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HYPOTHESIS AND THEORY

A novel hypothesis:

Could water trapped in bottles and containers affect the hydrological cycle and climate?

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Abstract

The Anthropocene marks a period where human activity dominates Earth's climate system. Since the Industrial Revolution, fossil fuel use, deforestation and intensive agriculture have sharply increased greenhouse gases, raising global temperatures by an average of 1.19°C between 2014 and 2024— approaching the 1.5°C threshold. Atmospheric CO_2 has climbed from ~280 to over 420 ppm, intensifying ocean acidification, sea-level rise and ecological disruption. This study introduces a new hypothesis: that disruptions in the natural water cycle also amplify climate change. Water trapped in bottled or packaged forms weakens carbon sinks and alters hydrological circulation. Industrialization and massive plastic bottle use reinforce this effect. Thus, climate mitigation should not only reduce emissions but also restore natural water flows. Key strategies include reducing packaged water, promoting clean tap water, expanding refill stations and improving water treatment. Furthermore, it is recommended that the storage and circulation of bottled and packaged water be better regulated and managed to minimize disruption to the natural hydrological cycle. Protecting water's natural flow is crucial for maintaining global climate stability.

Introduction

The Anthropocene is defined as a new era in which human activities are exerting dominant, geological-scale impacts on the planet's climate system (Waters *et al.* 2016). Since the Industrial Revolution, increases in fossil fuel consumption, land use changes, intensive agriculture and deforestation have rapidly increased atmospheric accumulation of greenhouse gases, particularly carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) (Richardson *et al*. 2009). The average human-induced global warming during the period 2014–2023 was 1.19°C, with the annual warming rate reaching the highest level on record at 0.26°C.

As a result, global temperature averages have been close to or above the 1.5°C threshold in recent years (Forster *et al*. 2024). During this period, CO_2 levels in the atmosphere increased from approximately 280 ppm to over 420 ppm currently, reaching levels not seen for 800,000 years (Summerhayes *et al*, 2024). Data indicate that the period 2011–20.0 was the warmest decade on record for both land and seas/oceans. At the same time, global surface temperatures increased by 1.1°C - 1.2°C compared to the period 1850–1900 (NOAA 2025).

The impacts of climate change range from ecosystem disruption and agricultural yield losses to health risks and economic instability. In contrast, utilizing renewable energy sources (especially solar, wind and wave action) offers low-cost and broad application. Furthermore, ecosystem-based adaptation strategies are among the methods that support transboundary sustainable development by preserving biodiversity (UNEP 2022; Forster *et al*. 2024).

As humans now dominate critical components of the hydrosphere (Rockström *et al*. 2012; Richey *et al*. 2015; Hoekstra and Mekonnen 2012) and 80% of the world's population faces water insecurity or severe water scarcity (Vörösmarty *et al.* 2010; Mekonnen and Hoekstra 2016), improving our understanding of the global water cycle has graduated from an academic exercise to a planetary priority (Abbott *et al.* 2019). Freshwater is a limited planetary resource and a control variable for several other limitations, such as water vapor and organic carbon feedbacks in the climate system (Abbott *et al*. 2019).

The source and amounts of trapped and imprisoned water are detailed below:

Trapped water (packaged water temporarily outside the active hydrological cycle); A closed bottle, box or any container that is outside the water cycle, but has the potential to be released and join the water cycle in a short time, e.g., liquids on supermarket shelves.

Imprisoned water (long-term sequestered water in landfills); This represents discarded liquids that are outside the water cycle, such as in a closed bottle, box or any container, but do not have the potential to be released and join the water cycle in a short time (They may remain there for >200 years), e.g., waste liquids (water in the organic waste is also included), that are underground but in closed containers

Human activities alter the water cycle in various ways. Thus, humans' appropriate water through the use of soil moisture for livestock, agriculture and forestry (greenwater use), water abstraction (bluewater use), and water required to assimilate pollution (greywater use) (Heathwaite 2010; Rockström *et al*. 2012; Hoekstra and Mekonnen 2012). Secondly, humans have degraded approximately three-quarters of Earth's ice-free land surface through activities such as agriculture, deforestation and wetland degradation (Ellis *et al.* 2010). These disturbances alter evaporation, groundwater recharge, river discharge and precipitation at continental scales (Wang-Erlandsson *et al.* 2018; Boers *et al*. 2017; Ellison *et al*. 2017).

This article examines the causes, types, ecological and societal impacts of anthropogenic pressure on the climate system, and the sustainable solutions, aiming to present some new hypotheses, breaks in the water cycle, that have not been previously considered. Also, it aims to develop effective strategies at global and local levels, based on scientific evidences.

