

**Climate change**-refers to any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among other effects, that occur over several decades or longer.

A Commentary by ELCA Bishop Emeritus Mark S. Hanson “We cannot escape the interconnectedness of the earth’s fabric of life. Creation is the matrix of all our activities, both as human beings and as Christ’s church. God gives us and all creatures life through the water, air, food, and all the other gifts that come to us from the earth. Everything we do both depends on these gifts, and has some kind of impact upon them. If these gifts are treated with contempt and abused, people, animals, and plants suffer together. If they are graciously received and cherished, people will flourish with the rest of creation. We cannot love God or our human neighbor without caring for creation. The question is not whether the church will engage what our society calls the environment, but how.”

*\* Excerpt of a November 2003 Letter, commemorating the 10th Anniversary of the ELCA ’s social statement:  
Caring for Creation: Vision, Hope & Justice*

"The Lutheran church teaches us that God is the owner of all things; we are simply caretakers. In Psalm 24:1 we read, 'The Earth is the Lord's and everything in it, the world and all who live in it.' So let us care for all creation as if it belonged to God, because it does." said the Rev. Gary M. Wollersheim, bishop, ELCA Northern Illinois Synod.'

**Monsanto-** There is broad consensus in the scientific community that climate change is happening. The Intergovernmental Panel on Climate Change and other respected third parties agree that the significant, long-lasting changes in temperature, precipitation, wind patterns and other measures of climate that are already occurring are related to an accumulation of high levels of carbon dioxide and other greenhouse gases in the atmosphere.

These are also the conclusions that Monsanto came to when, almost a decade ago, as part of our work to help farmers, we created a climate change panel composed of 25 of our senior scientists to study climate change, assess its potential effects on crop systems and devise strategies for change.

**In the face of climate-related challenges, it is more important than ever to advance sustainable agricultural practices that can help make balanced meals accessible to all.**

Farmers have been, and will continue to be, a positive force in the fight against climate change. And while great progress has already been made to reduce agriculture’s carbon footprint, to sustainably feed 9.6 billion people by 2050, we must work collectively to do even more.

Climate change is one of the biggest issues we face in agriculture, as well as one of the biggest issues facing humanity. That’s why we have pledged to do our part within our own business first, and to help support farmers and others as we all work to be a bigger part of the solution.

<http://www.monsanto.com/improvingagriculture/pages/climate-change.aspx>

Reagan-

Bishop Eaton- As members of the Evangelical Lutheran Church in America, we share a deep concern with our Catholic brothers and sisters for the well-being of our neighbors and of God's good creation. "Humans, in service to God, have special roles on behalf of the whole of creation. Made in the image of God, we are called to care for the earth as God cares for the earth" (ELCA social statement, "Caring for Creation: Vision, Hope and Justice").

Daily we see and hear the evidence of a rapidly changing climate. At the same time, we also witness in too many instances how the earth's natural beauty, a sign of God's wonderful creativity, has been defiled by pollutants and waste.

An accounting of climate change that has credibility and integrity must name the neglect and carelessness of private industry and the failure of government leadership that have contributed to these changes. However, it also must include repentance for our own participation as individual consumers and investors in economies that make intensive and insistent demands for energy.

Yet we find our hope in the promise of God's own faithfulness to the creation and humankind. We serve in concert with God's creative and renewing power, understanding that we have the resources and responsibility to act together for the common good, especially for those who are most vulnerable to the effects of climate change.

Today we join with Pope Francis in calling on world leaders to embrace our common responsibility as work continues toward a global agreement on climate change. We urge leaders to support an ambitious agreement that reduces greenhouse gas emissions, encourages development of low-carbon technologies, and supports the ability of countries to cope with the effects of a changing climate and build resiliency for a sustainable future.

The present moment is a critical one, filled with both challenge and opportunity to act as individuals, citizens, leaders and communities of faith in solidarity with God's good creation and in hope for our shared future.

