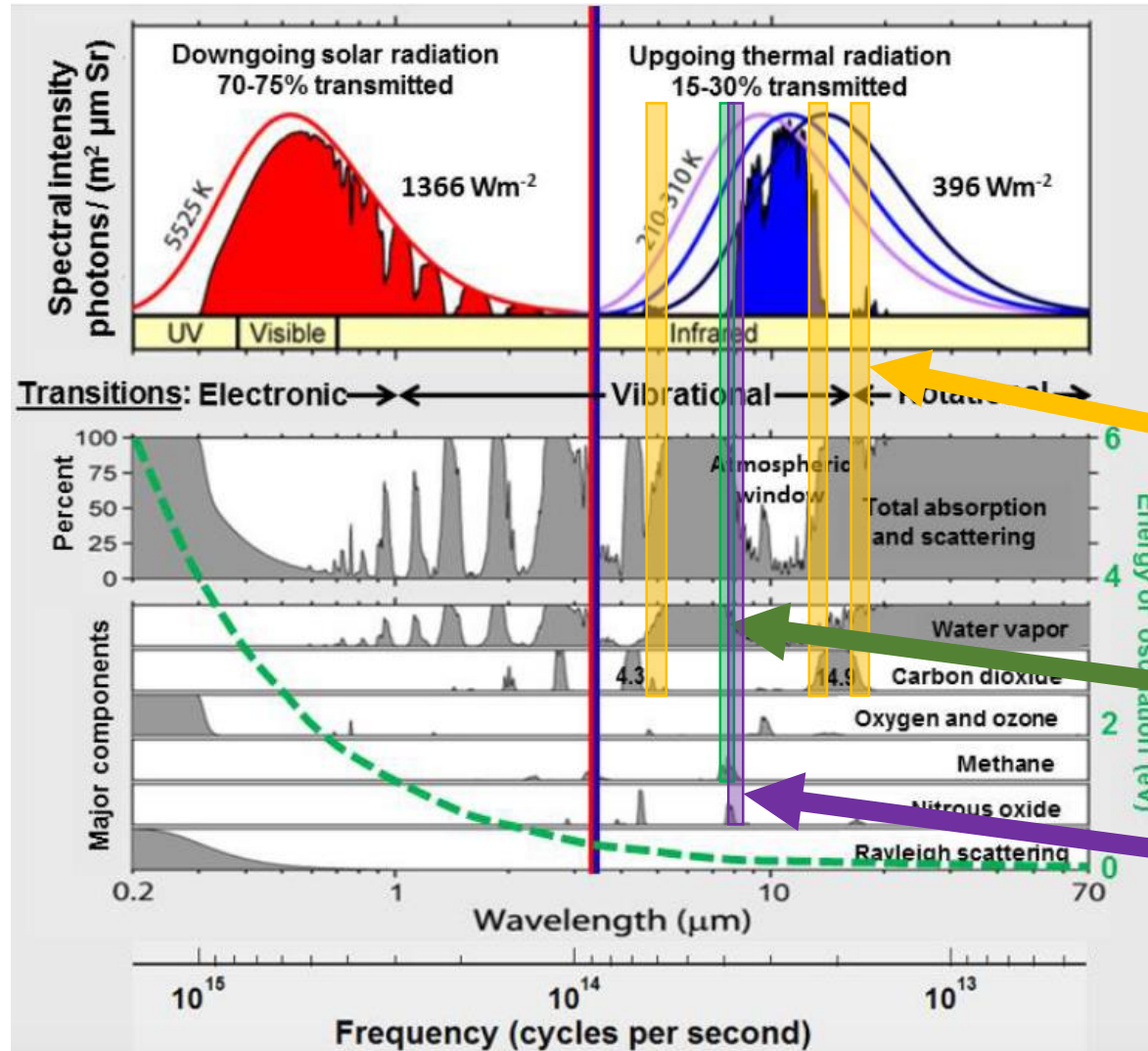
WHAT IS IMPORTANT:  
WHERE A  
GREENHOUSE GAS  
BLOCKS ADDITIONAL  
INFRARED IN THE  
NON-SATURATED  
BANDS INCREASES  
THE AMOUNT OF  
HEAT RETAINED BY  
THE EARTH



# THE SCIENCE

## THE “A” IN RAT

INCOMING  
SOLAR



OUTGOING  
INFRARED

NON-SATURATED  
CO<sub>2</sub> BANDS

NON-SATURATED  
METHANE BANDS

NON-SATURATED  
NO<sub>2</sub> BANDS

# THE SCIENCE

## GREENHOUSE GASES

RATED AS TO THEIR GLOBAL WARMING POTENTIAL

- CO<sub>2</sub> IS ASSIGNED A GWP OF 1.
- CO<sub>2</sub> IS NOT THE MOST POTENT GREENHOUSE GAS. IT IS CONSIDERED MOST IMPORTANT ONLY BECAUSE WE EMIT SO MUCH OF IT.
- ALL OTHER GREENHOUSE GAS GWP #'s ARE AS COMPARED TO CO<sub>2</sub>.
- GWP's TAKE INTO ACCOUNT NOT ONLY THEIR ABILITY TO BLOCK INFRARED, BUT ALSO THEIR LONGEVITY IN ATMOSPHERE AND INTERACTIVE EFFECTS.