The current situation

Causes

- Atmospheric CO_2 concentration reached 421 ppm by 2024 (NOAA 2024).
- Fossil fuel use accounts for 75% of global greenhouse gas emissions (IEA 2023).
- Deforestation and land use changes lead to annual greenhouse gas emissions of 3.5–4 Gt CO_2 equivalent (FAO 2022).

Most significant known impacts

- Global average temperature has reached +1.19°C compared to pre-industrial and pre-bottlenecking levels (ESSD 2024).
- An average 28% decrease in glacier mass has been observed over the last 50 years (NASA Earth Observatory).
- In 2024, two-thirds of the Earth's surface experienced the highest temperatures on record (The Guardian 2025).

Available solutions

- Renewable energy production increased by 17% between 2022 and 2023 (IRENA 2023).
- The topic of forest–water interactions has a lengthy and fascinating history (Levia *et al*. 2025) and restoring carbon sink ecosystems, namely forests, wetlands and seagrass meadows, could offset emissions of 5–7 Gt CO_2 equivalent per year (UNEP 2022).

Data demonstrates clearly that anthropogenic greenhouse gas emissions are a primary driver of climate change in the Anthropocene. Fossil fuel dependence and land use changes, in particular, trigger feedback mechanisms in the climate system (e.g., ice-albedo feedback, ocean warming), creating lasting impacts (IPCC 2023). However, in another study, it was reported that the amount of SO_2 in the troposphere, in addition to smoke aerosols, is converted into sulfate particles that reflect direct solar radiation and act as cloud condensation nuclei, thus increasing cloud albedo. Also, it was noted that the resulting cooling could nearly offset existing anthropogenic greenhouse warming (Chahine 1992a, b). This again suggests that something else must be considered to ensure equilibrium in the equation.

Current hypotheses

The dominant scientific hypothesis posits that atmospheric CO_2 is the primary driver of the greenhouse effect, wherein increased retention of solar radiation results in global warming. This framework, widely accepted within the scientific community (e.g. Summerhayes *et al*. 2024), generally excludes the alternative hypothesis that aerosols, such as dust, smoke and other byproducts of industrial activity, could exert a net cooling effect on the climate system. However, a key question arises: if oceans, seas, lakes, rivers and other surface waters are experiencing warming, why does this not consistently lead to enhanced evaporation, increased atmospheric water vapor, greater cloud formation and consequently higher levels of albedo-driven solar reflection, as well as intensified precipitation in the form of rain and snow? This suggests that some mechanisms within the climate system remain insufficiently explained.

A novel hypothesis

"The water trapped in millions of tonnes of bottles and the other closed containers affect the hydrological cycle and climate."

The hydrological cycle describes the continuous movement of water above and below the Earth's surface (Chahine 1992a, b). This cycle includes the journey of water from the oceans and seas to the atmosphere, from the atmosphere to the Earth's surface, and back to the seas and oceans. This term reflects that Earth's water resources neither increase nor decrease over time. The question to be resolved is the hydrological cycle sustainable today? Could it be delayed/altered due to unnatural processes? Recently, researchers discussed how much water or liquid is currently contained in bottles, and not in the natural cycle? (Can and Austin 2025). The answer will be discussed here.

Since the 1970s, global bottled water consumption has increased exponentially with every decade. The bottled water market has grown rapidly globally, with approximately 550 million households consuming bottled water by 2024. This translates to over 446 billion liters of water per year, or 1 million bottles per minute (Statista 2025). Most (95%) of plastic bottles in the USA end up in landfills or incinerators. This means that an average of 60 million plastic bottles end up in landfills or incinerators every day (URL 1). The amount of bottled water consumed over the past 50 years is estimated to be approximately 6–7 trillion liters (6–7 billion m^3). Whereas the majority of bottled water is returned to nature as wastewater after consumption, the remainder ends up in landfills, where it remains undisturbed for many years. If, at a minimum estimate, an average of 5–10 milliliters of water remain undrinkable in each bottle, this equates to 0.5–1% of total production. Even then, excluding other water-containing beverages and foods that are thrown away, an estimated 30–60 billion liters of water remain "imprisoned" with plastic waste, diverted from the natural water cycle. Could we reintroduce this water back into the cycle? Considering a bottle that is thrown away today, the water could still be imprisoned in 50 years.