*God's peace,*

*The Rev. Elizabeth A. Eaton, Presiding Bishop, Evangelical Lutheran Church in America*

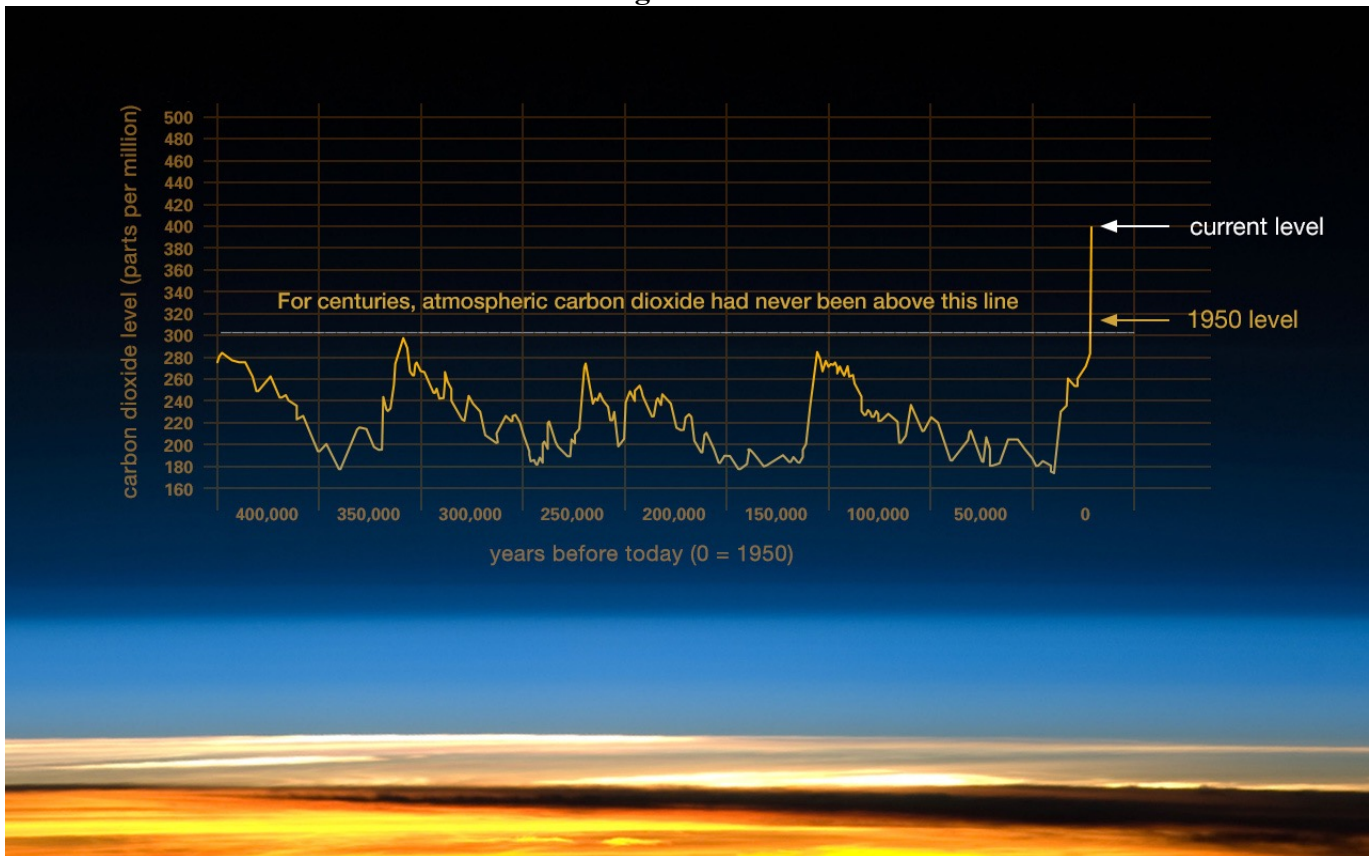
When we add in the environmental costs of mowing our giant lawns, the benefits of rethinking the lawn mentality become even more obvious. If you are concerned about the human impact on our planet's climate, reducing the amount of lawn you mow each week is one of the best things you can do to reduce your family's carbon dioxide emissions. On average, mowing your lawn for one hour produces as much pollution as driving 650 miles. Moreover, we now burn 800 million gallons of gas each year in our dirty little lawnmower engines to keep our lawns at bay.

