



Climate Change In the Arctic

4/6/2019

Stephen Hilton



Home

Live TV



12 years to stop climate catastrophe



Humans must make rapid, unprecedented changes to end global warming, experts say

Haunting virtual floods submerge cities around the world



Hunger rising with global temperatures, UN report says

OPINION: Set our sights higher to fight climate change

Undeniable climate change facts



NEWS

Climate Change Is Already Hurting U.S. Communities, Federal Report Says

November 23, 2018 · 2:02 PM ET

Heard on [All Things Considered](#)



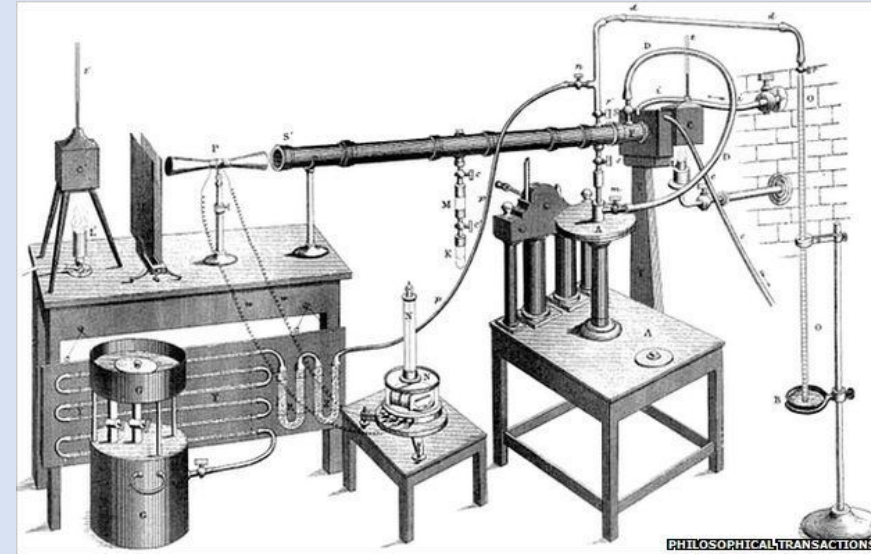
REBECCA HERSHER



Alexandria Ocasio-Cortez just released her massive Green New Deal — here's what's in it

Early Climate Scientists

- In 1824, Joseph Fourier realized that the atmosphere kept the earth warmer
 - Earth absorbs visible light, emits as heat (longwave radiation)
- In 1859, John Tyndall measured the greenhouse effect of carbon dioxide, methane, water vapor, and others
- In 1896, Svante Arrhenius estimated the heating from doubling carbon dioxide.
 - Included changes of water vapor, changes in snow.



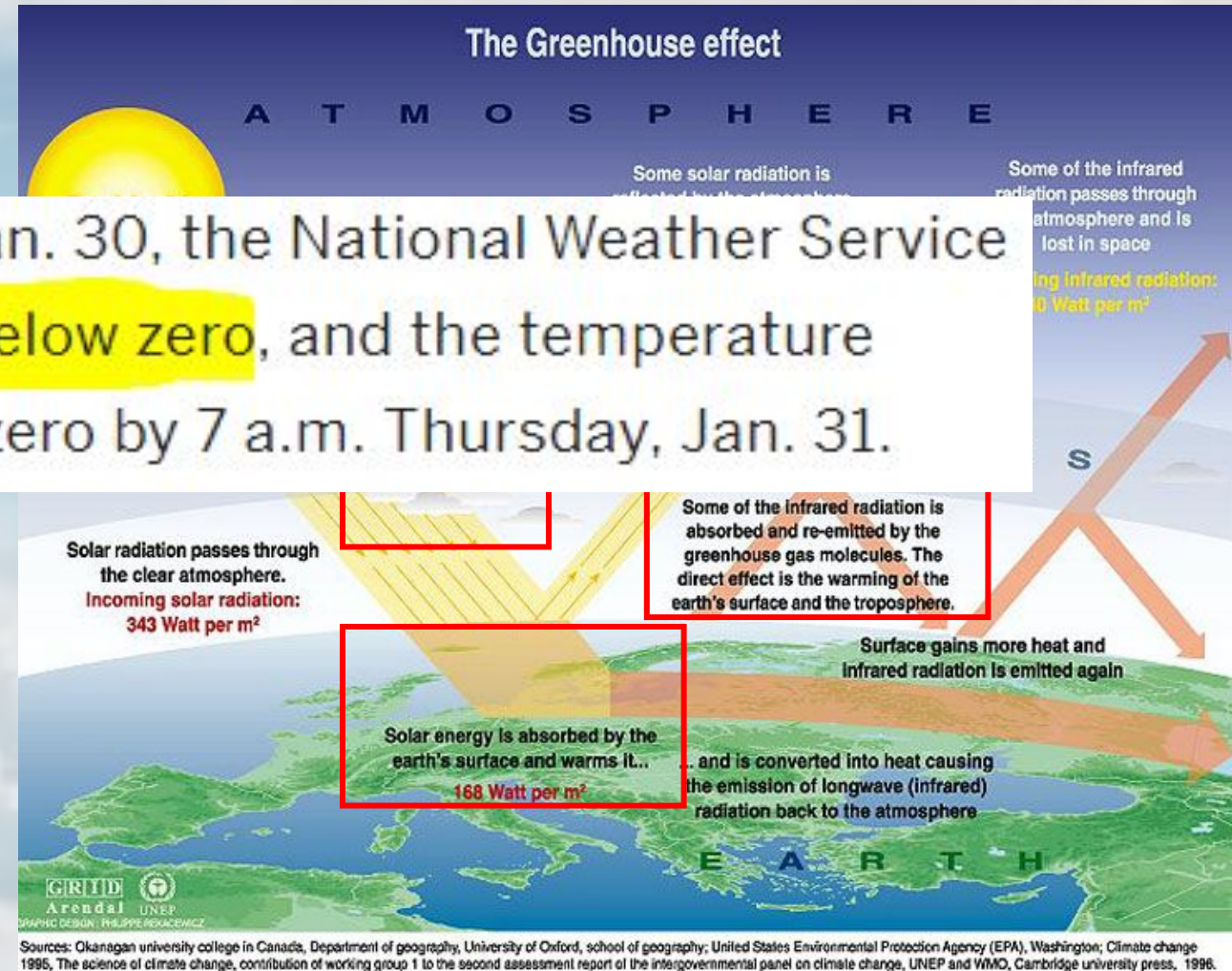
How Global Warming Works

- In a stable climate, energy in=energy out.

Just before midnight Wednesday, Jan. 30, the National Weather Service was reporting a temperature of 17 below zero, and the temperature dropped one more tick to 18 below zero by 7 a.m. Thursday, Jan. 31.

Some of the energy escapes the atmosphere, and will not continue to heat the Earth.