# THE SCIENCE

## GREENHOUSE GASES DUE IN LARGE PART DUE TO MAN

CO <sub>2</sub>	1 GWP	concentrations of CO <sub>2</sub> will last 1000's of years.
Methane (CH <sub>4</sub> )	34 GWP	CH <sub>4</sub> lasts about a decade on average. GWP also accounts for indirect effects, such as that CH <sub>4</sub> is a precursor to ozone, and ozone is itself a GHG.
Nitrous Oxide (N <sub>2</sub> O)	298	N <sub>2</sub> O emitted today remains in atmosphere for more than 100 years, on average.
CFCs	5,350	R-11 chlorofluorocarbons
HFCs	1,550	R-134a hydrofluorocarbons
HCFC-123	79	
PFCs	6,630 - 9,540	perfluorocarbons
SF <sub>6</sub>	23,500	sulfur hexafluoride
Carbon tetrafluoride	7,350	CF <sub>4</sub>
Sulfur hexafluoride	22,800	

THE SCIENCE

**QUESTIONS**

# LOSING THE BATTLE

- EARTH'S GREENHOUSE GAS CONCENTRATION HAS BEEN STEADILY INCREASING OVER THE PAST COUPLE OF HUNDRED YEARS.
- THE VAST MAJORITY IS ATTRIBUTABLE TO THE BURNING OF FOSSIL FUELS (WE CAN TELL BECAUSE OF THE ISOTOPIC MIX OF CARBON IN THOSE FUELS).

# LOSING THE BATTLE

## RE 2013 IPCC REPORT

### CONCENTRATIONS OF CO<sub>2</sub>, CH<sub>4</sub> (METHANE), N<sub>2</sub>O

- ARE NOW SUBSTANTIALLY HIGHER THAN THEY'VE BEEN FOR THE PAST 800,000 YEARS
- HAVE ALL INCREASED SUBSTANTIALLY SINCE 1750 DUE TO HUMAN ACTIVITY
- 2011 CONCENTRATIONS EXCEEDED PRE-INDUSTRIAL LEVELS BY 40%, 150%, & 20%, RESPECTIVELY

# LOSING THE BATTLE

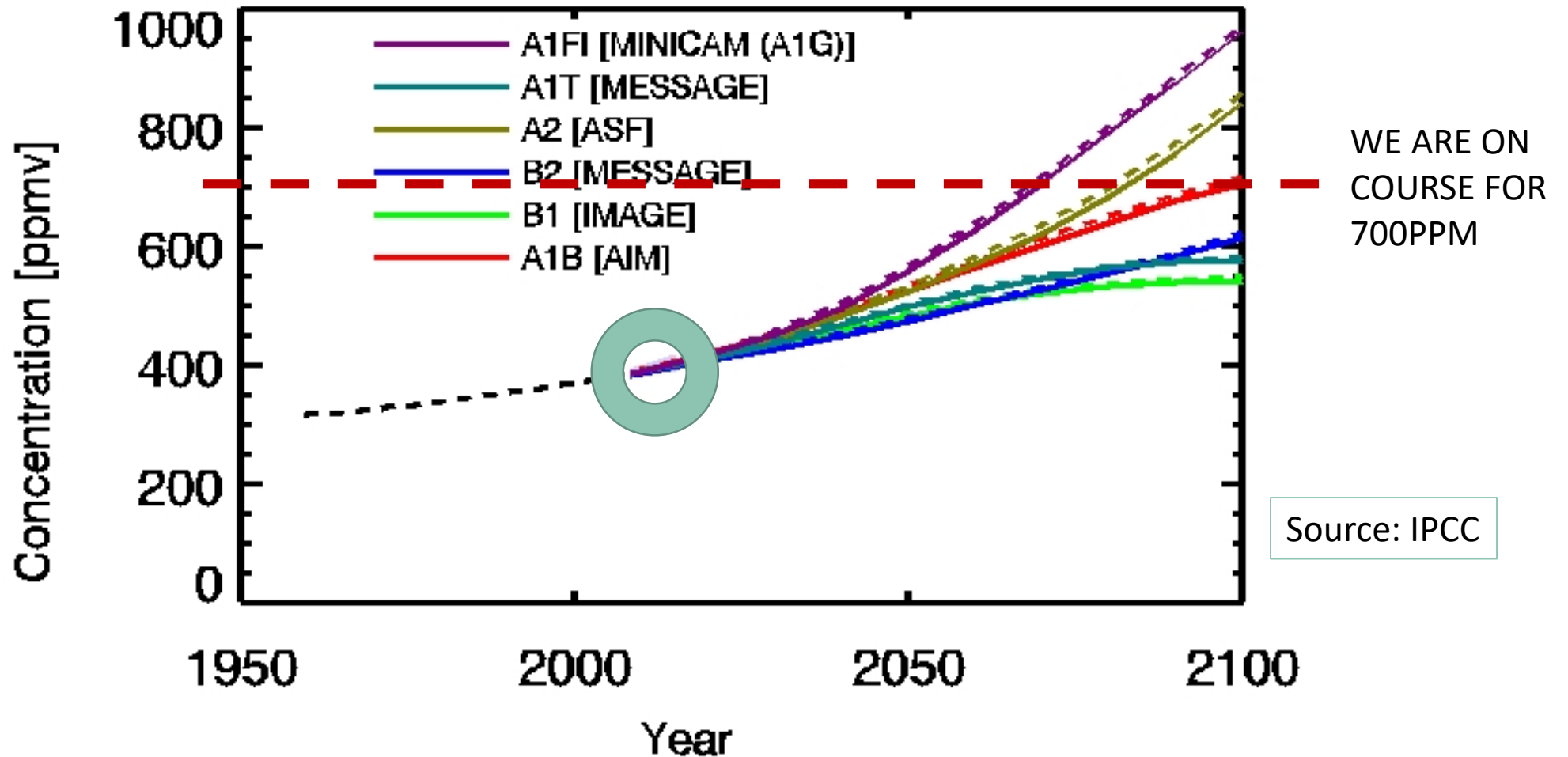
410 PPM CO<sub>2</sub> CONCENTRATION IS THE HIGHEST IT HAS BEEN IN AT LEAST THE LAST 800,000 YEARS