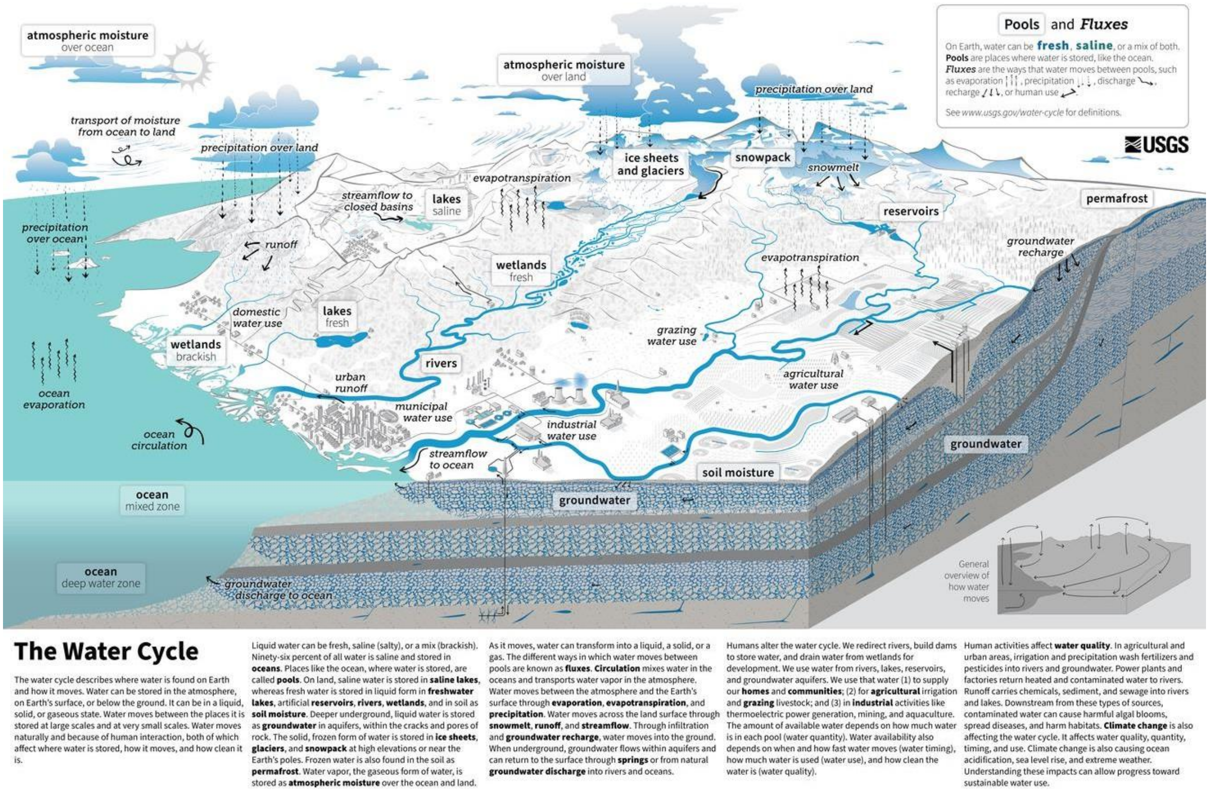

Figure 1. The water cycle (from USGS, https://www.usgs.gov/media/images/water-cycle-png)

The amount of water in the atmosphere is calculated to be 12.7 thousand km^3 /yr as shown in Fig. 1, and this means that we need every drop of trapped and imprisoned water. It is noteworthy that the global market for just three main types of bottled water was 350 billion liters (0,35 km^3/yr) in 2021 (Statista 2021). What percentage of water in the atmosphere is derived from the water in bottles? If this water is released into the atmosphere, how much will the humidity increase?

Just three main types of bottled water / the amount of water in the atmosphere *100 = ? %

0,35 km^3 /12.7 thousand km^3 *100= 0.028

The rate between water vapor and trapped water is 0,028%. If we consider other liquid-containing drinks and foods, and multiply this by 5 at least, the rate will increase even more.

If just this water -0,35 km^3- was released in its entirety and mixed evenly into the atmosphere over "land surfaces", the additional contribution to atmospheric column water vapor (precipitable water, PW) could be estimated as follows:

$\Delta h = V / A$

where:

- Δh = added water column height (m),

- V = additional water volume (m³),

- A = land surface area (m²).

The total land area of Earth is $A = 1.4894 \times 10^{14}$ m² (≈148.94 million km²) (UNEP, 2020). Substituting values:

$\Delta h = (0{,}35 \times 10^{9}\ m^3) / (1.4894 \times 10^{14}\ m^2) = 0.00000235\ m = 0.00235\ mm$

Thus, redistribution of 0.35 km³ of water corresponds to an increase of approximately 0.00235 mm in the average column of water vapor over land.