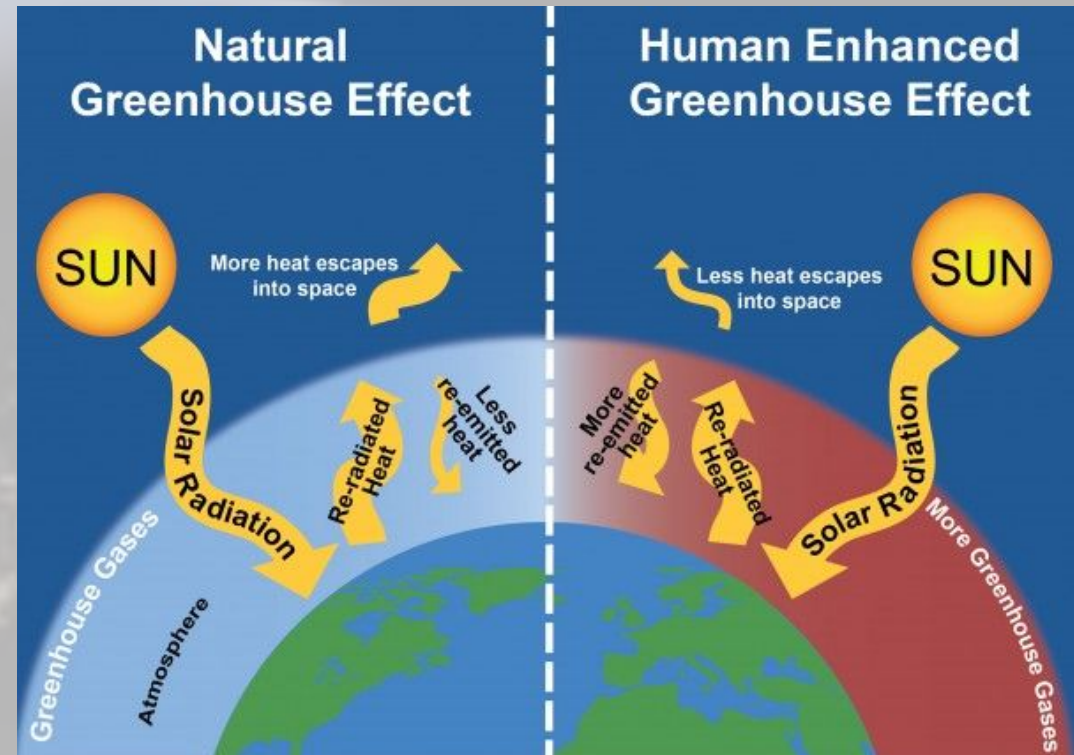
- Some is captured by greenhouse gas particles, and it will emit heat in all directions, including back down to the surface.
 - Increases the temperature