"Bringing Nature Home" Douglas W. Tallamy Copyright 2007 /

The reality we are looking at is a changing world. Technology and industry have advanced tremendously in the last century, and at some point we have to face the fact that as stewards of creation we not only have a stake in what happens in the world immediately around us, but we have a duty to God to take care of the precious creation with which we have been gifted, here and abroad. <sup>NIV</sup> **Genesis 2:15** The LORD God took the man and put him in the Garden of Eden to work it and take care of it.

Though thoughts on what steps to take can vary greatly, there are some who are struggling with the seeming politics of the situation. If we can take our various political views out of the picture for a moment, both the data and urgency of the situation are compelling. Current data show that 97% of climate scientists agree that we are currently in a state of global warming, and that human action is the primary cause of it<sup>1</sup> through activities that increase concentrations of greenhouse gases in the atmosphere, such as deforestation and the burning of fossil fuels. <sup>2,3,4</sup> As to the urgency of the situation we can look to the back across just the last 16 years and see that fourteen of the 15 hottest years on record have occurred since 2000, according to the UN World Meteorological Organization, as rising carbon emissions continue to trap heat and drive climate change.

## Climate change: How do we know?



(Credit: Vostok ice core data/J.R. Petit et al.; NOAA Mauna Loa CO2 record.)

The Earth's climate has changed throughout history. Just in the last 650,000 years there have been seven cycles of glacial advance and retreat, with the abrupt end of the last ice age about 7,000 years ago marking the beginning of the modern climate era — and of human civilization. Most of these climate changes are attributed to very small variations in Earth's orbit that change the amount of solar energy our planet receives.

The current warming trend is of particular significance because most of it is very likely human-induced and proceeding at a rate that is unprecedented in the past 1,300 years.<sup>5</sup>

Earth-orbiting satellites and other technological advances have enabled scientists to see the big picture, collecting many different types of information about our planet and its climate on a global scale. This body of data, collected over many years, reveals the signals of a changing climate.

The heat-trapping nature of carbon dioxide and other gases was demonstrated in the mid-19th century.<sup>6</sup> Their ability to affect the transfer of infrared energy through the atmosphere is the scientific basis of many instruments flown by NASA.

***Scientific evidence for warming of the climate system is unequivocal.*** - Intergovernmental Panel on Climate Change

Ice cores drawn from Greenland, Antarctica, and tropical mountain glaciers show that the Earth's climate responds to changes in greenhouse gas levels. They also show that in the past, large changes in climate have happened very quickly, geologically-speaking: in tens of years, not in millions or even thousands.<sup>7</sup>

## **Seas and Oceans-**

### ***Warming oceans***

The oceans have absorbed much of this increased heat, with the top 700 meters (about 2,300 feet) of ocean showing warming of 0.302 degrees Fahrenheit since 1969.<sup>8</sup>



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Flowing meltwater from the Greenland ice sheet

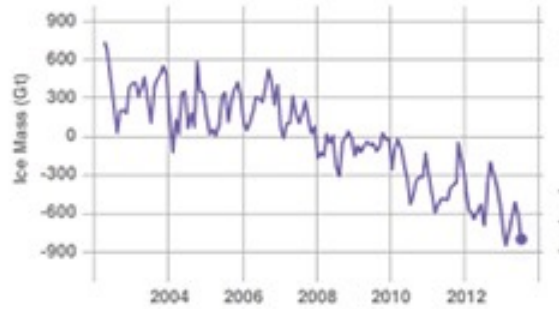
### ***Shrinking ice sheets***

The Greenland and Antarctic ice sheets have decreased in mass. Data from NASA's Gravity Recovery and Climate Experiment show Greenland lost 150 to 250 cubic kilometers (36 to 60 cubic miles) of ice per year between 2002 and 2006, while Antarctica lost about 152 cubic kilometers (36 cubic miles) of ice between 2002 and 2005. Though the trend of ice loss from Antarctica is quantifiable and significant, recent satellite data suggests that rising global temperatures have increased snowfall over Antarctica which has offset much of the loss.