Source: NASA

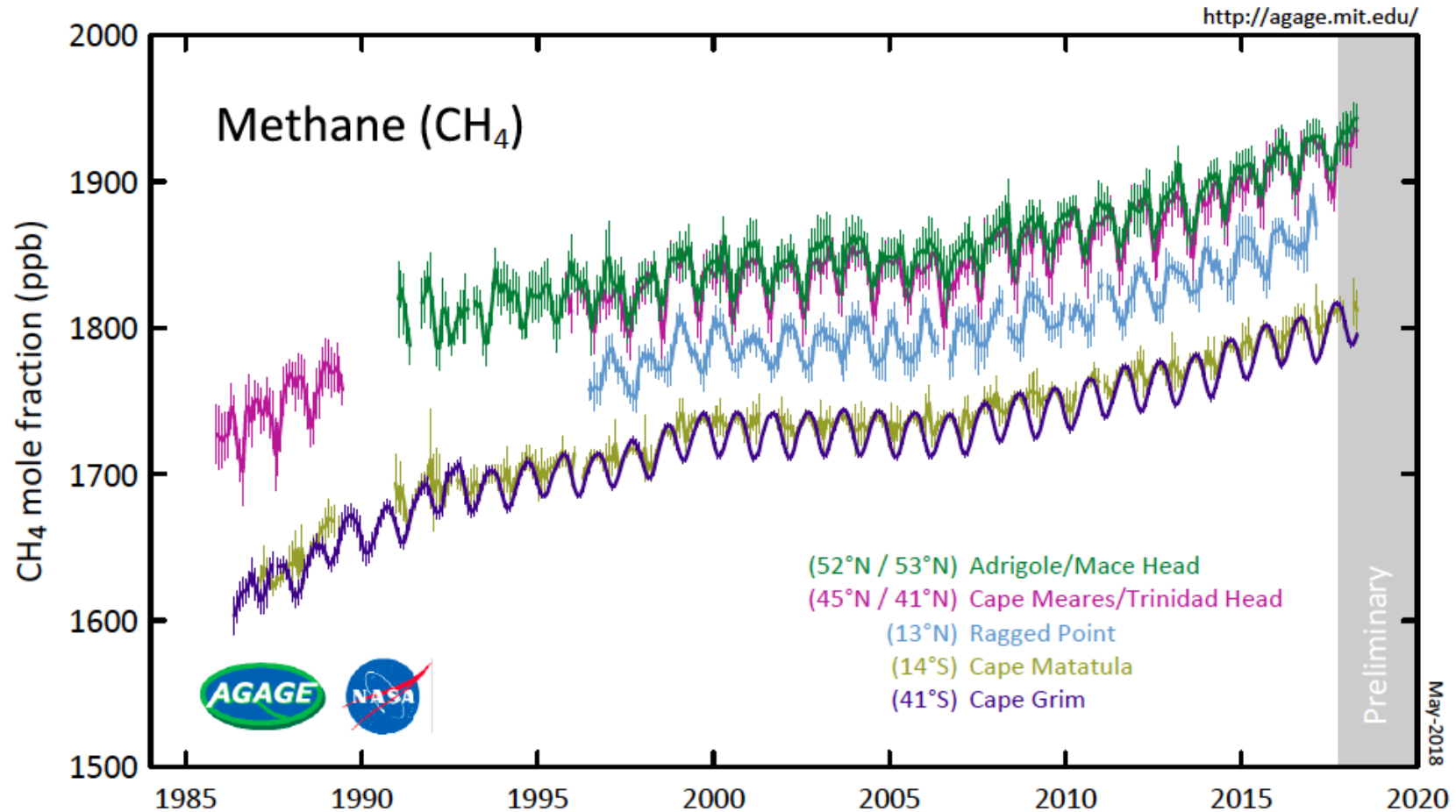
# LOSING THE BATTLE

- ROUGHLY 40+ BILLION TONS CO<sub>2</sub> EMITTED BY HUMANS IN 2017
- 2.5 MILLION TONS PER SECOND



# LOSING THE BATTLE

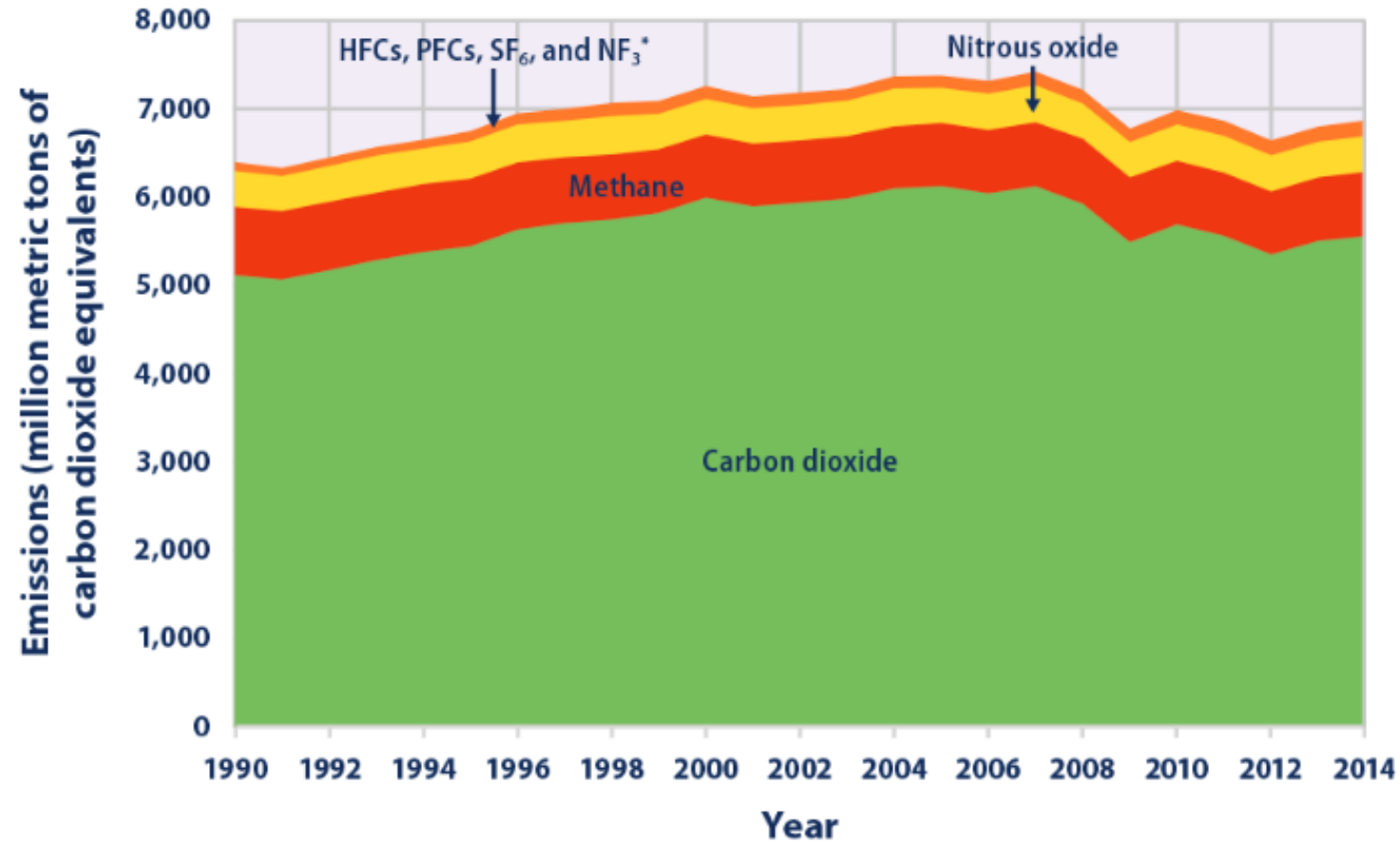
## METHANE EMISSION DUE TO HUMAN ACTIVITY (AND THEIR COWS)



Source:  
IPCC

# LOSING THE BATTLE

**Figure 1.** U.S. Greenhouse Gas Emissions by Gas, 1990–2014



Source: NASA



# LOSING THE BATTLE

FROM [HTTPS://CLIMATE.NASA.GOV/EVIDENCE/](https://climate.nasa.gov/evidence/)

Global temperature rise

Warming oceans

Shrinking ice sheets

Glacial retreat

Decreased snow cover

# LOSING THE BATTLE

FROM [HTTPS://CLIMATE.NASA.GOV/EVIDENCE/](https://climate.nasa.gov/evidence/)

Sea level rise

Declining Arctic sea ice

Extreme Weather Events

Ocean acidification

# THE IMPACT

**IF YOU THINK YOU, YOUR FRIENDS, FAMILY,  
AND COMMUNITY WILL NOT BE IMPACTED  
BY GLOBAL WARMING, YOU ARE**

**100% INCORRECT.**

**GLOBAL WARMING IS ALREADY IMPACTING YOU**

# THE IMPACT

- We are already feeling impact – storms, hurricanes, drought, flooding, more famine, heat-induced deaths, insects impacting ecosystems and humans, wildfires, ocean warming and acidification, death of coral reefs, species extinction, destruction of habitat, mass migration with resulting destabilization of governments and cultures, military actions, higher crime rates, higher insurance rates.
- Economic impacts.
- In short, we are conducting a real-time experiment with absolutely certain negative and potentially disastrous consequences.