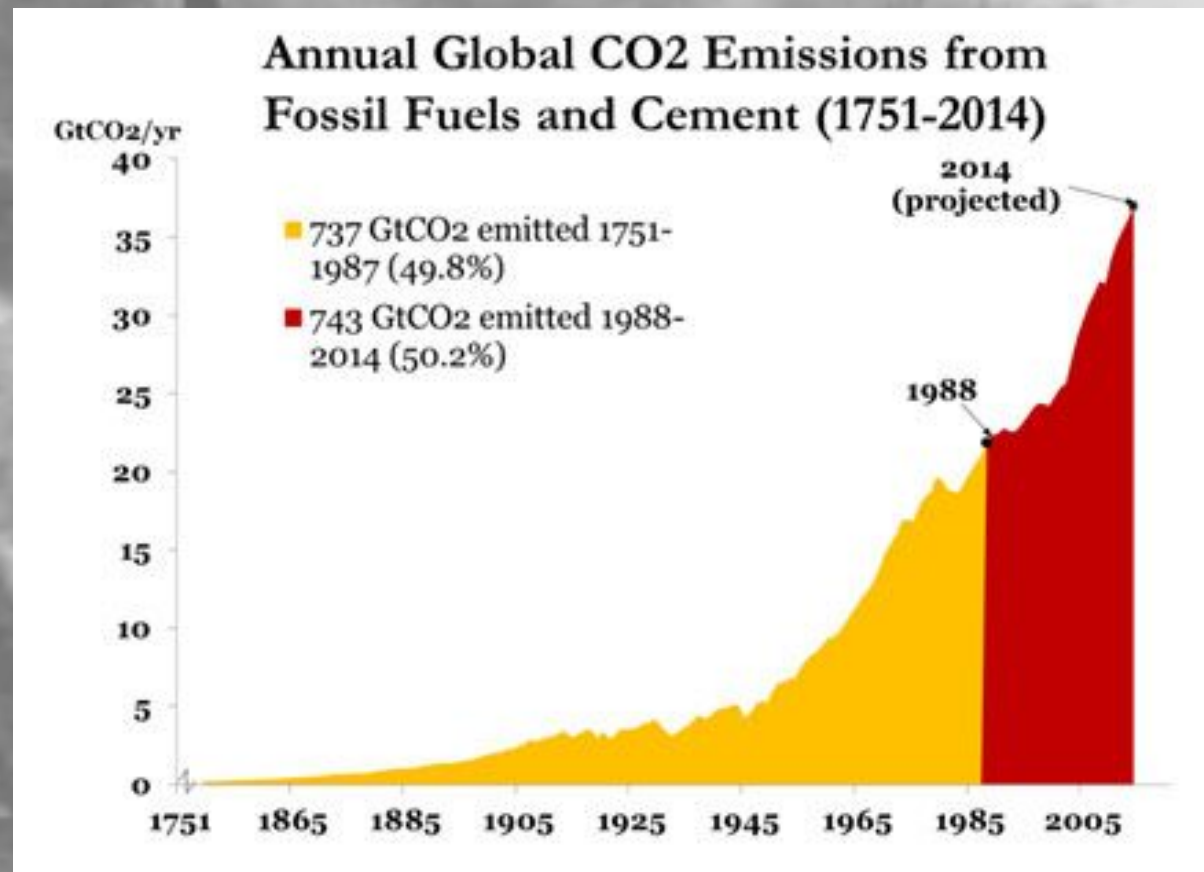
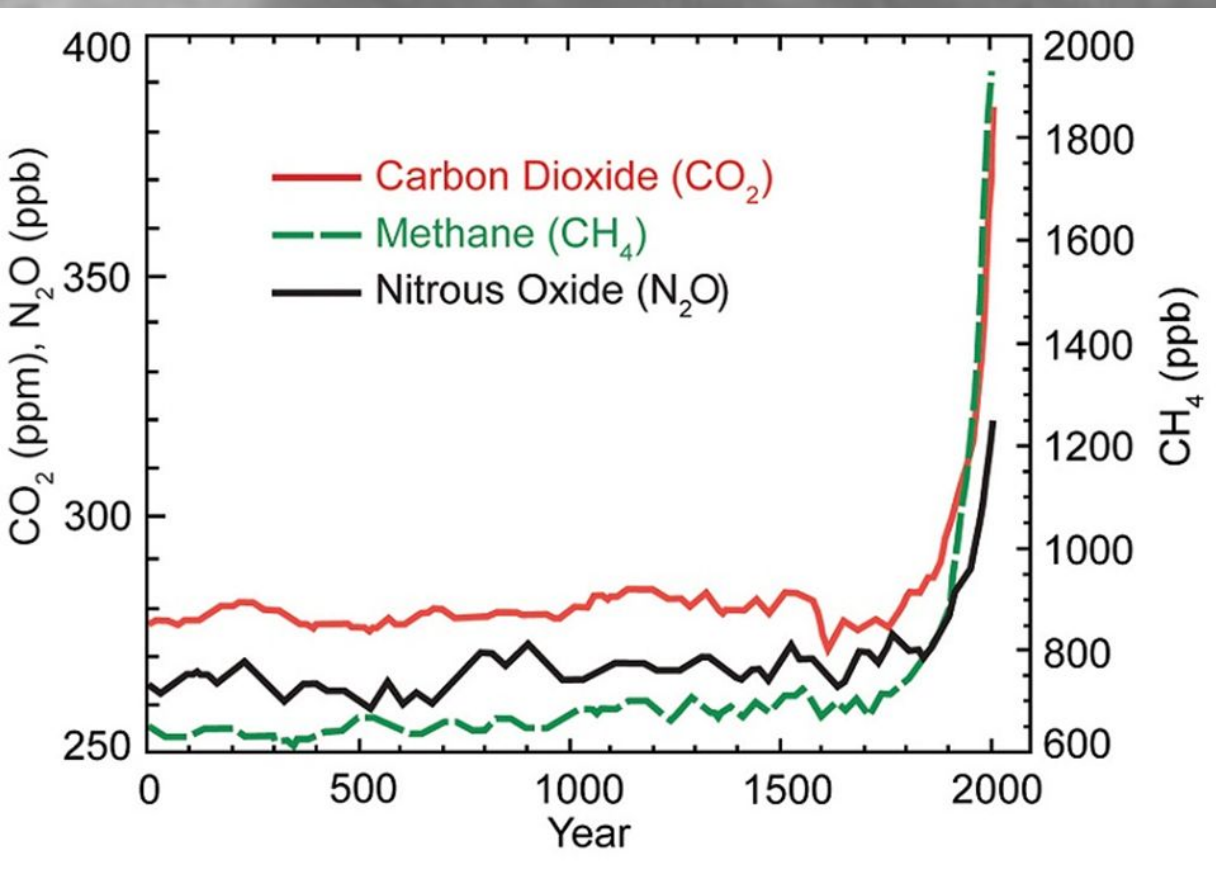
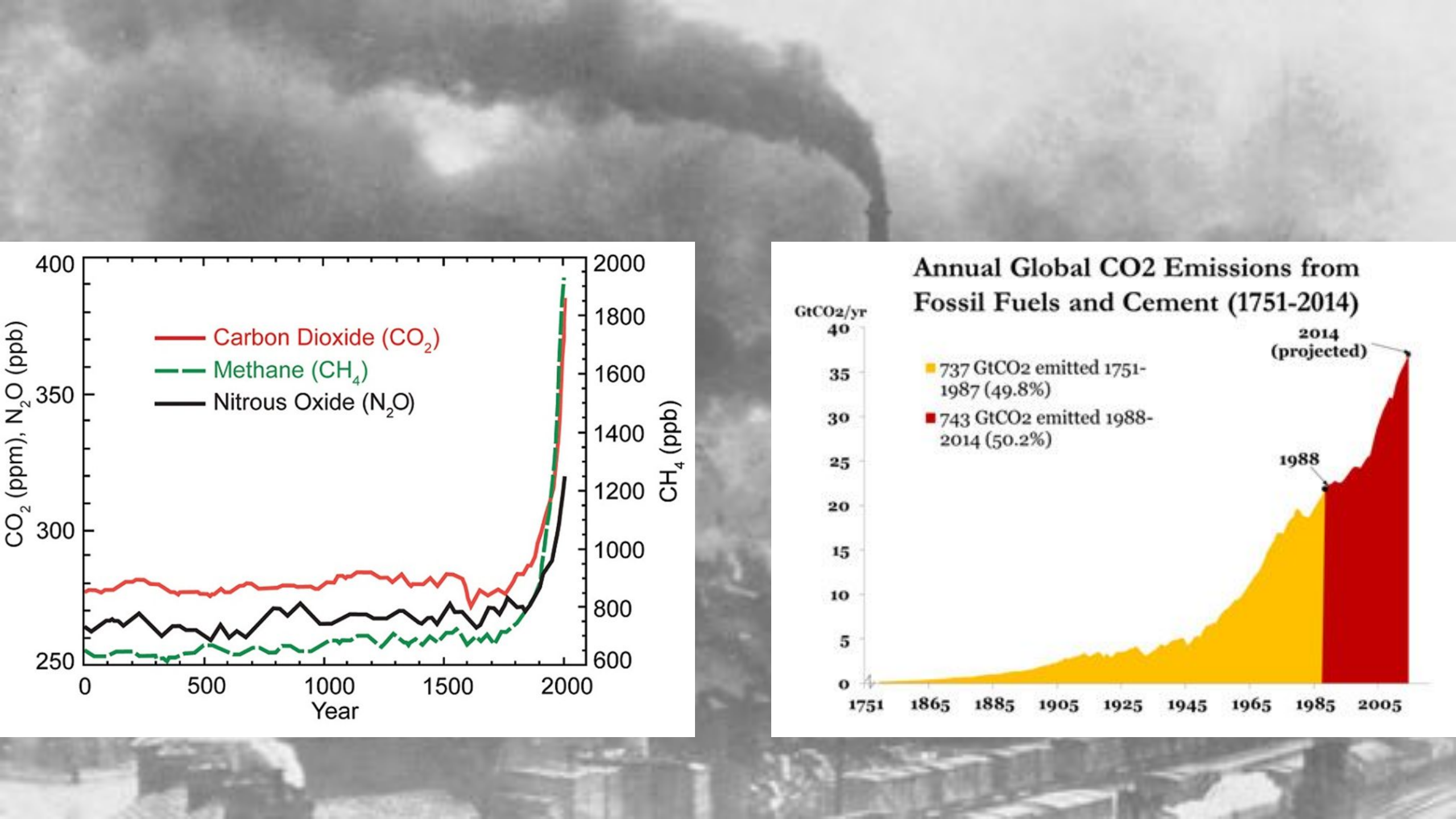


Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1996, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

