Windfarms, An Ingenuous Engineering Concept that will Rejuvenate our Climate -Only if Properly Operated

by
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Windfarms, an Ingenuous Engineering Concept that will Rejuvenate Our Climate—only if Properly Operated

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(Edited by Dr. Raymond H.V. Gallucci, P.E. [ret.])

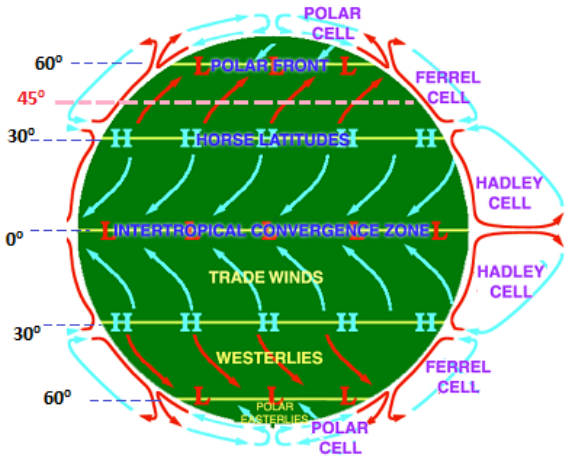
Abstract The carbon factor has too long been blamed for ruining the Earth's climate, even having been accused of potentially pushing our civilization to a dangerous point of no return. The reason that the carbon compounds, in particular carbon dioxide and methane, bear such notorious fame is fundamentally due to their heat absorption capacity. However, as to why such capacity leads to the yearly worsening pattern of climate change that we have experienced in the recent decades, no clear answer seems to have been proposed by experts. Generally, such an ever-deteriorating pattern can be condensed into a little "landscape" like this: In the North Hemisphere, the 45° latitude separates the areas into two large zones—north and south. Water distribution patterns from the sky over the northern and southern zones are contrastingly different. For the northern zone, water distribution becomes so scarce that a brutal drought has scorched across the land; the reemergence of the so called "hunger stones" (https://en.wikipedia.org/wiki/Hunger_stone) in some river beds left behind historically have caused great concern. For the southern zone, in the originally wetter areas, water dumped from the sky is so excessive that snow storms or weather cyclones relentlessly devastate the environment with ever increasing frequency and magnitude, menacing or ruining people's lives. The pattern has worsened yearly in recent decades, but the worsening is typically accentuated by geographical characteristics—the 45° latitude.

While most focus on complaining about the carbon compounds, and some even propose to completely stop using fossil fuel in order to "save" our civilization, we may be surprised to find that an already developing widespread infrastructure may hold the key to "revive" our climate in the future. This infrastructure is the windfarms that we have been building for years, but currently use only for harvesting the moving energy of nearly all the atmospheric currents, particularly those called Westerlies and Trade Winds. Some people claim that this harvesting is a great part of the effort expended to save the Earth's climate because, according to them, a substantial amount of fossil fuel is replaced and less carbon dioxide is produced. Encouraged by this unproven idea, they have pushed for an all-out effort for even more windfarms across the Earth. What makes us so sure that nature must endorse our "wisdom" in harvesting the moving energy of the atmospheric currents?

Keywords Hadley cell, Ferrel cell, Polar cell, Climate change

The overall atmospheric circulation enveloping the Earth consists of three basic circulating cells—the Hadley cell, Ferrel cell and Polar cell (Fig 1). While presented as a generalized description of air movement, these cells have no rigid boundary between them. Therefore, as they circulate, thermal energy redistributes and moisture diffuses from cell to cell naturally.

Generally, the air temperature and moisture content in the atmosphere near the equator are the highest, but both gradually decrease at higher latitudes. At both poles, the moisture content drops so low that the yearly precipitation matches that for deserts. This gradual tapering of moisture toward the poles makes it inevitable that land closer to the poles must rely more on the arrival of moisture from the tropics to supply enough water. To accomplish this, natural conveyor belts of some form are necessary to transport this moisture. Westerlies in the Ferrel cell shown in Fig. 2 are indeed such a typical and critical conveyor belt. However, should such conveyor belts be disrupted, drought in the areas of higher latitude must sooner or later happen.



An idealised view of three large circulation cells showing surface winds

H = high pressure
L = low pressure

Fig. 1

Source Credit
https://en.wikipedia.org/wiki/Atmospheric_circulation
(with minor modification from this author)

For a reason shown later, let us concentrate our examination on the North Hemisphere. The atmospheric current near the Earth's surface in the Ferrel cell, called Westerlies (abbreviated as WSLs), obtains its moisture from a down-draft of air movement about 12 kilometers in height around the 30° latitude. This down-draft column blends the warm moisture from current A in the neighboring Hadley Cell with the drier, colder and denser air from current B in the Ferrel Cell, as shown in Fig. 2. At the bottom of the down-draft column, the WSLs are endowed with a tremendous amount of kinetic energy as they move poleward. Such a huge amount of kinetic energy is converted from gravitational potential energy obtained by the air (of currents A and B in Fig 2) before it descends as the down-draft column. If WSLs are hindered from moving toward the pole, the moisture from current A will find it difficult to reach the higher latitudes. Unfortunately, for the lands at these higher latitudes, a strong and persistent mechanism causing such hindrance exists in nature.

The Earth's self-spinning produces a force that herds any free moving object toward the equator, as shown by force ***F*** for the object of mass ***m*** in Fig 3. As shown by the equations in Fig. 3, this force reaches its ***strongest*** magnitude at the 45°N and 45°S latitudes. Therefore, referring back to Fig 2, under the influence of the herding force ***F***, all air masses at the 45° latitude and higher would merge as a stubborn barrier resisting the WSLs from moving poleward. In fact, a force of the same nature, but caused by the WSLs' own mass, already constantly weakens the WSLs' movement before it meets that barrier. When the WSLs are blocked

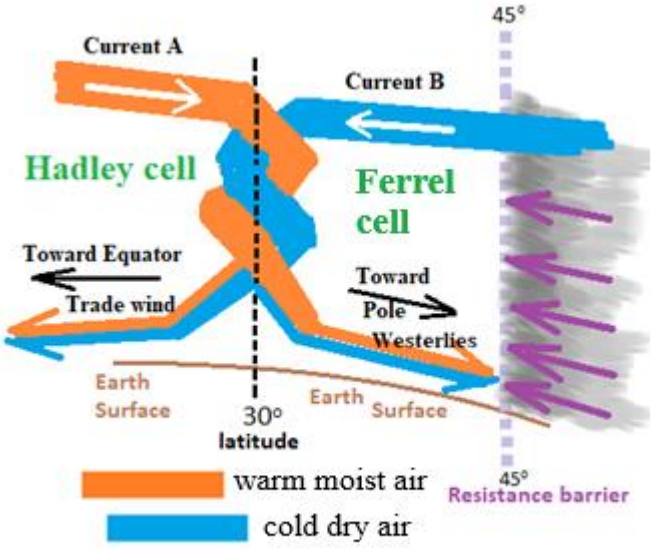


Fig. 2

by these two phenomena acting together, the following immediate **first tier consequences** become inevitable:

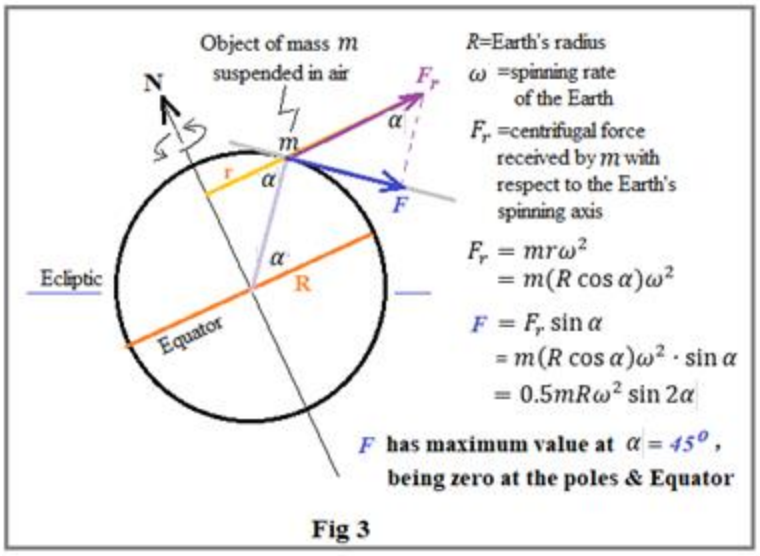


Fig 3

1. Scarcer moisture is delivered to the areas above the 45° latitude, such that drought is induced there; meanwhile
2. The moisture that cannot be exported is increasingly retained in areas below the 45° latitude. Sooner or later the air at these lower latitudes would become over-saturated, thereby releasing excessive moisture in the form of rainfall or snowfall. This ever-increasing accumulation of moisture in the air also exacerbates the accumulation of more rain clouds, thereby covering larger areas. This increased mass of primarily water vapor carries greater angular momentum, which is a natural consequence of the Earth's self-spinning. When this accumulation of more prominently spinning clouds eventually evolves into weather cyclones, the cyclones slam the environment with more catastrophic power [1].

Due to the blocking of the WSLs, the rising part of the air (white arrow in Fig 4) in the Ferrel cell carries less water vapor and is thus denser (a single O_2 or N_2 molecule is heavier than a single H_2O molecule), and will require a greater push to reach the top of the Ferrel cell to become current B. But, the blocked WSLs about the 45° latitude have stagnated as a large air mass, clogging the circulation route of the Ferrel cell. Not only does the rising air fail to adequately propel upward, it also reduces the descending speed of current B. The denser mass of the rising air but inadequate propelling force from the WSLs combine to force current B, the top circulating layer of the Ferrel cell, to move at both lower speed and elevation. A major heat exchange mechanism between the Earth and outer space is thus crippled. Subsequently, more heat in the atmosphere, produced by whatever means, is potentially retained and accumulated. Unless this heat exchange mechanism can be reinvigorated, local warming is manifested as the **second tier consequence** due to the blocking of the WSLs; more and more such local warming will enhance the appearance of global warming.

As the blocked WSLs create a huge resistance against the descent of the down-draft of air at the 30° latitude, far less cool air from the Ferrel cell is able to diffuse into the bottom current, called the Trade Winds, of the Hadley cell (Fig 4). This not only results in less cooling available to lower the tropics' temperature, but also a great reduction in circulation momentum to the Hadley cell. Lacking enough propelling force, the rising air of this cell is unable to reach higher elevations toward the tropopause. Just like what happens to the Ferrel cell, the top circulating layer in the Hadley cell also moves at both lower speed and elevation. Again, another critical heat exchange mechanism between the Earth and outer space is therefore impaired. Unless some cure appears to revive these two major heat exchange mechanisms from the Ferrel and Hadley cells, heat in the atmosphere gradually accumulates and global warming becomes more and more of a reality.

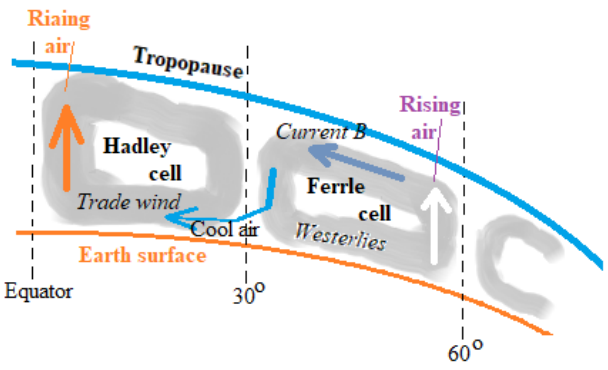


Fig 4

The weakened circulation of the Hadley cell further reduces the amount of moisture to be injected into the WSLs. Then, the further drying of current B of the Ferrel cell can only in turn provide even less cooling air to lower the temperature of the Hadley cell, elevating the moisture retaining capacity of the Hadley cell, which in turn further

dries up the Ferrel cell. Under such detrimental "positive feedback," the difference in the moisture content between these two cells must continuously widen year after year, assuming the Sun's evaporative power over the Earth's surface stays the same.

This ever worsening of the gap in moisture content is naturally modulated by the Earth's yearly alternation of seasons. For the large zone above the 45°N latitude, the modulation may not be too pronounced, although the yearly lessened moisture content continuously makes the drought worse and worse. For the large zone below the 45°N latitude, however, the modulation becomes quite pronounced. In summer, and for the areas in and near the tropics, increasingly worse rainstorms appear more frequently. In winter, the cold air in the areas about the 45°N latitude easily induce more and more severe snowstorms because of the increasingly elevated moisture content. Seeing this increasing modulation, we may have reason to feel dreadful if we are told that the moisture content supplying these snowstorms is not entirely from the tropic oceans, as opposed to the mechanism by which the tropic storms are supplied. Instead, it is the Arctic ice sheet that "generously" supplies these snowstorms, resulting in the thinning of the Arctic ice cap, which comprises the **third tier consequence** resulting from the WSLs being blocked.

The Arctic ice cap thins as its ice sublimates. When the WSLs fail to adequately penetrate beyond the 45°N barrier, water's partial pressure in the Arctic air lowers accordingly, accelerating this sublimation of the ice. The vapor so appearing after sublimation condenses into snow or ice granules suspended in the air, which becomes more susceptible to the herding force ***F*** shown in Fig 3. Propelled by ***F***, the air is easily pushed by the Arctic wind, speedily reaching the areas about the 45°N latitude and beyond. The atmospheric water content in the large southern zone subsequently increases. During summer such increased water content may help to escalate the magnitude of the rainstorms in further southern areas, but such effect may not be directly noticeable to us. During winter, however, the solid water particles from the Arctic definitely elevate the snow quantity in the upper air near the 45°N latitude, which is easily drawn to the ground by gravity before traveling farther south. When these solid water particles reach the ground, they also transport the Arctic temperature if their journey has not allowed them enough time to warm up. The thickness of the Arctic sheet has to gradually suffer if the sublimation finds no chance to cure itself, but instead becomes uncurbed. The reduction in the thickness of the Arctic ice sheet can easily accelerate the entire feedback process. Then the Earth will not only eventually lose one of its indispensable temperature modulators for life, but will also lose a powerful retainer of water that prevents the ocean level from rising. The third tier consequence is therefore the worst of the three.

The term "global warming" nowadays is primarily perceived as manmade when explaining why the global climate has deteriorated so rapidly in the recent decades. However, global warming alone seems difficult to convince us why it has affected the global climate so distinctively with respect to the geographical characteristics related to latitudes. All previous analyses suggest to us that the swiftness of the WSLs' movement holds the key to climate change. For the global climate to return to a friendlier state, the WSLs need to be "oiled" with energy that would benefit their movement. But further study reveals that the WSLs are heavily "molded" by geographical elements, which usually only rob them of the needed oiling energy and reduce their speed of movement. From this, the Earth shows strong evidence to support the contention that increasing the speed of the WSLs' movement can revitalize the Earth's climate to become more benign, or at least diminish its rate of deterioration.

Compared to the rapid disappearance of the Arctic ice cap, the Antarctic ice cap appears to lag behind the pace, so far remaining better preserved, although the "global warming" is supposed to be *globally* sweeping across the entire Earth. A direct answer to this "anomaly" between the rates of reduction in the Arctic and Antarctic ice caps is that there is far less land area in the Southern Hemisphere. Less land area means less ground friction to interfere with the air movement and therefore, the three cells over the Southern Hemisphere need overcome far less resistance during their circulation. Subsequently, the overall distribution of water and temperature in the Southern Hemisphere is more favorable to the preservation of the Antarctic ice cap. In the Northern Hemisphere, in addition to its greater land area, the topography there is also far more resistant to air circulation—there is no need for this author to remind anyone where to find the Tibetan Plateau and Himalayan Mountains. With more

land mass and more flow-resistant topography, the energy sustaining the movement of the northern WSLs is therefore far more heavily taxed than its southern counterpart; the northern WSLs are far more vulnerable. Subsequently, the Arctic ice sheet is increasingly compromised as we can see today.

