

How Much do we Affect Climate Change? A Look at the Water System and its Function

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Abstract

This brief article discusses the impact of contained water on the water system, global warming and climate change. Previously, climate change was thought to be caused by industrialization and excessive gasses in the atmosphere. These gasses interact within a complex system that has been upset by contained water and a water shift from natural sources to above ground containers.

Keywords: Regional climate; Global warming; Climate change

Introduction

Climate change is soon to have a massive effect on the world as we know it. From the industrial-era on, the climate has been shifting, ice melting, and greenhouse gasses have been accumulating. Contained water may have a role in the changes we have seen and predict for the future. Contained water in this article refers to water in food packages, bottles of water, soda, juice and sports drinks, water in piping, or any other water that does not have access to open air. The author proposes the hypothesis that though the amount of water compared to the Earth's supply is small that is contained, contained water has an overall significant effect on the water cycle/system, including climate change and global warming. Comparing the water cycle to that of the refrigerant cycle in a working refrigerator can help paint a picture of the cause and effect discussed in this article.

Global Warming and Climate Change

According to Abram et al. [1], "The oceans represent a major heat reservoir taking up more than 90% of the total global energy imbalance since the 1950s". The authors go on to discuss the increase of greenhouse gas emissions and the use of fossil fuels in the industrial era. First there was a cooling period between 1400 and 1800 due to large volcanic eruptions, but this cooling was reversed in the industrial era. The warming began around 1830, but this may have been normal, following a pattern of cooling, and may have been sustained due to the extra emissions and use of fossil fuels. According to Abram et al. the Northern hemisphere showed signs of warming in the mid-nineteenth century and the Southern hemisphere followed about 50 years later. Significant warming was found in the Antarctic peninsula and in West Antarctica from the mid-twentieth century on. The emergence of regional climate change following industrial era warming began in the Arctic. "Despite the large variability of Arctic climate, the paleoclimate time-of-emergence assessment indicates that the early onset and rapid rate of warming resulted in the emergence of climate change during the 1930's..." [1].

In the simplest of terms, global warming is caused by greenhouse gasses holding an excess amount of heat within the atmosphere. During the industrial era, carbon dioxide levels in the atmosphere began to rise due to the burning of fossil fuels. Emissions continued to rise over the years. Carbon is also used by plants. Vegetation, for instance is growing in the United States, according to Lovett [2], thought to be caused by forest regrowth spurred on by global warming and a carbon sink from rainfall. Water is a greenhouse gas as well, and that is how the global water cycle comes into play.

Closed Systems

The Earth and the cycles within it are closed systems. This includes the carbon cycle, the water cycle, and even the circle of life in which plants and animals return to the soil. Each system has its own inner workings, but they all work together to create a balance that the Earth thrives on.

Air Conditioners and Refrigerators

A refrigerator is a closed system broken up into five parts. The refrigerant in the system is the life force; like blood to a human body (or water to the Earth). The refrigerant is compressed in the start and becomes a high heat, high pressure gas. It travels through the tubing where it is put through the second part of the system, the condenser, in which it is cooled and condensed becoming a low heat, high pressure liquid. The refrigerant goes through a valve, or capillary tubing, the fourth part of the cycle, where it is sent into the evaporator as a low pressure, low heat liquid and transformed there into high heat, low pressure gas. The evaporator is the fifth part of the cycle. This system is reliant on proper pressures, superheat, and proper amounts of refrigerant (in a vacuum) [3]. A refrigerator that is attempting to cool too much at once, with blockages in piping or on the fans, or with too little or too much pressure/refrigerant will run hot or shut down. The system requires each part to run smoothly to give over to the next part. For instance, from this information one can conclude that the compressor may get flooded if the evaporator feeds a low heat liquid into it.

When a refrigerator breaks down, troubleshooting is not as simple as it may seem. A troubleshooter must first isolate the problem by relating what is happening on the gauges and evaporator and finding the part of the cycle that is causing the issue. Each part must run smoothly for the entire machine to do its job.

The Water Cycle

The water cycle is much more complex than that of an air conditioner. The water on Earth is utilized for many different things as it travels

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through the cycle. It cools, and at times it heats. Water reflects light and heat rays, protecting people from harmful rays and keeping the Earth at a bearable temperature. Water holds life and thus changes with that life and all of the life around it.

According to Berner and Berner [4] the annual precipitation rate is $0.506 \times 10^6 \text{ km}^3$ or 5.06×10^{20} kilograms, with the land and seas accounting for most of the evaporation or precipitation, respectively. Water lives in the ocean for 38,000 years while its residence time in the atmosphere is only about 11 days. Rain and snow only occur due to proper amounts of water in rising air and the air and water moving through any one region works together with outside regions to create the climate and weather we see. Ogino et al. states that, "Evaporation is greater than precipitation over the ocean, and vice versa over the land, and the consequent imbalance is compensated for by the atmospheric water vapor transport from the ocean to the land and by river and groundwater discharge from the land to the ocean". The winds carry the water, and the water falls where it is cold, and it gathers, meaning the winds also have cold and warm changes with movement across regions [4].

What is the relationship?