How Global Warming Works-Continued

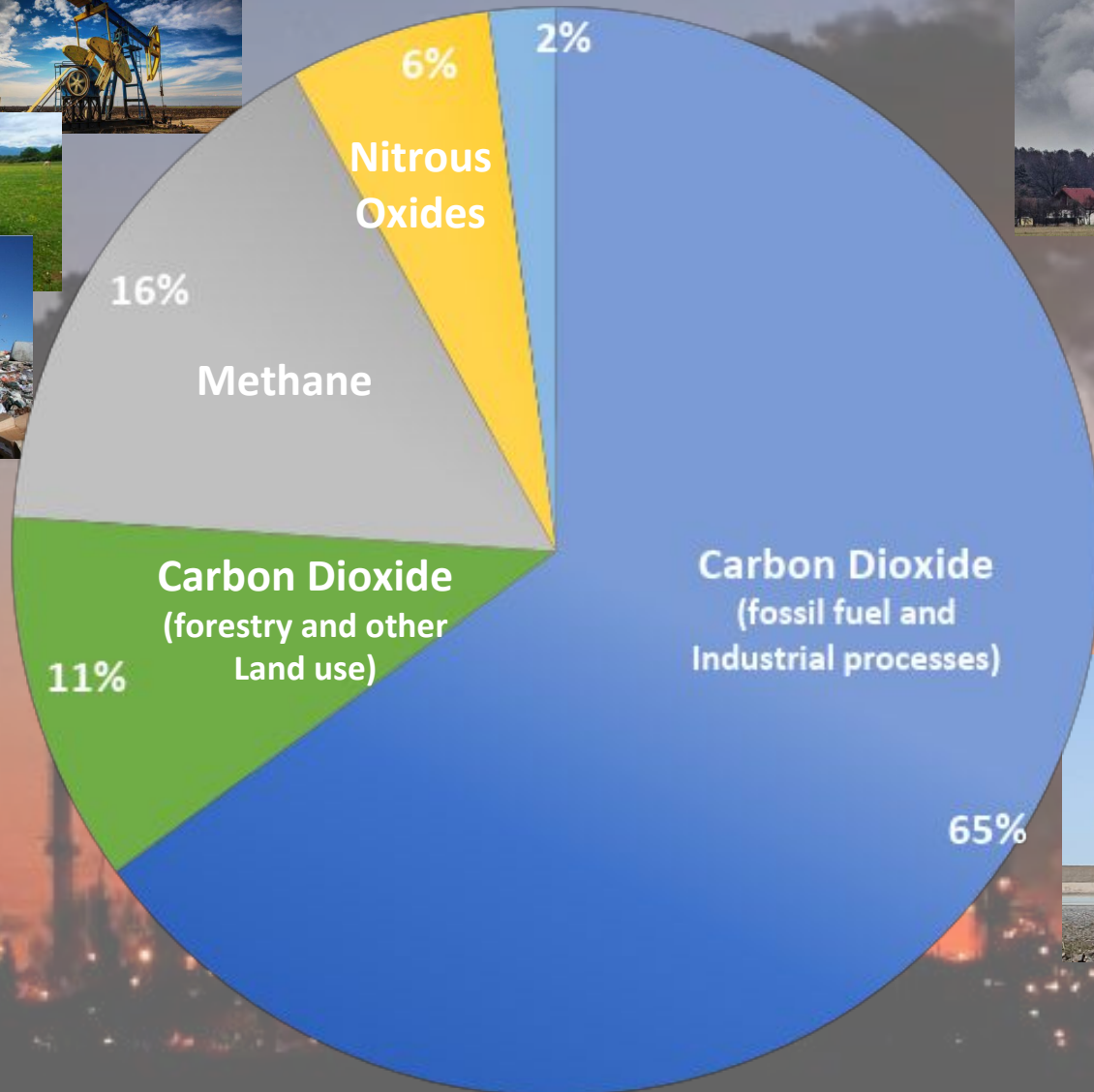
- With more greenhouse gases, more of this heat is captured.
- Energy in > Energy out





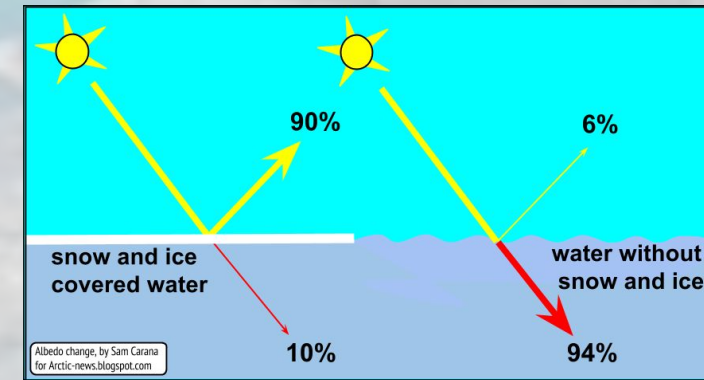
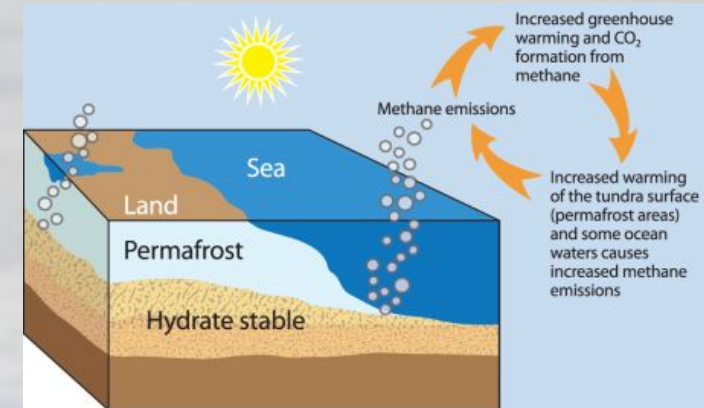


F-gases



Climate Feedbacks

- Climate Feedback-Responses that increase or decrease warming
 - Negative Feedbacks-Reduce warming
 - Some clouds will reflect more energy
 - Some plants may uptake more carbon dioxide
 - Ocean absorbs carbon dioxide
 - Positive Feedbacks-Increase Warming
 - Ice Melt
 - Permafrost thawing
 - Ocean emitting carbon dioxide as climate warms*



Locked in Climate Change

- If greenhouse gas emissions, will take about 40 years to stop warming
 - Committed warming or climate lag
- Causes
 - Ice melting, more heat absorbed
 - Ocean heats slowly
 - As ocean heats, it emits more carbon dioxide
- Sea level continues rising, ice keeps melting
- Many greenhouse gases will remain in the atmosphere for hundreds to thousands of years.