# THE IMPACT

## ECONOMIC IMPACT

- **CITIBANK REPORT: ENERGY DARWINISM II**
  - LOOKED ONLY AT DIRECT FINANCIAL ISSUES - IGNORING NON-MEASUREABLE 'UNKOWNS' SUCH AS EXTREME WEATHER, MILITARY CONFLICT, MASS MIGRATION, STARVATION, ETC.

### 25 YR IMPACT OF:

- **STAYING THE CURRENT COURSE:**

- **\$XSS NET  
NEGATIVE**

**TRANSITION AWAY FROM  
FOSSIL FUELS:**

- **\$XXXXX TRILLION  
NET POSITIVE**

# THE IMPACT

## **RIISING SEA LEVELS**

- **EXPANDING WARM SEAWATER**
- **MELTING ICE SHEETS**
- **SEA LEVEL PREDICTED TO RISE ANYWHERE FROM 1-6 FEET BY 2100**
- **WILL CONTINUE TO RISE FOR CENTURIES EVEN IF WE EVENTUALLY STABILIZE GREENHOUSE-GAS LEVELS**

# THE IMPACT

## **RIISING SEA LEVELS**

- **BETWEEN 1900 AND 2016, THE SEA LEVEL ROSE BY 6.3–8.3” – AT AN ACCELERATED RATE SINCE 1993.**
  - **THERMAL EXPANSION - 42%**
  - **MELTING OF TEMPERATE GLACIERS - 21%**
  - **MELTING OF GREENLAND - 15%**
  - **MELTING IN ANTARTICA - 8%.**
- **THE RATE WILL ACCELERATE DURING THE 21ST CENTURY**
- **BILLIONS OF PEOPLE WILL BE IMPACTED**

# THE IMPACT

## EXTREME WEATHER EVENTS

- **STRONGER AND MORE INTENSE HURRICANES**
  - OCEAN WATERS ARE WARMING RAPIDLY. THE WARMER THE OCEAN WATER, THE MORE POWERFUL THE HURRICANE.
  - GULF WATER WAS HIGHER TEMPERATURE THAN EVER RECORDED FOR HURRICANE HARVEY



# THE IMPACT

## EXTREME WEATHER EVENTS

- MORE DROUGHTS AND HEAT WAVES
- MORE EXTREME HEAVY PRECIPITATION EVENTS
  - EXPECTED TO OCCUR EVEN IN REGIONS WHERE TOTAL PRECIPITATION IS EXPECTED TO DECREASE, SUCH AS THE US SOUTHWEST.
  - PAKISTAN:
    - The highest temperature ever recorded in [Pakistan](#) is 128°F which was recorded in [Moenjo Daro](#), [Sindh](#) on 26 May 2010. It was not only the hottest temperature ever recorded in Pakistan but also the hottest reliably measured temperature ever recorded on the continent of [Asia](#), and the fourth-highest temperature ever recorded on [Earth](#). The second-highest temperature ever recorded in Pakistan is 127°F which was recorded in [Larkana](#), [Sindh](#) on 26 May 2010.<sup>[2]</sup> It is hottest city in Pakistan, as well as the second-hottest city in the world, but it is second-hottest place in Pakistan and fifth-hottest place in the world. It is fifth-highest temperature ever recorded on [Earth](#). The highest rainfall of 620 millimetres (24 in) was recorded in [Islamabad](#) in 24 hours on 23 July 2001. The record-breaking rain fell in just 10 hours

# THE IMPACT

## IMPACTS ON OCEAN LIFE

- **YOU THINK IT'S HOT ON LAND? OCEANS HAVE ABSORBED >90% OF THE ADDITIONAL HEAT ADDED TO EARTH DUE TO GLOBAL WARMING**

# THE IMPACT

## IMPACTS ON OCEAN LIFE

### • DEATH OF CORAL REEFS

- 50% OF CORAL REEFS ARE ALREADY DEAD OR DYING.
- ROUGHLY A FIFTH OF ALL CORAL IN THE WORLD HAS DIED IN THE PAST 3 YEARS. SOME EXPERTS BELIEVE THAT THERE IS NOW JUST HALF THE AMOUNT OF CORAL THAT WAS IN THE OCEANS 40 YEARS AGO.
- GLOBAL WARMING IS EXPECTED TO WIPE OUT 90 PERCENT OF REMAINING CORALS BY 2050.
- CORAL REEFS COVER A MERE 0.1% OF THE WORLD'S OCEAN FLOOR BUT THEY SUPPORT ABOUT 25% OF ALL MARINE SPECIES.
- AROUND HALF A BILLION PEOPLE RELY ON FISH FROM CORAL REEFS AS THEIR MAIN SOURCE OF PROTEIN.

# THE IMPACT

## IMPACTS ON OCEAN LIFE

- **OCEAN ACIDIFICATION**

- THE OCEAN HAS ABSORBED A LARGE PORTION OF THE CO<sub>2</sub> THAT MAN HAS EMITTED. AS A RESULT, THE ACIDITY OF THE OCEAN HAS MEASURABLY CHANGED.
- THE RESULT OF CONTINUING ACIDIFICATION MAY WELL CAUSE DIE-OFF OR DETERIORATION OF SOME MARINE LIFE.

