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Permanent Address: <http://blogs.scientificamerican.com/observations/2014/01/31/12-graphics-that-contain-everything-you-need-to-know-about-climate-change/>

## **12 Graphics That Contain Everything You Need to Know about Climate Change**

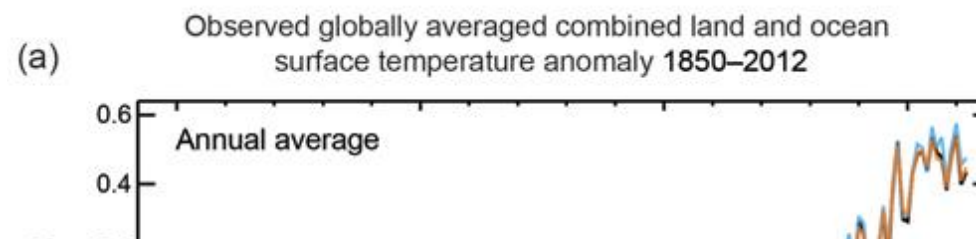
By David Biello | January 31, 2014

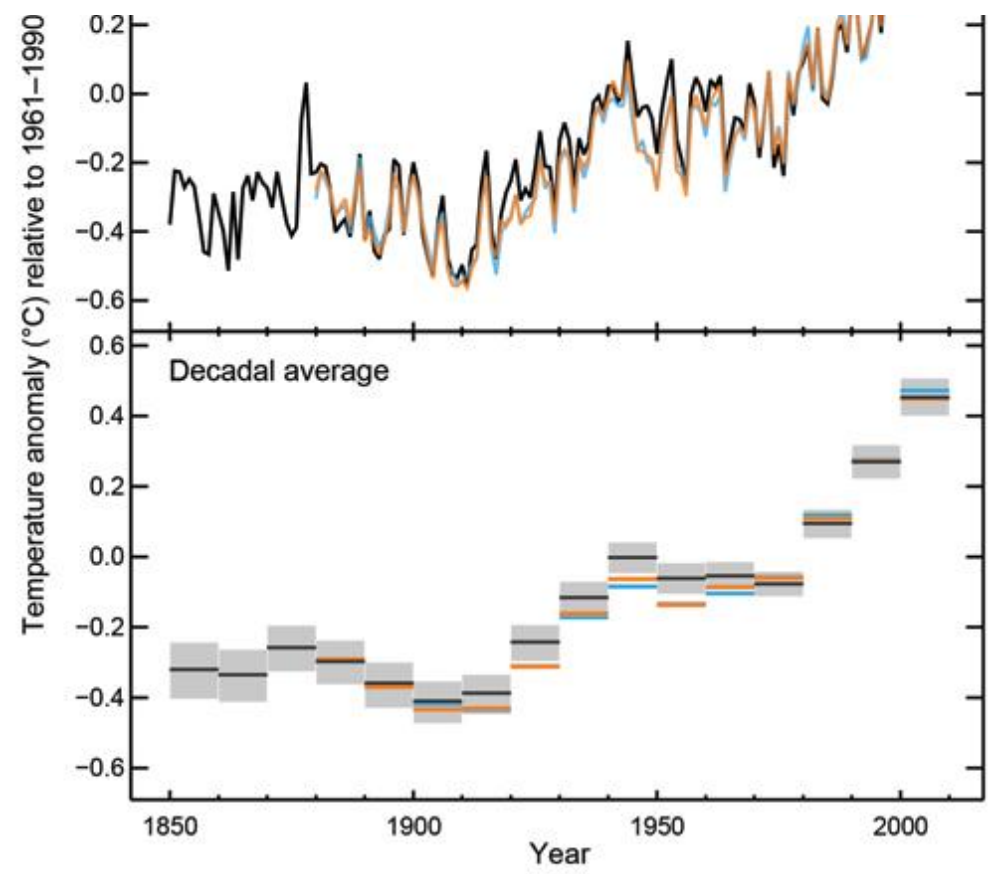
[Climate change](#) is real, it's here and it will be affecting the planet for a long, long time. That's the lesson of the latest iteration of the [Intergovernmental Panel on Climate Change's state of climate science report](#), released in its entirety on January 30.

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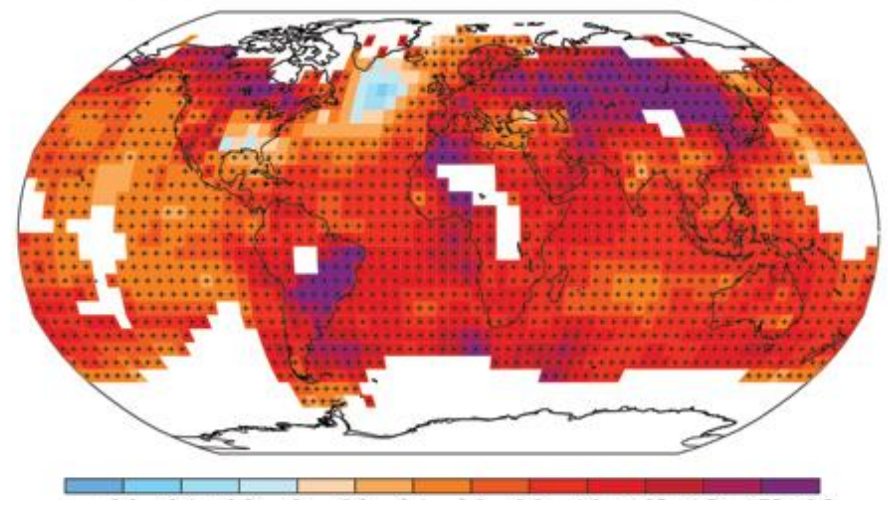
Concentrations of carbon dioxide in the atmosphere have now [touched 400 parts-per-million](#)—and greenhouse gas pollution generally shows little sign of slowing. In fact, pollution has outpaced even the worst-case scenario imagined by the IPCC as recently as 2007. The following charts and graphics explain what that might mean for you, your children and [many generations to come](#).