As previously stated, water is a greenhouse gas, and it holds heat in bands similar to the way carbon dioxide does [5]. Though both of these greenhouse gasses block excess heat from entering the atmosphere as well as allowing excess heat to leave the atmosphere through non-overlapping bands, water holds heat [6] as does carbon, so the more water and carbon dioxide in the air, the hotter the air will be. Water, however, condenses and falls to the Earth, which, in effect brings chemicals down with it along with the heat it is holding creating phenomenon such as the carbon sink [2]. Once on the Earth it can be absorbed into soil, redirected to the ocean, or it may fall directly into any other body of water. Each one of these options shifts the amount of chemicals, including carbon dioxide, in the air to chemicals in the soil (which plants need to grow), or in bodies of water where they are dissolved or evaporated back into the air [5]. If water continues to be evaporated at the same rate, then the water that has been taken out of the system and placed into containers must displace another part of the cycle. Ground water replenishment, for instance, comes from both rain water and "via leakage from surface waters (that is, ephemeral streams, wetlands or lakes)" according to Taylor et al., and Famiglietti [7,8] notes the depletion of groundwater globally, stating that it is unknown where the water is going when rain would usually replenish the sites. The water may simply be shifting from the ground to above ground containers.

While climate change and global warming are blamed on the industrialization seen across the globe, there has been an oversight. Bottled water became popular after its beginnings in 1845 by Poland Spring, according to the Nestle Waters website (nestle-watersna.com, n.d.). The Poland Spring website [9], though, brings the date up to 1859, stating that the beginnings of the company's water distribution was that year. Perrier then began bottling water in 1863, and Deer Park followed suit in 1873. The industry grew from there with five major bottled water companies being born before 1900. Abram et al. states that the beginnings of industrial-era warming can be dated soon after 1800. As we continued to bottle water, we also began containing water in other ways such as water heaters, toilet tanks, aquariums and indoor swimming pools. The beverage industry alone has displaced gallons upon gallons of water, and it adds up quickly. The Coca Cola company began in 1886 and Pepsi in 1893. Reservoirs, storage tanks and water towers also displace water and indoor plumbing came to the United

States in the 1930's. The effects on the water system may be subtle and, in all areas, (ground water, ocean water, rivers, lakes, streams, puddles, atmospheric water, clouding), or there could be a single hardship in one area, with the rest looking normal with all possibilities in between, similar to the way a refrigerator reacts when losing refrigerant or has a blockage.

Discussion

Air conditioners and refrigerators are finicky systems. Much of the work done to them must be done and left to sit while the machine runs and levels off. The water system works just like that of a refrigerant system in that it has a liquid that vaporizes and cools, as well as the fact that the system takes time to settle.

How much is too much?

First one must identify how much water the system actually runs on. The water system must be broken down into parts as a refrigerator is. Much of the ocean will not be counted as part of the system as it is reserve. Recall, water stays in the ocean for 38,000 years [4]. The water that is running through the system is the water in the atmosphere (totalled at $0.0155 \times 10^{18} \text{ kg}$), a percentage of groundwater ($15.3 \times 10^{18} \text{ kg}$), a percentage of lake ($0.125 \times 10^{18} \text{ kg}$) and river water ($0.0017 \times 10^{18} \text{ kg}$), and a percentage of the oceans (the mixed layer will be used which totaled at $50 \times 10^{18} \text{ kg}$) with the ice caps and glaciers ($0.09 \times 10^{18} \text{ kg}$) and the ice shelves ($0.7 \times 10^{18} \text{ kg}$) playing their own roles [4]. This gets rid of about 95 percent of the Earth's water.

The proposition of this author is that each stand-alone system within the water cycle (e.g. lakes, rivers and streams, the oceans, ground water) can be upset by a shift in water availability, causing a problem with the system as a whole. The oceans carry the largest amount of water (1400×10^{18} kilograms according to Berner and Berner [4] but smaller systems have smaller amounts of water. When humans remove water from a single location, it has an effect on the daily product of that location, and humans are taking water at astounding rates. While some systems may be able to compensate, others cannot.

How much water have we taken?

If one were to stop time, how much water would be contained and unable to work in the system? This is the important question. The U.S. Census Bureau [10] states there were 134,054,899 household units in 2016. To give a quick example, if every home held 50 gallons of water in it, that would be equivalent to 189.271 litres which is equal to approximately the same amount in kilograms. The amount of water taken out of the system would be 2.537×10^{10} kilograms. 50 gallons runs out fast when you have a 50-gallon hot water tank or larger. This is just a fraction of what has been contained. Now consider every store in the world's stock of water, soda, juice, liquor, detergent, etcetera. Toilets everywhere must be added, as well as water heaters at places like hotels and resorts. Indoor pools that have no runoff to the outdoors and spas, and indoor aquariums small and large. All types of stores usually carry a large stock of beverages including plain water and the water piping to all of these places in the entire globe must be counted, as well as all of the factories of the beverage companies and their trucks on the road. Water reservoirs, storage tanks, pumps and piping are also a location of contained water. Unfortunately, there is no way to get an accurate estimate of contained water.

Future Research

This article is simply calling for more research in the area of waterless

alternatives as well as research on the effect of contained water on the water cycle/system. Some waterless alternatives may be introduced as more innovative piping systems that increase the likelihood of having emergency water and making waterless toilet tanks more mainstream. Beverage companies can move toward home soda dispensers. More research is needed to know the effects of water shift or water containment on weather and ocean temperatures. Agricultural change must also be analyzed in the light of water shift or contained water. Research in these areas will likely provide insight into the immediate effects of reversing the loss of system water. The concept here is simple, but the solution is not. However, moving toward waterless alternatives is a step in the right direction to cure the Earth of an ailment humans have caused.

Conclusion

The water system does not necessarily include all of the water we see on Earth. Much of that water is in reserve for up to 38,000 years while the rest of the water interacts with the system. Because of this it takes less contained water to upset the water system and cause shifts in climate and warming. Finding alternative ways of keeping usable water available may aid in the lessening of changes on the planet as well as push technology forward overall.

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