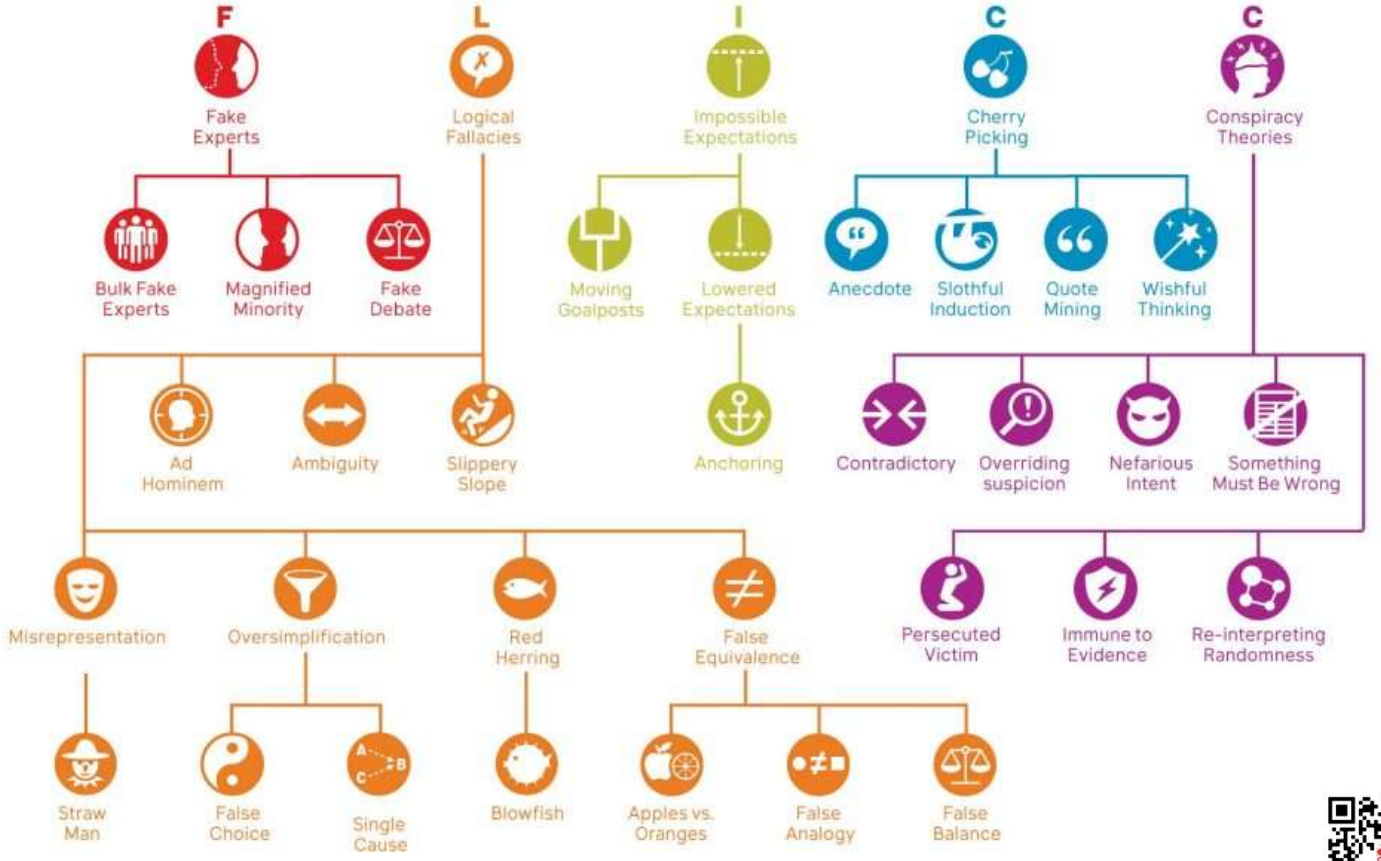
# Fact - Myth - Fallacy Compilation of Slides



# The FLICC Techniques of Science Denial



# Components of successful debunking

| | |
|---|---|
| **FACT** | Lead with the fact if it's clear, pithy, and sticky—make it simple, concrete, and plausible. It must "fit" with the story. |
| **WARN ABOUT THE MYTH** | Warn beforehand that a myth is coming... mention it once only. |
| **EXPLAIN FALLACY** | Explain how the myth misleads. |
| **FACT** | Finish by reinforcing the fact—multiple times if possible. Make sure it provides an alternative causal explanation. |



# Some notes about this slide-deck

The code words on the index page are from here:
https://skepticalscience.com/shorturls.php

The shown graphics are just suggestions –
there may be better ones to suit your purposes

The Fact-Myth-Fallacy texts are just very short explanations

Please use the URL shown at the bottom right of
each slide for longer explanations

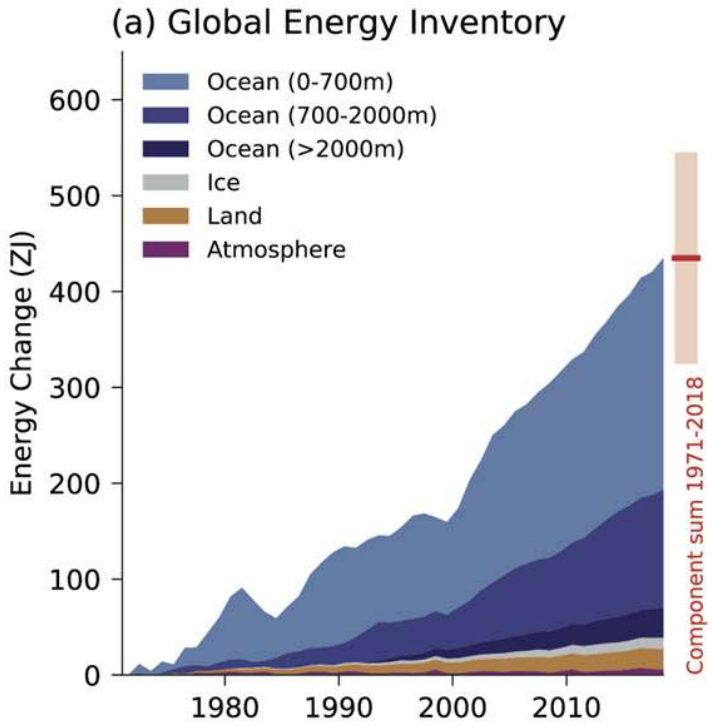
| | | | | | |
|---|---|---|---|---|---|
| Global Warming is happening | 1998 | Cold | Glacier | Greenland | Antarctica |
| | Temp | UHI | Winter | Name | |
| We are causing Global Warming | $CO_2$ | Volcano | Residence | Thermo | Saturate |
| | Lag | Hotspot | Trace | Sun | Consensus |
| Past and future climate change | Past | LIA | Past $CO_2$ | MWP | Model |
| | Hansen1988 | Weather | 1970s | Iceage | |
| Climate change impacts | Vapor | Cloud | Species | Bear | Acid |
| | Impacts | Pollutant | Plant | Extreme | |

# Global Warming is happening

**FACT**
Our planet has continued to build up heat since 1998 - global warming is still happening.

**MYTH**
Global warming stopped in 1998.

**FALLACY**
Looking at one region or a short period ignores the full picture.




Source: Cross-Chapter Box 9.1 Figure 1 (part a) IPCC AR6 WGI Chapter 9.

**Cherry-picking**

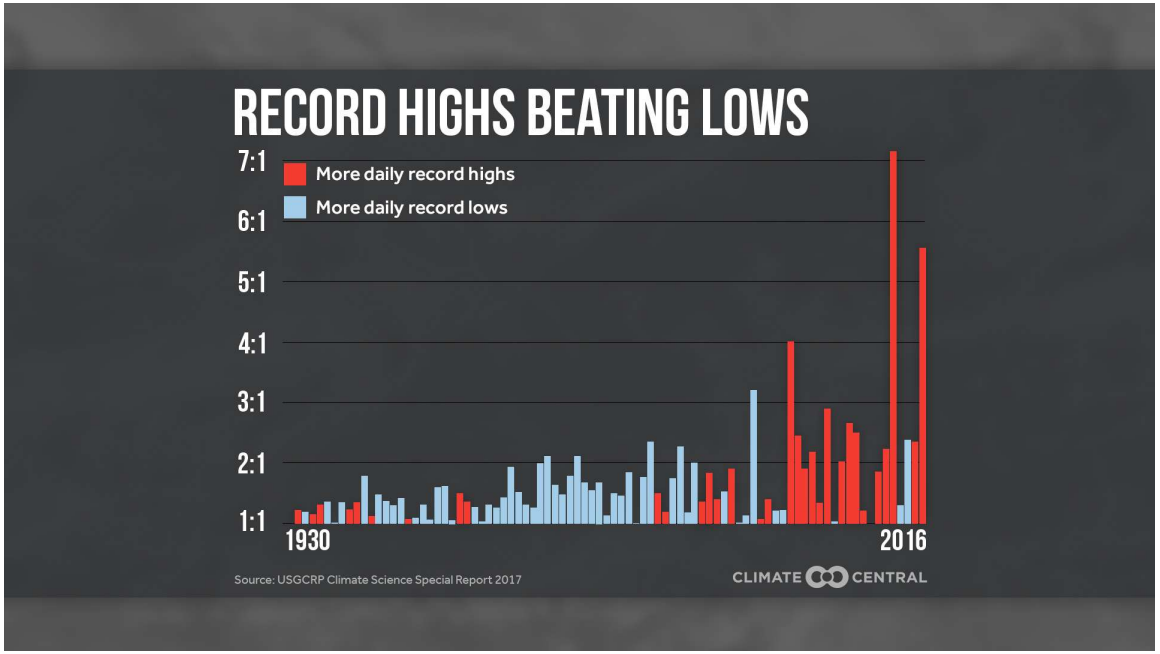
**http://sks.to/1998**

# Global Warming is happening

**FACT**
Global warming is like rigging the weather dice, making it more likely to get hot days.

**MYTH**
It's cold outside, so global warming must have stopped.

**FALLACY**
Global warming doesn't mean no more cold weather, just fewer cold days compared to hot days.




Climate Central - http://www.climatecentral.org/gallery/graphics/daily-record-highs-are-dramatically-outpacing-daily-record-lows

**Impossible Expectations**

sks.to

**http://sks.to/cold**

# Global Warming is happening

**FACT**

Overall, glaciers across the globe are shrinking at an accelerating rate, threatening water supplies for millions of people.

**MYTH**

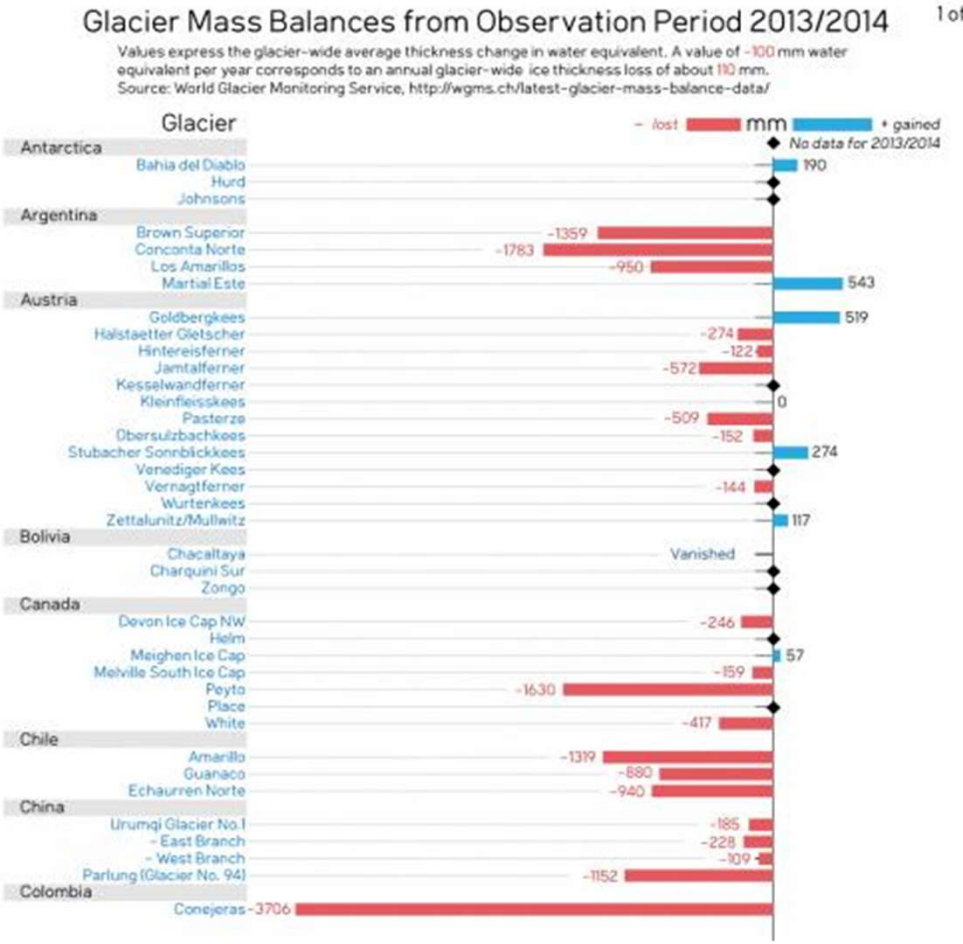
Glaciers around the world are increasing, disproving global warming.