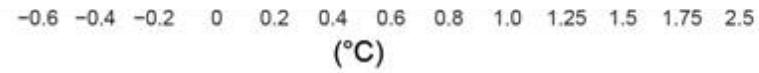
“The debate is settled,” noted President Barack Obama in his [2014 State of the Union](#) address, speaking about the scientific evidence. “Climate change is a fact.” So what will be done about it?





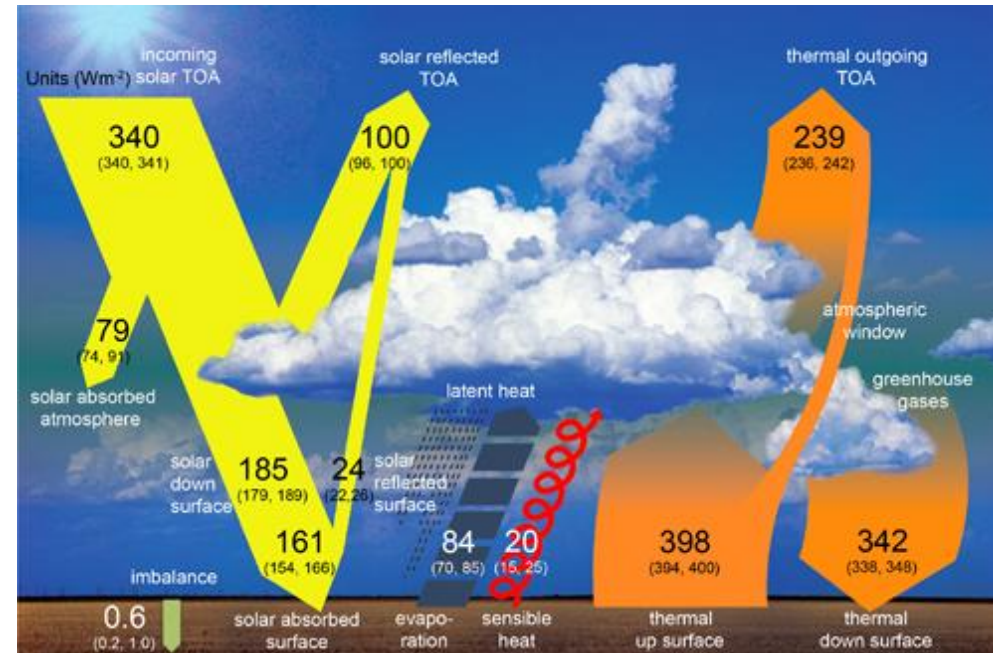
(b) Observed change in surface temperature 1901–2012





Courtesy of IPCC AR5

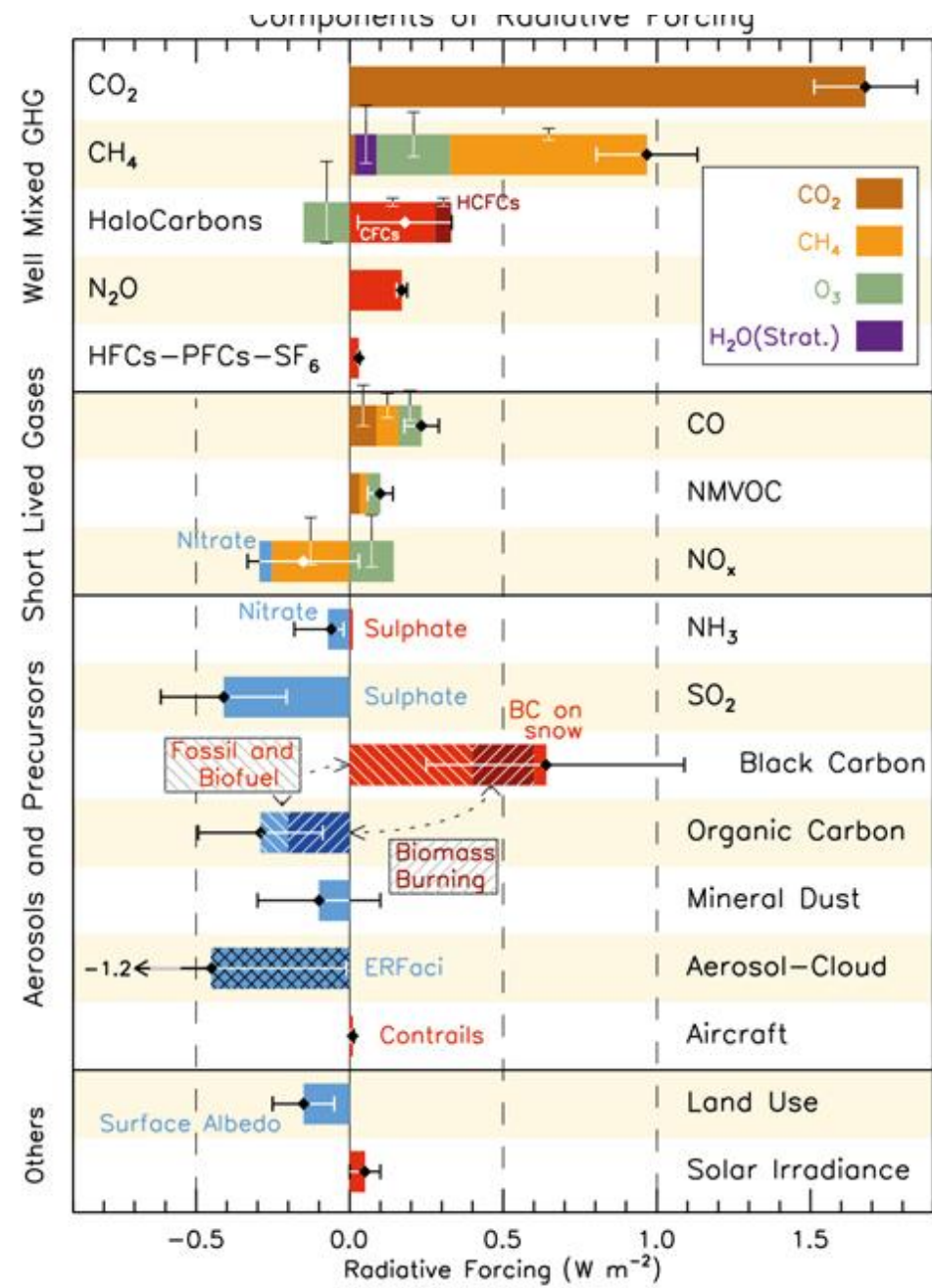
This is a record of climate change to date, otherwise known as warming in average surface temperatures across the globe. Note that the past three decades have been the [warmest since comprehensive records began](#) in the 1850s—by a lot.