That the Arctic ice cap has been well preserved in history until the recent decades tells us that (1) nature's balance maintaining the preservation of the Arctic ice cap is originally quite delicate and (2) the pace showing the upset of this delicacy is in beat with the modernization of human society. With this consideration, shall not we wish that the reason damaging this delicacy be solely manmade? If solely manmade, we hold the key whether to rein the damage under control or let it run wild. If we let it run wild, the Arctic cap will be gone someday. Then, how much longer will the Antarctic one last? Sadly, it will eventually be "cooked" into water by the heat accumulated in the Northern Hemisphere and later spread southward by the incessant ocean currents. Already we see that the Australian Great Barrier Reef is being slowly cooked to "well done;" how do we guarantee we will not suffer the same fate? From these above analyses, the climate-worsening pattern characterized by the Earth's geographical appearance seems to be telling us to attribute the manmade reason for damaging our climate more directly to a mechanical reason rather than to a chemical one [2]. By this we mean the exhaustion of moving energy of the natural atmospheric currents, as opposed to the increased carbon dioxide in the atmosphere.

How can the speed of circulation of the WSLs be restored once it has been blocked? The Earth's history seems to tell us that nature offers the means by which the WSLs can be extricated from their stagnancy. The moisture delivered from the tropics at where the WSLs are blocked cannot be limitlessly stocked. Above a certain limit, it would diffuse and permeate to some neighboring areas. The neighboring areas, having been dominated by dryer air for some time but now receiving such moisture, would have a chance to become lighter and warmer. If such an improvement in the quality of this air mass happens to lie in the path that the WSLs normally take, the gridlock against the circulation of the Ferrel cell would alleviate itself to some extent. Bit by bit, a better climate cycle returns to the larger zone above the 45^{o}N latitude, and consequently to the other zone below the 45^{o}N latitude. Since the 45^{o} barrier is in perpetual existence due to the Earth's spinning, it is only a matter of time when the WSLs will become blocked and once again stagnate. Such swinging of the climate pendulum has happened countless times in the Earth's history, although, as far as the intensity and period are concerned, no obvious regularity seems apparent. In other words, nature's self-regulation cannot be reliably predicted. What can be predicted is that the decrease in the circulation of WSLs can be made even worse by additional means. When these additional means are sufficiently detrimental to the climate, the climate pendulum can be constrained to swing only on the side of increased deterioration, making it more difficult to alleviate. Although we have mentioned the three tiers of consequence, we have not even mentioned how wild firestorms can appear far more easily and spread far more rapidly (e.g., Australia). Wild firestorms constantly attack our oxygen supply, not to mention the carbon dioxide absorption potential of the forests and jungles.

If nature's self-regulation is not reliable enough, or at least not timely enough, in restoring the circulation of the WSLs, can human beings establish some artificial means to help? It seems that the answer is positive. Does not each of us already know since childhood that a fan can thrust air forward? For the purpose of thrusting the WSLs forward, mankind already has a widespread infrastructure—the windfarms—which are, however, currently used to harvest the circulating energy from the WSLs, indeed, nearly all atmospheric currents. By harvesting and consequently diminishing air circulation capability, they are truly culprits that keep escalating global warming.

Each wind turbine in a windfarm nowadays functions as a power generator, harnessing the power provided by the movement of all natural currents besides the Trade Winds and the WSLs. If each of these wind turbines is converted to function as a motorized fan spinning in the same direction as they do when serving as a generator but at a higher speed than the natural air current, they should indisputably add energy to the currents' circulation (Fig 5). Then, at least, the currents A and B of the major circulation cells in Fig 2 would have a chance to avoid being clogged. Once unclogged, they can move at higher elevations with higher speed, directly restoring their

heat exchange function for the Earth. Following the restoration of the heat exchange function will be more even distribution of water content between the two large climate zones divided by the 45°N latitude.

Converting wind turbines into cooling fans is nearly effortless. The big problem is who pays for the huge cost of putting these fans to work. With the ecological situation we globally face today, some people already cry that we are in a crossroad that will choose between the continuation or extinction of our civilization. While the urgency they spell out may have a certain degree of truth, they seem to limit their attention to the wrong scapegoat, namely the carbon factor. Possibly, if human beings are told that they are left with only two choices—life or death—and also that a monetary contribution can save them, they would be willing to so contribute. With resources pooled together, all of mankind would engage in a worldwide project of general welfare focused on doing one job—reinvigorating the circulation of all atmospheric currents, particularly the WSLs. Operating such a project, the windfarm companies would run a money-making business to maintain a better distribution of both temperature and water content across the Earth. The fund paying these windfarm companies would be the responsibility of all of mankind. Who will coordinate the conversion for these windfarm companies to evolve from energy producers to energy consumers? Possibly, with the political structure of the current world, the first candidate of whom people would think is the United Nations.

Before the conversion of the wind turbines can be realized, should people let the current wind turbines continue to function as they have been? This is a question equivalent to whether or not we should continue to harvest the moving energy of all the atmospheric circulating currents. Let us imagine an extreme case: What if all the circulation currents stop? The answer is that the Earth would immediately be enveloped by a highly efficient, thermal insulation blanket of 10 kilometers in thickness. Should we let the windfarms continue to damage the Earth's heat exchange mechanisms, perhaps even stop them altogether, or should we start to utilize them to improve the environment? We can easily answer this question now. Should we continue to blame carbon dioxide and ignore a true culprit that causes damage to our Earth? This answer seems also readily apparent.

Operating the wind turbines as cooling fans requires energy. Ironically, as far as we can see today, there are only two efficient energy sources for this purpose: (1) fossil fuel and (2) nuclear fuel; both are in the "against" list of the environmentalists. As to the carbon dioxide from fossil fuels, we may plant more trees, and seaweed as well, to compensate for the adverse effect caused directly by the increase in carbon dioxide. As to nuclear fuel, the long-lived nuclear waste may eventually prove a threat to future human beings. But at least nuclear power can buy us time, with the hope that future generations can find ways to reduce any detrimental effect from the waste.

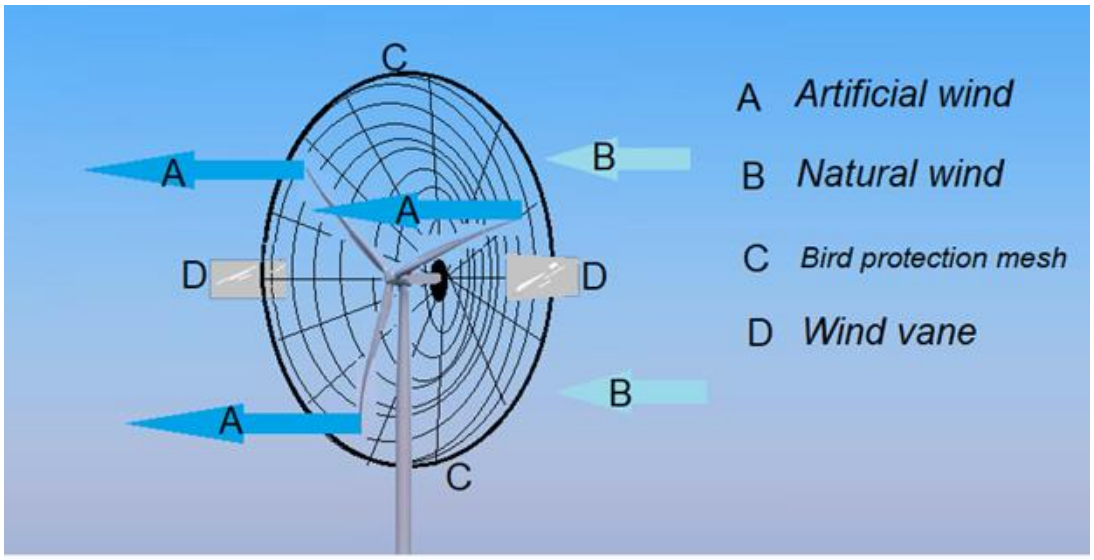


Fig 5 **A fan that should help to cool off our Earth — converted from wind turbine**