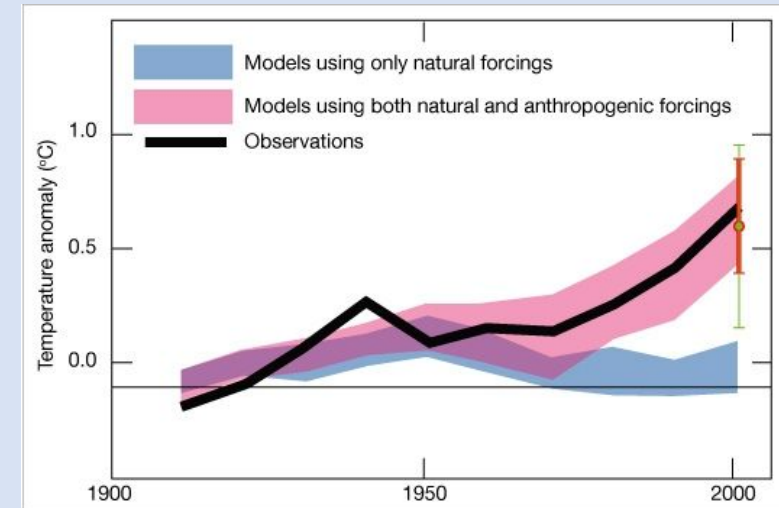
13 MAR 2019 | PRESS RELEASE | CLIMATE CHANGE

Temperature rise is 'locked-in' for the coming decades in the Arctic

Nairobi, 13 March 2019 – Even if the world were to cut emissions in line with the existing Paris Agreement commitments, winter temperatures over the Arctic Ocean would rise 3-5°C by mid-century, finds a new report by UN Environment.

Broad scientific agreement

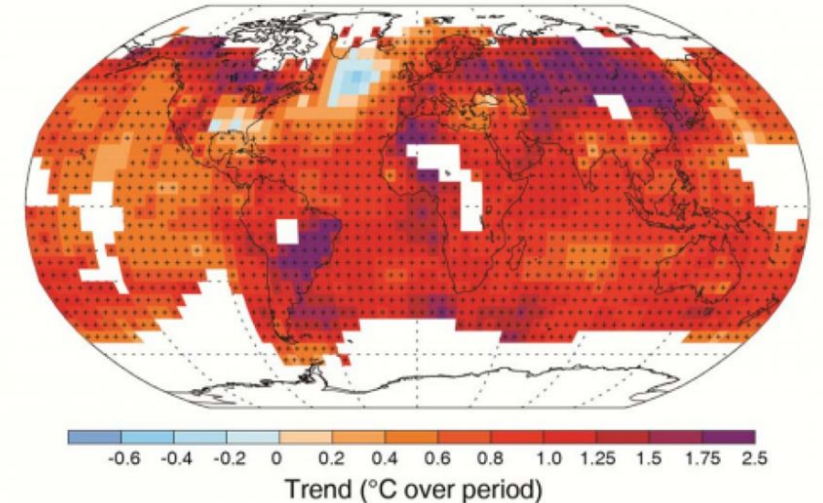
- Neither natural or human caused emissions account for observed warming
 - Only models including both agree with observed emissions.
- Overwhelming evidence for human-driven climate change
 - Around 97% of climate experts believe human actions are causing climate change (Cook et al., 2016), and most scientific institutions



Effects of Climate Change-Warming

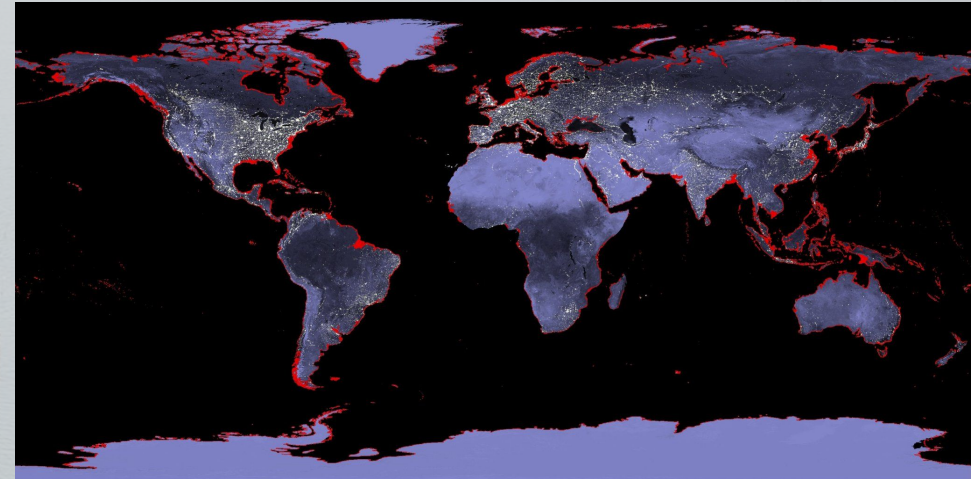
- The Earth has warmed 1.8 °F (1 °C) on average
 - This heating is NOT uniform
 - Arctic warms twice as fast
- This has increased heatwaves, changed where species live, introduced range of certain diseases.
- The cause of melting ice and thawing permafrost

(b) Observed change in average surface temperature 1901–2012



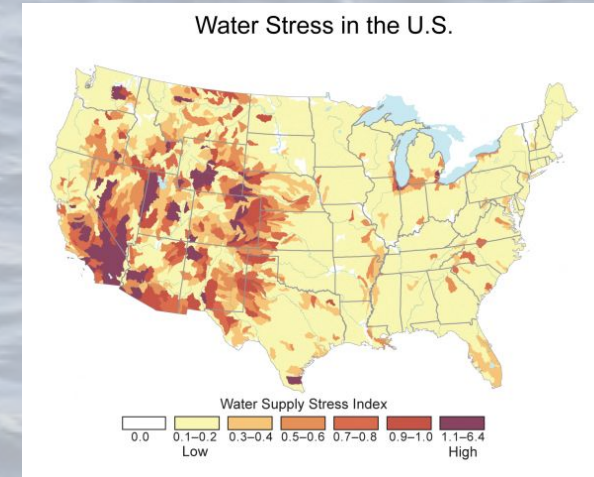
Effects of Climate Change-Sea Level Rise

- Causes:
 - Heat expanding water volume
 - Melting glaciers
- Not Uniform
- Many live in areas that will be below water
- Storm surges cause more damage
- Increases erosion
- Saltwater intrusion in aquifer



Effects of Climate Change-Water

- Too little water
 - Reduce glacier and snowmelt for water supplies
 - More intense droughts, less frequent rain
 - May increase aquifer depletion
- Too much water
 - More floods and hurricanes
 - More intense rains
 - Decrease water quality
- Stable water supply needed for drinking, food, energy
 - Currently unpredictable, potential conflict