### ANTARCTICA MASS VARIATION SINCE 2002

Data source: Ice mass measurement by NASA's Grace satellites.

Credit: NASA

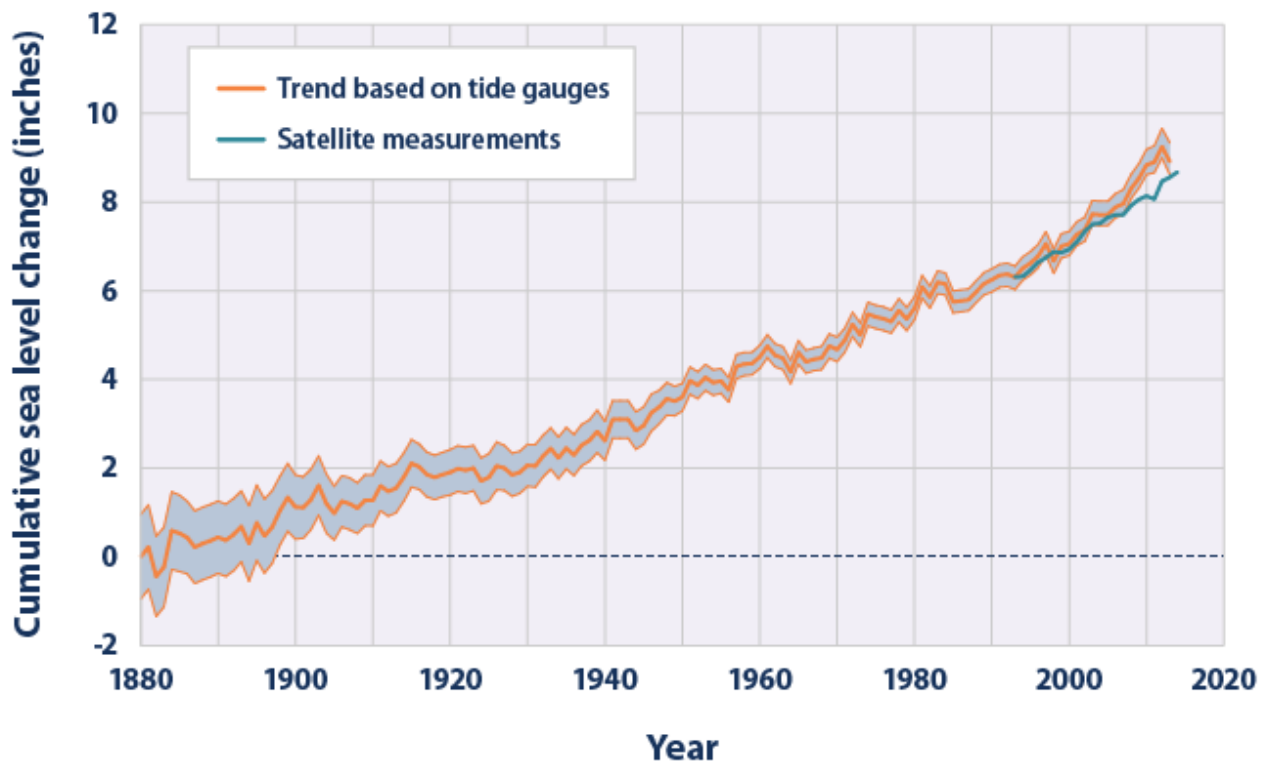


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- An indicator of the current volume and the Antarctica and Greenland ice sheets using data from NASA's Grace satellite.

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### Sea Level

### Global Average Absolute Sea Level Change, 1880–2014



Data sources:

- CSIRO (Commonwealth Scientific and Industrial Research Organisation). 2015 update to data originally published in: Church, J.A., and N.J. White. 2011. Sea-level rise from the late 19th to the early 21st century. *Surv. Geophys.* 32:585–602. [www.cmar.csiro.au/sealevel/sl\\_data\\_cmar.html](http://www.cmar.csiro.au/sealevel/sl_data_cmar.html).
- NOAA (National Oceanic and Atmospheric Administration). 2015. Laboratory for Satellite Altimetry: Sea level rise. Accessed June 2015. [http://ibis.grdl.noaa.gov/SAT/SeaLevelRise/LSA\\_SLR\\_timeseries\\_global.php](http://ibis.grdl.noaa.gov/SAT/SeaLevelRise/LSA_SLR_timeseries_global.php).