Here we do have some good news concerning the long-lived radioactivity from nuclear waste. According to Dr. Raymond H.V. Gallucci, a nuclear engineer, the concern over the long-lived radioactivity from nuclear waste has been over-dramatized for years by nuclear power's enemies. Safe, very long-term disposal/storage of the waste has been feasible for decades, but politically unpalatable to governments. Major proposals, such as disposal in deep salt mines (at least 600 m below the surface) has long been an option, since the mere existence of such mines reveals that there has been no water intrusion for millions of years. Retrievable storage has also been demonstrated, especially if any liquid wastes are first solidified to minimize, if not eliminate, any likelihood of "leaching" back into the environment. A multi-year project at Yucca Mt., Nevada, was scrubbed after completion for political purposes while Dr. Gallucci was working. It continues to remain as a most viable option for retrievable, safe storage, but just seems always to be a "no-no" in the current and foreseen political environment.

References

[1] The True Force Compelling a Cyclone to Spin—Coriolis Force Is a Wrong Candidate, *Cameron Rebigsol*, General Science Journal, https://www.gsjournal.net/Science-Journals/Research%20Papers/View/7823

[2] The first eight of the following figures show the yearly geographic precipitation across the globe from 2016 through 2019 as to its deviation from the base period of 1961-1990. These provide the general impression that the deviation in precipitation aligns more to the world's topographical and geographical variations, as shown in Fig. E1, rather than to a CO_2 pattern map shown in Fig. F1.

If we compare among Figs. A1, B1, C1 and D1 we can tell a general development of some increasingly wetter areas below 45^{o}N but increasingly dryer areas above 45^{o}N. The same pattern is evident among Figs. A2, B2, C2 and D2. The most recent development, as shown by the 2019 patterns in Figs. D1 and D2, is very alarming. The widely developed dry areas in southern Europe and southern Russia in Asia bordering 45^{o}N strongly suggest that the unusually plentiful precipitation in northern Europe and northern Russia in Asia below the Arctic circle is not supplied by any moisture source below 45^{o}N, but instead, by the Arctic ice sheet above the Arctic circle. It is in this year that we have heard the outcry that the thinning of the Arctic ice sheet is accelerating. If this remains uncurbed, Europe and Russia will eventually become bone dry. This is because (1) the northern water source, i.e., the ice sheet, will no longer exist, and (2) no moisture from areas south of the 45^{o}N can reach here. Nothing can bring more despair to the inhabitants of these lands once the ice sheet is gone; and, unfortunately, nature seems unable to offer any self-remedy.

That such unusually plentiful precipitation is supplied by the Arctic ice sheet can be logically deduced by comparison with the following evidence. In the North American continent, instead of being developed in areas away from the 45^{o}N latitude like the European counterpart, the plentiful precipitation here is developed near and below the 45^{o}N latitude. The reason is that the sublimated water from the ice sheet can easily travel over through the flat land of Canada, as shown in Fig E1, and reach northeast America. However, the counter part in the Eastern Hemisphere must spend far more energy in its southward journey. It must overcome the Scandinavian mountains and later all the mountains and highland along the 45^{o}N line. All the collections of sublimated water in America, Europe and northern Asia are compelled to move southward by the force $\boldsymbol{F}$ shown in Fig. 3 in the main text. $\boldsymbol{F}$ is statistically the same for any collection at the same latitude.

After all these analyses, we should find it difficult to follow Fig. F1 when visualizing how the global CO_2 pattern can induce a climate development that is so strongly characterized with Earth's topography and geography. An overall mean estimate of the value of the CO_2 concentration from Fig. F1 is 411 ppm in the year of 2019. The highest value shown in the same figure is 417 ppm for the same year; the deviation from the mean value is about 0.015(= 6/411). Someone would need to strive excessively to explain how such a small deviation can manifest into such contrastingly different conditions between two areas. "Hunger stones" remind people of the abhorred

climatic history in Europe while insurance companies in America must pay huge amounts to compensate for the devastating loss caused by deluges, storms, etc.