**FALLACY**

Picking a handful of growing glaciers ignores the vast majority of glaciers that are shrinking.



**Cherry-picking**




Skeptical Science - https://skepticalscience.com/graphics.php?g=246

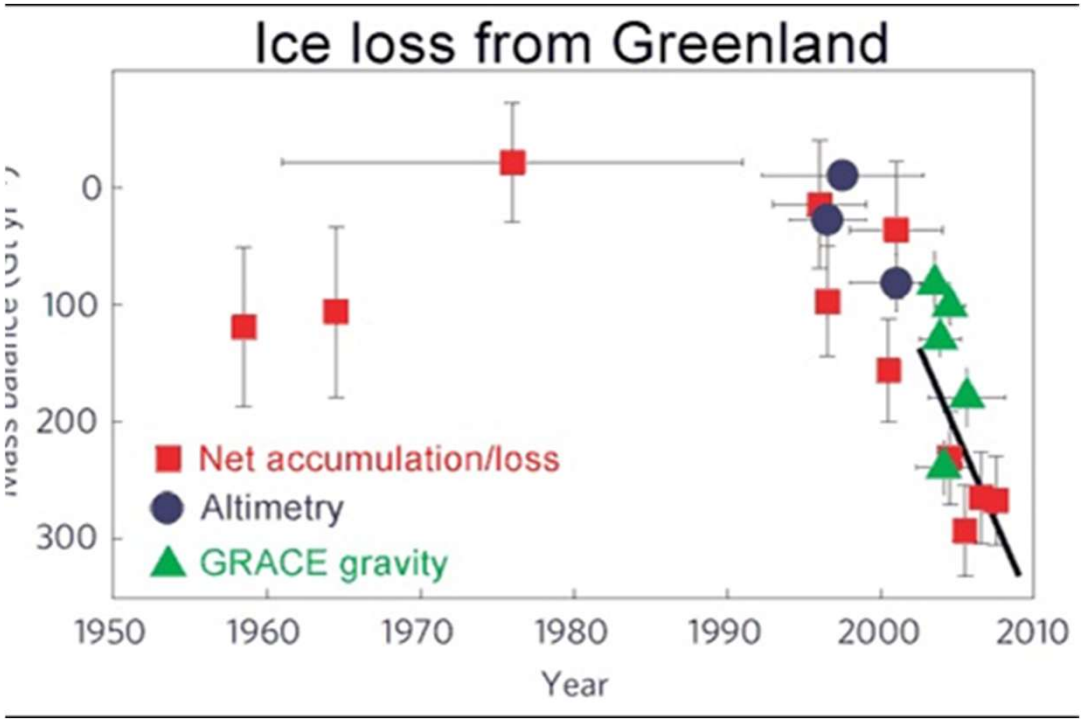
**http://sks.to/glacier**

# Global Warming is happening

**FACT**
Greenland on the whole is losing ice, at a rate of over 2 Mount Everests worth of ice every year.

**MYTH**
Greenland ice sheet is thickening in the middle so it must be gaining mass.

**FALLACY**
Looking at the whole ice sheet shows it's thickening in the middle but ice loss at the edges is accelerating.




Estimated Greenland Ice Sheet mass balance changes since 1950 using three different methods (Jiang 2010)

**Cherry-picking**

sks.to

**http://sks.to/greenland**

# Global Warming is happening

**FACT**

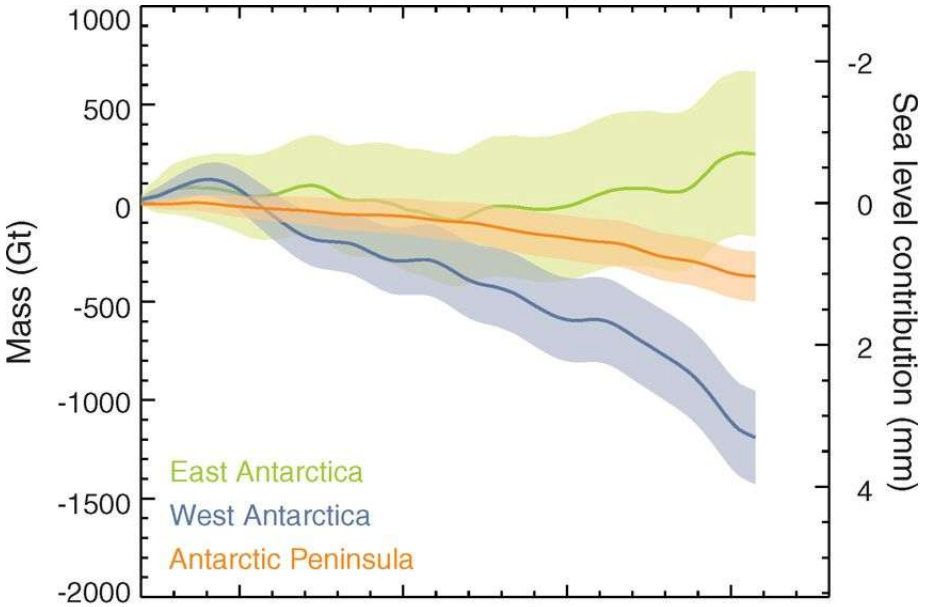
The West Antarctic ice sheet is losing hundreds of billions of tonnes of ice every year, making it a major contributor to global sea level rise.

**MYTH**

Antarctic sea ice is on the increase and casts doubt on global warming.

**FALLACY**

A number of factors may contribute to the increase in sea ice - but in no way does it change the fact that climate change is happening.




Estimates of total Antarctic land ice changes and approximate sea level contributions using a combination of different measurement techniques (Shepherd, 2012).

**Over-simplification**

**http://sks.to/antarctica**

# Global Warming is happening

**FACT**

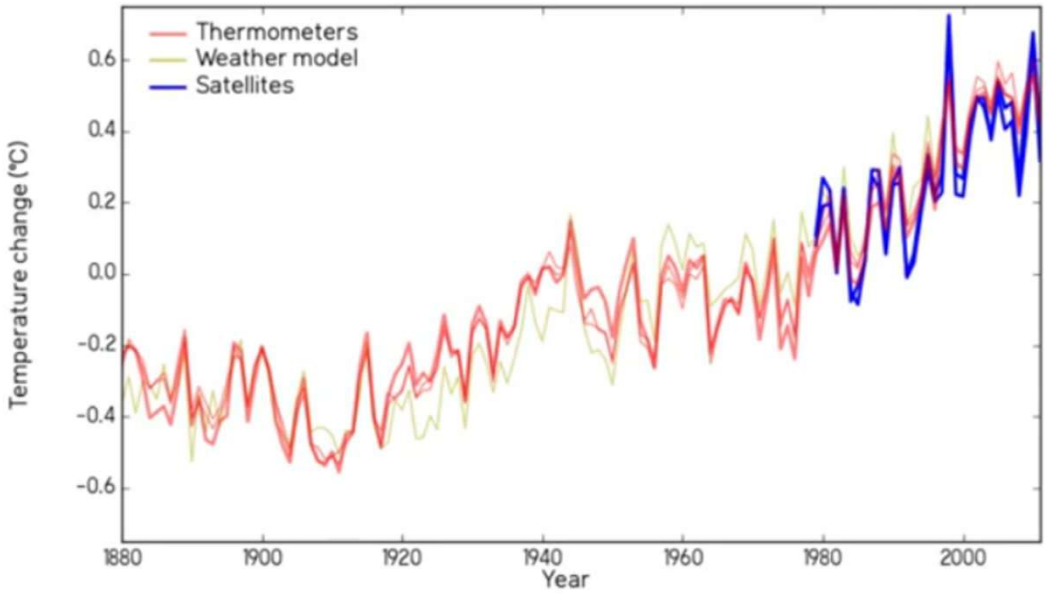
We can measure temperature in many ways and they all say the same thing - our planet is warming.

**MYTH**

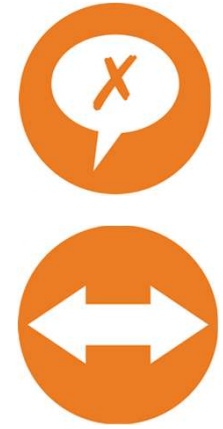
The thermometer record is unreliable.

**FALLACY**

Just because measurements have uncertainties doesn't mean it's unknowable. The uncertainty is smaller than measured global warming. The ambiguity of the term “uncertainty” is exploited.




Denial101x - 2.4.1. - https://youtu.be/YKQiyBkt4Vs



**Ambiguity**

sks.to

**http://sks.to/temp**

# Global Warming is happening

**FACT**

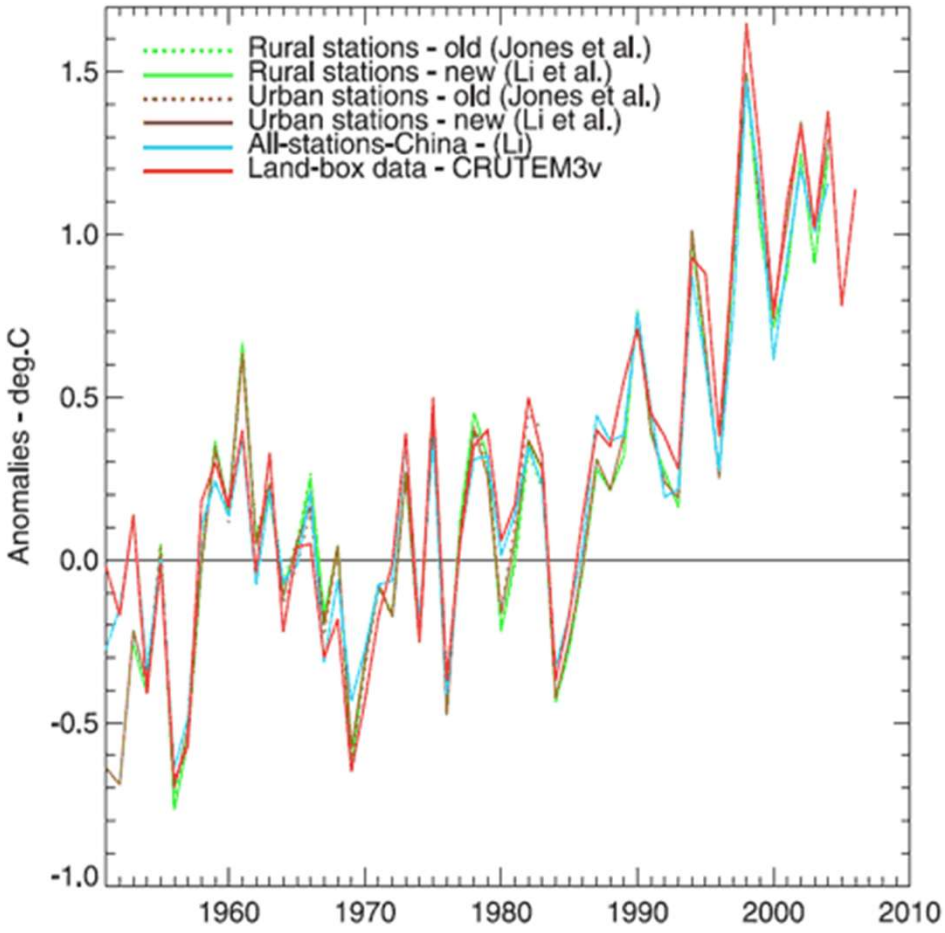
Urban heat has had minimal effect on the climate record, with much warming happening where there is little urban development.

**MYTH**

Urban development is responsible for much of global warming over the last century.

**FALLACY**

Just because urban heat might affect the climate record doesn't mean it does. Scientists have confirmed it has negligible effect.