Effects of Climate Change-Biodiversity

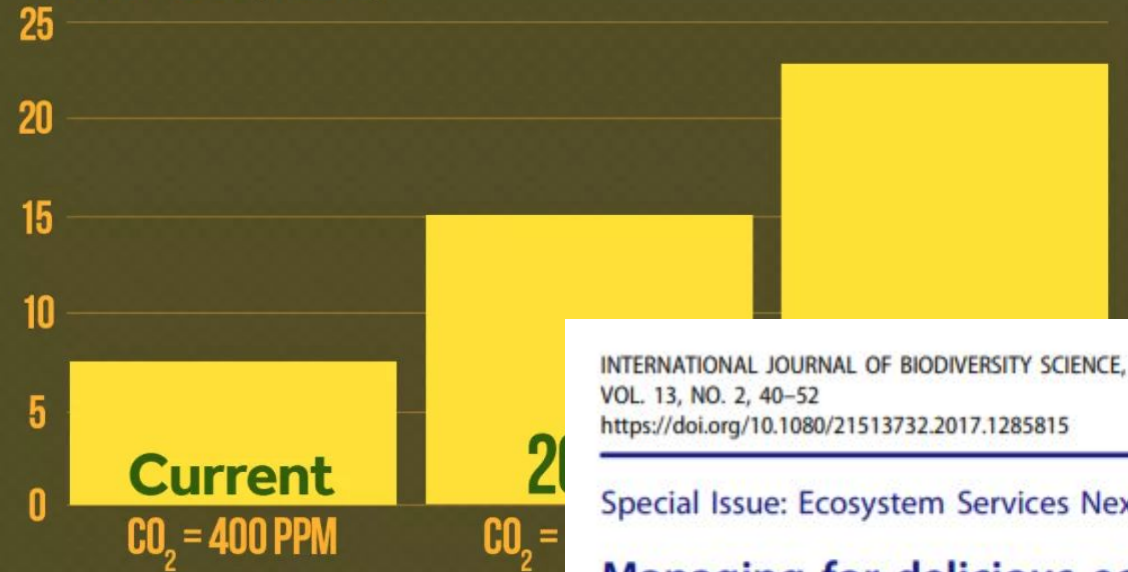
- Changes too quick for many species to adapt
- Many species will lose their geographic living areas
 - Coral reefs will decline by a further 70-99%
 - Many species shift north or up mountains
- Arctic ecosystems especially affected
 - Loss of sea ice
 - Species can't go "up"
- Many pests thriving
- Losing ecosystem services
 - Purifying water, pollination, erosion control, cultural and spiritual benefits



Climate Change Impacts

Climate Change Increases Grass Pollen Production

Grains of Pollen (millions)



Source: Albertine et al. 2014

INTERNATIONAL JOURNAL OF BIODIVERSITY SCIENCE, ECOSYSTEM SERVICES & MANAGEMENT, 2017
VOL. 13, NO. 2, 40–52
<https://doi.org/10.1080/21513732.2017.1285815>



Special Issue: Ecosystem Services Nexus Thinking

OPEN ACCESS

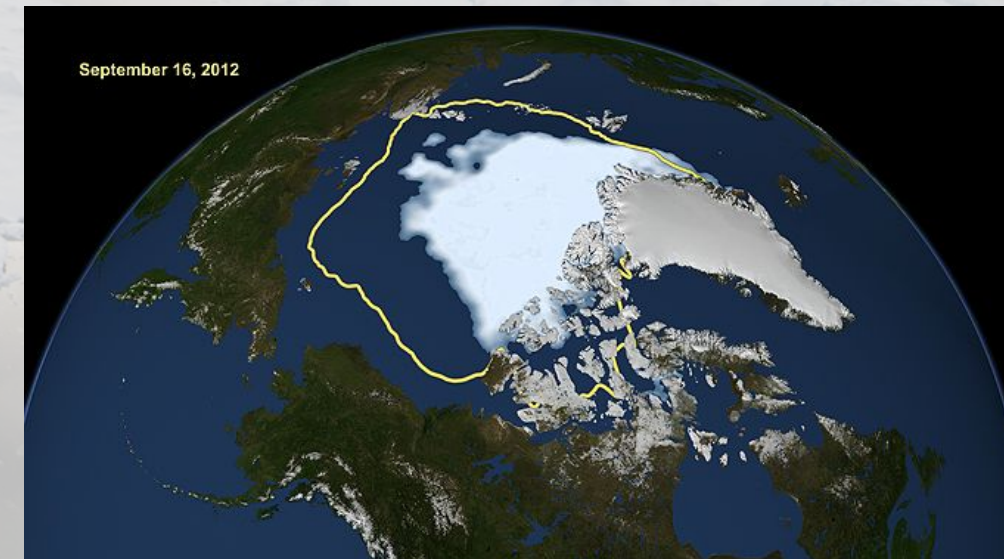
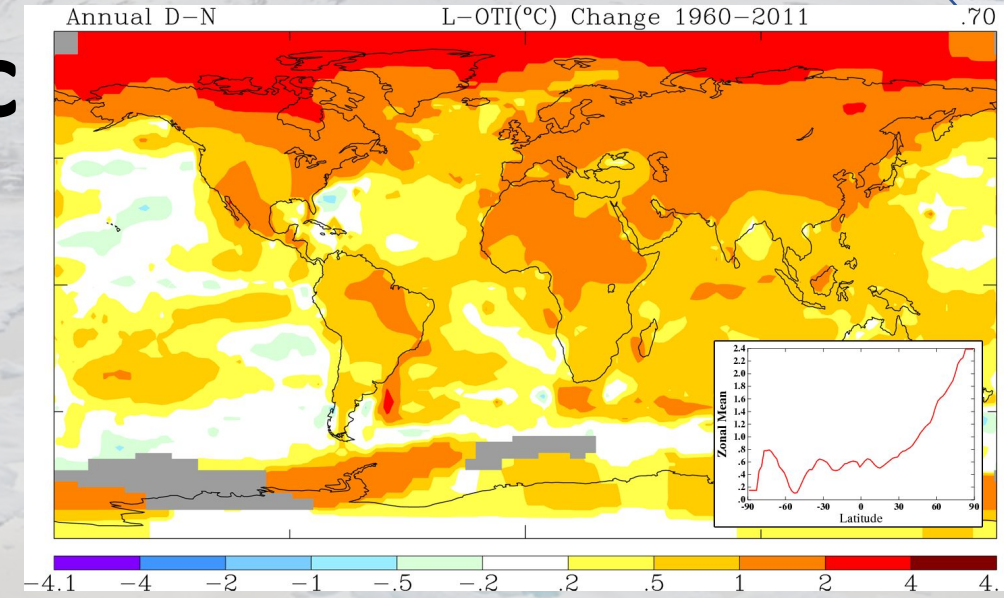
Managing for delicious ecosystem service under climate change: can United States sugar maple (*Acer saccharum*) syrup production be maintained in a warming climate?