- **CHANGING FISHING PATTERNS**

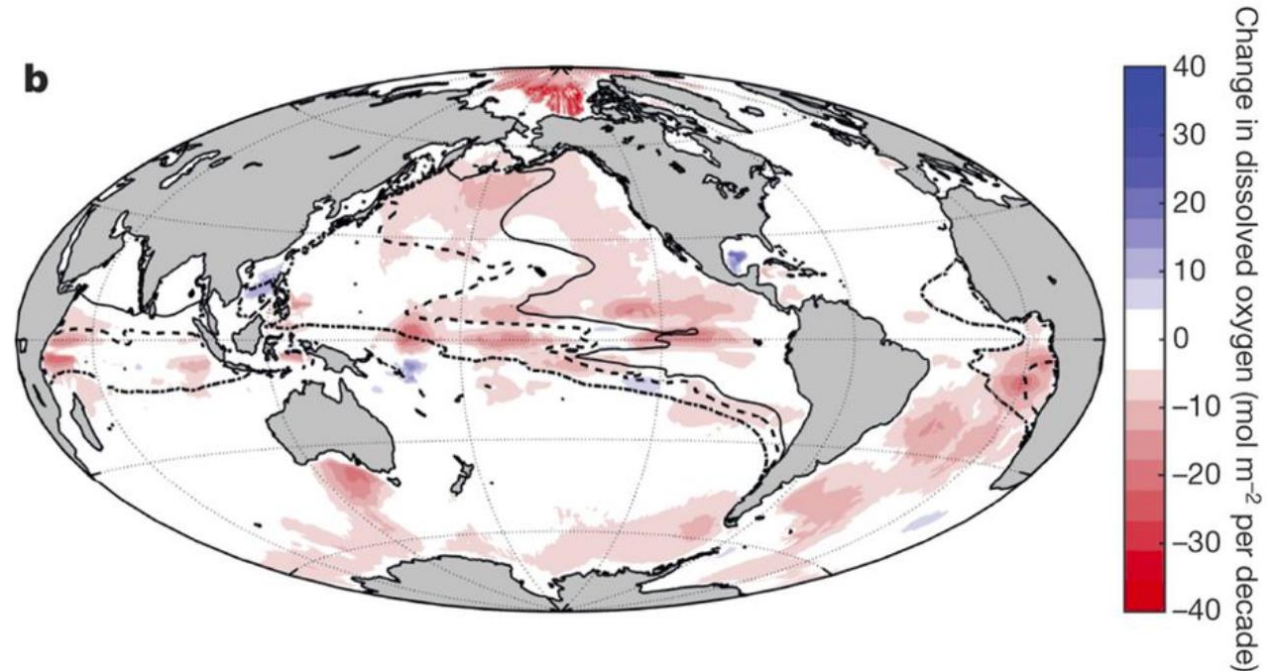
- MANY SPECIES OF SEA LIFE HAVE TO MOVE OR DIE BECAUSE OF WARMER WATERS. LOSS OF CURRENT FISHERIES AS FISH MOVE NORTH OR DIE.

# THE IMPACT

## IMPACTS ON OCEAN LIFE

- **LOSS OF OXYGEN**

- 30-40% LOSS IN SOME AREAS OF THE OCEAN IN PAST 50 YRS.
- 2% AVERAGE THE OCEAN OVER.
- THIS IS YET ANOTHER STRESSOR ON ALREADY STRESSED OCEAN LIFE.



<https://www.scientificamerican.com/article/the-ocean-is-running-out-of-breath-scientists-warn/>

# THE IMPACT

## HUMAN HEALTH AND WELL BEING

- INSECTS AND DISEASES
- RISING TEMPERATURES WILL LIKELY LEAD TO INCREASED AIR POLLUTION, A LONGER AND MORE INTENSE ALLERGY SEASON, THE SPREAD OF INSECT-BORNE DISEASES.
- CRIME INCREASES WITH HIGHER TEMPERATURE
- HEAT-RELATED DEATHS

# THE IMPACT

## **SPECIES EXTINCTION**

- **MANY PLANT AND ANIMAL SPECIES WILL NOT BE ABLE TO ADAPT TO WARMER CLIMATE**
- **10'S OF MILLIONS OF TREES HAVE DIED IN THE ROCKY MOUNTAINS OVER THE PAST 15 YEARS, VICTIMS OF A CLIMATE-DRIVEN TRIPLE ASSAULT OF TREE-KILLING INSECTS, WILDFIRES, AND STRESS FROM HEAT AND DROUGHT.**

# THE IMPACT

## SPECIES EXTINCTION

- THE IPCC SAYS A 1.5°C (2.7 °F) AVERAGE RISE MAY PUT 20-30% OF SPECIES AT RISK OF EXTINCTION.
  - IT IS A PIPE DREAM THAT WE CAN LIMIT WARMING TO 1.5°C.
  - WITHOUT SERIOUS STEPS TAKEN IMMEDIATELY, EARTH WILL LIKELY WARM XXXX°C.



