

Letter to the Congregation #2
Project Snowfall, UUSG 7/25/2018

GLOBAL WARMING – *HOW BAD IS IT, REALLY?*

By Bill Koehl and Dave Hanchette

On January 25, 2018, the “Bulletin of the Atomic Scientists” advanced its famous Doomsday Clock to 2 minutes before midnight, citing two threats to our survival: nuclear weapons, and “unchecked climate change.” The Bulletin condemned world leaders who “failed to act with the speed, or on the scale required to protect citizens from potential catastrophe,” so endangering “every person on Earth.” -<https://thebulletin.org/2018-doomsday-clock-statement>

For now, let's assume the best -- assuming worst means earth becomes uninhabitable. Let's assume that people *will, before time runs out*, take the major action steps needed to reverse global warming. Until those steps are taken, though, it makes sense to ask the following question:

Since climate change is basically unchecked right now, what should I expect to see from it during my lifetime?

The answer – plenty.

More Powerful Storms - Storms are more powerful now because so much heat is held in our atmosphere by the greenhouse effect. Heat is energy, and energy drives the weather.

How much energy is being **added** to our atmosphere in the form of heat right now? The energy being added is ***the amount that would be released by:***

- 1) detonating 4 Hiroshima atomic bombs in our atmosphere every second, or
- 2) half a million lightning bolts striking the Earth every second, or
- 3) 3,000 F5 tornados wreaking havoc on Earth every day, or
- 4) having two different places in the world being struck by a hurricane as powerful as Hurricane Sandy (a monster) constantly! - <https://www.skepticalscience>

Extreme Weather Events - Besides making storms more powerful, global warming makes them more likely. We now expect hurricanes, thunderstorms, winter storms, and other extreme weather events to become more numerous, more severe, or both.

There has been a marked increase in climate-related natural catastrophes since 1980. These include extreme temperatures, droughts, forest fires, floods, and mass movements of human and animal populations, in addition to storms. - Jeffrey Bennett, *A Global Warming Primer*, © 2016, p.62.

Heat waves have become more common than cold spells; record high temps have become more common than record lows. ***And heat waves kill more people globally than any other weather*** - www.cdc.org/climateandhealth

Effects of Global Warming on Agriculture - Agricultural disruption is never a good thing. It has been a nemesis of humanity for all of civilization.

Changes in weather patterns will cause major disruptions to modern agricultural practices. The earlier arrival of spring will lead to longer, hotter and drier summers and disrupt pollination patterns. There will also be increasing stress from floods, droughts, invasive insects and diseases. This will lead to increased costs from reduced supply of crops, requirements for new investments, and disruptions to food processing and transportation and financial systems. And if that's not enough, the chances of simultaneous major crop failures in multiple locations will increase.

“For the top four maize-exporting countries, which account for **87% of global maize** exports, the probability that they will have simultaneous production losses greater than 10% in any given year is presently virtually zero, but it increases to 7% under 2°C warming and **86% under 4°C warming.**” <http://www.pnas.org/content/early/2018/06/04/1718031115>

Health – “Climate change is set to increase the amount of ground-level ozone and fine particle pollution we breathe, which leads to lung disease, heart conditions, and stroke. Less rain and more heat means this pollution will stay in the air longer, creating more health problems.” - [Climate Change set to Increase Air Pollution Deaths](#)

Research published in [Nature Climate Change](#) found that if climate change continues unabated, it will cause about 60,000 extra deaths globally each year by 2030, and 260,000 deaths annually by 2100, as a result of the impact of these changes on pollution.”

Higher levels of greenhouse gases encourage plants to produce more pollen. This creates "super pollen" that's larger and more allergenic. Scientists predict that pollen counts will double by 2040. ***Stanford University professor Mark Jacobson estimates that 1,000 people will die from air pollution for every 1°C rise in global temperatures.***

Mosquito-borne diseases like the Zika virus and dengue fever are becoming more prevalent. Mosquitos pick up these diseases by biting an infected person and spread the diseases to other people through subsequent bites --*but only after an incubation period.* Research shows, however, that warmer temperatures shorten the incubation period, so the diseases are spreading more rapidly than before. Warmer temperatures also increase the geographic range of insects, so insect-borne illnesses are spreading into new areas. Today's shorter winters reduce the die-off rate of disease-carrying pests. As a result of these factors, areas that were once unaffected by the West Nile virus, malaria, and even bubonic plague are seeing breakouts.

Lyme disease is on the increase because tick populations are expanding their ranges. Ticks move north as the climate warms. Warmer temperatures increase not only the range in which Lyme disease-carrying ticks can survive but also the amount of time during which ticks can feed. In warmer years the ticks emerge as much as three weeks earlier, posing an increased risk to public health.