Stephen N. Matthews^{a,b} and Louis R. Iverson

^aSchool of Environment and Natural Resources, Ohio State University, Columbus, OH, USA; ^bNorthern Research Station, USDA Forest Service, Delaware, OH, USA

Climate Change in the Arctic

- Temperatures increasing twice as fast
- Arctic sea ice
 - Extent decreased by about 40% since 1979
 - Decreased thickness
 - Sea ice free summers may begin around 2030



Climate Change in the Arctic

- Coastal erosion
 - Sea ice used to be a barrier from storms
 - Sea level rise
 - Thawing permafrost
- Thawing permafrost
- Unpredictable weather
 - Don't know when seasons will end and begin
 - Lost in snowstorms
 - Stronger winds



Climate Change in the Arctic

- Ecology

- Shifts in habitats

- Losing sea ice
 - Shrinking tundra, advancing forests

- Many animals decreasing

- Caribou and Reindeer
 - Seals
 - Polar bears
 - Some estimate that the walrus, polar bears, and seals may go extinct around 2070-2090

- Some fish populations may increase



Climate Change and Food

- Hunting is more difficult for many reasons
 - Unpredictable weather and lack of ice
 - Loss of species-Caribou, Polar Bears, seals
 - Hunting is a part of their culture
- Purchased food is more expensive
- Fish *may* become more abundant



Climate Change and Coastal erosion

- In 2009, 12 villages were considering relocating village
- These may become the United States first climate refugees
- Coastal towns eroding
 - Often building coastal walls-short term fix
 - May not be present in the future
- Each storm further erodes the coast



Coastal erosion-Kivalina

- Lost more than half the area since the 50's
- Will be uninhabitable
- Permafrost damaged airstrip
- Expected cost of relocation is \$400 million, no agency will pay
- Tried to sue 24 oil and energy companies
 - Case dismissed



DTE Energy[®]
Know Your Own Power[®]

Gulf of Alaska[®]

Bering Sea

Climate Change and Infrastructure

- Most infrastructure constructed in a stable climate
- Permafrost can now melt and refreeze, stresses
 - Buliding
 - Airstrips
 - Water and wastewater infrastructure
 - Pipelines
- Can isolate communities
- Often cannot afford to repair



Climate Change-Culture and Mental Health

- Increased isolation
- Providers of hunted food feel disempowered
 - Feel as if lost connection to environment
- Many archaeological artifacts *were* preserved in frozen ground
- Increased anxiety and grief, may increase substance abuse, suicide

How the Arctic affects us

- When ice melts, warming increases
- Thawing permafrost emits powerful greenhouse gases
- Can lead to extreme weather incidents
 - Warming arctic may have contribute to polar vortex



Donald J. Trump ✓

@realDonaldTrump

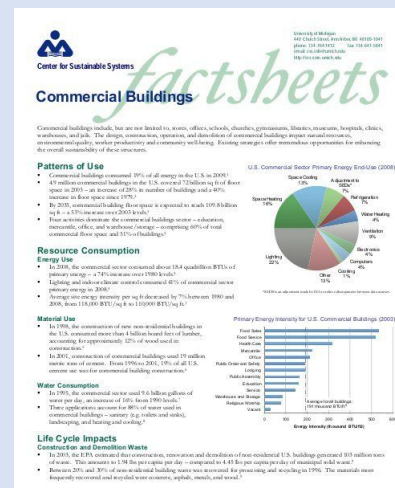
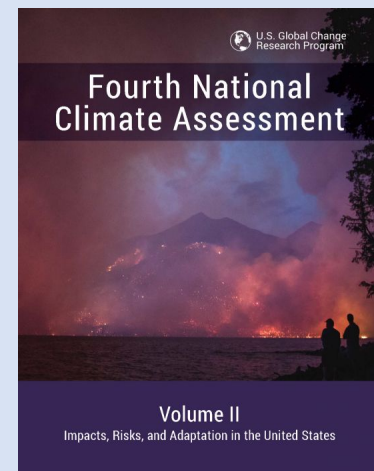
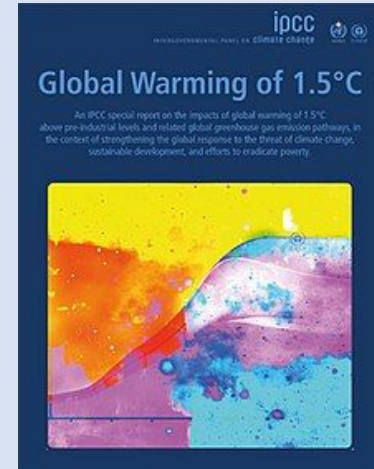
In the beautiful Midwest, windchill temperatures are reaching minus 60 degrees, the coldest ever recorded. In coming days, expected to get even colder. People can't last outside even for minutes. What the hell is going on with Global Waming? Please come back fast, we need you!

Climate Change Mitigation

- Determine your biggest impacts: <http://www.footprintcalculator.org/>
- Reduce transportation impact
 - One gallon of gas emits more than 20 lbs of carbon dioxide*
 - Accelerating less substantially reduces gas consumption
- Eat less red meat and dairy (responsible for about 15% of world greenhouse gases), waste less food
- Use Energy Star Products
- Buy less or reused
- Advocate for increasing renewable energy
- Advocate for climate-friendly policies

Good sources for information

- IPCC-International Panel on Climate Change
- NCA-National Climate Assessment, US focused
- SkepticalScience-Climate Change Mythbusters
- NASA, NOAA
- Carbon Brief
- DeSmogBlog-Great at letting you know who NOT to use for information
- Center for Sustainable Systems



Source NOT TO TRUST on climate change

- API-American Petroleum Institute
- The Heartland Institute
 - Made a group called the NIPCC
- CO2 Coalition
- Center for Accountability in Science
- AFP-Americans for Prosperity



