



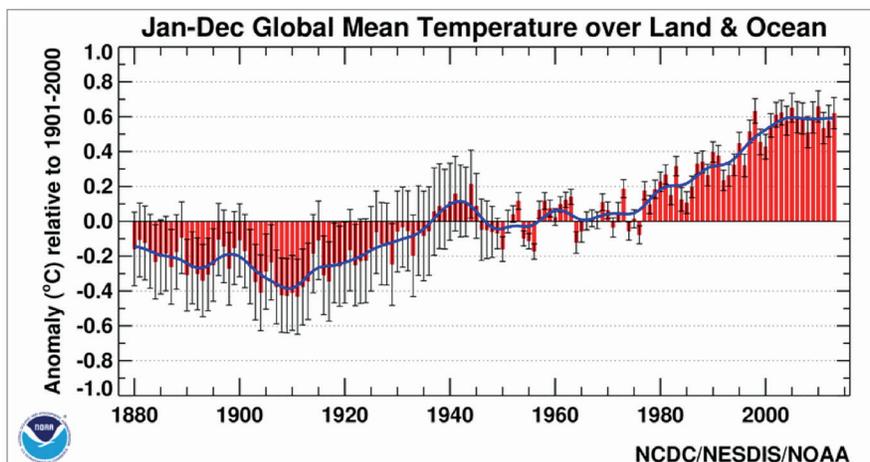
Climate Change

warming up to the facts

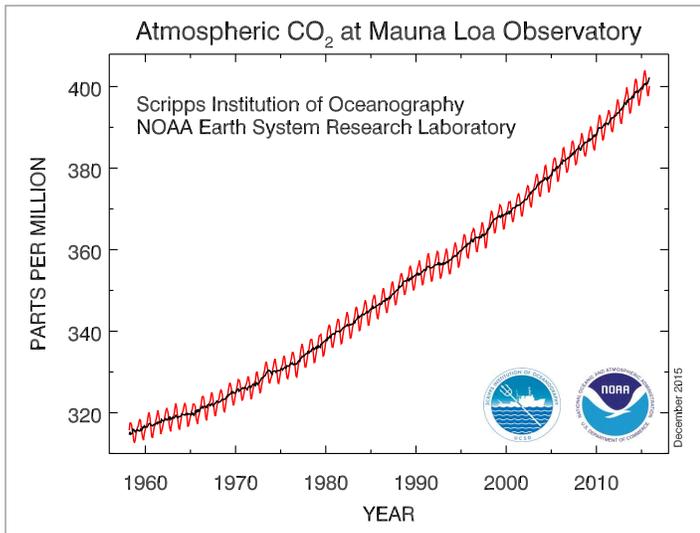
Both NASA and the National Oceanic and Atmospheric Administration (NOAA) have concluded that 2015 was the warmest year on earth since official record-keeping began in 1880. Scientists tell us that 18 of the hottest years since 1880 have occurred in the past 20 years.¹ The annual average temperature in 2015 was 0.90°C (1.62°F) above the average of the 20th century² and this increase is likely to exceed 2°C (3.6°F) by the end of this century.

Global ocean temperatures have also increased by 0.74°C since the late 19th century.³ Since over 90% of excess atmospheric heat is absorbed by the oceans⁴, at the current rate of greenhouse gas emissions ocean temperatures could increase by 4.0°C (7.2°F) by the end of the 21st century.⁵

The majority of scientists believe these increases in temperature are caused by accumulating concentrations of greenhouse gases and other human activities, and predict that warming temperatures can have devastating consequences, resulting in changing global weather patterns, food and water scarcity, and displacing tens of millions of people.



Source: NOAA



Source: NOAA

Greenhouse Gas Emissions

Research on climate change suggests that increasing amounts of carbon dioxide, methane, and other gases are trapping heat in the atmosphere, and such gases are accumulating in an unprecedented manner. Atmospheric concentrations of carbon dioxide topped 400 parts per million for the first time in 2013, and are forecast to average over 400 ppm in 2016.⁶ Concentrations of other greenhouse gases, such as methane (CH₄) and nitrous oxide (N₂O), are also reaching record levels.