**Misrepre-sentation**

sks.to

**http://sks.to/uhi**

# Global Warming is happening

**FACT**

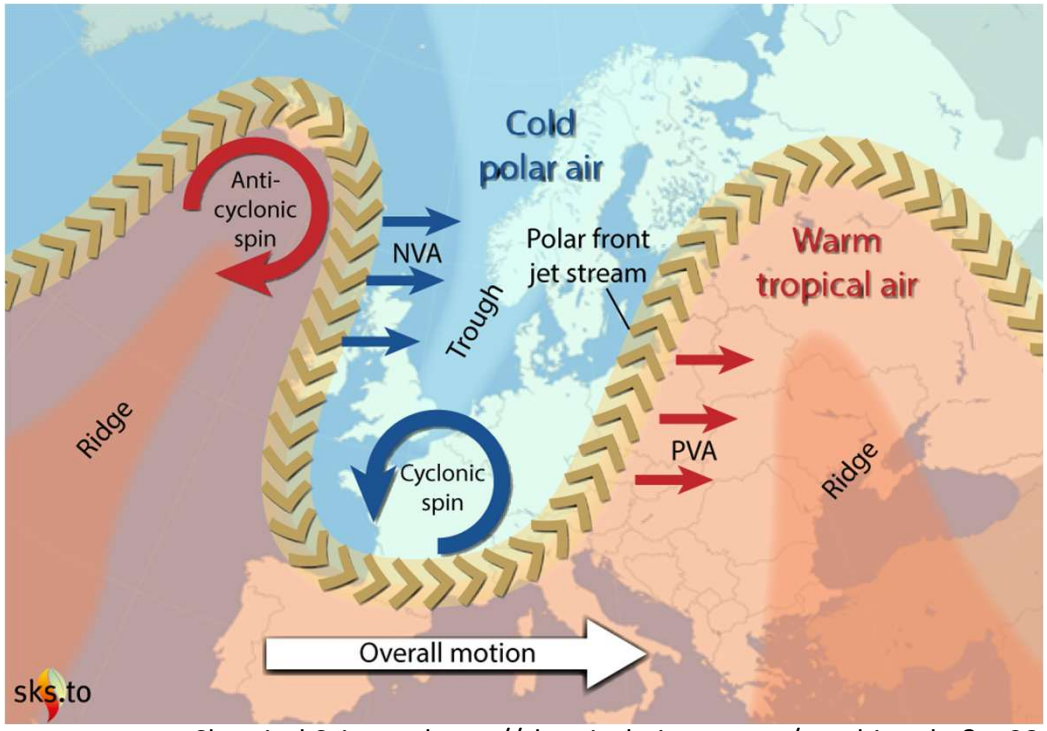
Slowing jet stream is causing Arctic cold air to leak down into Europe and North America, like an open fridge leaking cold air into the kitchen.

**MYTH**

Record cold winters disprove global warming.

**FALLACY**

A cold winter doesn't disprove global warming, you need to look at the big picture.




Skeptical Science: https://skepticalscience.com/graphics.php?g=98



**Impossible Expectations**

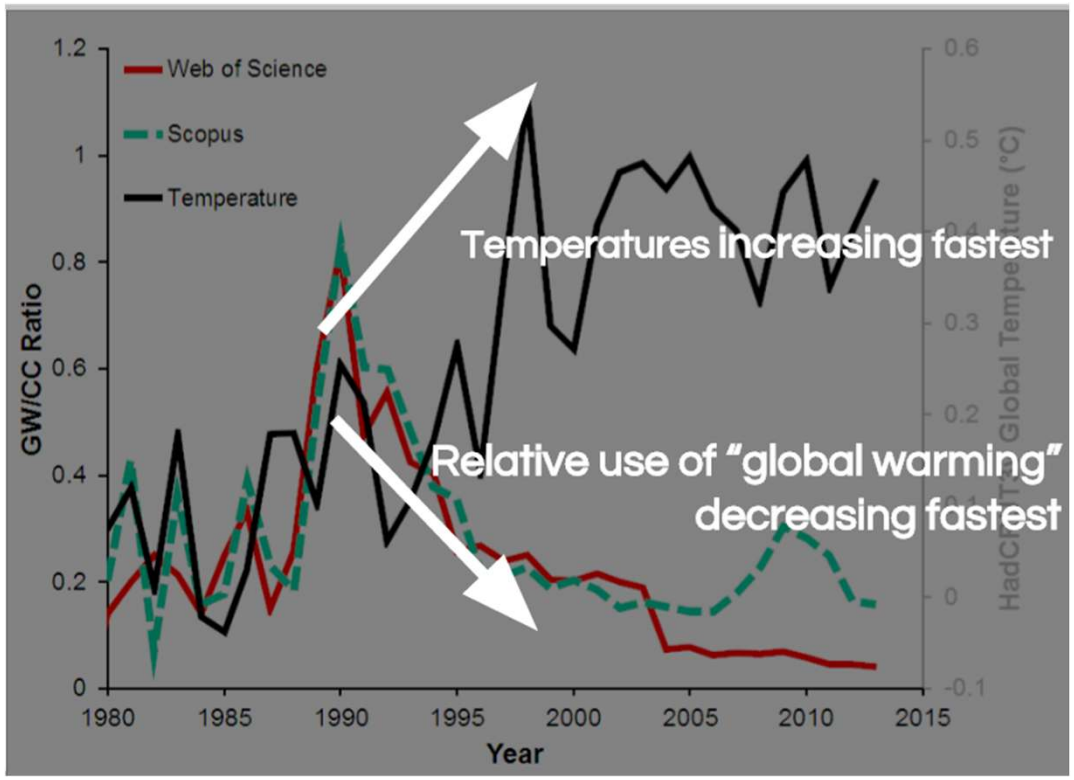
**http://sks.to/winter**

# Global Warming is happening

**FACT**
Climate change and global warming have both been used for decades.

**MYTH**
They changed name from ‘global warming’ to ‘climate change’.

**FALLACY**
They didn't change the name (let alone in connection with temperature changes!)




Denial101x – 2.4.4.1

**Misrepre-sentation**

sks.to

**http://sks.to/name**

| | | | | | |
|---|---|---|---|---|---|
| Global Warming is happening | 1998 | Cold | Glacier | Greenland | Antarctica |
| | Temp | UHI | Winter | Name | |
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| Past and future climate change | Past | LIA | Past $CO_2$ | MWP | Model |
| | Hansen1988 | Weather | 1970s | Iceage | |
| Climate change impacts | Vapor | Cloud | Species | Bear | Acid |
| | Impacts | Pollutant | Plant | Extreme | |

# We are causing global warming

**FACT**

For thousands of years, our atmosphere has been in balance. Humans have upset the balance..

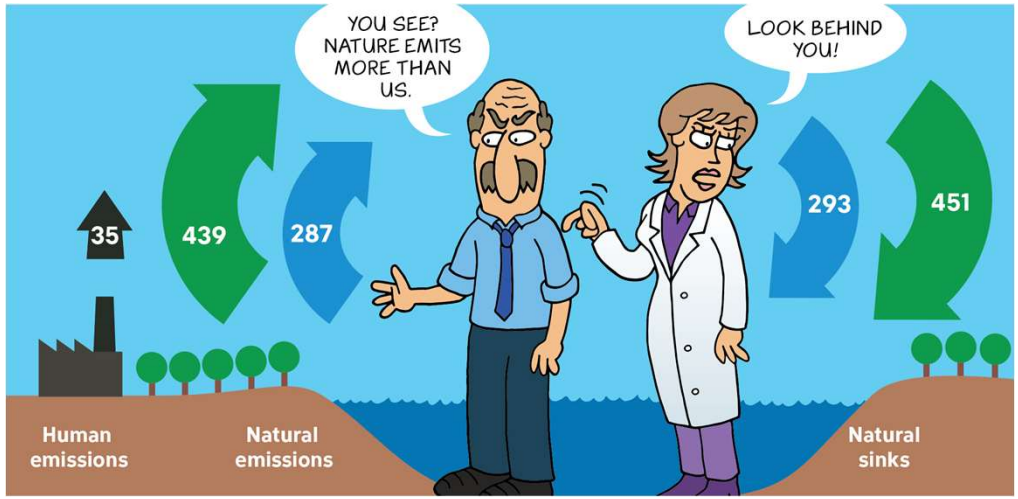
**MYTH**

Human $CO_2$ emissions are tiny compared to natural $CO_2$ emissions so our influence is negligible.

**FALLACY**

Considers only natural $CO_2$ emissions and ignores natural $CO_2$ sinks.

**Over-simplification**




Source - https://skepticalscience.com/graphics/CrankyCartoon-CarbonCycle-EN.jpg

sks.to

**http://sks.to/co2**

# We are causing global warming

**FACT**

Human emissions are responsible for all of the increase in $CO_2$ in the air over the past two centuries.

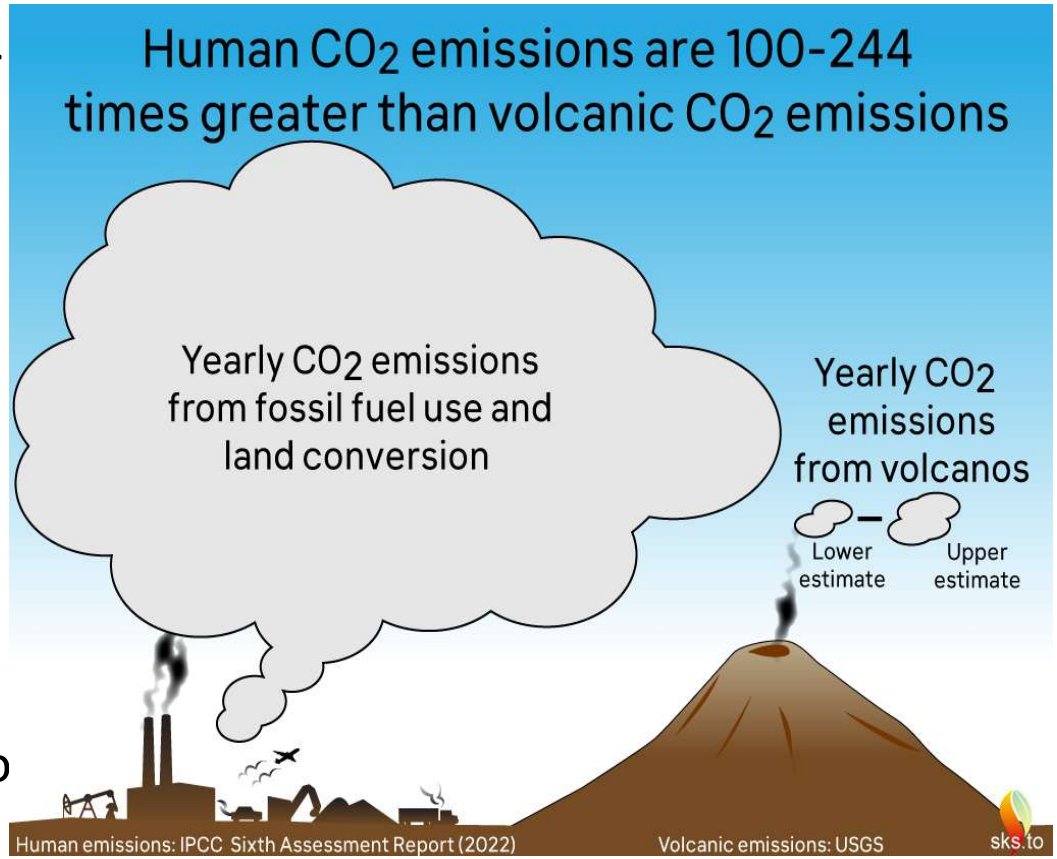
**MYTH**

Volcanoes produce more CO2 than humans.

**FALLACY**

Volcanoes do produce $CO_2$, but over recent centuries the amounts are too small to account for the observed changes in the air. We emit 100 to 244 more $CO_2$ than volcanoes.

**Misrepre-sentation**




Skeptical Science - https://skepticalscience.com/graphics.php?g=468

**http://sks.to/volcano**

# We are causing global warming

**FACT**

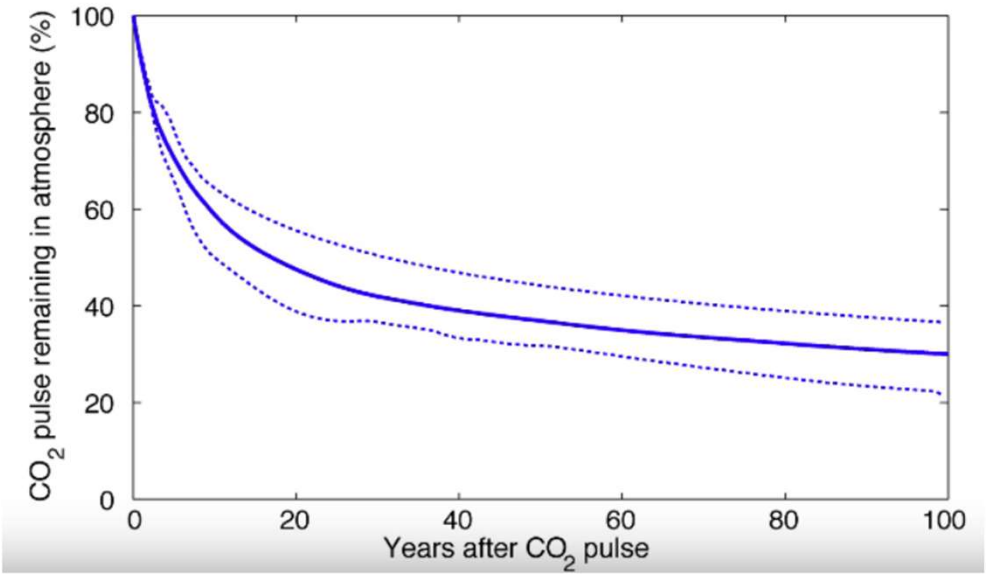
If we stopped emitting $CO_2$, it would take thousands of years for the atmosphere to return to pre-industrial levels.

**MYTH**

$CO_2$ has a residence time of only 4 years so $CO_2$ levels would fall quickly if we stopped emitting.