Courtesy of IPCC AR5

The problem is a [build-up of greenhouse gases in the atmosphere](#), primarily carbon dioxide. As a result, less of the light that comes in from the sun is being radiated back to space as heat, trapped by the thickening blanket of CO<sub>2</sub> and other greenhouse gases. So far that blanket is pretty thin—just an increase to 0.04 percent in concentrations of atmospheric CO<sub>2</sub>—but that’s already enough to help trap an extra 0.6 watts of energy per square meter. And that little bit of extra energy is enough to change everything, from temperatures in the oceans to the amount of annual rain and snowfall.

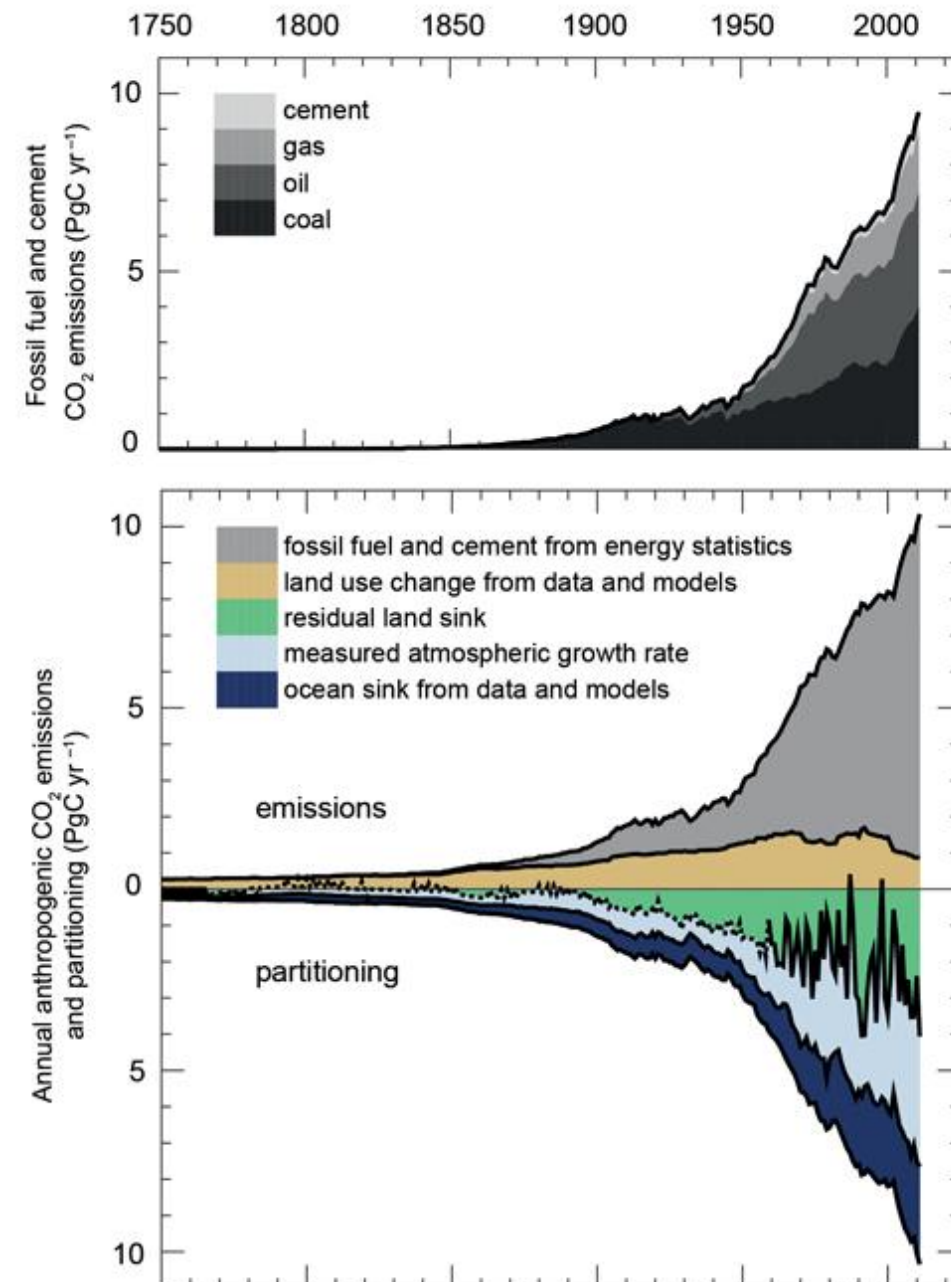
Components of Radiative Forcing

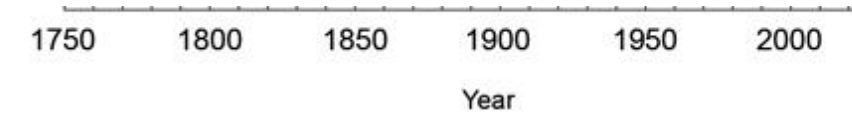


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It's not just CO<sub>2</sub> of course, though CO<sub>2</sub> concentration is by far the biggest direct cause of climate change. Scientists call such changes in