Carbon dioxide results from the combustion of fossil fuels, which combines carbon with atmospheric oxygen to create CO₂. Since 1970, about 78% of greenhouse gas emissions have come from the combustion of fossil fuels and industrial production.⁷ The Carbon Tracker Initiative, an international effort to track carbon emissions, maintains that 60-80% of the world's remaining coal, oil, and gas reserves needs to stay in the ground for the world to have anything of a chance of staying within a safe degree of global temperature increase (2°C / 3.6°F).

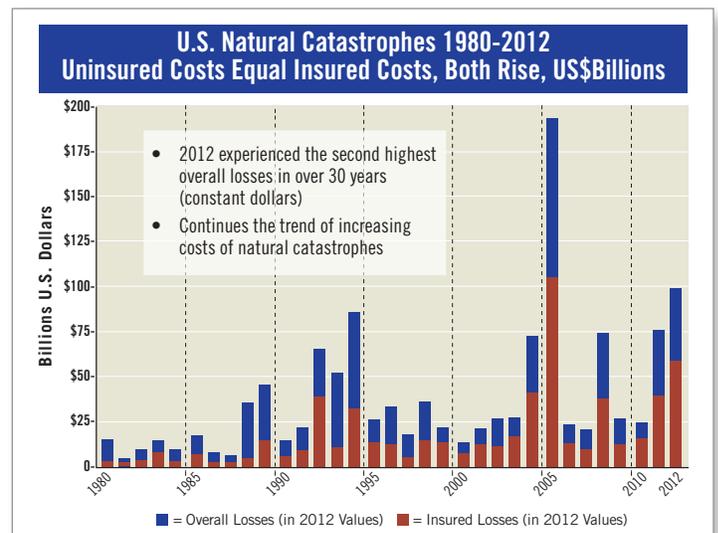
Impacts of Climate Change

Extreme Weather Events

The effects of climate change are being felt unevenly, as global warming will result in less precipitation in some parts of the world and more in others. Climate change will result in more frequent extreme weather events such as intense precipitation, increased hurricane wind intensities from

higher sea surface temperatures, and drought. The annual incidence of weather-related catastrophes in North America has quadrupled since the early 1980's.⁸ This has increased the cost burden to state and federal programs such as the Disaster Relief Fund, the National Flood Insurance Program, Federal Crop Insurance Program, and wildfire protection. Average annual appropriations to the Disaster Relief Program alone have more than tripled since 2000 to \$9.4B, from \$2.6B during the 1990s.⁹ Globally, average annual weather-related losses have increased from \$10B per year from 1974-1983 to \$131B from 2004-2013, according to a report by Ceres.¹⁰