**FALLACY**

How quickly a $CO_2$ molecule moves around the climate system is different to how long it takes $CO_2$ level to return back to normal.




Denial101x – 3.2.3.1

**Over-simplification**

sks.to

**http://sks.to/residence**

# We are causing global warming

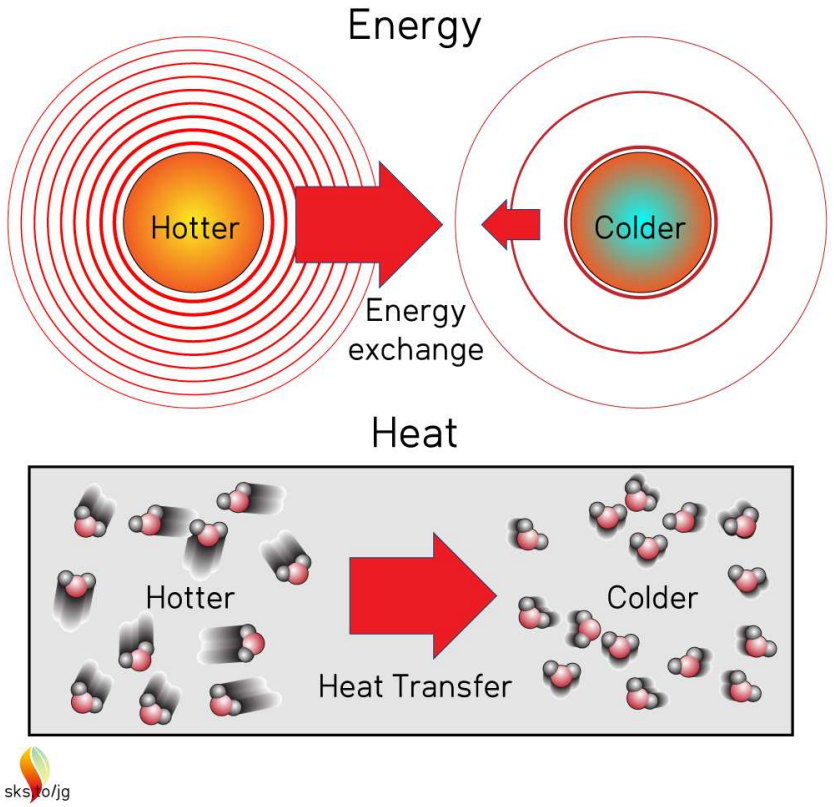
**FACT**
Greenhouse gases are like a blanket. They trap heat, sending it back down to Earth where we measure it.

**MYTH**
Greenhouse effect violates the 2nd law of thermodynamics.

**FALLACY**
2nd law talks about net flow of energy and doesn't forbid some flow from cool to hot. The ambiguity of “energy flow” is exploited.



**Ambiguity**




Skeptical Science - https://skepticalscience.com/graphics.php?g=304

**http://sks.to/thermo**

# We are causing global warming

**FACT**

Emitting more $CO_2$ means more heat is being trapped higher up in the atmosphere where the air is thinner.

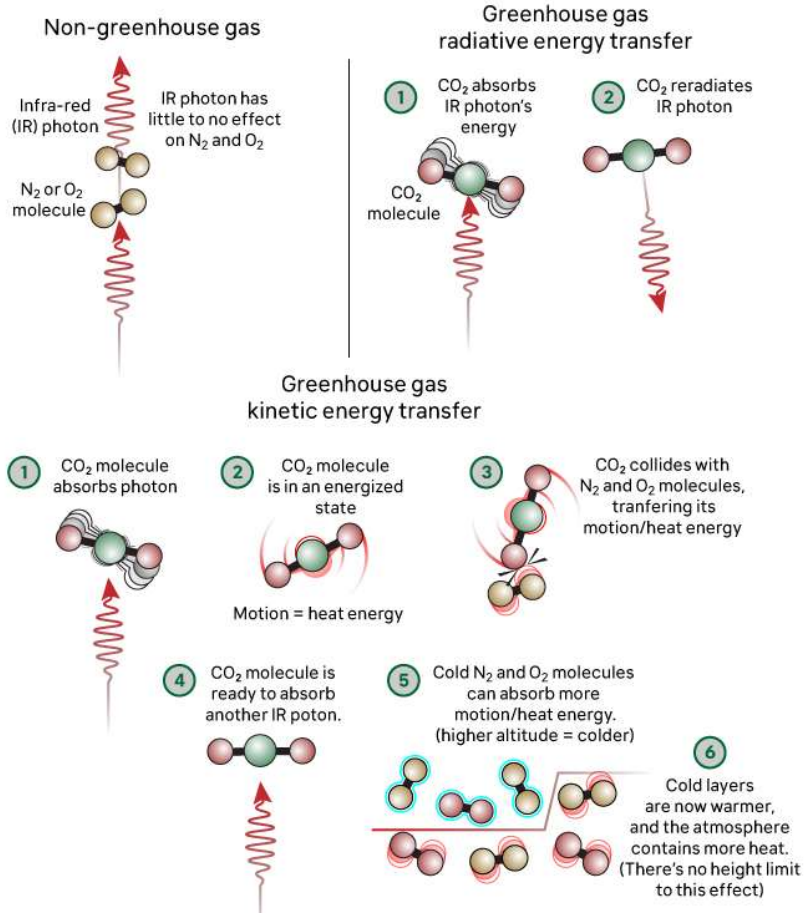
**MYTH**

The greenhouse effect is saturated so adding more $CO_2$ won't affect it.

**FALLACY**

Considers the atmosphere as a single layer when it's multiple layers.

**Over-simplification**




Skeptical Science: https://skepticalscience.com/graphics.php?g=475

**http://sks.to/saturate**

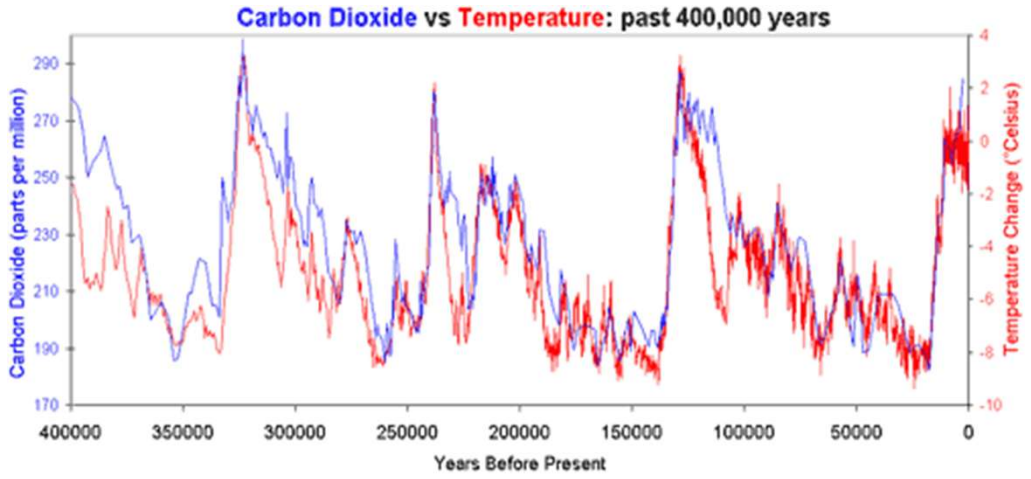
# We are causing global warming

**FACT**

Ice cores tell us warming causes the ocean to emit more $CO_2$. Combined with greenhouse effect, this is a reinforcing feedback.

**MYTH**

$CO_2$ lagging temperature means greenhouse effect is minimal.




Vostok Antarctic ice core records for carbon dioxide concentration (Petit 2000) and temperature change (Barnola 2003)

**FALLACY**

It's not one or the other but both. $CO_2$ causes warming and warming causes $CO_2$ to rise.

**False Choice**

sks.to

**http://sks.to/lag**

# We are causing global warming

**FACT**

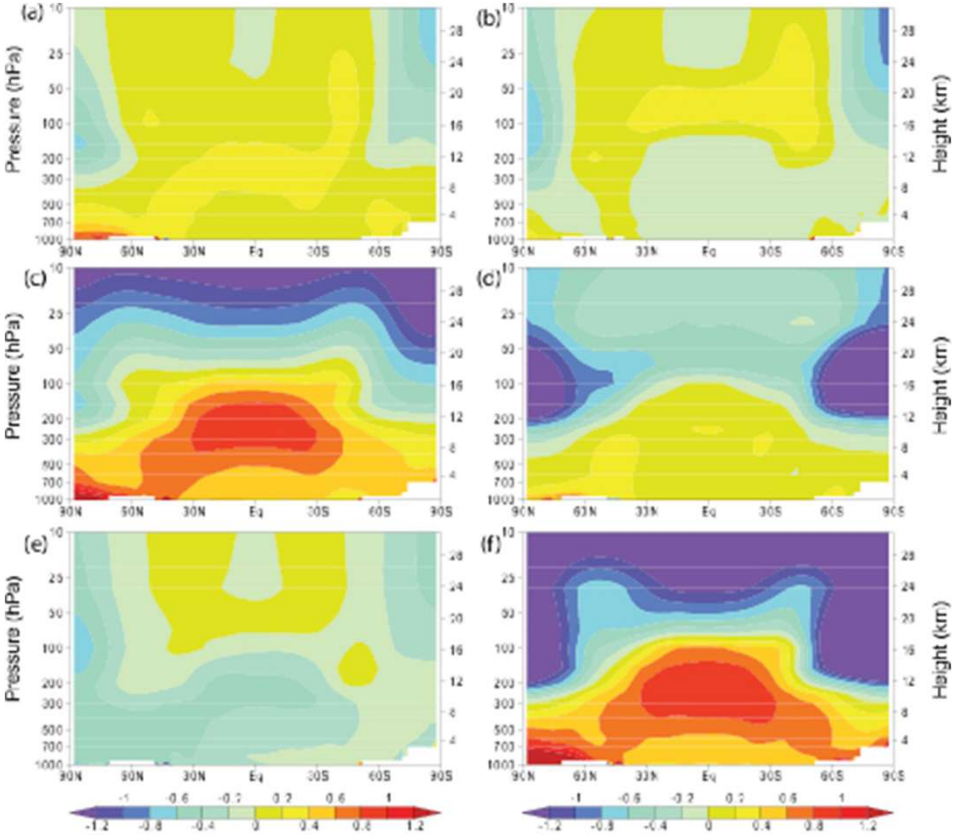
One human fingerprint is a cooling upper atmosphere with a warming lower atmosphere. Satellites have measured this pattern.

**MYTH**

One fingerprint of human-caused global warming is the tropospheric hot spot which hasn't been observed.

**FALLACY**

A hot spot should appear for any type of surface warming so is not linked uniquely to greenhouse warming.




Atmospheric temperature change from 1890 to 1990 from (a) solar forcing, (b) volcanoes, (c) greenhouse gases, (d) ozone, (e) sulfate aerosols and (f) sum of all forcing (IPCC AR4)

**http://sks.to/hotspot**

**Ambiguity**

# We are causing global warming

**FACT**

Satellites measure the warming effect from CO2. The increased greenhouse effect is an observed reality. It was predicted before it could be measured.

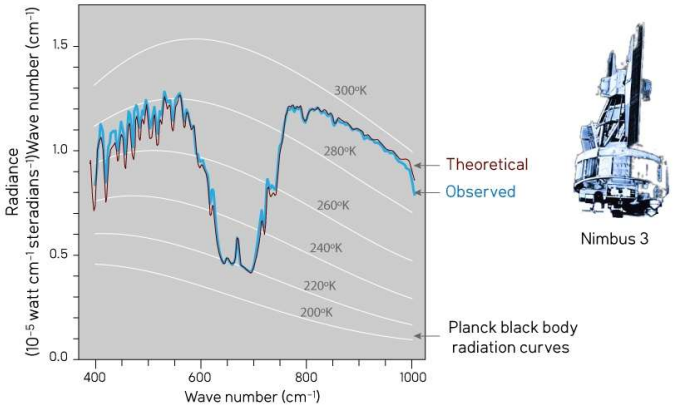
**MYTH**

$CO_2$ is a trace gas so it's warming effect is minimal.

**FALLACY**

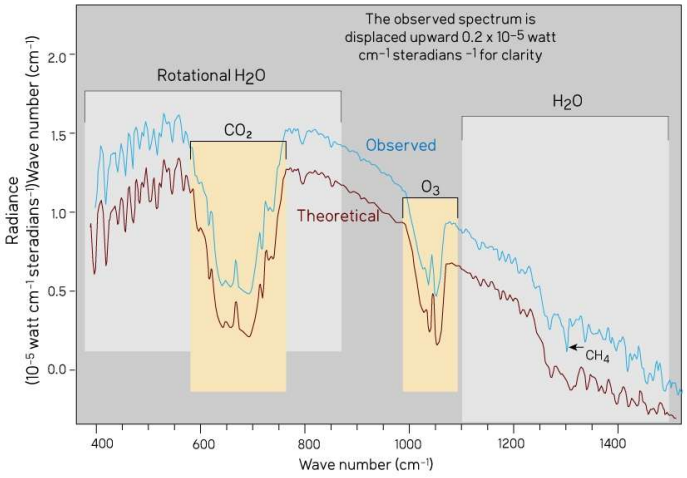
The fact that CO2 is a trace gas is irrelevant to whether it can impact climate. Trace amounts of substances can have a strong effect.