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at [www.epa.gov/climatechange/indicators](http://www.epa.gov/climatechange/indicators).



Global sea level rose about 17 centimeters (6.7 inches) in the last century. The rate in the last decade, however, is nearly double that of the last century.<sup>9</sup>

### ***Ocean acidification***

Not only have there been decreases in ice sheets and glaciers, and increases in the global sea level, but the build up to carbon dioxide in our atmosphere has also greatly affected our oceans (which absorb 25-30% of the carbon dioxide from our atmosphere), leading to changes in the acid/base makeup of our largest bodies of water. Since the beginning of the Industrial Revolution, the acidity of surface ocean waters has increased by about 30 percent.<sup>10,11</sup> This increase is the result of humans emitting more carbon dioxide into the atmosphere and hence more being absorbed into the oceans. The amount of carbon dioxide absorbed by the upper layer of the oceans is increasing by about 2 BILLION tons per year.<sup>12,13</sup>

With ocean acidification, corals cannot absorb the calcium carbonate they need to maintain their skeletons and the stony skeletons that support corals and reefs will dissolve. Already, ocean acidification has lowered the pH of the ocean by about 0.11 units (SCOR 2009). Moving the ocean's pH from 8.179 to a current pH of 8.069, which means the ocean is about 30% more acidic now than it was in 1751 (SCOR 2009). If nothing is done to reduce carbon dioxide emissions into the atmosphere, ocean acidification will increase and more and more corals will be damaged or destroyed.<sup>14</sup>

Ocean acidification affects more than just corals. Snails, clams, and urchins also make calcium carbonate shells and ocean acidification negatively impacts these organisms as well. Just like corals, ocean acidification makes it harder for these organisms to absorb the calcium carbonate they need to build their shells.

### ***Extreme Weather and Farming***

The number of record high temperature events in the United States has been increasing, while the number of record low temperature events has been decreasing, since 1950. The U.S. has also witnessed increasing numbers of intense rainfall events.<sup>15</sup>

Changing weather affects farming and local food security. For example, three billion people around the world eat rice each day. Sixty percent of Asia's poorest and most undernourished people depend on rice as their staple food. But a recent report published by the National Academy of Sciences found that rising temperatures over the last 25 years have cut global rice yields by as much as 10 to 20 percent in some parts of Asia. As climate change continues and both day and nighttime average temperatures continue to rise, yields of this critical crop will continue to drop, with serious consequences for global food security. Scientists expect to see continued shifts in weather patterns and increases in extreme weather events around the globe if we do not begin to reduce emissions of carbon dioxide and other "greenhouse" gases from our homes and cars, our factories and farms. These shifts in climate will profoundly affect the global food supply and the food security of billions of people. Farming is highly vulnerable to shifts in weather patterns. As these patterns become less predictable and more extreme, food supplies will suffer in many regions.<sup>16</sup>

## References

1. J. Cook, et al, "[Consensus on consensus: a synthesis of consensus estimates on human-caused global warming](#)," *Environmental Research Letters* Vol. 11 No. 4, (13 April 2016); DOI:10.1088/1748-9326/11/4/048002

Quotation from page 6: "The number of papers rejecting AGW [Anthropogenic, or human-caused, Global Warming] is a miniscule proportion of the published research, with the percentage slightly decreasing over time. Among papers expressing a position on AGW, an overwhelming percentage (97.2% based on self-ratings, 97.1% based on abstract ratings) endorses the scientific consensus on AGW."

J. Cook, et al, "[Quantifying the consensus on anthropogenic global warming in the scientific literature](#)," *Environmental Research Letters* Vol. 8 No. 2, (15 May 2013); DOI:10.1088/1748-9326/8/2/024024

Quotation from page 3: "Among abstracts that expressed a position on AGW, 97.1% endorsed the scientific consensus. Among scientists who expressed a position on AGW in their abstract, 98.4% endorsed the consensus."