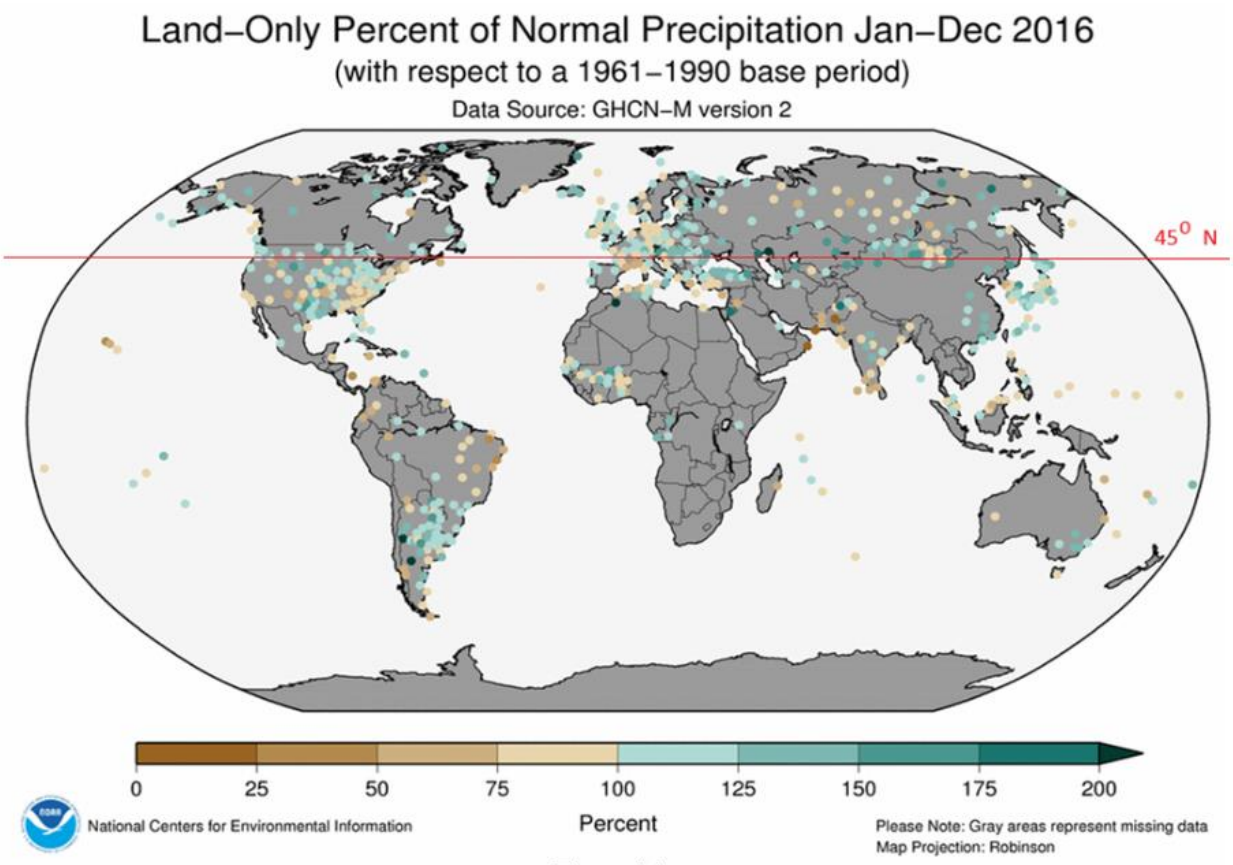


Fig. A1

Credit source: https://www.ncdc.noaa.gov/sotc/global/201613

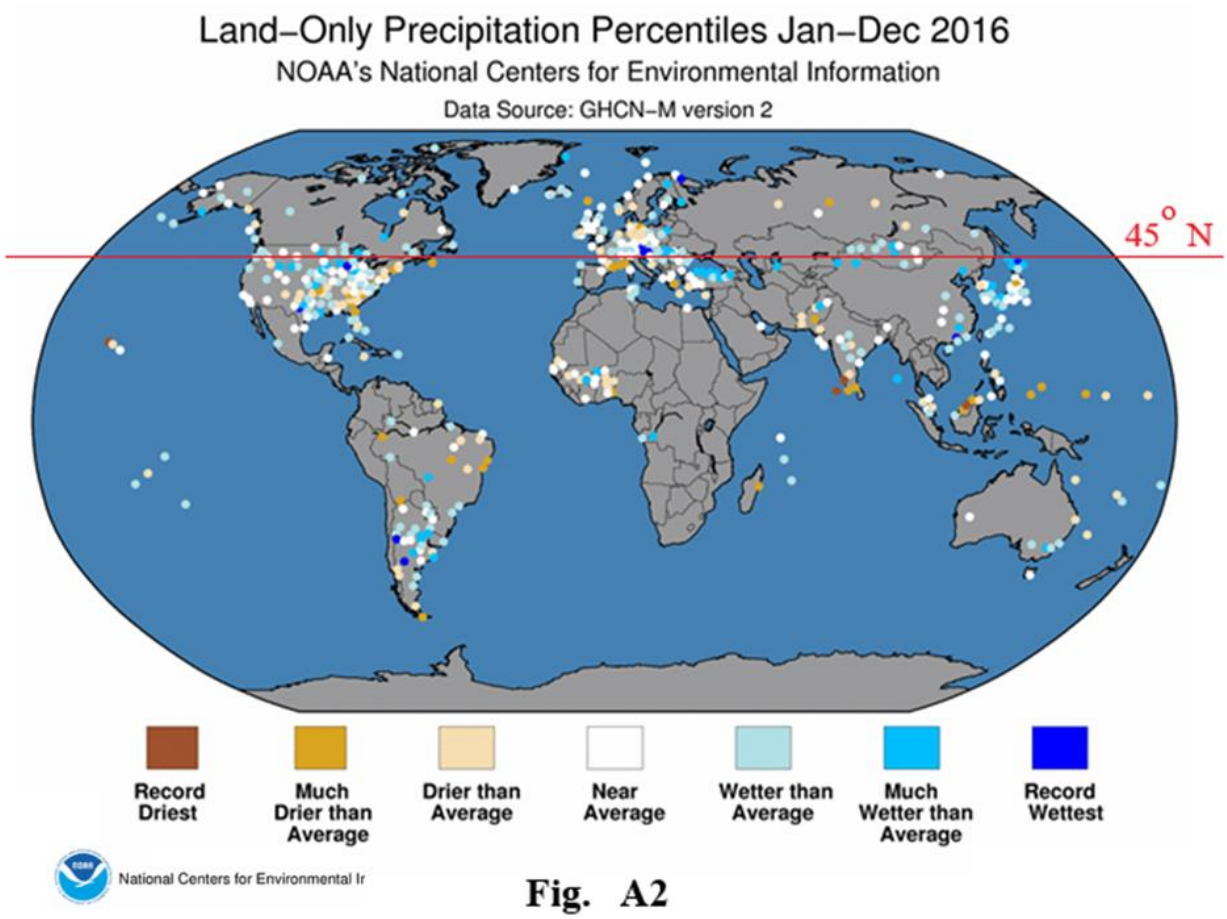


Fig. A2

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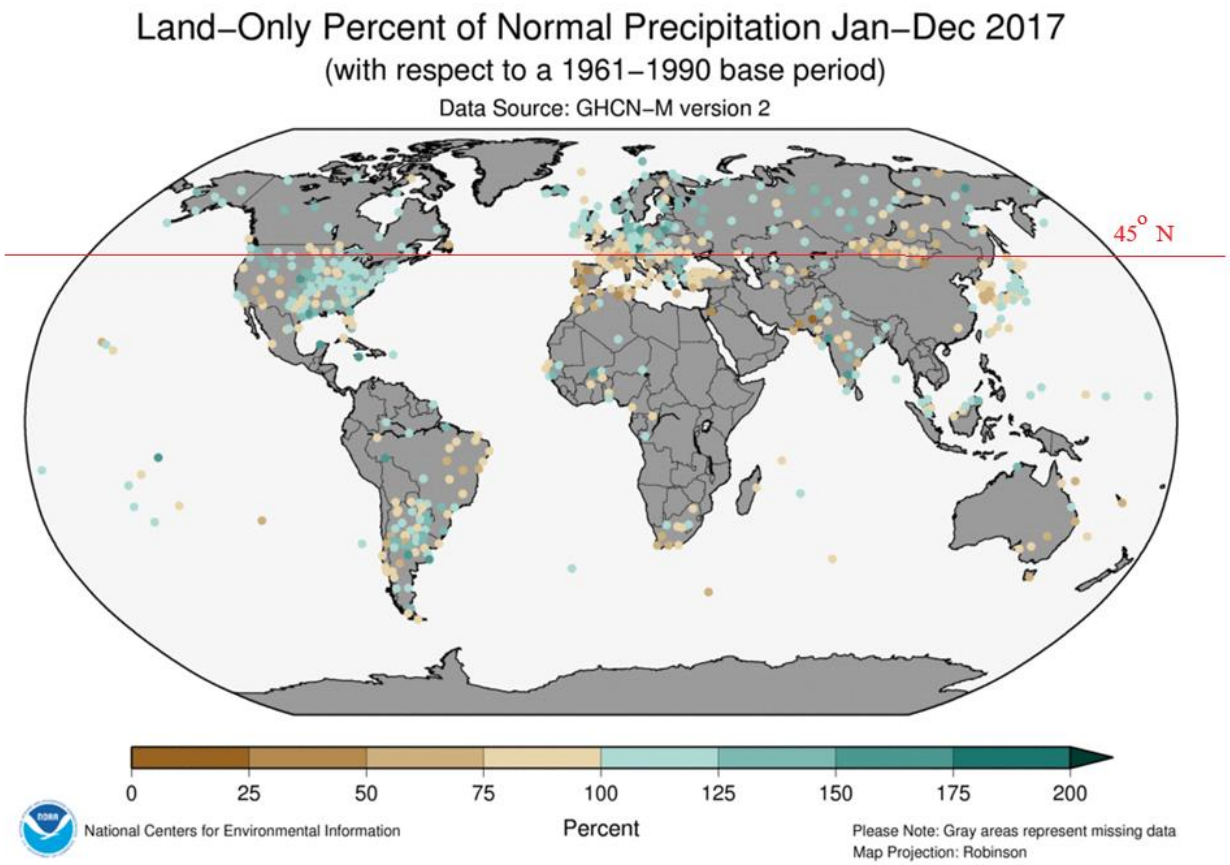