**Red Herring**










Skeptical Science - https://skepticalscience.com/graphics.php?g307

**http://sks.to/trace**

# We are causing global warming

**FACT**

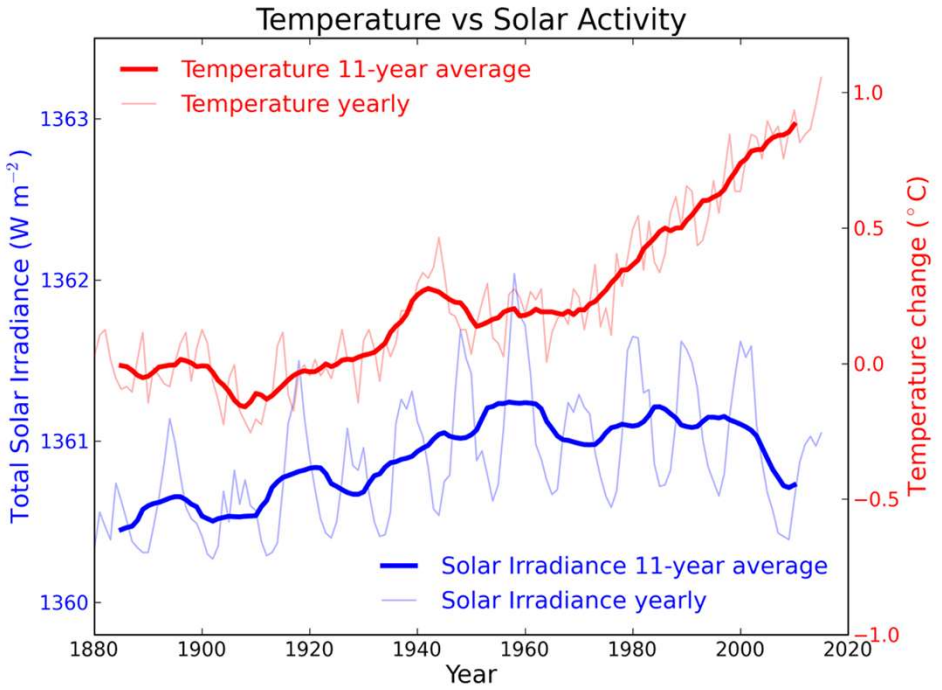
The Sun has been getting colder for the last 30 years as the Earth has been warming. Sun and climate are moving in opposite directions.

**MYTH**

The sun is causing global warming.

**FALLACY**

Ignores human fingerprints and recent period where sun and climate move in opposite directions.




Skeptical Science - https://skepticalscience.com/graphics.php?g=5



**Cherry-picking**

sks.to

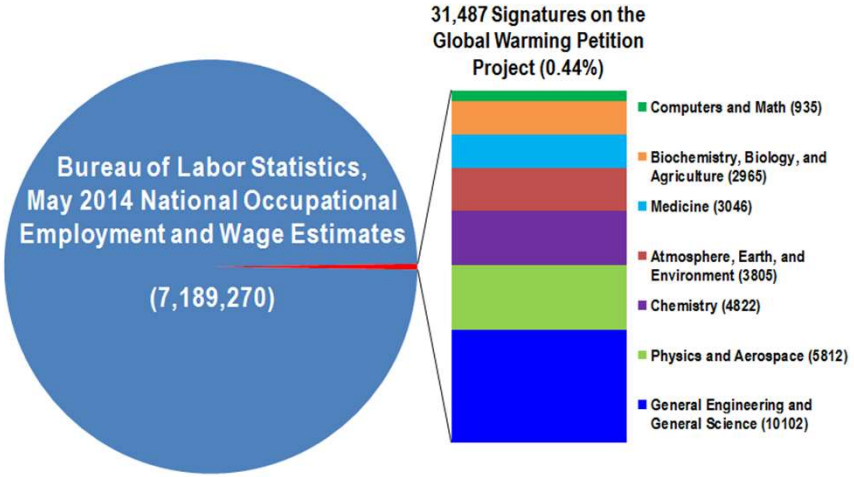
**http://sks.to/sun**

# Consensus

**FACT**
Between 90 and 100 % of climate experts agree that we are mostly responsible for current global warming.




**MYTH**
More than 31,000 scientists disagree with the consensus.






**Fake Experts**



**Magnified Minority**

**FALLACY**
The myth relies on fake experts and a magnified minority. Just about 0.1 % of signees are actively publishing climate scientists while most of them work in other areas.

Brian Angliss – Scholars & Rogues (2015)

**http://sks.to/consensus**

| | | | | | |
|---|---|---|---|---|---|
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| Climate change impacts | Vapor | Cloud | Species | Bear | Acid |
| | Impacts | Pollutant | Plant | Extreme | |

# Past and future climate change

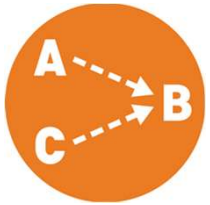
**FACT**

Past climate change tells us climate is sensitive to the warming effect of $CO_2$.

**MYTH**

Natural climate change in the past implies current climate change is also natural.




**Single Cause**

**FALLACY**

Although climate change happened naturally in the past, today's cause is human activity.




Skeptical Science - https://skepticalscience.com/graphics.php?g=417

sks.to

**http://sks.to/past**

# Past and future climate change

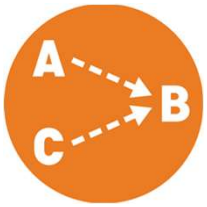
**FACT**

Natural influences that ended the Little Ice Age have been swamped by recent human activity.

**MYTH**

Current warming is just the continuation of natural recovery from the Little Ice Age.

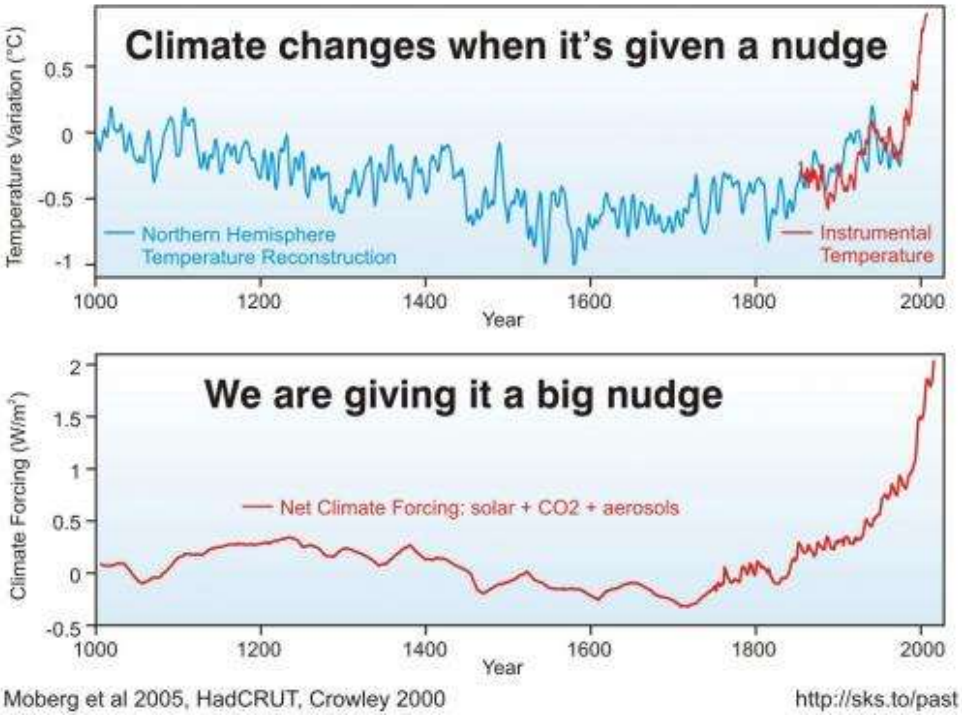



**Single Cause**

**FALLACY**

The natural factors that ended the Little Ice Age are no longer significant.




Skeptical Science - https://skepticalscience.com/graphics.php?g=40

sks.to

**http://sks.to/lia**

# Past and future climate change

**FACT**

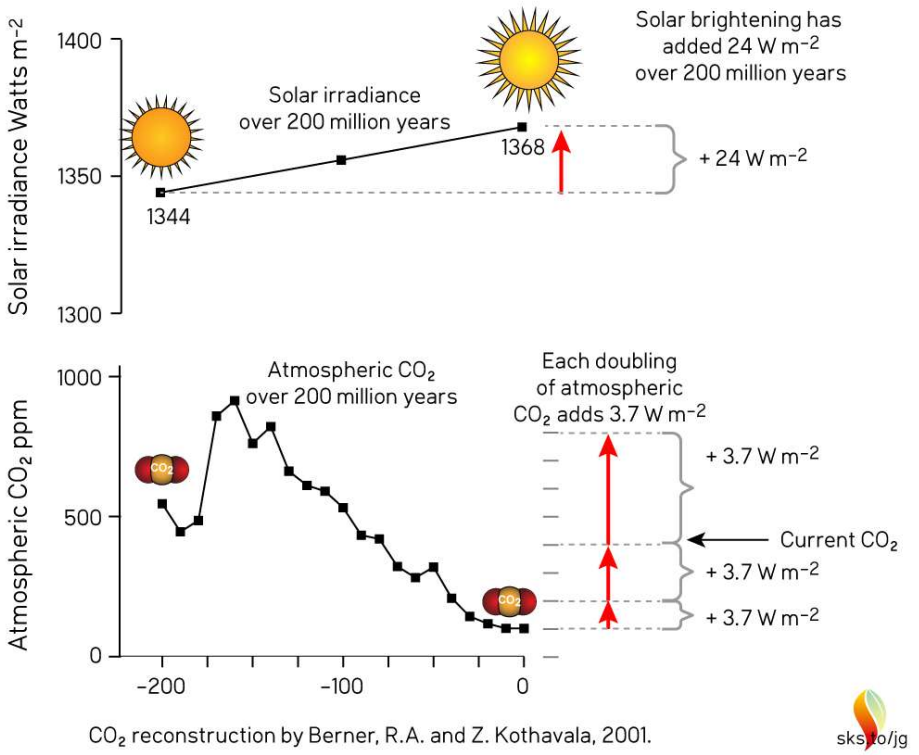
In the past when the sun was cooler, $CO_2$ was higher. The two roughly balanced each other. We are now raising $CO_2$ levels with a warmer sun.

**MYTH**

$CO_2$ was higher in the past but the world didn't boil away so the greenhouse effect is weak.

**FALLACY**

Ignores the role of the sun which was cooler in the past.




Skeptical Science - https://skepticalscience.com/graphics.php?g=303

**Slothful induction**

**http://sks.to/pastco2**

# Past and future climate change

**FACT**

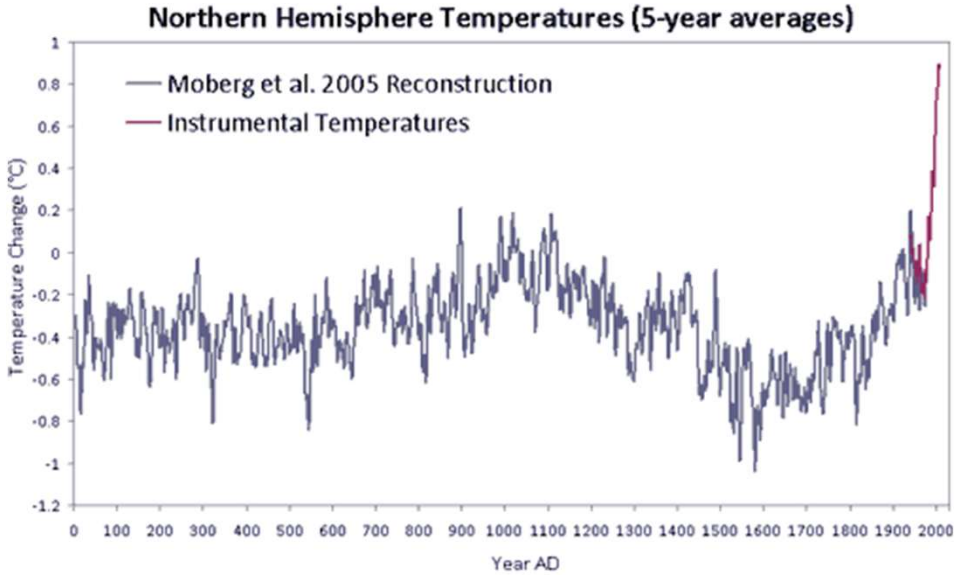
While the Medieval Warm Period saw unusually warm temperatures in some regions, globally the planet was cooler than now.

**MYTH**

The Medieval Warm Period was warmer than current conditions. This implies recent warming is not unusual and must be natural.