Relative increase in precipitable water

Average terrestrial precipitable water (PW) values are typically reported in the range of 15–25 mm (Trenberth *et al.* 2011; ERA5 reanalysis). The relative increase may be expressed as:

$\%\Delta PW = (\Delta h / PW) \times 100$

The calculated percentages are:

- For PW = 20 mm: %ΔPW = (0.00235 / 20) × 100 ≈ 0.0118 %

At the global scale, the complete release of just bottled water into the atmosphere would result in an increase in precipitable water of 0.00235 mm (≈0.01%), for which the meteorological or climatological impact remains uncertain. However, the situation may differ at smaller spatial scales. For example, on the scale of Türkiye, the increase reaches approximately 0.45 mm, corresponding to a 2–3% change and indicating a weak effect. Under summer conditions in the Aegean Region, the increase in precipitable water is ~4.1 mm (12–14%), a magnitude capable of influencing local meteorological processes. In the most extreme scenario, during summer in İzmir, precipitable water could increase by ~29 mm (80–100%), pointing to the potential for short-term, intense meteorological responses. If we consider other liquid-containing drinks and foods, the quantity will increase even more.

Prediction for the near future;

Per-capita bottled water consumption has been increasing steadily, and with an expected annual growth rate of 10% until 2026, it remains the fastest-growing segment of the packaged beverages sector (Parag et al. 2023). If this growth trend continues a baseline volume of 0,35 km³ would reach approximately 1 billion m³ after 10 years. If the increase continues at this rate, we would not want to predict what these amounts would reach. The proviso is that the water in the aquifers would not be completely depleted by then.

The interactions between water vapor, clouds and radiation constitute one of the most controversial feedback processes in the atmosphere. Thus, the rapid recycling of atmospheric water vapor exerts a disproportionate control over the energy of the climate system. Small changes in water vapor concentration result in significant changes in cloudiness and radiation intensity (Chahine 1992a, b). Most atmospheric water vapor is found at the surface, and its concentration varies by several orders of magnitude within the troposphere (Chahine 1992a, b). Our understanding of its vertical distribution and horizontal variability is inadequate, and the estimation of water vapor remains controversial.

At the same time, the balance of the global water budget is working rapidly:

For land:

Precipitation = 107

Evaporation = 71

Runoff = 36

Calculation: 107 (precipitation) – 71 (evaporation) = 36 (excess water going to the sea → runoff)

For sea:

Evaporation = 434

Precipitation = 398

Runoff (from land) = 36

Calculation: 434 (evaporation) – 398 (precipitation) = 36 → this deficiency is offset by runoff from land.

The diagram shows the "equivalence of land + sea":

Land area: +36

Sea area deficit: –36

The data for land and sea complement each other, and the global water budget is balanced (Trenberth *et al.* 2007; 2011). Is this balance a reality today?

Can we calculate how much water (including all liquids, including milk and other dairy products, fruit juices, mineral water, canned goods, energy drinks, carbonated drinks (e.g. cola, and soda), iced teas and coffees (bottled or canned) is trapped in bottles or another containers? Are we sure that trapped water does not affect the hydrological cycle?