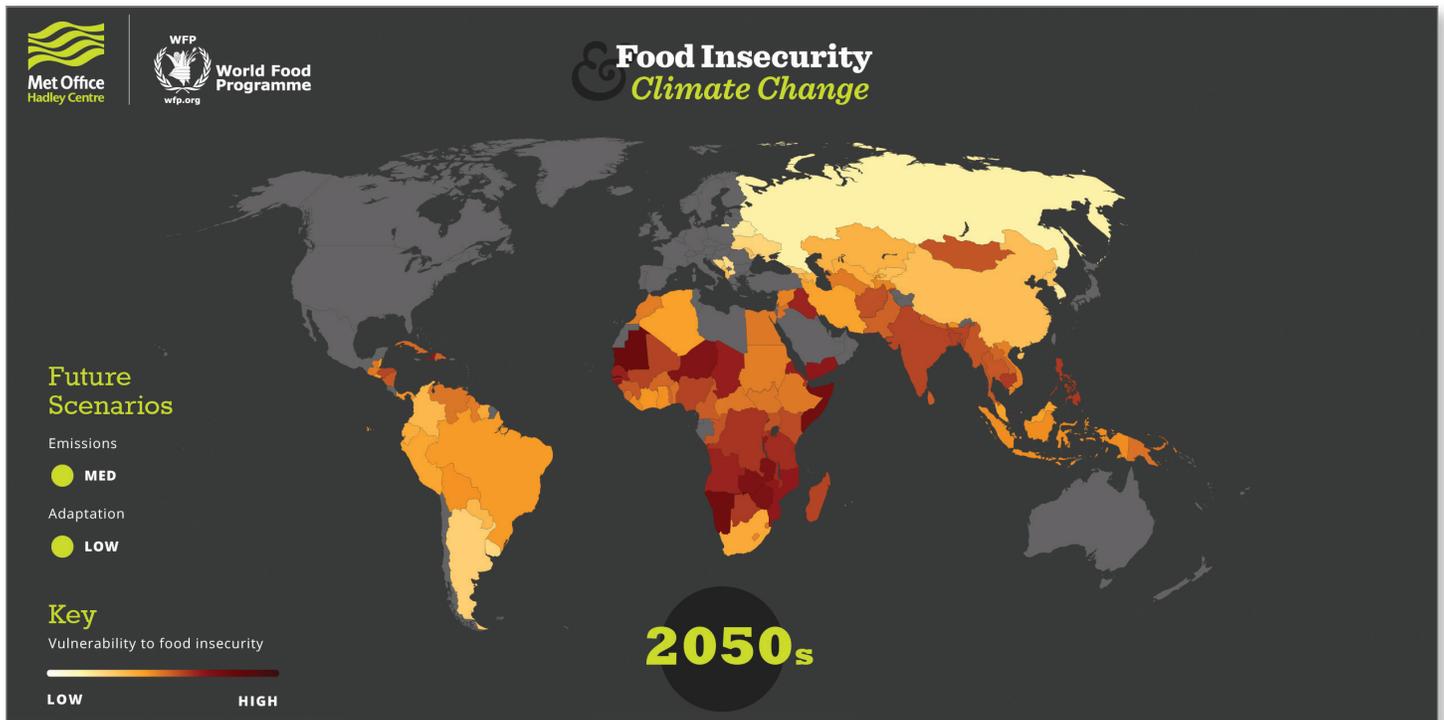
Warmer air is capable of holding more water vapor, which leads to increased evaporation of rain or snow in a given year. California has warmed by more than 2°F since 1895, and warming temperatures are estimated to have contributed between 15%-20% of the recent moisture deficit in California.¹¹ Climate change has lengthened the wildfire season from four to over six months in the U.S. and annual spending on wildfire protection has tripled since the 1990s.¹²



Source: Ceres / MunichRe NATCAT Service¹³

Food Security

There is a broad consensus that the effect of climate change on agricultural productivity will be negative. While agricultural yields have increased dramatically over the past 50 years, higher ambient temperatures and increased periods of extreme drought will impact future yields through desiccation and changes to soil chemistry, in addition to



Source: World Economic Forum

the impact from more extreme weather disasters. The World Economic Forum has forecast agricultural yields will drop by 20% in some parts of the world, affecting food security in many developing nations.¹⁴

Melting Glaciers

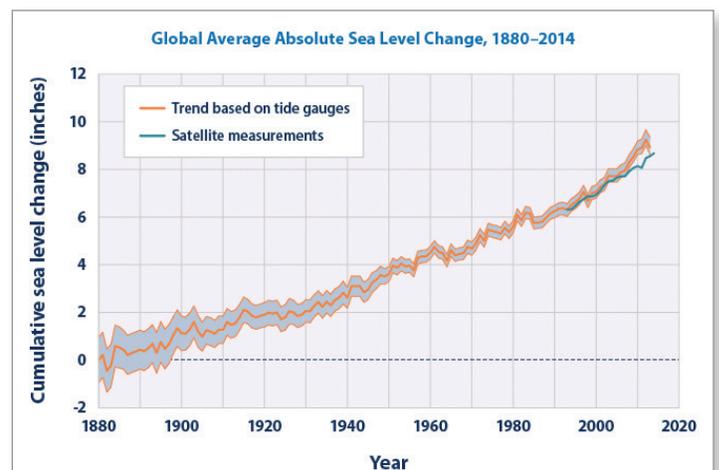
Warming temperatures are taking a toll on sea ice, glaciers and permafrost on almost all regions. The Arctic and Greenland ice sheets have been particularly vulnerable. While the Arctic sea ice has decreased in size by 3.5% - 4.1% per decade since 1979, the thickness, and hence ice volume, has decreased by over 30%.¹⁵ Total glacier area has decreased in all mountain regions, and more than 600 glaciers have disappeared.¹⁶ Permafrost up to 15 m thick has completely thawed in the Russian European North region.¹⁷ In parts of Siberia, melting permafrost is creating massive craters where methane gas once trapped inside the ice is being released into the atmosphere.