# THE IMPACT

## CLIMATE REFUGEES

- **BY 2050, THE WORLD BANK SAYS MORE THAN 140 MILLION PEOPLE WILL BE CLIMATE REFUGEES.**
- **RESULT WILL BE TURMOIL FOR GOVERNMENTS; ENTIRE REGIONS WILL BE AFFECTED.**
  - **CLIMATE CHANGE THOUGHT TO BE MAJOR CONTRIBUTOR TO WAR IN SYRIA**
  - **CLIMATE CHANGE MAY LIKELY BE A DRIVER OF OUT-MIGRATION FROM CENTRAL AMERICA**

# THE IMPACT

## AGRICULTURAL IMPACTS

- **WITH WARMER WEATHER**
  - **FRUIT & VEGETABLE PRODUCTION FALLS**
  - **NUTRITIONAL VALUES FALL**
- **MORE MOUTHS TO FEED WITH**
  - **POPULATION EXPECTED TO RISE TO 10-12 BILLION BEFORE 'STABILIZING'**
- **IMPACT ON FARMING COMMUNITIES**
- **AGRICULTURE WILL MOVE NORTH WITH LONGER GROWING SEASON;**

# THE IMPACT

## AGRICULTURAL IMPACTS

- **MORE FAMINES**

- WE WILL HAVE XXXX BILLION MORE MOUTHS TO FEED IN XX YEARS
- THE WORLD'S BEST AGRICULTURAL LAND IS ALREADY UNDER CULTIVATION
- HIGHER CO<sub>2</sub> DOES NOT TRANSLATE TO PROPORTIONALLY HIGHER CROP OUTPUT
- LESS GLACIAL RUNOFF, DROUGHT, AND EXTREME WEATHER EVENTS WILL REDUCE AGRICULTURAL OUTPUT

# THE IMPACT

## FIRE

- XXX
- XX
- **201XXX FIRES IN CALIFORNIA MOST EXTENSIVE AND COSTLY EVER (\$XXX BILLION).**
- Forest and grass fires ARE NOT caused by global warming. However:
- Longer and more damaging wildfire seasons
- Wildfires more frequent and wildfire season is getting longer in the Western U.S. as temperatures rise. Higher spring and summer temperatures and earlier spring snow-melt result in forests that are hotter and drier for longer periods of time, [priming conditions for wildfires to ignite and spread.](#)