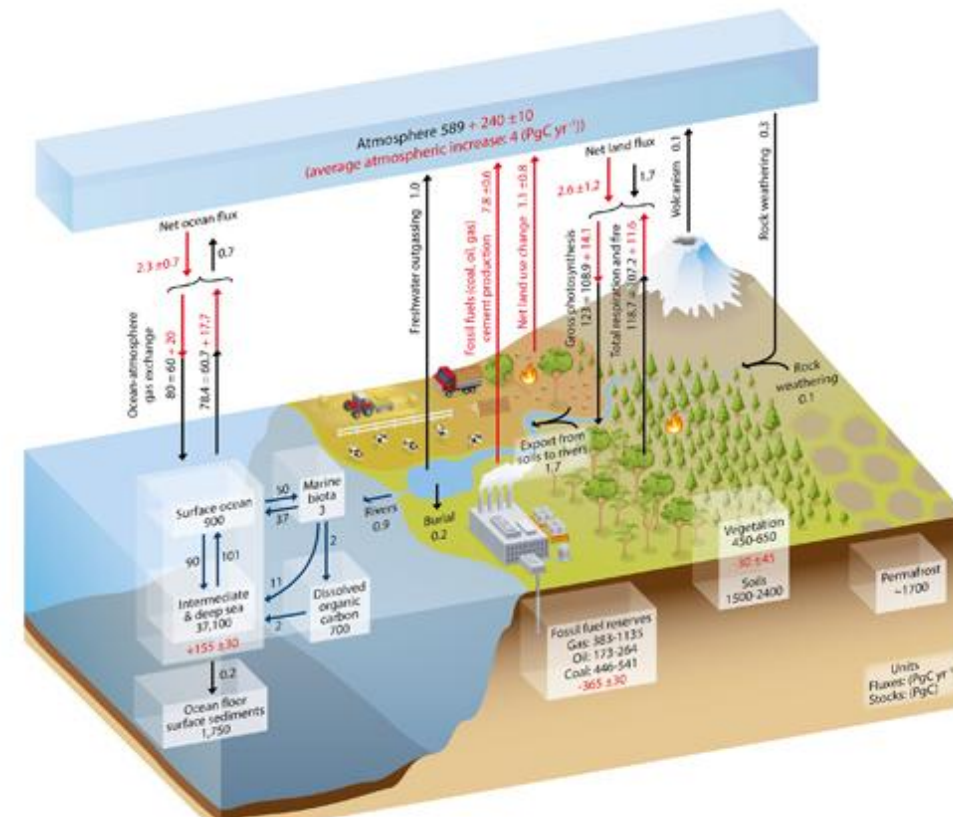
the planet's energy budget a “[radiative forcing](#),” which can either heat or cool the planet. Above they all are shown, from the tiny (but fast-growing) contribution of airplane contrails to changes in the power of the sun itself.





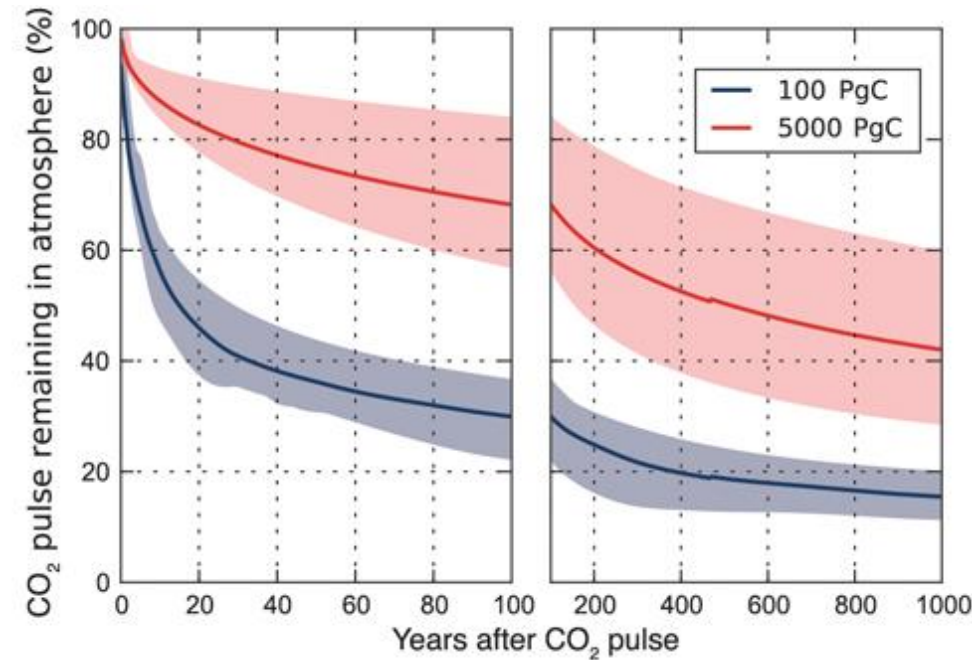
Cement, natural gas, oil and coal—these are the fundamental inputs of the modern world. They are also the four main reasons for rising greenhouse gas emissions, as the world burns ever more fossil fuel and builds more and more cities (for every ton of cement made, roughly a ton of CO<sub>2</sub> enters the atmosphere). The most polluting is coal, so cutting back on coal burning (or [capturing the CO<sub>2</sub>](#) and other air pollution it creates) is the number one priority for combating climate change.