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P. T. Doran & M. K. Zimmerman, "Examining the Scientific Consensus on Climate Change," *Eos Transactions American Geophysical Union* Vol. 90 Issue 3 (2009), 22; DOI: 10.1029/2009EO030002.

N. Oreskes, "Beyond the Ivory Tower: The Scientific Consensus on Climate Change," *Science* Vol. 306 no. 5702, p. 1686 (3 December 2004); DOI: 10.1126/science.1103618.

2. "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level." Intergovernmental Panel on Climate Change (IPCC), [Synthesis Report](#), [Section 1.1: Observations of climate change](#), in [IPCC AR4 SYR 2007](#).
3. IPCC, "[Summary for Policymakers](#)", *Detection and Attribution of Climate Change*, «It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century» (page 15) and «In this Summary for Policymakers, the following terms have been used to indicate the assessed likelihood of an outcome or a result: (...) extremely likely: 95–100%» (page 2)., in [IPCC AR5 WG1 2013](#).
4. [Notes-SciPanel] *America's Climate Choices: Panel on Advancing the Science of Climate Change; National Research Council (2010). [Advancing the Science of Climate Change](#). Washington, D.C.: The National Academies Press. ISBN 0-309-14588-0. (p1) ... there is a strong, credible body of evidence, based on multiple lines of research, documenting that climate is changing*



*and that these changes are in large part caused by human activities. While much remains to be learned, the core phenomenon, scientific questions, and hypotheses have been examined thoroughly and have stood firm in the face of serious scientific debate and careful evaluation of alternative explanations. \* \* \* (p21-22) Some scientific conclusions or theories have been so thoroughly examined and tested, and supported by so many independent observations and results, that their likelihood of subsequently being found to be wrong is vanishingly small. Such conclusions and theories are then regarded as settled facts. This is the case for the conclusions that the Earth system is warming and that much of this warming is very likely due to human activities.*

5. IPCC Fourth Assessment Report, Summary for Policymakers, p. 5

B.D. Santer et.al., "A search for human influences on the thermal structure of the atmosphere," Nature vol 382, 4 July 1996, 39-46

Gabriele C. Hegerl, "Detecting Greenhouse-Gas-Induced Climate Change with an Optimal Fingerprint Method," Journal of Climate, v. 9, October 1996, 2281-2306

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B.D. Santer et.al., "Contributions of Anthropogenic and Natural Forcing to Recent Tropopause Height Changes," Science vol. 301 (25 July 2003), 479-483.

6. In the 1860s, physicist John Tyndall recognized the Earth's natural greenhouse effect and suggested that slight changes in the atmospheric composition could bring about climatic variations. In 1896, a seminal paper by Swedish scientist Svante Arrhenius first speculated that changes in the levels of carbon dioxide in the atmosphere could substantially alter the surface temperature through the greenhouse effect
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10. <http://www.pmel.noaa.gov/co2/story/What+is+Ocean+Acidification%3F>
11. <http://www.pmel.noaa.gov/co2/story/Ocean+Acidification>
12. C. L. Sabine et.al., "The Oceanic Sink for Anthropogenic CO<sub>2</sub>," Science vol. 305 (16 July 2004), 367-371
13. [Copenhagen Diagnosis, p. 36.](#)

14. [http://www.teachoceanscience.net/teaching\\_resources/education\\_modules/coral\\_reefs\\_and\\_climate\\_change/how\\_does\\_climate\\_change\\_affect\\_coral\\_reefs/](http://www.teachoceanscience.net/teaching_resources/education_modules/coral_reefs_and_climate_change/how_does_climate_change_affect_coral_reefs/)
15. <http://lwf.ncdc.noaa.gov/extremes/cei.html>
16. [https://www.myfortune3cart.com/elca/ELCACS1097-Agriculture\\_And\\_Food\\_Security\\_In\\_A\\_Changing\\_Climate.pdf](https://www.myfortune3cart.com/elca/ELCACS1097-Agriculture_And_Food_Security_In_A_Changing_Climate.pdf)