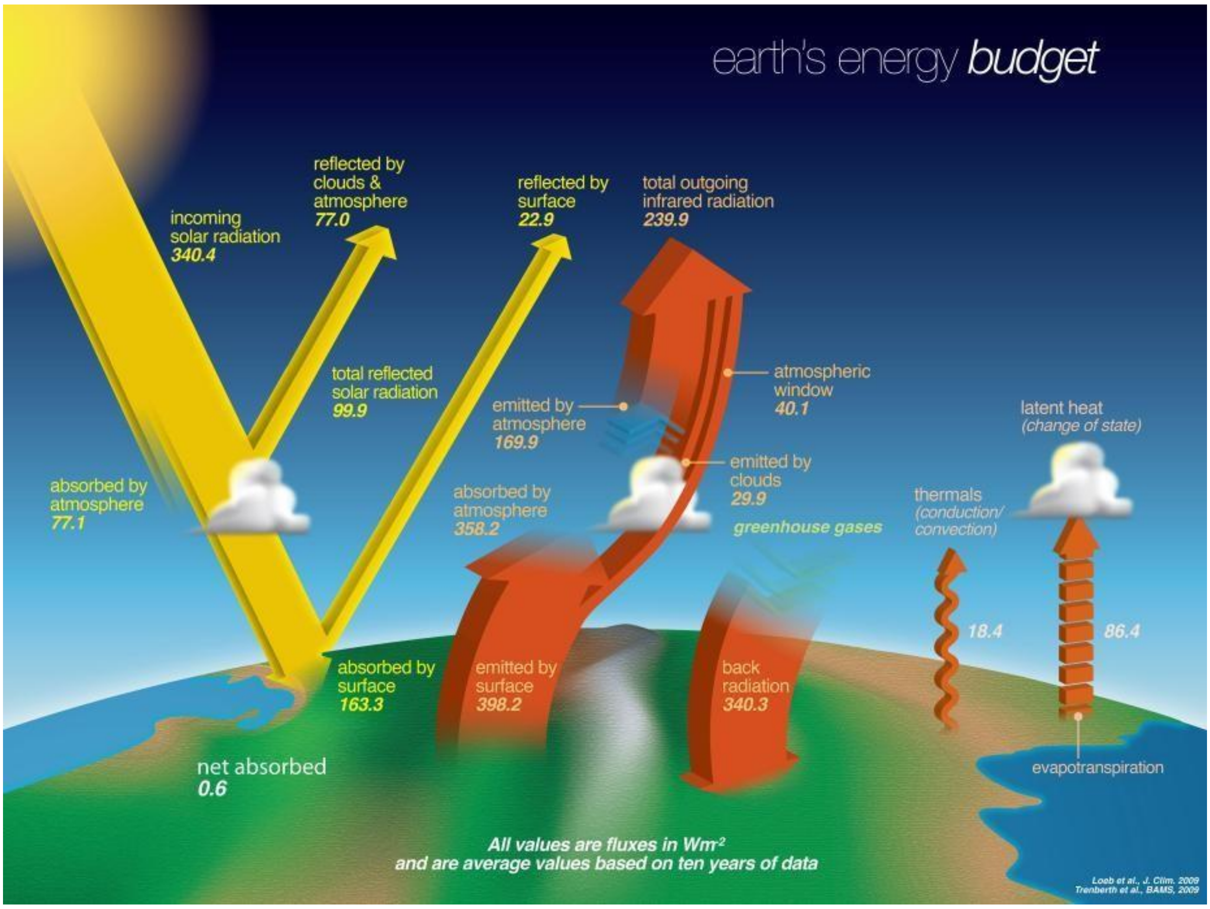

Fig. 2. The balance of the global energy (Credits: NASA GPM; Education Overview – CERES, 2022)

Could the energy budget be affected by trapped and imprisoned water? Science should search for answers to this question.

The continuous exchange of water between the reservoirs, shown in Fig. 3, occurs primarily through evaporation and precipitation. This exchange is driven by differential solar heating, which varies with latitude, but the exchange pathways are controlled by surface properties and atmospheric and ocean circulation. When an energy imbalance occurs in the atmosphere or at the surface, the atmosphere-surface system acts to restore equilibrium. In the atmosphere, equilibrium is most efficiently restored by the transfer of latent heat through evaporation and condensation (Chahine 1992 a, b).

The uncertainties in assessing the effects of global-scale perturbations to the climate system are due primarily to an inadequate understanding of the hydrological cycle, the cycling of water in the oceans, atmosphere and biosphere. Overcoming this problem necessitates new ways of regarding a field traditionally divided amongst several disciplines, as well as new instrumentation and methods of data collection (Chahine 1992 a, b). Water exhibits a healthier ecological structure when it is in a dynamic cycle. Interruption of this cycle disrupts the overall balance of the system and negatively impacts ecosystem functioning.

Hypotheses - Opinions and evidence

Opinion 1 (O1)

When water [vapor], which should be naturally present in the atmosphere, is trapped in bottles, cloud formation will decrease. Since clouds have the ability to reflect sunlight (albedo), a decrease in cloud cover will prevent this reflection, and global warming will increase.

Evidence for O1

In addition to their role as rain- and snow-makers in Earth's water cycle, clouds play a major part in Earth's energy budget—the balance of energy that enters and leaves the climate system. Clouds may have a warming or cooling influence depending on their altitude, type and when they form. Clouds reflect sunlight back into space, which causes cooling. However, they may also absorb heat that radiates from the Earth's surface, preventing it from freely escaping to space (NASA 2025).

Opinion 2 (O2)

CO_2 is a nutrient source for plants and forests. In this case, it is also a nutrient source for forests, being one of the main requirements for photosynthesis. So why does CO_2 cause global warming? CO_2 + H_2O with sunlight = nutrient + oxygen. Here, water is the primary ingredient. If the water in the air decreases, the equation will not hold. This is the reason we really need to free trapped water**.**

Evidence for O2

Trees need moist air. If the humidity (= water vapor) level in the air decreases, the effectiveness of forests declines (Liu *et al.* 2017). Because forests are the most important absorbers of sunlight, the outcome will exacerbate global warming. This may be referred to as the forest's water vapor effect. Forests absorb CO_2 from the atmosphere through photosynthesis and store it in biomass and soil. This is an important process that slows global warming (Lejeune *et al.* 2018).