Rising Sea Levels

Rising atmospheric temperatures are leading to rising sea levels, but the rate of rise is not uniform. According to NASA, the world's sea level has risen an average of 3

inches since 1992, although some locals have experienced sea level rises of as much as 9 inches.¹⁸ NASA scientists estimate that a third of sea level rise is caused by expansion of warming water, a third due to ice loss from the massive Greenland and Antarctic ice sheets, and the remaining third results from melting mountain glaciers.

There is great uncertainty in the scientific community about the rate and ultimate degree of sea level rise, with some forecasts as high as a foot per decade. A 2013 assessment of international researchers by the United



Source: U.S. Environmental Protection Agency

Nations Intergovernmental Panel on Climate Change forecast global sea levels will likely rise by 1- 3 feet by the end of the century.

The effects of rising oceans will have a catastrophic impact in some regions of the world, with coastal flooding increasing in frequency and severity. Low-lying countries such as Bangladesh and Pacific island nations are already experiencing the effects of rising sea levels. This phenomenon if continued will lead to the displacement of millions of people from developing countries most severely affected.

Ocean Acidification

The build-up of carbon dioxide in the atmosphere is affecting the ocean's chemistry. This increase in carbon dioxide has the effect of lowering the ocean's pH, or increasing water acidity. The acidification of the ocean affects coral reefs and shellfish which rely on the absorbance of calcium carbonate (limestone). The resulting acidification from a rise in atmospheric temperature of 2°C (3.6°F) will result in very low calcification rates, meaning that reefs will cease to grow, and at approximately 3°C (5.4°F) reefs could start to dissolve.¹⁹

Coral reefs are a critical part of the ocean ecosystem, providing habitat and food for thousands of marine species. Increased water temperatures can also result in coral bleaching as zooxanthellae, which corals depend on for some of their food, to leave their tissue, weakening coral and decreasing its ability to fight off disease. The Worldwide Fund for Nature (WWF) reported that in the past 30 years tropical reefs have lost half their corals and that "at current projected levels of warming and

acidification, coral reefs could be lost altogether by 2050".²⁰ The Caribbean has seen a 75%-85% loss in reef coverage in the past 35 years.²¹

Global Climate Negotiations

Global climate negotiations by 195 nations in Paris focused on slowing the growth of greenhouse gas emissions to limit future average global temperature rises to no more than 2°C (3.6°F) from pre-industrial levels.

The final agreement was based on voluntary commitments to limit greenhouse gas emissions by all countries, while the United States was prominent among industrialized nations opposing legally binding limits. The agreement did legally bind countries to common reporting standards, and to periodic reviews of greenhouse gas emissions over time.

Estimates of country-by-country pledges would still allow global temperatures to climb by 2.7°C (4.9°F) to 3.5°C (6.3°F). Success in achieving a goal of limiting global warming to under 2°C (3.6°F) is dependent on pledges by countries to increase future emission reductions, which will be reviewed every five years, beginning in 2020.

Finally, adding to the scientific imperative, Pope Francis' 2015 encyclical on the environment, framed climate change as a moral issue that will disproportionately impact the poor and developing countries. He reminded us that "human life is grounded in three fundamental and closely intertwined relationships: with God, with our neighbor, and with earth itself."



Disclaimer:

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End Notes:

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Coral Bleaching photo:

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