**FALLACY**

For average temperature over wide regions, the hot regions were cancelled out by other cool regions.




Northern Hemisphere Temperature Reconstruction by Moberg et al. (2005) shown in blue, Instrumental Temperatures from NASA shown in Red.



**Slothful induction**

sks.to

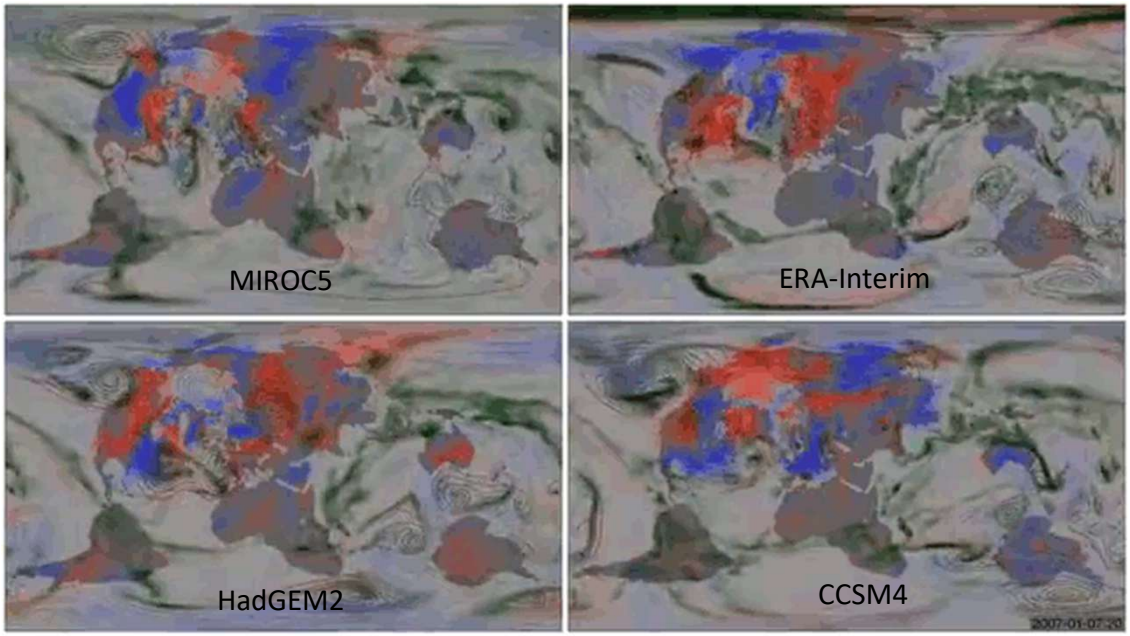
**http://sks.to/mwp**

# Past and future climate change

**FACT**
Models are based on fundamental physical principles.

**MYTH**
Models are unreliable.

**FALLACY**
No model is perfect but they are useful tools that can reproduce the past and provide insights into the future.




One of these panels shows observed weather (as estimated by Era-Interim); the other three weather simulated by three different climate models (HadGEM2, CCSM4, and MIROC5) - which is which? Click to find out!
Video from Philip Brohan - https://vimeo.com/213117747



**Impossible Expectations**

sks.to

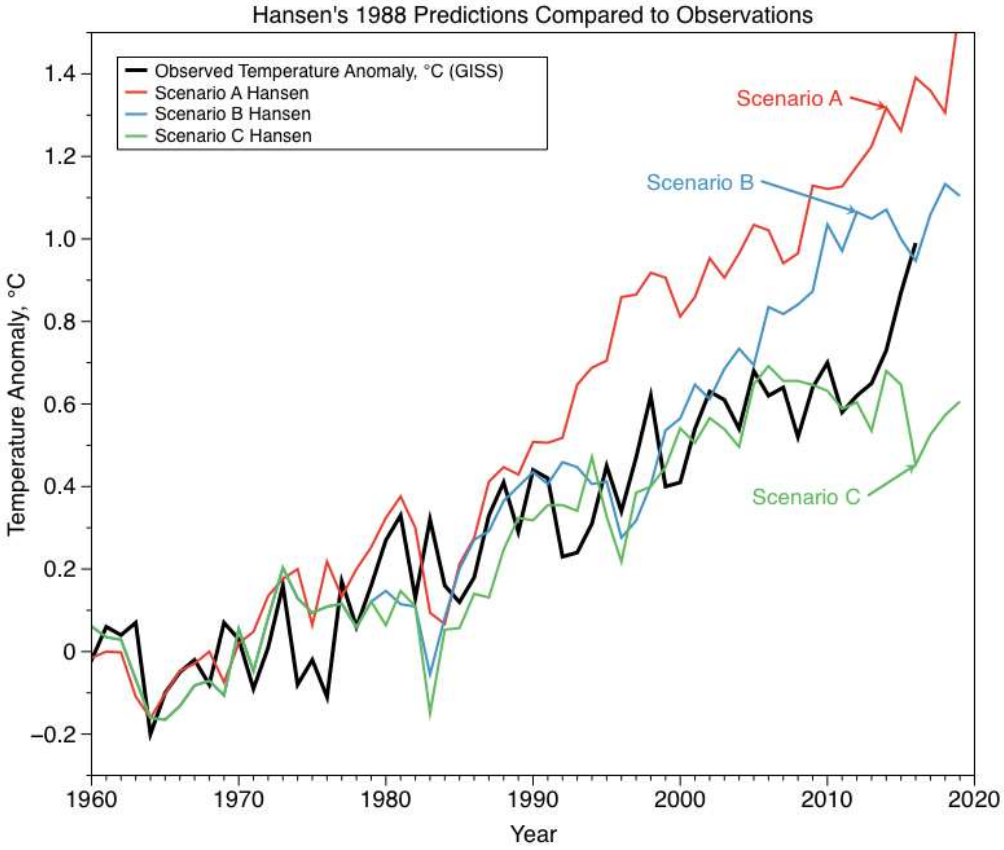
**http://sks.to/model**

# Past and future climate change

**FACT**
Models have made a number of successful predictions.

**MYTH**
Models predictions have failed, making them unreliable.

**FALLACY**
Climate models have had great success at predicting long-term effects like greenhouse warming.






**Impossible Expectations**

sks.to

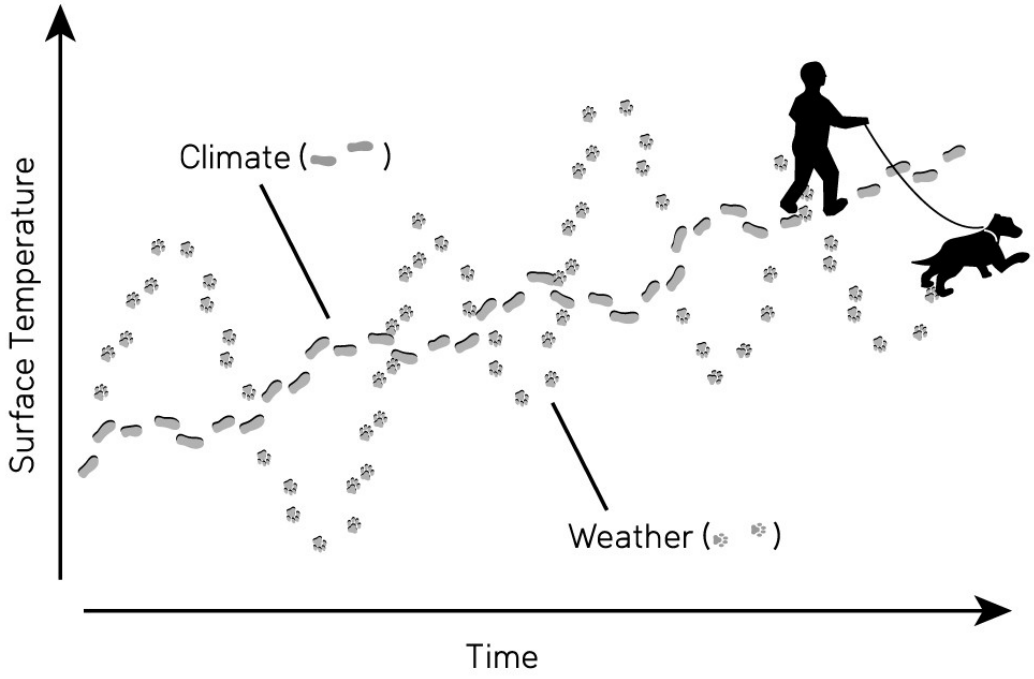
**http://sks.to/hansen1988**

# Past and future climate change

**FACT**
Climate models simulate climate which is weather averaged over time.

**MYTH**
Scientists can't even predict weather.

**FALLACY**
Confusing weather with climate distracts from the fact that short-term predictions have little relevance to long-term climate predictions.




Skeptical Science - https://skepticalscience.com/graphics.php?g=308

**Ambiguity**

**http://sks.to/weather**

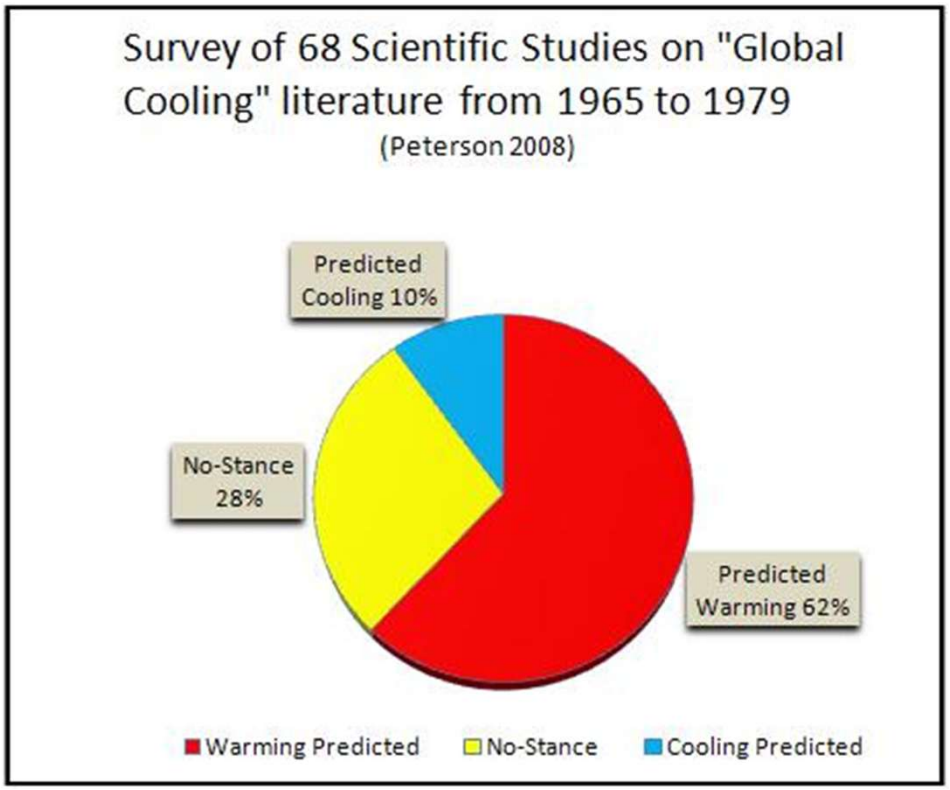
# Past and future climate change

**FACT**
In the 1970s, the majority of climate papers were predicting warming.

**MYTH**
In the 1970s, climate scientists were predicting an ice age.

**FALLACY**
Confuses mainstream media reports with scientific papers which overwhelmingly pointed towards warming.

**Misrepre-sentation**




sks.to

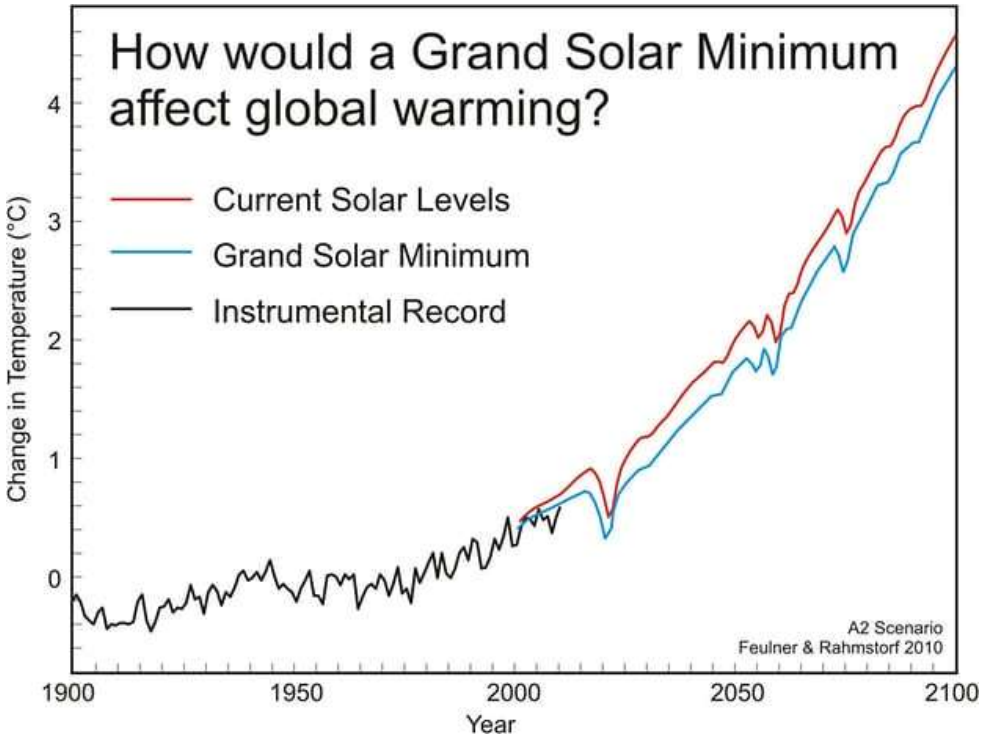
**http://sks.to/1970s**

# Past and future climate change

**FACT**
Even if the sun fell to Maunder Minimum levels, it would only delay global warming by a decade.

**MYTH**
We're heading into another ice age because of the cooling sun.

**FALLACY**
Overstating the role of solar activity on climate - it actually has had little effect.




Skeptical Science - https://skepticalscience.com/graphics.php?g=21




**Single Cause**

**http://sks.to/iceage**

| | | | | | |
|---|---|---|---|---|---|
| Global Warming is happening | 1998 | Cold | Glacier | Greenland | Antarctica |
| | Temp | UHI | Winter | Name | |
| We are causing Global Warming | $CO_2$ | Volcano | Residence | Thermo | Saturate |
| | Lag | Hotspot | Trace | Sun | Consensus |
| Past and future climate change | Past | LIA | Past $CO_2$ | MWP | Model |
| | Hansen1988 | Weather | 1970s | Iceage | |
| Climate change impacts | Vapor | Cloud | Species | Bear | Acid |
| | Impacts | Pollutant | Plant | Extreme | |