According to data from the Copernicus Climate Change Service, a decrease in average relative humidity over land areas" has been observed over the last 40 years (Denson *et al*. 2021; Bourdin *et al*. 2021). This decrease has been particularly pronounced since the start of this millennium, and relative humidity has been reported to be mostly below average since then. Global reanalysis datasets, such as ERA5 and JRA-55, indicate a decrease in relative humidity over land areas over the last 40–60 years (Bourdin *et al.* 2021). This situation increases the risk of climate-related events, especially forest fires.

"$6\ CO_2 + 12\ H_2O$ + light energy $\rightarrow C_6H_{12}O_6 + 6\ O_2 + 6\ H_2O$." (Abeles *et al*. 1992)

According to NASA, water vapor is responsible for ~50% of global warming in the atmosphere; clouds (clusters of small droplets of water and/or ice, not water vapor) are responsible for ~25%; CO_2 is responsible for ~20%. The remaining ~5% comes from minor greenhouse gases, such as ozone (O_3) and CH_4, along with a small amount from aerosols (Schmidt *et al.* 2010). Water vapor does not reach the stratosphere, where cold temperatures convert it to ice crystals, effectively freezing H_2O out of the greenhouse gas equation at those altitudes (Summerhayes *et al.* 2024). The risk of fire is increasing exponentially compared to the past in forest areas, which are located in regions experiencing long-term drought under the influence of heat waves when relative humidity is very low (Dabanlı 2021). Aquatic currents and atmospheric winds (local and regional) exert important roles in water circulation. Thirty-five percent of terrestrial precipitation comes from marine evaporation due to winds; 65% is from terrestrial evaporation. The mean residence time of water in the atmosphere and oceans is an important climate parameter. The atmosphere recycles its entire water content 33 times annually (total yearly precipitation divided by atmospheric storage). (Chahine 1992a, b). In this context, a good understanding of these flows is needed to make an opinion about the irregular rainfall that has increased recently.

How do we influence water, which exists in liquid, solid and gaseous forms in nature in varying proportions? Specifically, has the amount of gaseous water in nature changed proportionally over the last 50 years?

Which is correct? The water cycle effects climate, or climate change effects the water cycle? Our hypothesis is that both affect each other. The relationship between the water cycle and climate change is bidirectional: whereas changes in the hydrological cycle influence climatic patterns (Chahine 1992a, b); climate change in turn significantly alters the water cycle (Trenberth 1999; Kundzewicz 2008; Yang *et al*. 2011).

Groundwater is used heavily by sectors, including terrestrial agriculture and aquaculture, and industries, such as bottled beverage production. When these water reserves are depleted, seawater infiltrates the groundwater basins, creating a risk of salinization (Peters *et al.* 2022). Thus, it appears that nature is trying to rebalance these waters, especially those that have been confined to a closed cycle and not part of the natural water cycle in accordance with current hydrological regulations. However, to replace the missing stores, it is necessary to release the trapped water. For example, in the USA alone, total volume of bottled water sold in 2022 reached 15.9 billion gallons, which is the highest volume ever recorded there (The International Bottled Water Association; IBWA). Globally, the bottled water industry grew by 73% in the last decade. More than one million bottles are sold globally every minute (Bouhlel *et al*. 2023). This growth poses a threat to groundwater resources (aquifers), contributes to plastic bottle pollution and carbon emissions, and undermines the role in ensuring universal access to drinking water (Bouhlel *et al*. 2023). Like many other industries, the bottled water sector is a massive consumer of water fueling the demand for what is regarded as a higher quality product than what is obtained from municipal supplies (Ragusa and Crampton 2016). This may be true in developing countries where the sanitary quality of municipal water supplies may be questionable, but less so in richer nations with effective water purification schemes. Beyond being the end product itself, vast quantities of water are consumed during production processes (Nestlé 2021; Coca-Cola Company 2021). For example, Coca-Cola uses an average of 1.95 liters of water to produce one liter of beverage; Unilever 3.3 liters; and Nestlé 4.1 liters (Hall 2009). Although water may be packaged in glass bottles, aluminum cans and cartons (Ghoshal 2019), plastic containers dominate the market as the most common form of packaging. Every single minute, over one million plastic bottles are sold worldwide (Plastics Europe 2020; UNEP 2022), fueling a growing plastic pollution crisis. Plastic waste poses a massive environmental threat, taking up to 1,000 years to decompose (Statista 2021). However, beyond the visible pollution, an often overlooked issue is the vast volume of water trapped, sealed and imprisoned within these containers. This ‘hidden’ water represents a massive, untapped resource, locked away behind plastic walls, highlighting the urgent need to rethink how we use and manage water in packaging industries.