Fig. B1

Credit source: https://www.ncdc.noaa.gov/sotc/global/201713

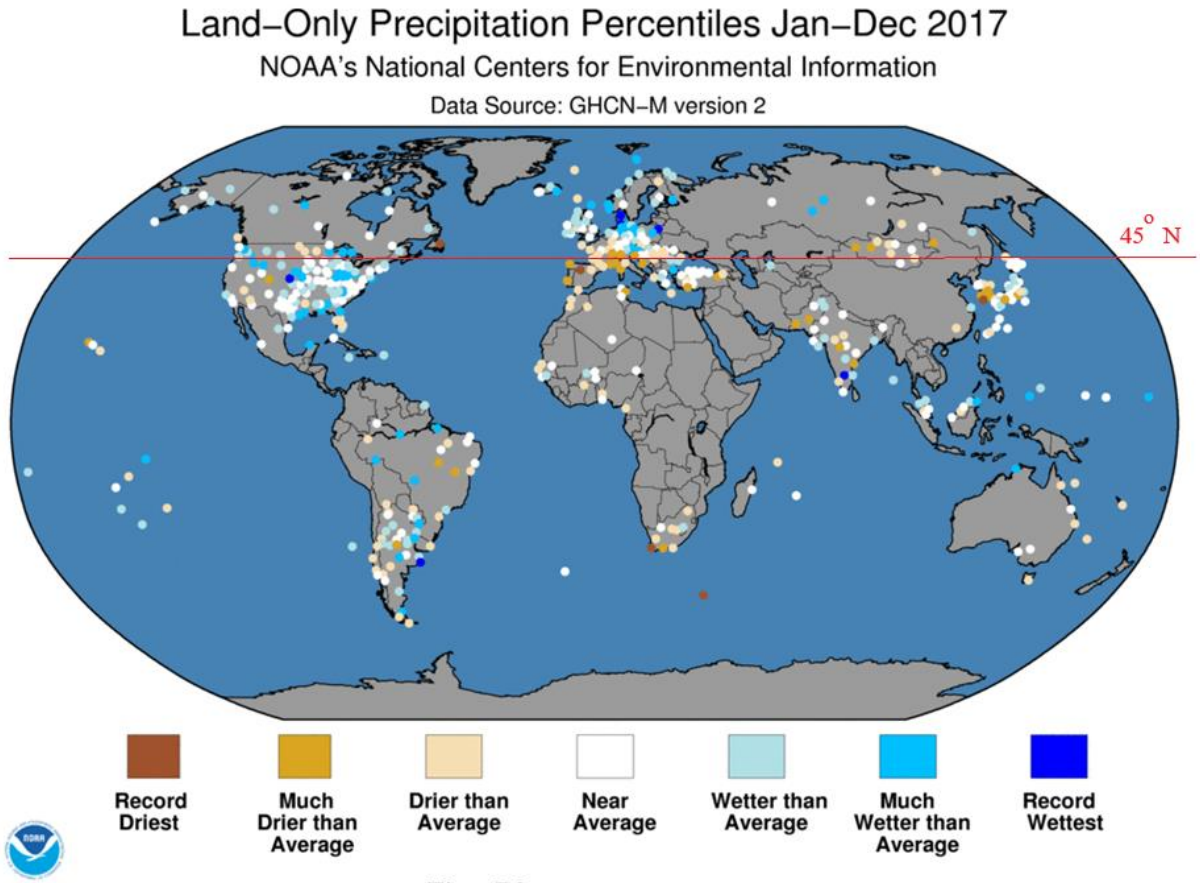


Fig. B2

Credit source: https://www.ncdc.noaa.gov/sotc/global/201713

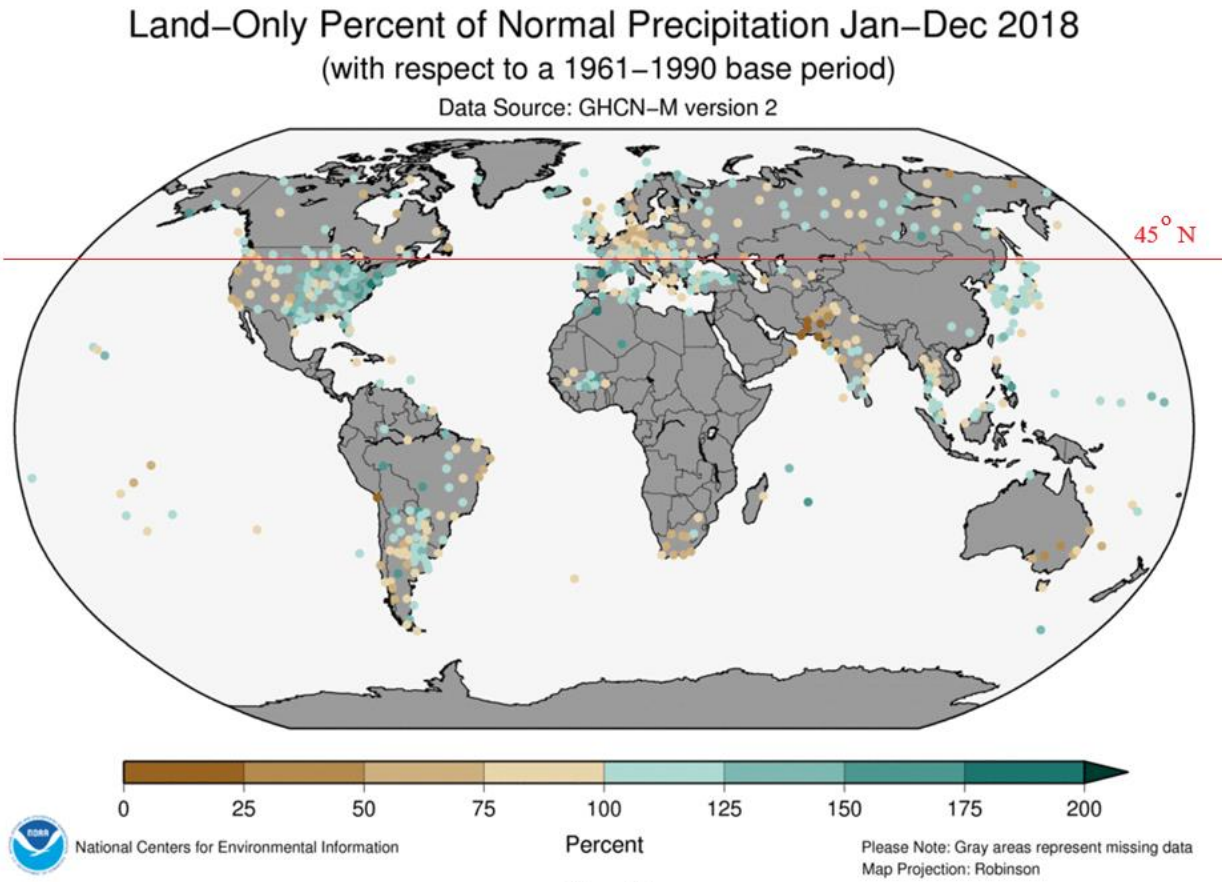


Fig. C1

Credit source: https://www.ncdc.noaa.gov/sotc/global/201813

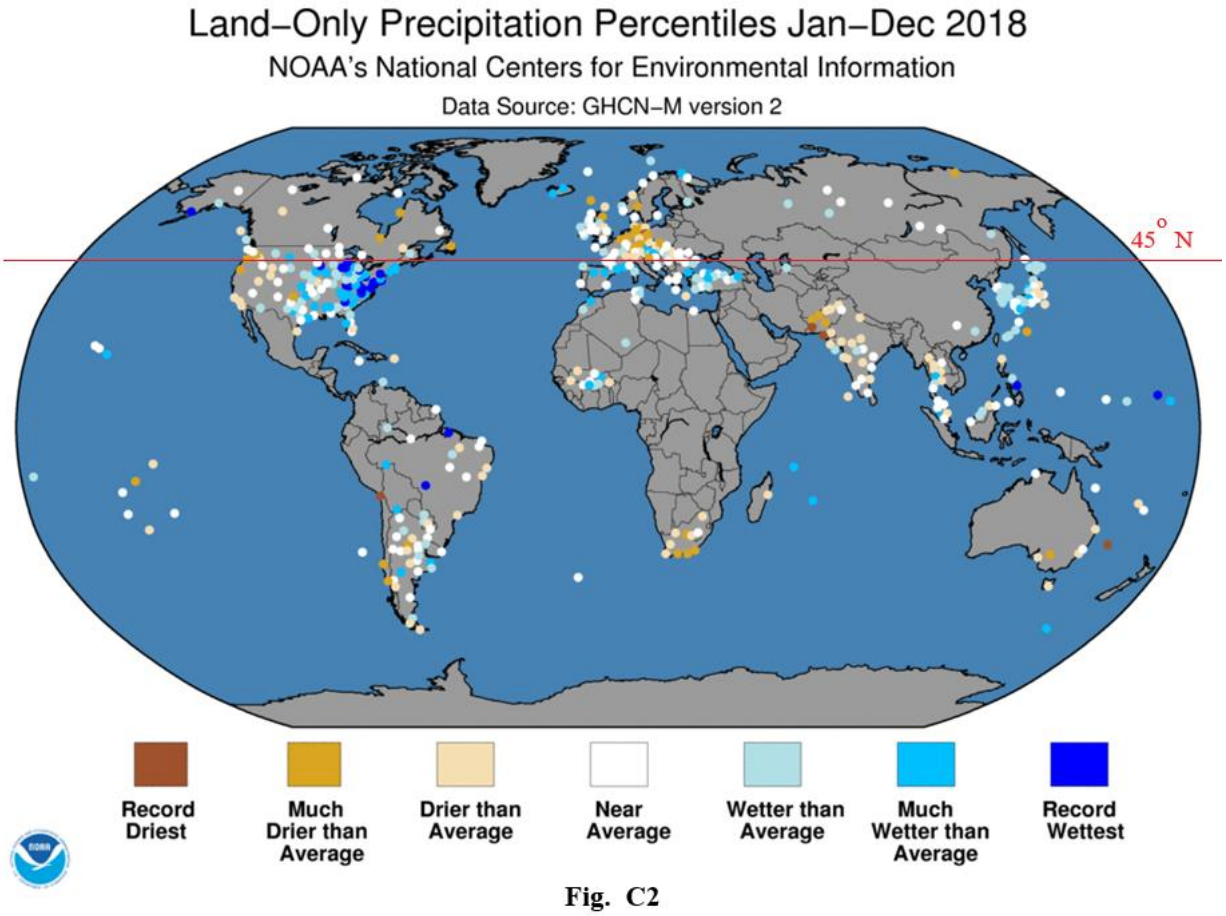


Fig. C2

credit source: https://www.ncdc.noaa.gov/sotc/global/201813