CO2 COALITION

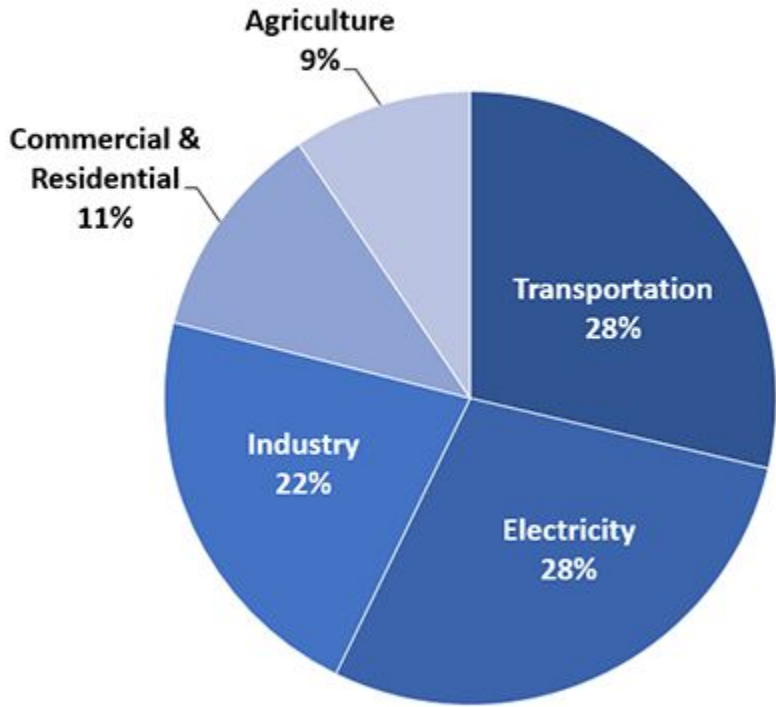


An aerial photograph of a vast sea ice field. The ice consists of numerous irregular, white and light blue floes of varying sizes, scattered across a dark, calm sea. In the background, a large, flat-topped mountain or plateau is visible, its surface covered in a layer of snow and partially obscured by low-hanging clouds. The overall scene is desolate and cold.

Questions?

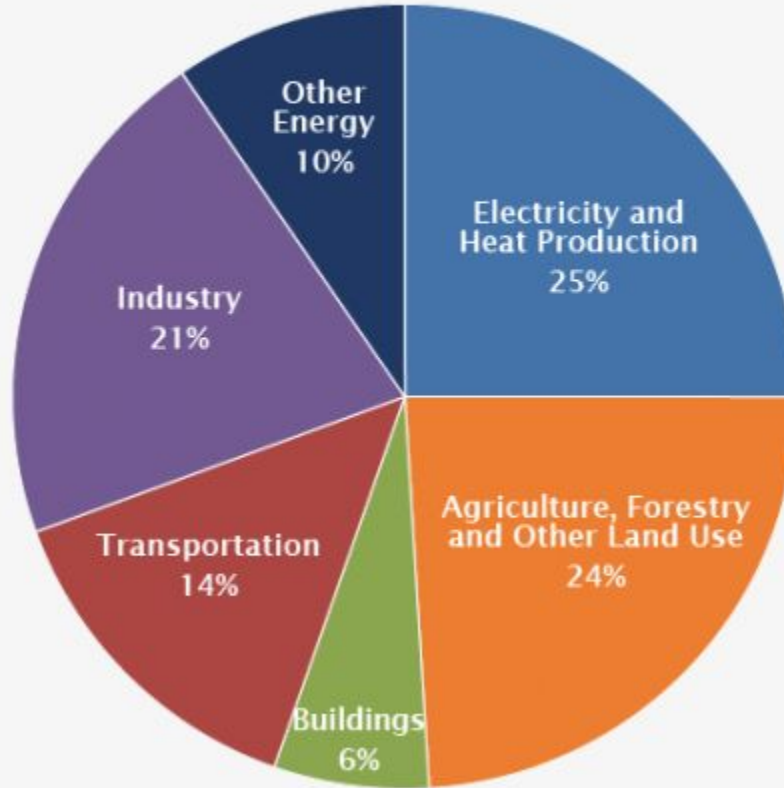
sphilton@umich.edu

Total U.S. Greenhouse Gas Emissions by Economic Sector in 2016

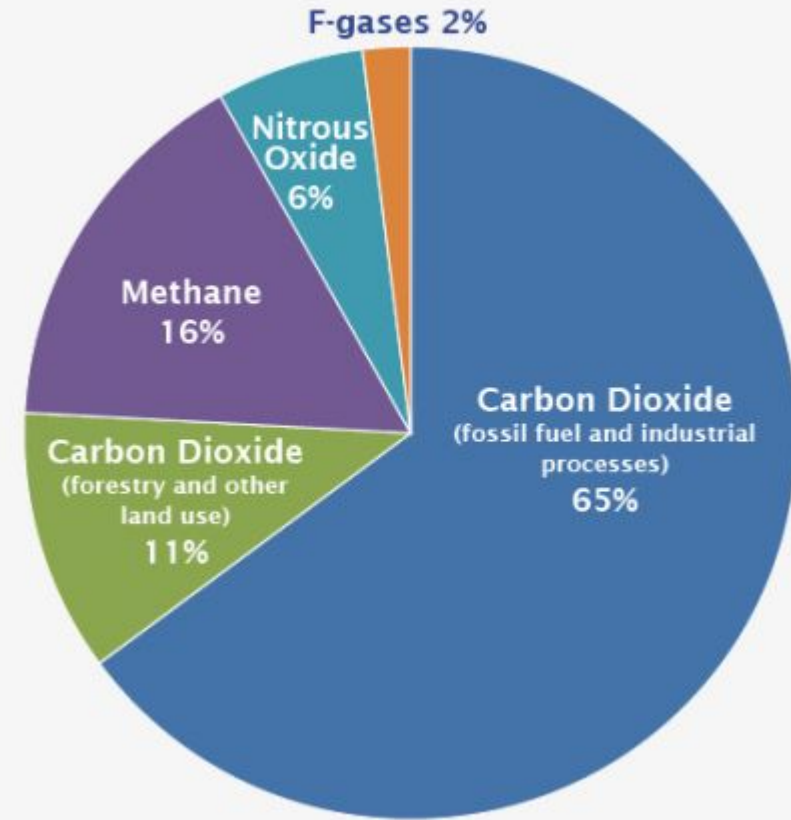


U.S. Environmental Protection Agency (2018). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016

Global Greenhouse Gas Emissions by Economic Sector



Global Greenhouse Gas Emissions by Gas



CORAL BLEACHING

Have you ever wondered how a coral becomes bleached?

HEALTHY CORAL

1 Coral and algae depend on each other to survive.



Corals have a symbiotic relationship with microscopic algae called zooxanthellae that live in their tissues. These algae are the coral's primary food source and give them their color.

STRESSED CORAL

2 If stressed, algae leaves the coral.



When the symbiotic relationship becomes stressed due to increased ocean temperature or pollution, the algae leave the coral's tissue.

BLEACHED CORAL

3 Coral is left bleached and vulnerable.



Without the algae, the coral loses its major source of food, turns white or very pale, and is more susceptible to disease.

WHAT CAUSES CORAL BLEACHING?



Change in ocean temperature

Increased ocean temperature caused by climate change is the leading cause of coral bleaching.



Runoff and pollution

Storm generated precipitation can rapidly dilute ocean water and runoff can carry pollutants — these can bleach near-shore corals.



Overexposure to sunlight

When temperatures are high, high solar irradiance contributes to bleaching in shallow-water corals.



Extreme low tides

Exposure to the air during extreme low tides can cause bleaching in shallow corals.



NOAA's Coral Reef Conservation Program
<http://coralreef.noaa.gov/>