Bottled water has links with and impacts on many Sustainable Development Goals (SDG) of the UN Agenda 2030. The withdrawal of groundwater for bottled water contributes to increasing water stress (SDG Indicator 6.4.2) in already water-depleted areas. Adoption of sustainable practices and integration of sustainability information into public reporting by bottled water companies would increase sector transparency in accordance with SDG 12 on responsible consumption and production (Bouhlel *et al*. 2023).

However, solutions, such as the transition to renewable energy, carbon capture technologies, especially the assumptions coded h2 in this study, are crucial for carbon capture because plants directly convert carbon into nutrients in the presence of H_2O and ecosystem restoration exert critical roles in both greenhouse gas reduction and climate change adaptation. Yet, political will, international cooperation and financial support mechanisms are essential for the success of these strategies (UNFCCC 2023).

The need for a better quantitative understanding of energy flows and water exchanges is fundamental to all climate studies, yet quantitative knowledge of the global hydrological cycle remains surprisingly inadequate (Chahine 1992 a, b).

Conclusions

The Anthropocene demonstrates clearly the decisive role of human impact on climate. Findings show that climate change is a preventable process; however, if effective and coordinated policies are not implemented, the 1.5°C target of temperature increase could be exceeded within the next decade. In this context, it would be beneficial to take the necessary precautions for all existing and new hypotheses, at least those that are feasible. For example, scientists could conclude, based on information about the expansion of the universe, that our planet is moving away from the sun—which is sufficient information to hypothesize a contribution to global cooling. Unfortunately, there is nothing we can do to prevent this. Other hypotheses favoring cooling or warming may be put forward, but what matters is not the temperature change by itself, but the effects of these factors. If we do not disrupt the circulation of water and allow it to flow freely, perhaps we will be minimally affected by these factors. We believe that this normalization process may be accelerated thanks to new hypotheses. Science is being updated regularly, and this is now the norm. To support this hypothesis, a comparison is made between the history of plastic—the invention of the bottle—and the current main hypothesis, the increase in CO_2 due to industrialization, within the context of global warming and glacier melting (Table 1). Thus, the development of industrialization and the discovery of plastic parallel the history of the confinement of water-containing foods and beverages in bottles (Table 1). This strengthens our hypothesis. Indeed, any argument against the assumption that water confinement could disrupt the water cycle seems scientifically infeasible. We believe that simply reducing carbon emissions is not enough to combat climate change. Our goal is to extract water from the confinement that will transform carbon into nutrients.

Table 1. Historical Timeline Table: Plastic – Industrialization & CO_2 – Glacier Melting

Year Period	Plastics History (Chalmin 2019; Geyer 2020; Lancen 2023; Olatunji 2024).	Industrialization & CO_2 Levels	Glacier Melting Status
1850	No plastics, glass bottles widely used	Industrial Revolution underway; CO_2 ~280 ppm (Aresta and Dibenedetto 2021)	Global temperatures slightly increasing, slow glacier retreat *(IPCC AR6)*
1862	First synthetic plastic	Widespread use of steam and coal; CO_2 rising (Aresta and Dibenedetto 2021)	Melting remains minimal *(IPCC AR6)*
1907	Bakelite invented, first fully synthetic plastic	Second Industrial Revolution grows; CO_2 continues to climb (Volk 2010)	Glaciers mostly stable; slight regional change *(WGMS data)*
1930–1940s	PVC, polyethylene, nylon developed	Mass production era; CO_2 ~310 ppm (Tkachenko *et al.* 2021)	Initial Alpid glaciers retreat *(WGMS)*
1947	First plastic bottle used commercially	Post-WWII boom; CO_2 ~313 ppm *(Keeling Curve data)*	Glacier retreat accelerating in parts of world *(WGMS)*
1950	Industrial-scale plastic production begins	"Great Acceleration" begins; CO_2 ~315 ppm *(Keeling Curve)*	Global glacier loss begins in modern era (Zemp *et al*. 2019)
1973	PET plastic invented	Oil crisis, consumerism increase; CO_2 ~330 ppm *(NOAA)*	Melting exceeds 20th-century average *(IPCC AR6)*
1977	First PET water bottle deployed	Continued industrial expansion; CO_2 ~335 ppm *(NOAA)*	Annual glacier loss ~200 billion tonnes *(WGMS)*
1990	Global explosion in plastic bottle usage *(PlasticsEurope)*	CO_2 ~355 ppm amid globalization *(NOAA)*	Accelerating mass loss—Greenland and Antarctica in net negative *(NASA)*
2000–2020	Hundreds of billions of bottles/year	CO_2 rising from ~370 to ~415 ppm *(NOAA)*	Annual glacier loss 500–800 billion tonnes; sea level rising *(IPCC AR6)*
Today	~500 billion plastic bottles/year, with ~400-year persistence	CO_2 at record ~426–427 ppm *(NOAA)*	50-year glacier loss ~9,600 km³; record melting rates *(NASA)*