# Climate change impacts

**FACT**

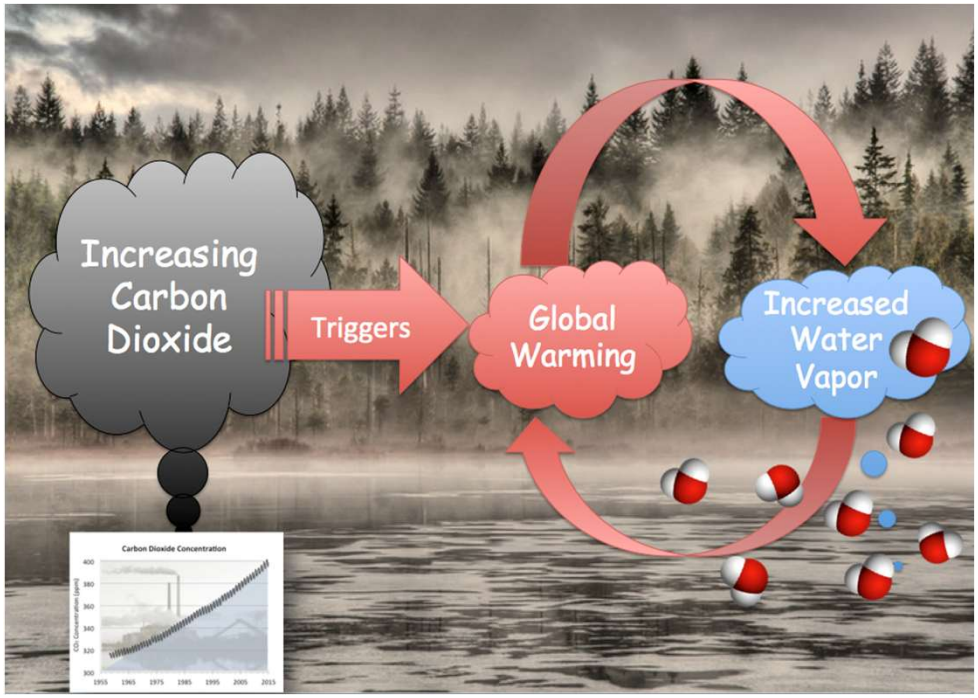
The amount of water vapor in the air depends on temperature. Warming causes water vapor to rise, which causes further warming: a reinforcing feedback.

**MYTH**

Water vapor is the strongest greenhouse gas so CO2 emissions don't matter.

**FALLACY**

The fact that water vapor is a strong greenhouse gas means it amplifies the warming from greenhouse gases.




Denial101x - 5.2.2 - Water Vapor

**Misrepre-sentation**

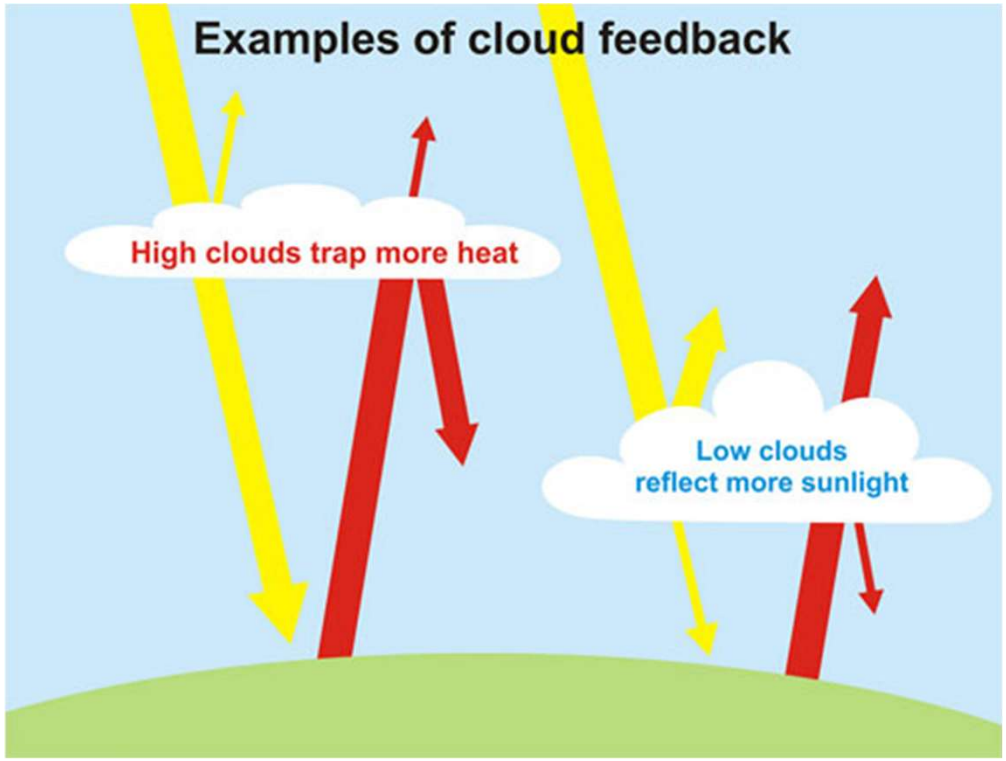
sks.to

**http://sks.to/vapor**

# Climate change impacts

**FACT**
Clouds provide a reinforcing feedback but the effect isn't strong. Clouds play a minor role in climate sensitivity

**MYTH**
Clouds provide negative feedback




Skeptical Science - https://skepticalscience.com/graphics.php?g=21





**FALLACY**
Acting as if clouds only have a cooling effect ignores that they can also warm.

**Over-simplification**

sks.to

**http://sks.to/cloud**

# Climate change impacts

**FACT**

Mass extinctions happen when climate changes too fast for species to adapt. Currently species are going extinct at similar rates to past mass extinctions.

**MYTH**

Species can adapt to climate change.

**FALLACY**

Just because species can adapt to some climate change doesn't mean they can adjust to the rapid climate change happening now.

**Misrepre-sentation**

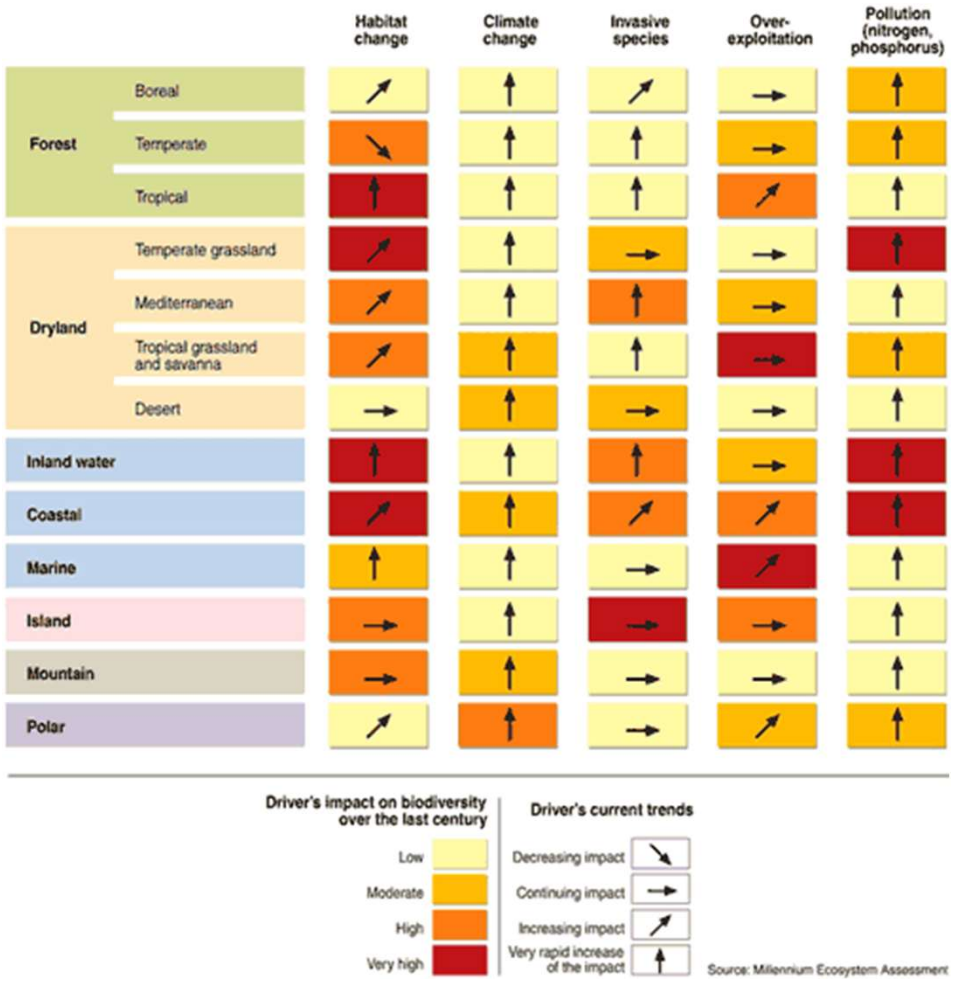



Figure from the Millennium Ecosystem Assessment

**http://sks.to/species**

# Climate change impacts

**FACT**
Polar bears need sea ice to hunt so the shrinking of Arctic sea ice is endangering their populations.

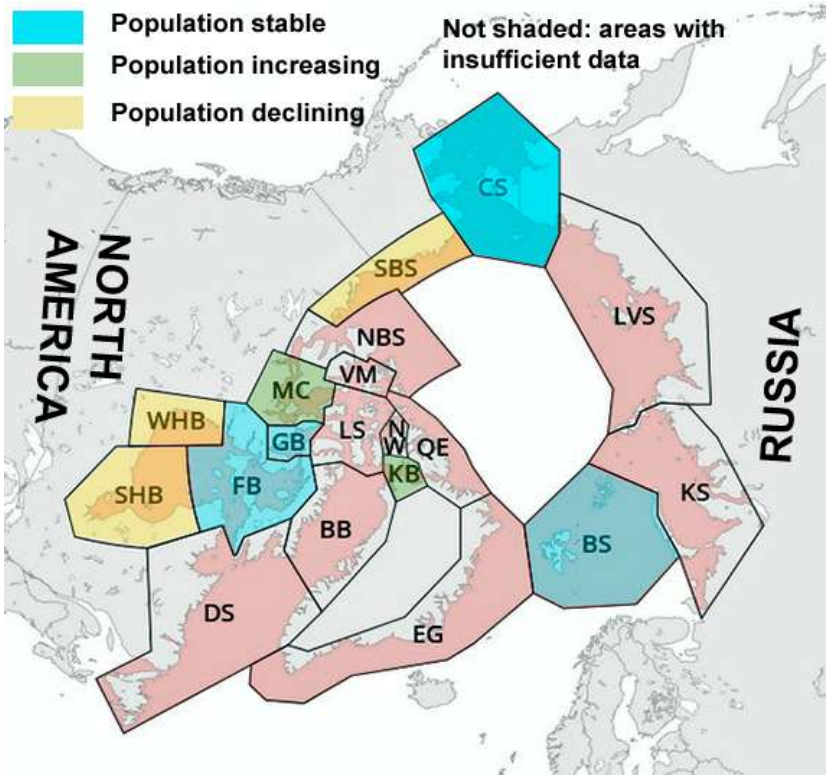
**MYTH**
Polar bear numbers have increased so they're in no danger from global warming.