Where does it all go? Below is a nice graphic showing all the places that carbon resides on Earth, from still underground fossil fuel reserves to the growing amount in the ocean (leading to problems such as ocean acidification). The key to combating climate change is keeping the amount of carbon in the atmosphere from growing—and potentially [reducing it from present concentrations](#).



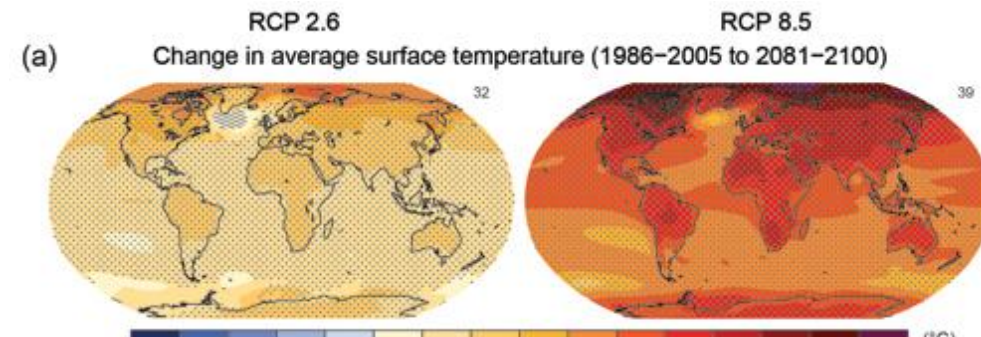
Courtesy of IPCC AR5

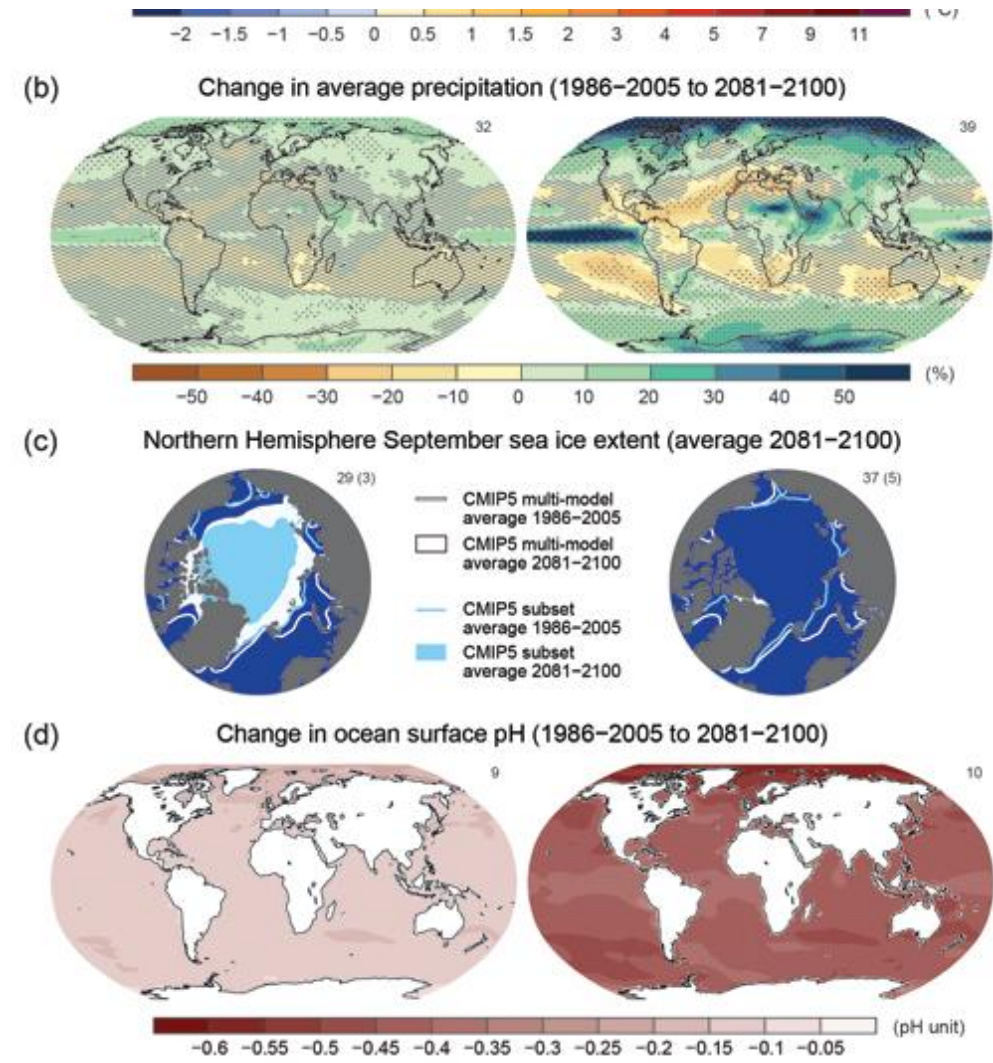
Keeping additional CO<sub>2</sub> out of the atmosphere is key because a significant portion of it remains in the atmosphere even 1,000 years after it is emitted, still trapping heat.