In this context:

- Globally, all liquid-containing beverages and foods must be clearly identified and limited as much as possible. Previously, when bottling was not common, drinks, such as fruit-flavored drinks, colas and lemonade, were sold in powder form and mixed with water by the consumer. A return to this method could be beneficial. At the same time, solutions must be developed to prevent water on bottles from being thrown away and trapped for long periods in the ground. Water is the most important tool for absorbing carbon. Regulation alone is not enough; individuals should be trained, particularly concerning water and the water cycle, and the importance of this issue should be emphasized. We all use the same water. Young people are especially sensitive to this issue, and this is encouraging and hopeful.
- Promoting safe tap water instead of bottled water. Installing tap water dispensers and filling stations in public areas and workplaces, taking the water cycle into account. Increasing water quality through strict inspections and building public confidence in tap water. Designs that minimize plastic use may actually be a return to the old ways of using water.
- Installing effective, economical and environmentally friendly water treatment systems in homes and public areas. This will both improve water quality and reduce packaging waste. The consumption of fresh water may be reduced by making widespread use of desalination of seawater especially in areas close to the coast. Also, local governments could renew their water infrastructure, addressing leakages in the old distribution systems.
- Measures should be taken to ensure that water-containing food that ends up in the trash is immediately re-entered into the water cycle. The prolonged storage of organic food waste in landfills—often enclosed in plastic bags or sealed packaging—delays the release of the substantial water content naturally present in these materials, thereby preventing its timely reintegration into the hydrological cycle. Given that fruits, vegetables and animal-based products typically contain 60–95% water, large metropolitan areas can accumulate significant volumes of such "captive water" through annual food waste generation. Therefore, the separate collection of organic waste by municipalities and relevant public institutions, followed by its rapid processing through composting or other biological recovery systems, would enable the prompt return of this water to soil and atmosphere while also reducing the volume of contaminated leachate produced in landfills. This approach should be considered a practical and effective policy option that supports the sustainability of urban water cycles.
- Barriers, rain catchers should be designed to prevent rainwater from flowing into the sea before it reaches the ground, especially in residential areas. This way, aquifers that have been depleted due to human-induced groundwater extraction can be recharged.
- Water treatment technologies should be developed to increase the reuse of domestic wastewater. Converting wastewater used in industry and agriculture into integrated systems would increase efficiency through the development of treatment technologies and the optimization of adaptation techniques. An example would be treating a factory's wastewater and using it for vegetable production. Special organized areas encompassing shared agriculture and industry could be established for the use of recycled water for agricultural irrigation, using appropriate treatment technologies. Similarly, wastewater from aquaculture should also be treated, and hydroponic and aquaponic systems should be encouraged within these jointly organized agricultural zones.
- A 90% reduction in greenhouse gas emissions should be targeted by 2030 (compared to 1990 levels).
- Renewable energy capacity must be rapidly increased. Also, increasing use of solar panels could be an important carbon sink, as they convert incoming sun light into electrical energy.

- Ecosystem-based adaptation strategies must become a priority policy, and the researchers from various scientific areas are included in the related commissions, because sometimes we should look from the outside to see the whole.
- A global fight against forest fires must be launched, and the rate of tree planting should be rapidly accelerated. It is important to increase forestation, and prevent deforestation—which is feasible considering the amount of money spent on the search for extraterrestrial life—and, of course, free the trapped water. As mentioned previously (Can and Austin 2025), steps should be taken to release water that is not in the water cycle, but imprisoned underground in bottles (food leftovers, all other liquid-containing drinks), and strategies should be developed to prevent more liquid-containing water and food from being thrown away.
- Climate change: Why doesn't 2+2 equal 4? There are unknowns in the equation. The impact of modern human life on nature requires greater efforts to ensure equality in the equation, taking into account all global and universal factors.

Thus, the fight against climate change requires a holistic approach that includes not only technological but also social, economic, and cultural transformation.

Our greatest fear is that large companies and governments, anticipating a water shortage in the future, may store water by locking it into bottles and/or large closed containers (tanks). More trapped water means more disruption to the water cycle, more climate change. We believe that water is truly the greatest weapon we can use as a carbon sink. It is about releasing water to its natural habitat, to rivers, clouds and rain.

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Ethical approval

The authors declare that this study complies with research and publication ethics.

Informed consent

Not available.

Author contribution

Erkan Can: Writing – original draft, writing – review and editing, conceptualization, investigation.

Brian Austin: Writing – original draft, writing – review and editing, investigation

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The authors report no financial relationships with commercial interests.

Data availability

There is not any research data associated with this publication.

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