**FALLACY**
One threat (hunting) has been removed but replaced with an increasing threat (melting sea ice).





**Over-simplification**




Adapted from: https://commons.wikimedia.org/wiki/File:Polar_bear_subpopulation_map.svg

**http://sks.to/bear**

# Climate change impacts

**FACT**

Ocean acidity has increased 30% and poses serious threats to coral reefs that are also threatened by warming oceans and bleaching.

**MYTH**

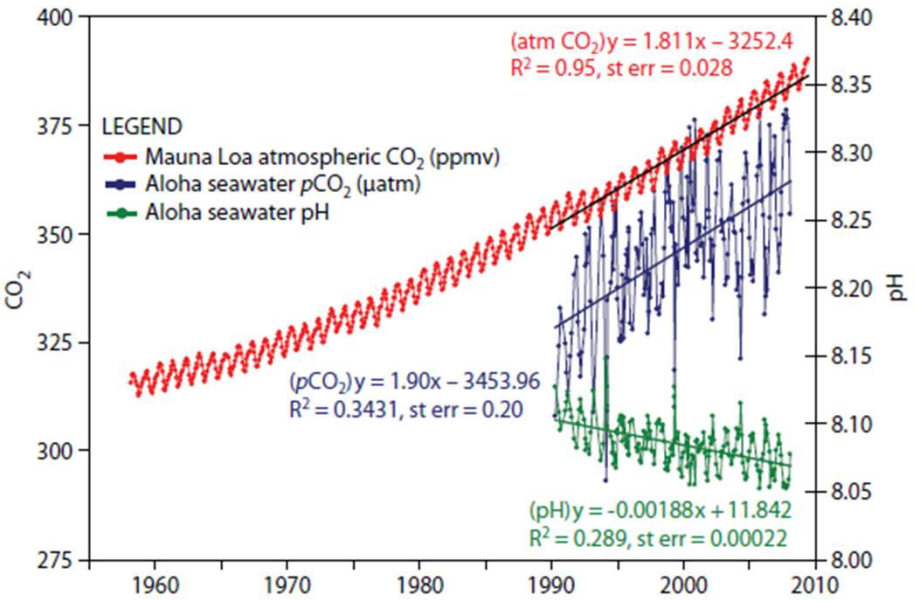
Ocean acidification isn't serious.



**Red Herring**

**FALLACY**

Ocean acidification means oceans are decreasing in pH so they are getting more acidic, even if they are not actually acid.




Annual variations in atmospheric $CO_2$, oceanic $CO_2$, and ocean surface pH. Strong trend lines for rising $CO_2$ and falling pH.

**http://sks.to/acid**

# Climate change impacts

**FACT**

Climate change is having negative impacts on all parts of society.

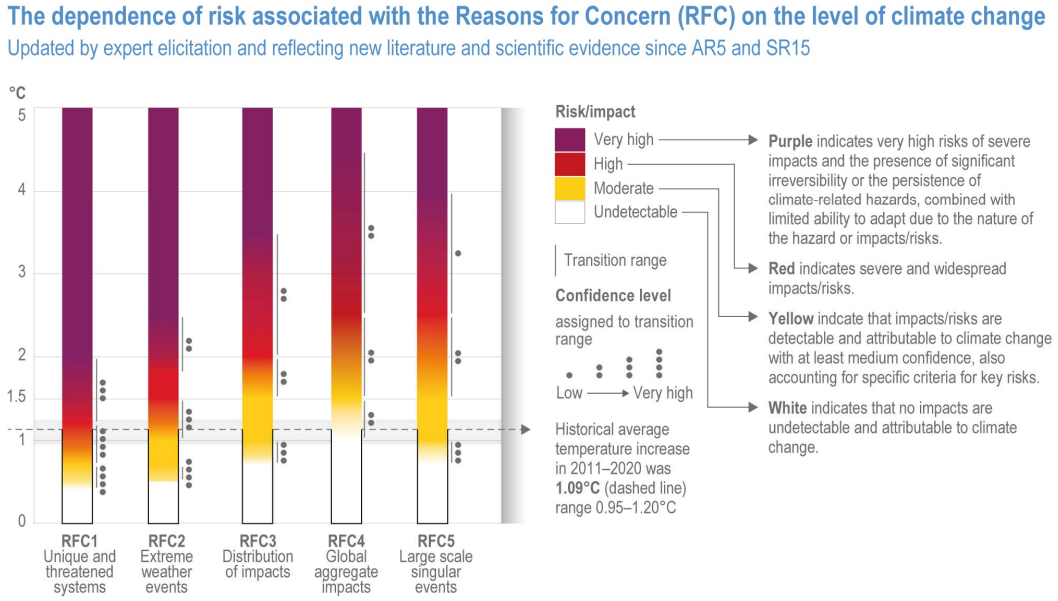
**MYTH**

Global warming is good.

**FALLACY**

This focuses on a few good impacts of global warming but ignores the overwhelming number of bad impacts.

**Cherry-picking**




"Burning embers" - https://skepticalscience.com/pics/IPCC_AR6_WGII_Figure_16_FAQ_16_5_1_WithCaption.png

**http://sks.to/impacts**

# Climate change impacts

**FACT**

A pollutant is any substance that disrupts the environment - $CO_2$ does that by trapping heat.

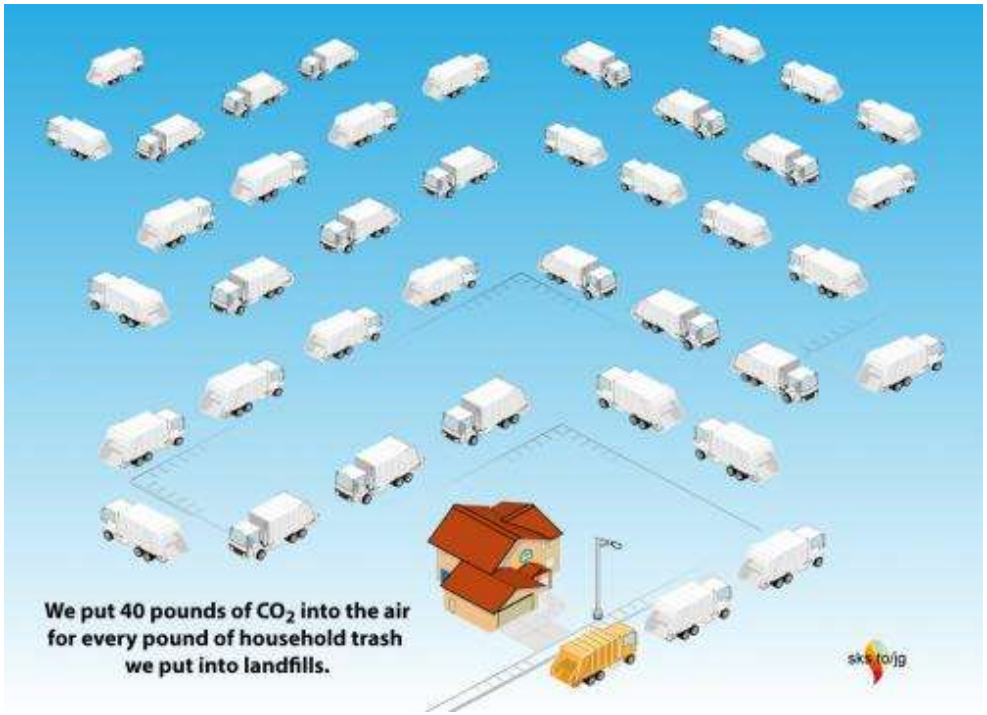
**MYTH**

$CO_2$ is not a pollutant.

**FALLACY**

Quibbling over technical definitions of pollutant is a distraction from the realities of the negative impacts of global warming.

**Red Herring**




Skeptical Science - https://skepticalscience.com/graphics.php?g=21

**http://sks.to/pollutant**

# Climate change impacts

**FACT**

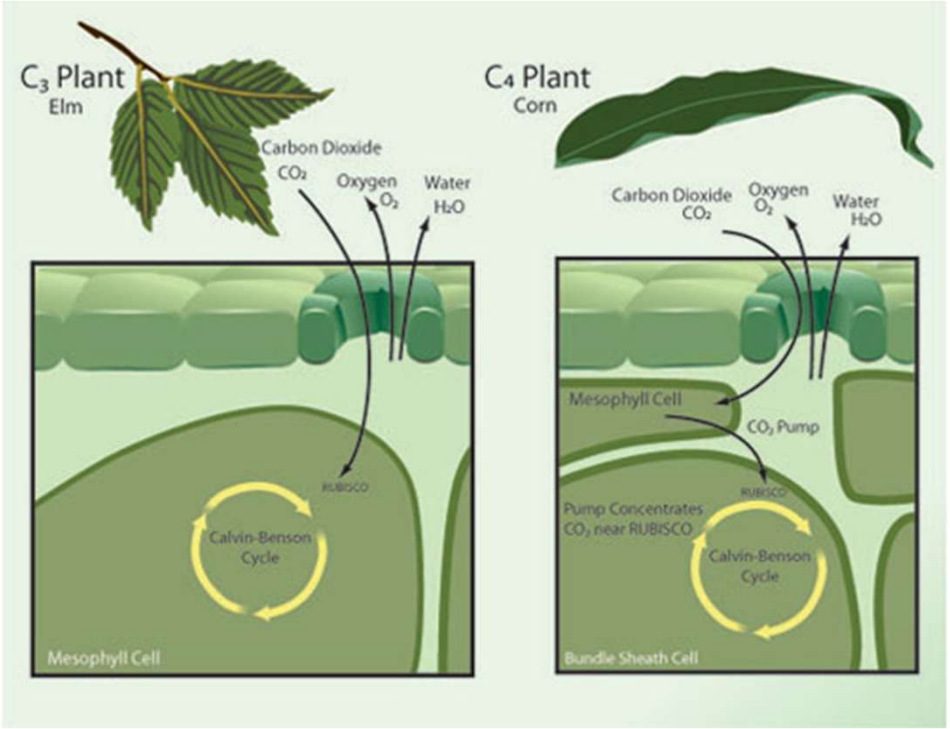
Climate change impacts agriculture through extreme weather: heat stress and flooding.

**MYTH**

$CO_2$ is plant food.

**FALLACY**

$CO_2$ fertilisation is just one factor affecting plant growth. The full picture shows that negative impacts outweigh benefits.




A simplified diagram contrasting C3 vs. C4 plant photosynthesis.
From Nature Magazine.

**Slothful Induction**

sks.to

**http://sks.to/plant**

# Climate change impacts

**FACT**

Risk from extreme weather is increasing, albeit some forms of extreme weather are more confidently linked to global warming than others.

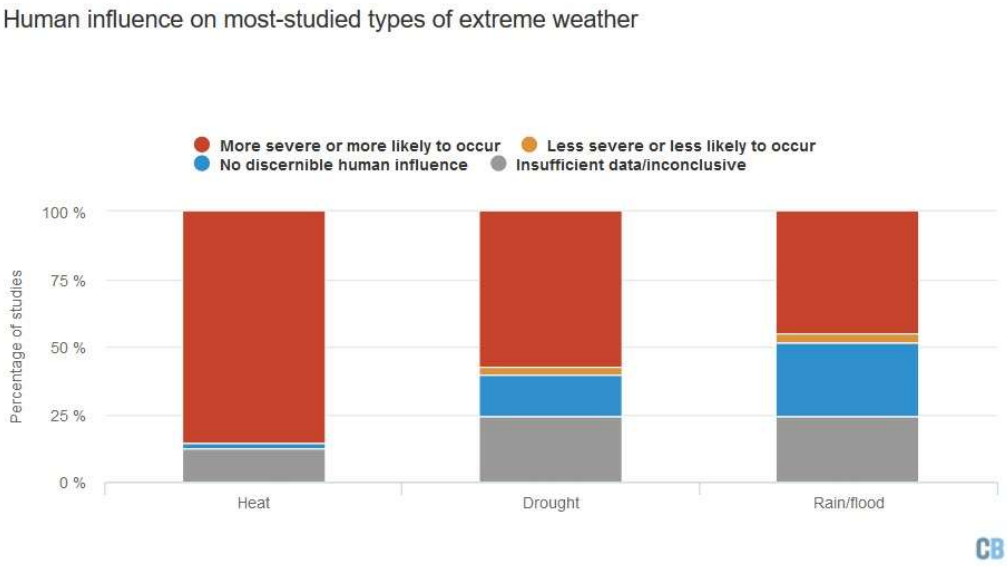
**MYTH**

Extreme weather not linked to global warming.

**FALLACY**

Just because extreme weather happened in the past doesn't mean climate change isn't having an influence now.

**Misrepre-sentation**




Mapped: How climate change affects extreme weather around the world
https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world

**http://sks.to/extreme**

# Slide-deck put together by Bärbel Winkler

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FLICC Cheat Sheet – https://sks.to/flicc-cheat-sheet