Courtesy of IPCC AR5

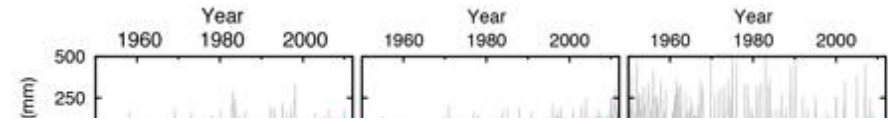
In other words, if the people of 3100 do not like the weather, they may have us to blame.



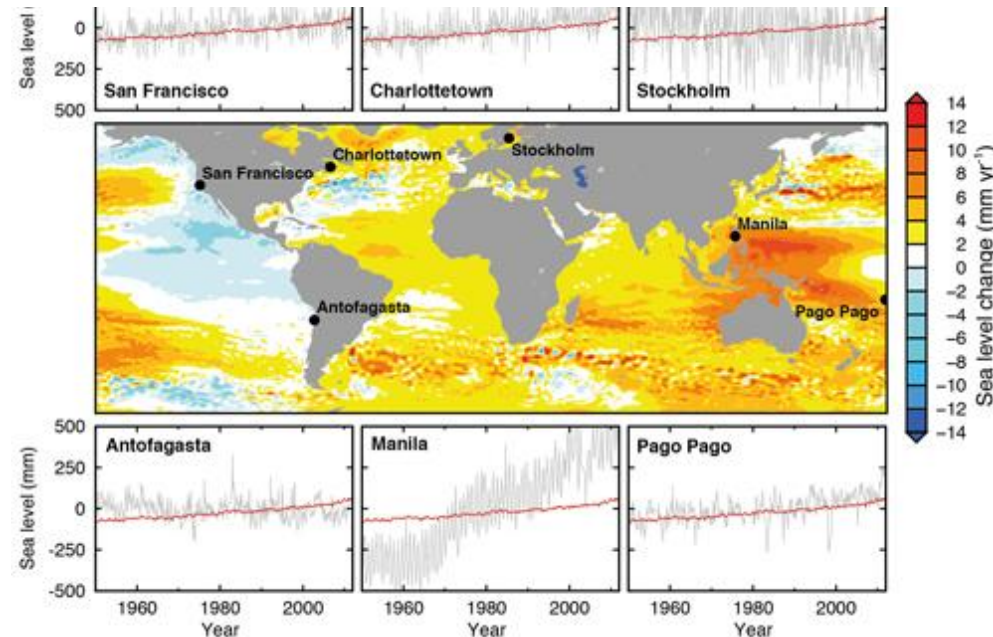


Courtesy of IPCC AR5

Climate change is not merely the long-term forecast. It is already here, and it is likely to get significantly worse by the end of this century. The [seas will sour](#) as the water grows more acidic, extreme weather will become more extreme and more common, and [Arctic sea ice in the summer may be a memory](#), as shown above.