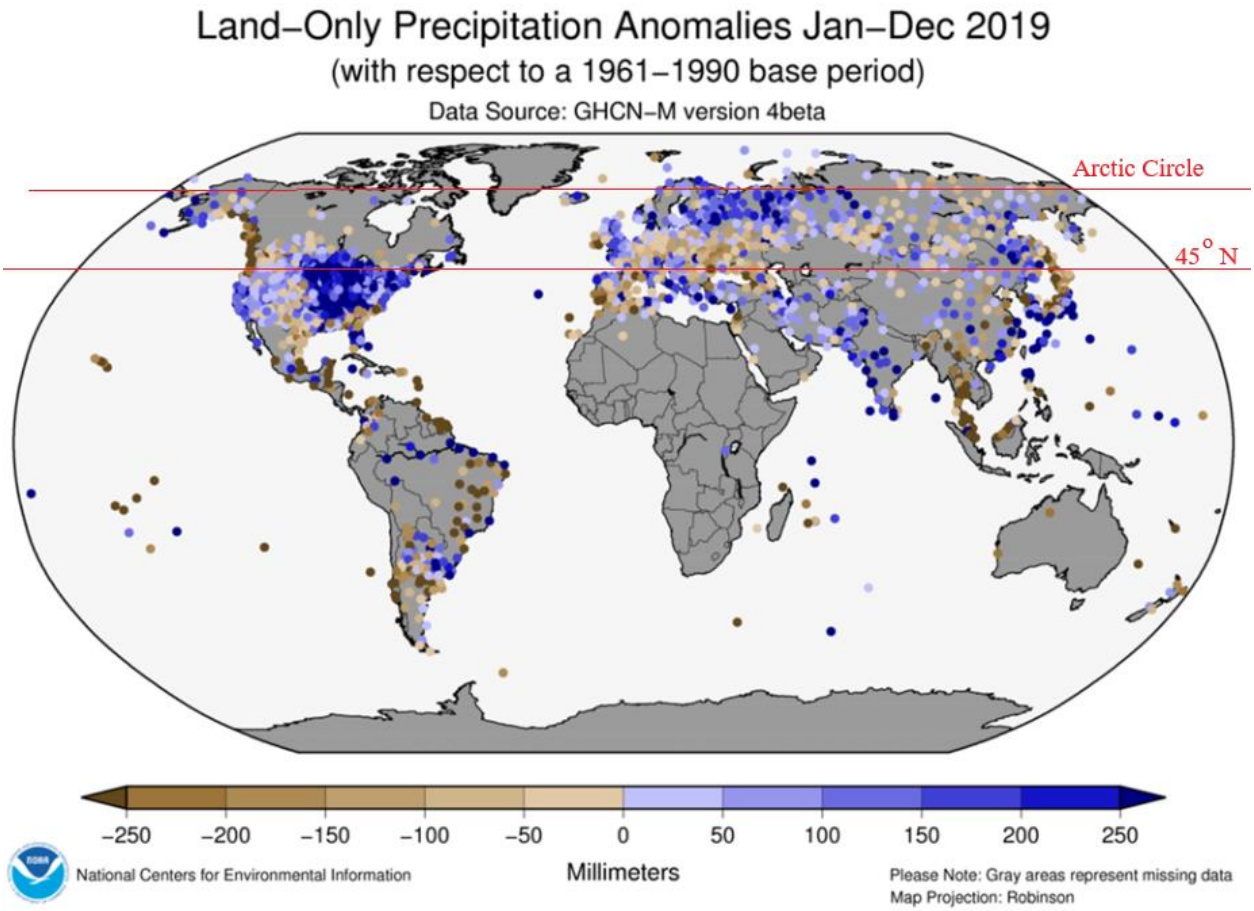


Fig. D1

Credit source: https://www.ncdc.noaa.gov/sotc/global/201913

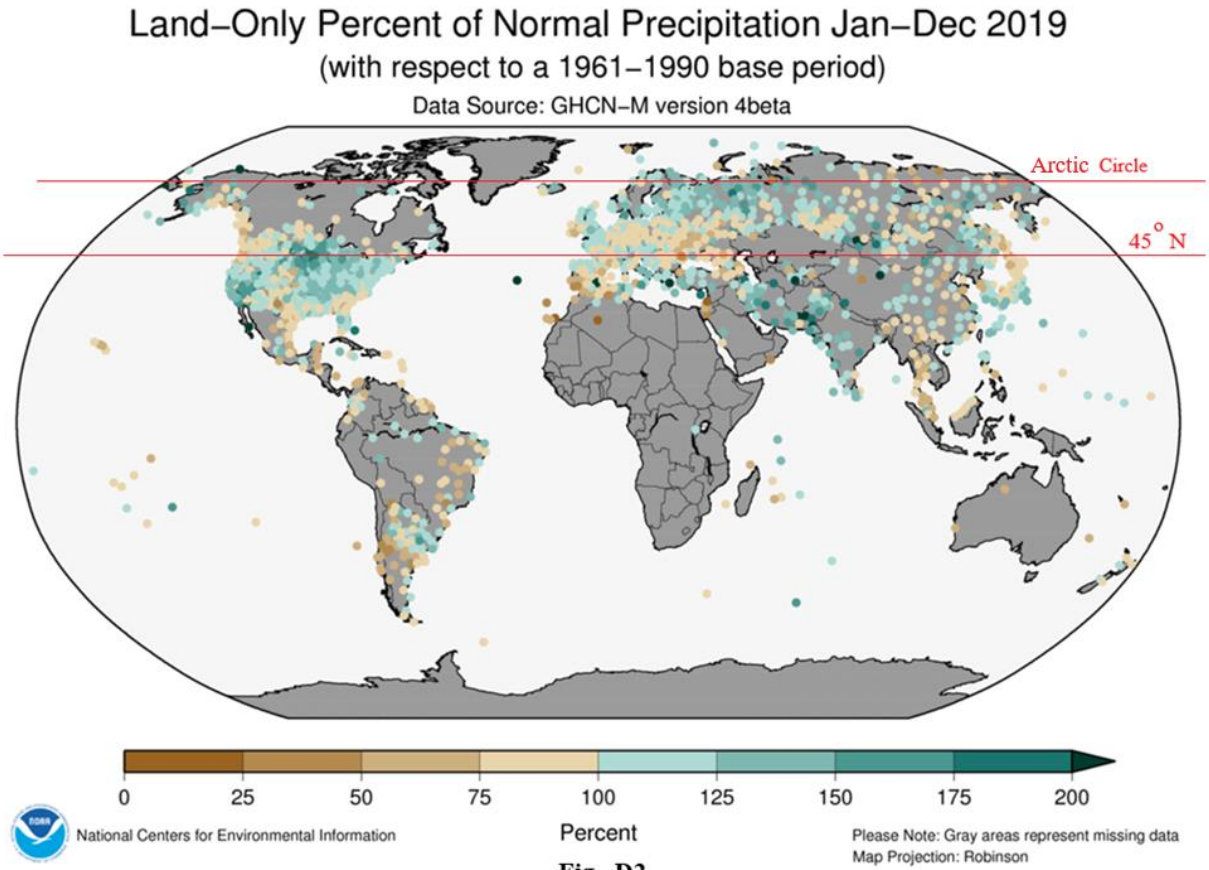
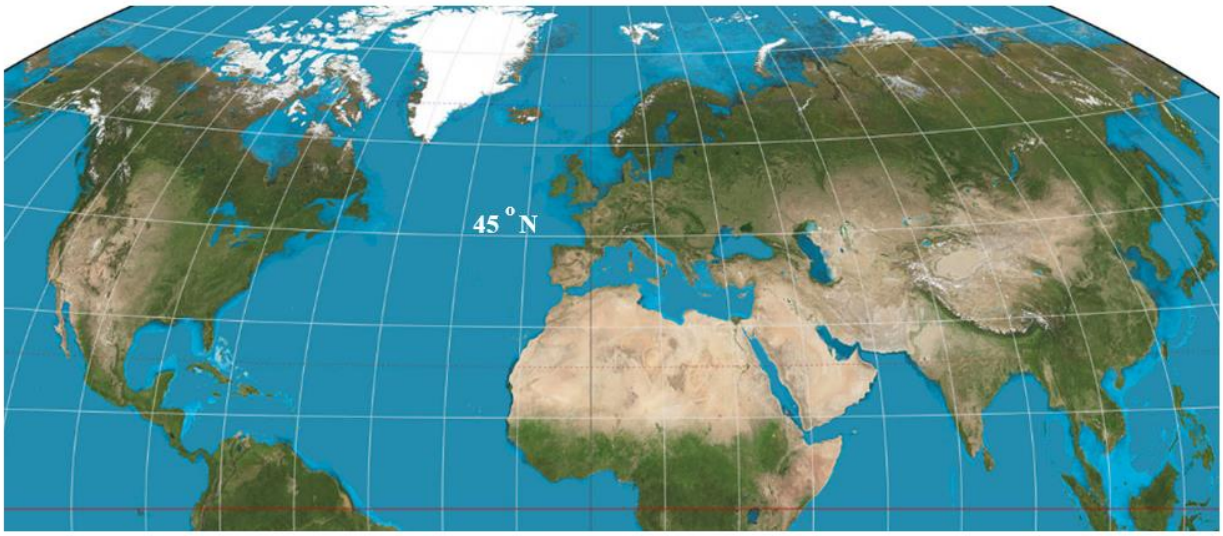


Fig. D2

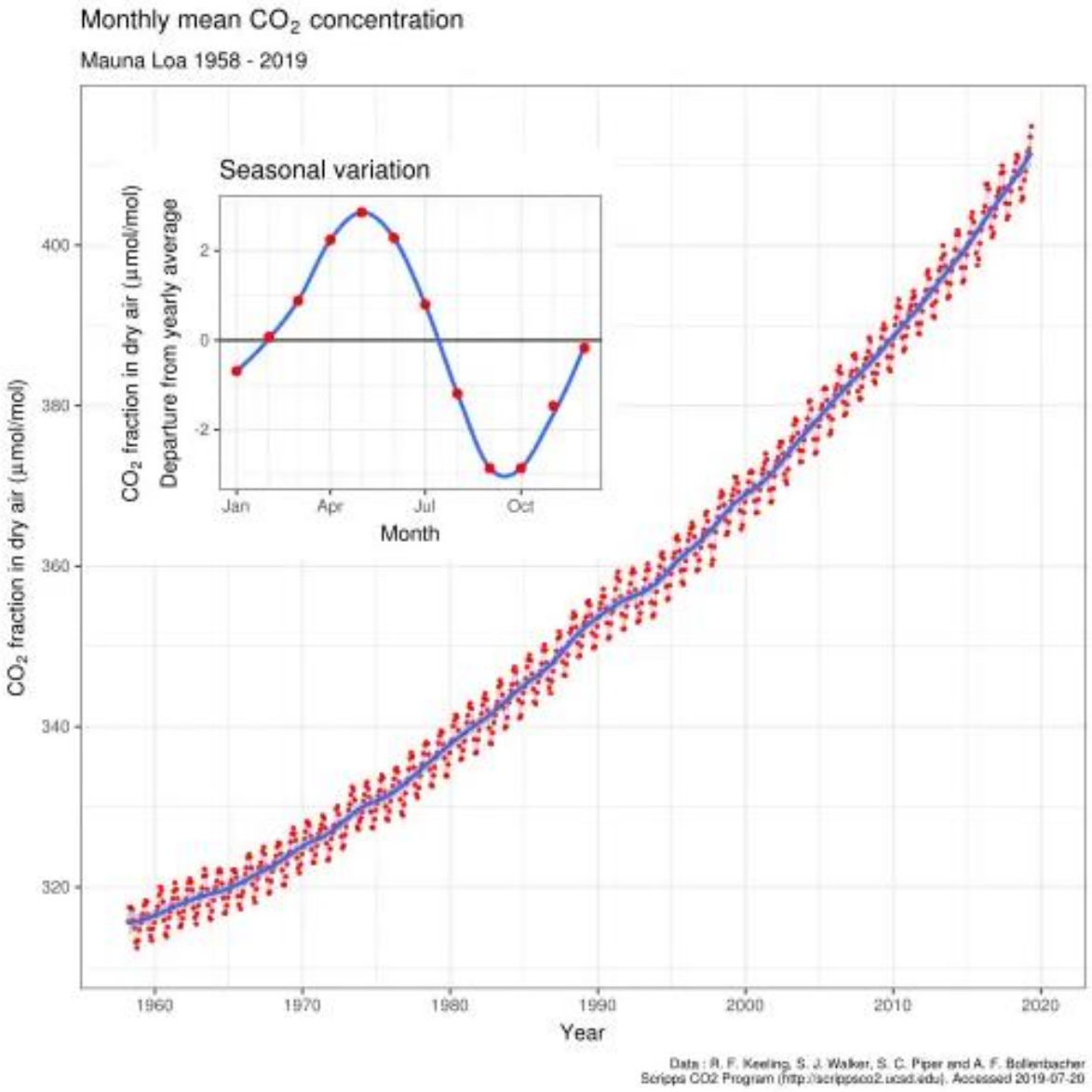
Credit source: https://www.ncdc.noaa.gov/sotc/global/201913



Most area above and along the 45°N in the Eurasian land is mountain land, but at about the same latitude the land in the northeast America is flat land.

Fig. E1 North Hemisphere, partially cropped from a world map

Credit source for the complete map:
https://en.wikipedia.org/wiki/World_map#/media/File:Winkel_triple_projection_SW.jpg



Credit source: https://principia-scientific.org/the-great-co2-is-rising-keeling-curve-fraud/

Fig. F1