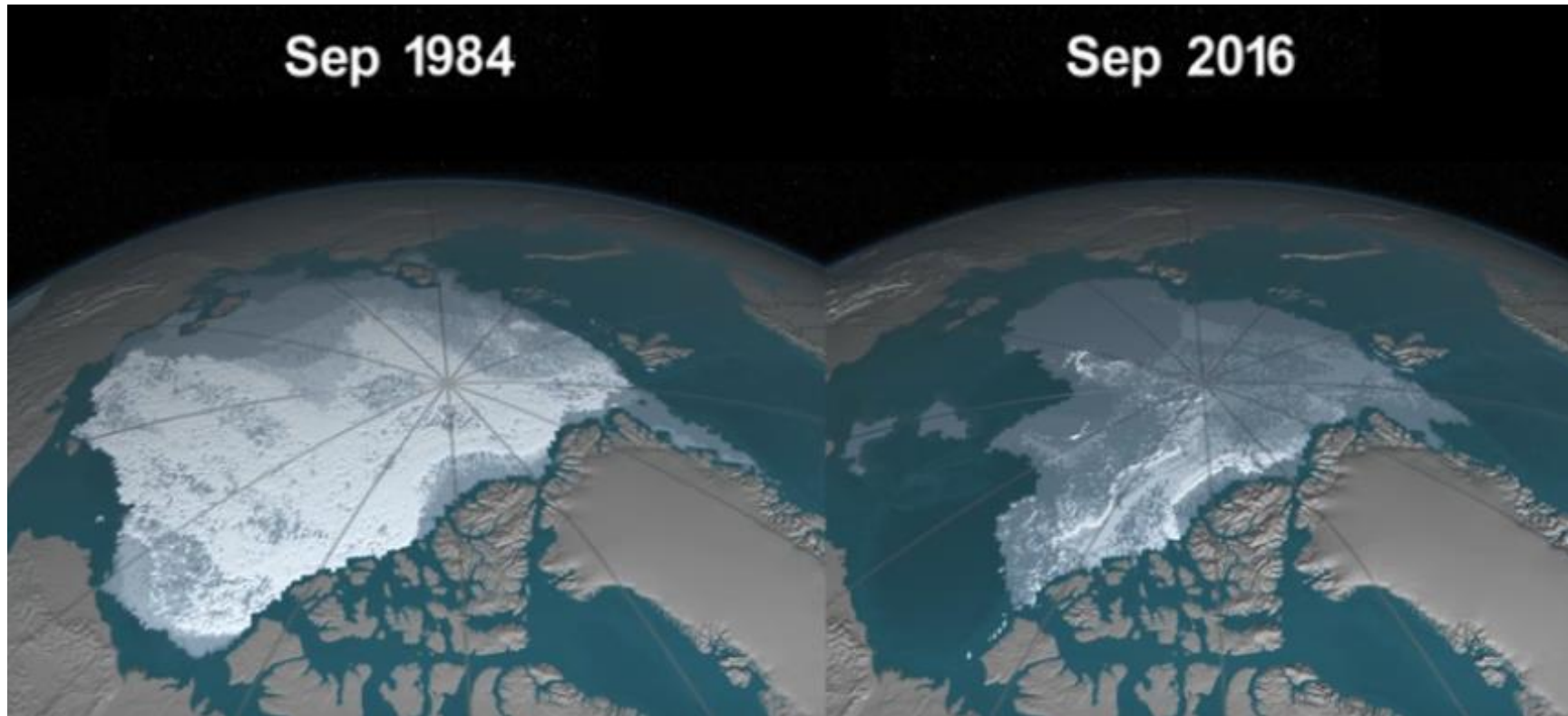
# THE IMPACT

## MILITARY IMPACTS

- THE U.S. MILITARY CALLS GLOBAL WARMING A “THREAT MULTIPLIER”.
- MORE MILITARY CONFRONTATIONS EXTREMELY LIKELY.
- RISING SEAS WILL INCREASINGLY FLOOD MANY OF OUR COASTAL MILITARY BASES.
- DESPITE THE GOVERNMENT’S STANCE, THE U.S. MILITARY IS ALREADY PREPARING RESPONSE PLAN FOR EFFECTS OF WARMING.

# THE IMPACT

## ARCTIC ICE



THE ARCTIC WILL BE ICE FREE IN SUMMER VERY SOON, AND  
PERMANENTLY FREE OF ICE BY XXXX

# **DON'T FALL FOR THE IGNORANCE**

- **GOD WON'T ALLOW IT.** Limbaugh: "If you believe in God, then intellectually you cannot believe in manmade global warming."
- **CO2 CAN'T BE BAD – WE BREATHE IT!**
- **MELTING ICE DOESN'T CAUSE WATER LEVEL TO RISE – NOT IN RUSH LIMBAUGH'S GLASS.**
- **VOLCANOES EMIT MORE CO2 THAN MAN.**
- **IT'S JUST THE WEATHER!**
- **COLD SNAPS PROVE THE EARTH IS NOT WARMING.**

# DON'T FALL FOR THE IGNORANCE

- **IT IS GOING TO BE ECONOMICALLY DEVASTATING TO ADDRESS THE PROBLEM. “I thought it must be true until I found out what it cost.” Imhofe Citibank report** People are so arrogant to think that they can change climate.  
Sen. Imhofe
- **SCIENTISTS DON'T KNOW WHAT THEY'RE TALKING ABOUT; THEY SAID NOT LONG AGO THE EARTH WAS COOLING.**
- **IT IS A CONSPIRACY OF SCIENTISTS BENT ON GETTING RICH DOING STUDIES.**
- **THE SUN IS PUTTING OUT MORE HEAT!**



# **DON'T FALL FOR THE IGNORANCE**

- **THE MILKY WAY IS SHIFTING ON ITS AXIS.**
- **AIR CONDITIONING MAKES US FEEL WARMER!  
(THANKS FOR THE INSIGHT, RUSH)**
- **11/6/12: “THE CONCEPT OF GLOBAL WARMING  
WAS CREATED BY AND FOR THE CHINESE.” D.  
TRUMP**
- **TECHNOLOGY WILL SOLVE ALL OUR CLIMATE  
PROBLEMS**

# WHAT TO DO

- **NEVER VOTE FOR ANYONE WHO DOES NOT SUPPORT TAKING CLIMATE ACTION**
- **CONTACT & LOBBY YOUR REPRESENTATIVES**
- **LETTERS TO EDITOR / OP-EDS**
- **TALK ABOUT THE ISSUE WITH OTHERS**

# WHAT TO DO

- **SUPPORT ENVIRONMENTAL ORGANIZATIONS THAT ARE TRYING TO ADDRESS THE ISSUE**
- **CHANGE YOUR OWN ACTIONS**
- **CITIZENS CLIMATE LOBBY**
- **CLIMATE LEADERSHIP COUNCIL**

# WHAT TO DO

- **CHANGE YOUR HABITS**
  - **AVOID THE I.C.E.**
  - **BE ENERGY EFFICIENT**
  - **XXX**

# WHAT TO DO

- **CITIZENS CLIMATE LOBBY**
  - **100,000 MEMBERS ACROSS THE WORLD**
  - **PURPOSE: TO LOBBY FOR CARBON FEE & DIVIDEND ACT**
    - **PLACES FEE ON ALL GREENHOUSE GASES**
    - **\$15/EQUIV TON INCREASING \$10/YEAR**
    - **REVENUE NEUTRAL: RETURNS MONEY TO TAXPAYERS**

# WHAT TO DO

- **CLIMATE LEADERSHIP COUNCIL**
  - **FOUNDED BY PROMINENT BI-PARTISAN GROUP**
  - **PURPOSE: TO PROMOTE A FEE ON GREENHOUSE GASES**

# WHAT TO DO

- **CLIMATE CAUCUS**
  - **BI-PARTISAN GROUP OF US HOUSE REPS**
  - **NOAH'S ARK MODEL**

# WHAT TO DO

## **THE ENERGY INNOVATION & CARBON DIVIDEND ACT (H.R. 7173)**

- **KEEP <2°C TEMP RISE SET BY THE IPCC BEFORE PARIS ACCORD**
- **EMISSION TARGETS OF 90% BELOW 2015 LEVELS BY 2050.**
- **EST'D TO REDUCE U.S. EMISSIONS BY >40% WITHIN 12 YRS**
- **ENACTS A CARBON FEE STARTING AT \$15/TON OF EQUIVALENT CO<sub>2</sub> AND RISING STEADILY BY AT LEAST \$10/YEAR.**