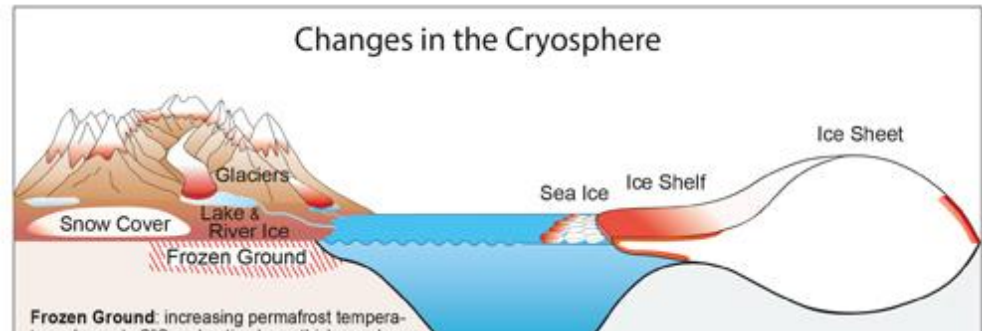


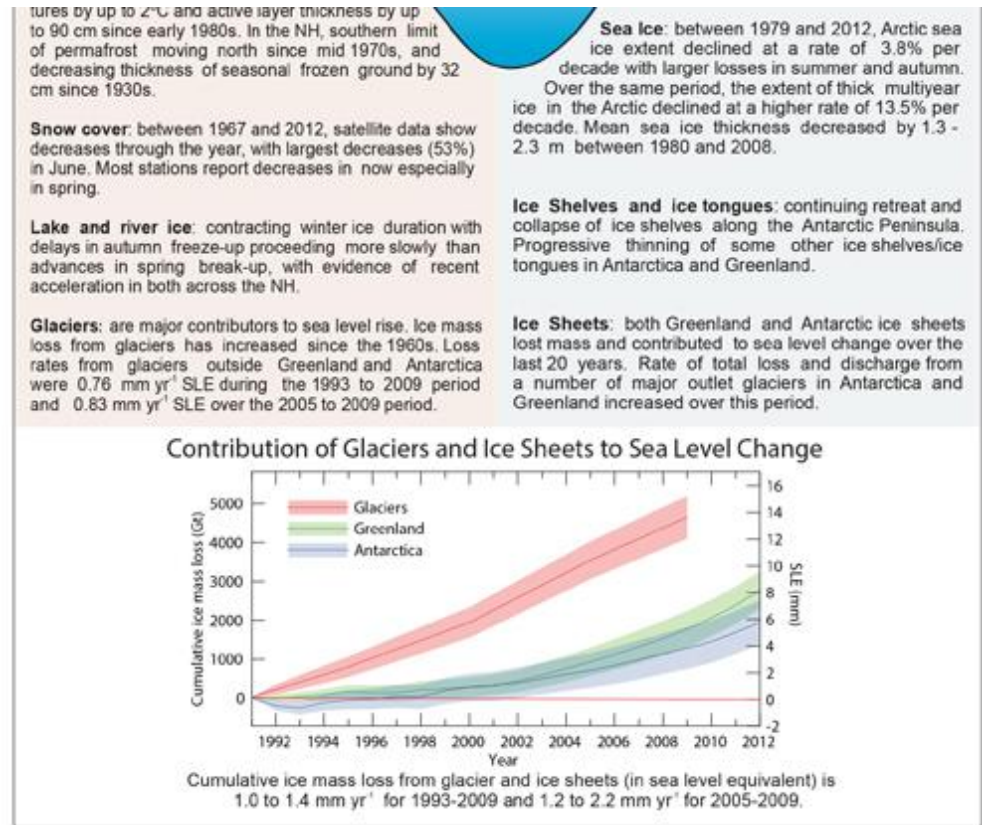


Courtesy of IPCC AR5

Extra atmospheric heat causes ocean waters to expand and glacial ice to melt, both of which [raise sea levels around the globe](#). Given that half of the world's population lives within 100 kilometers of a coastline—including most of the world's [megacities](#)—sea level rise could prove the most pressing challenge to humanity that climate change poses.

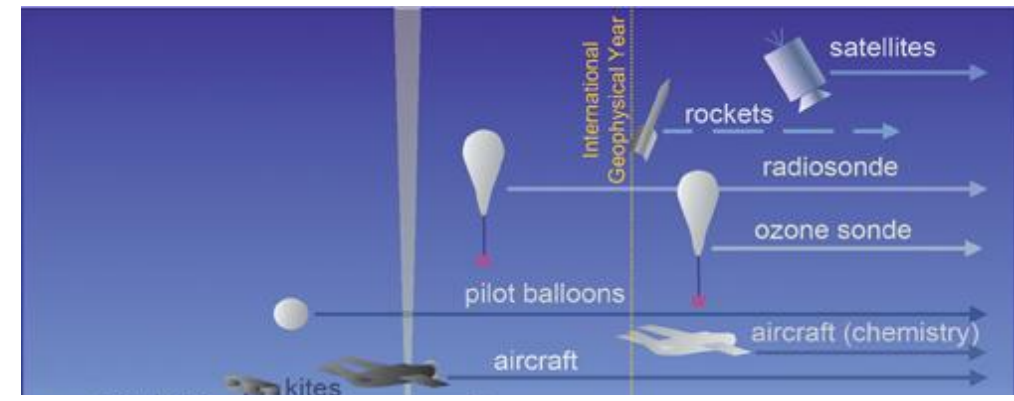
As climate change continues, [more and more ice on land will melt](#), as seen below. That will contribute to sea level rise but also mean freshwater is no longer available in certain places, to either people or nature. Eventually, over centuries or even millennia, the massive ice sheets of Greenland and Antarctica could melt away.