Melting Ice - The polar regions are warming much faster than the rest of the planet. The amount of area covered by Arctic sea ice has dropped an average of 13% per decade for 30 years. Sea ice melting amplifies global warming because the water absorbs more heat than the more reflective ice. The warming of the polar atmosphere causes changes to the jet stream and polar vortex which affect weather patterns in the Northern Hemisphere.

http://nsidc.org/cryosphere/sotc/sea_ice

Sea Level Rise - Global warming causes sea levels to rise in two ways.

Water expands as it warms. This **thermal expansion** largely accounts for the 8-inch rise in sea level since 1880 and is expected to cause another 1-foot rise by 2100. “A rise of as much as 8 feet by 2100 cannot be ruled out.” <https://science2017.globalchange.gov/chapter/executive-summary/>

NASA reports that the rate of sea level rise is accelerating as a result of **the melting of both glaciers and of land ice in Greenland and Antarctica**. If the melting continues to accelerate at the present rate, sea levels will rise more than 2 feet by the year 2100. This conservative estimate based on 25 years of NASA data suggests that the problem of rising sea levels is likely to get worse.

<https://climate.nasa.gov/news/2680/new-study-finds-sea-level-rise-accelerating/>

Ocean Acidification – By releasing carbon dioxide into the atmosphere, humans are rapidly altering the chemistry of the ocean and affecting marine life. When carbon dioxide dissolves in the **ocean**, carbonic acid is formed. This leads to higher acidity, mainly near the surface, which has been proven to inhibit shell growth in marine animals like corals, lobsters, crabs, clams, oysters, and other shellfish that build their shells out of calcium carbonate compounds. Increased acidity slows the growth of calcium carbonate structures, and under severe conditions, can dissolve structures faster than they form. The acidified water can also threaten certain tiny plankton and larvae that depend on the carbonate ion, too. This threatens the health of the ocean food web.

<https://www.nps.gov/articles/ocean-acidification-101.htm>

Weather Cost - The U.S. has sustained 230 weather and climate disasters since 1980 where overall damages/costs reached or exceeded \$1 billion. The total cost of these 230 events exceeds \$1.5 trillion.

During 2017, the U.S. experienced a historic year of weather and climate disasters. In total, the U.S. was impacted by 16 separate billion-dollar disaster events, tying 2011 for the record number of billion-dollar disasters for an entire calendar year. More notable than the high frequency of these events was the cumulative cost, which exceeded \$300 billion in 2017 — a new U.S. annual record.

<https://www.ncdc.noaa.gov/billions/>

Energy Costs - “As a result of higher temperatures, economists estimate that net energy costs to consumers will increase by 10 to 22 percent.” - <https://toolkit.climate.gov/topics/energy-supply-and-use/energy-consumption>

Wages - “Without global GHG mitigation, labor hours in the U.S. are projected to decrease due to increases in extreme temperatures. Over 1.8 billion labor hours are projected to be lost in 2100, costing an estimated \$170 billion in lost wages.” - <https://www.epa.gov/cira/climate-action-benefits-labor>

Transportation - “As our infrastructure comes under threat, we will be forced to spend more to maintain it – or, with increasing likelihood, to replace it. We will see these costs in rising taxes and user fees, higher insurance rates and more wear and tear on our vehicles. We will also see it in higher prices for nearly everything we buy as transportation disruptions along the supply chain are transferred to consumers.” - <https://money.usnews.com/money/blog>

Potential Surprises - Compound Events and Tipping Points

From the Climate Science Special Report [CSSR 2017] - <https://science2017.globalchange.gov>

There is an increasing risk of extreme weather events happening simultaneously or multiple events happening in short succession. These are called “Compound Extremes”.

There are also many possible tipping points in the Earth's climate system. Once passed, they will continue changing regardless of what we do.

Changes in atmosphere-ocean circulation in the North Atlantic, South Pacific and Equator. Melting of the Arctic Sea Ice, Antarctic or Greenland ice sheets. There are two carbon cycle tipping points in the Arctic. The first is carbon buried in the permafrost and the second in methane hydrates in sediments of the continental shelves of the Arctic Ocean.

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OK, ‘nuff said. It’s time to conclude. We were asking: ***Since climate change is basically unchecked right now, what should I expect to see from it during my lifetime?*** Having read this far, you must have some ideas about that, so I’m going to let you answer that question yourself.

One critical reminder, though: ***If somehow people don’t act in time or don’t do enough to reverse global warming, then *everyone* is beyond endangered, and the Earth, in time, will become uninhabitable.*** So here’s one final question which we’re hoping you’ll find motivational:

It’s 2 minutes ‘till midnight: Are your grandchildren safe?