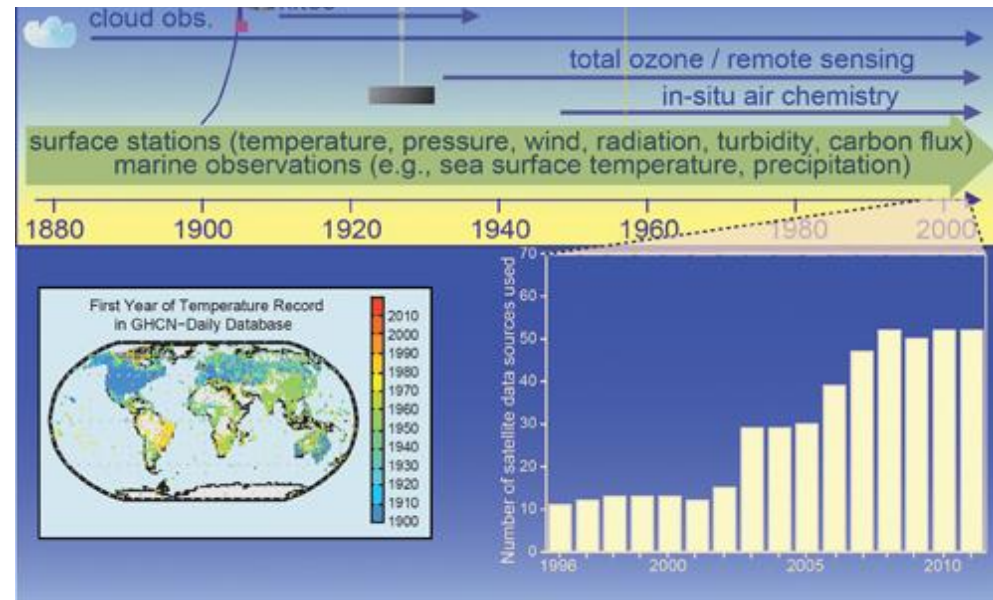




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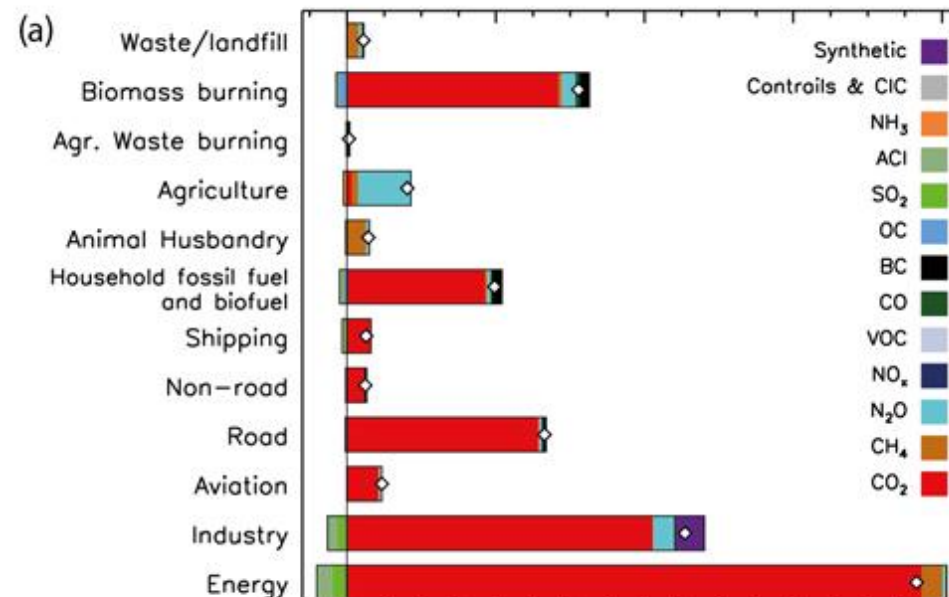
Some politicians still question climate change, or at least humanity's role in it. But a massive body of observations, taken via the methods shown below, illustrates that global warming is indeed a scientific fact.

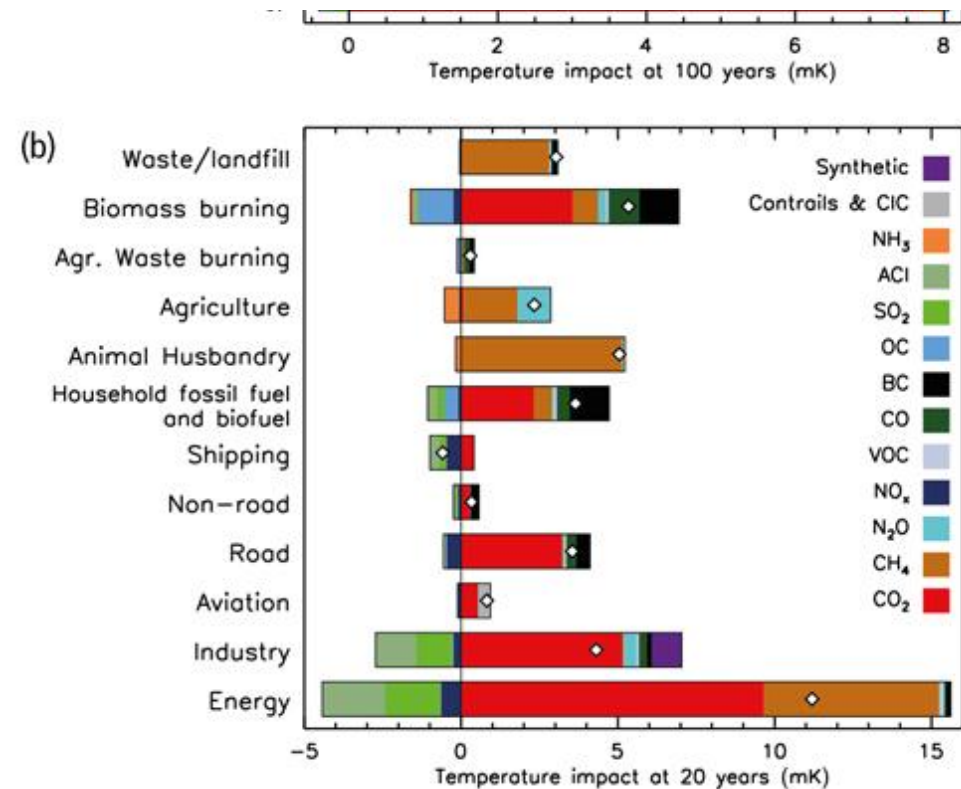




Courtesy of IPCC AR5

Human activities—whether burning fossil fuels for electricity or clearing land with fire—are behind climate change. Curb the cutting down of trees or pollution from industry and [climate changing pollution will fall](#).





Courtesy of IPCC AR5

If the world continues on its present path of failing to significantly and strategically restrain the pollution that causes climate change, there is another way—[geoengineering](#). Such large-scale manipulations of the planetary environment range from so-called solar radiation management, achieved by blocking sunlight with a sulfurous haze, for example, to the perhaps more palatable “carbon dioxide removal.” The latter includes techniques such as [fertilizing the ocean with iron](#) to force large plankton blooms and thereby bury carbon in the abyss.





Courtesy of IPCC AR5

An embrace of any of these fixes is troubling due to their massive scale, potential for unanticipated outcomes and novelty. The problem is [we just might need them](#).



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