



## Using an Emergency Medicine Mindset to Guide Climate Action

WILLIAM H. CALVIN, Ph.D.  
University of Washington School of Medicine, Seattle, and the CO<sub>2</sub> Foundation



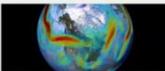
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**3. Why the Surge in Extreme Weather Created an Emergency.**



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**4. How physicians think about emergencies.**



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**5. Avoiding Collapse.**

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We now need a paradigm shift away from focusing on the next fractional-degree temperature rise (merely reducing CO<sub>2</sub> annual emissions, rather like cutting back to one pack per day) to a new focus on the extreme weather shifts; they require removing the excess CO<sub>2</sub> to actually

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# Using an Emergency Medicine Mindset to Guide Climate Action

**William H. Calvin**

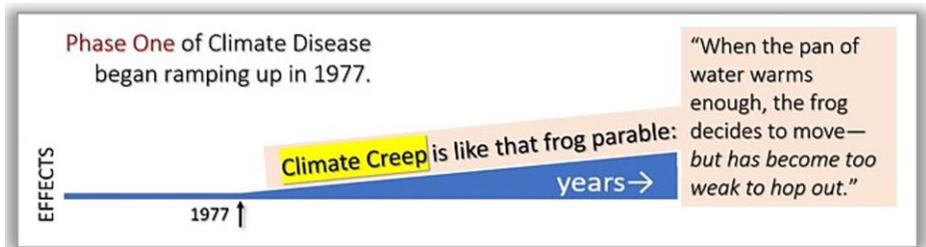
University of Washington School of Medicine, Seattle  
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## 1. For climate, it is now time to adopt the emergency mindset from medicine



*The critical threshold is when one can no longer act effectively to save oneself.*

Our climate problem has turned into a climate **emergency**, largely because of **surges in extreme weather** about ten years ago.

Then I focus on the **mindset of emergency medicine physicians** that we will need to adapt.

The finale is about *urgency*, the fast-track actions now needed for a **fast-enough climate fix**.

Here I will illustrate how the emerging climate crisis would be viewed by those in the medical community who are used to dealing with fuzzy categories and their closing windows of opportunity. I hope to provide a better intellectual toolkit for facing up to the climate crisis, largely borrowed from what medical school professors teach about dealing with emergencies.

“Climate *emergency*” is not the usual rhetorical exaggeration of *needed* and *urgent*. To speak of an *emergency*, one means an unexpected

dangerous situation—one that requires immediate action as there is a closing window of opportunity for taking effective action.

Climate *urgency* became a climate *emergency* a decade ago, but we have only recognized that in retrospect when the new extremes were sustained. For example, the annual number of severe inland windstorms is up 600% after 2008. In the same way that we would organize to deflect a meteor strike in 2030, we must act on the climate emergency.

Gradual overheating is no longer the correct focus for understanding the risk we now face, as we have entered the territory where faster tracks to disaster must be forestalled. In relying exclusively on an emissions reduction strategy, we have been “betting the farm” on something that will not do the job in time. We must add a carbon removal strategy—very quickly.

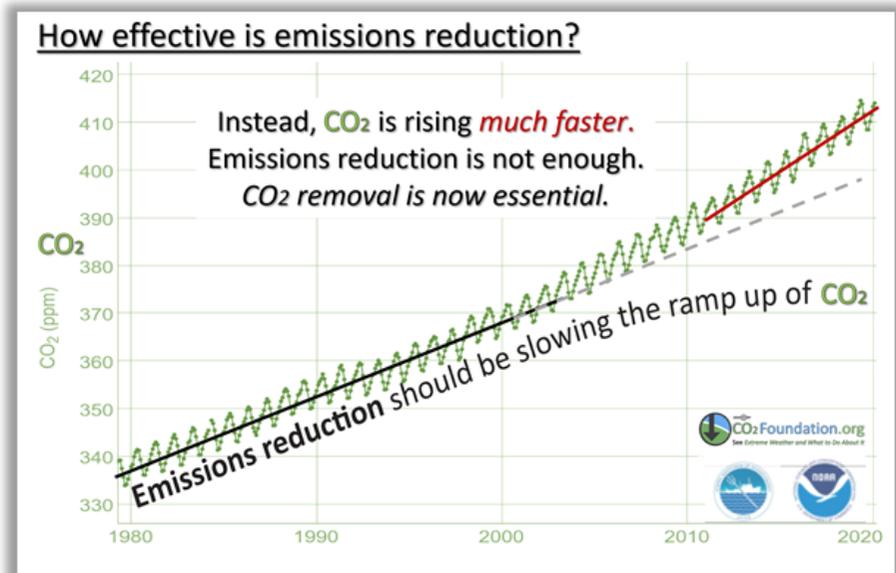
However logical it seems to tackle the root cause, burning fossil fuels, *it is no longer the most immediate problem we face*. We now have fast-moving secondary problems, such as the extreme weather shifts.

As in medicine, one has to first head off the immediate threats—and then educate the patient about preventing a recurrence. The important response to a dental abscess is not a prevention measure, such as cutting down on sugary drinks. It is stopping the infection from “going systemic” and killing the patient.

We now need a paradigm shift away from focusing on the next fractional-degree temperature rise (merely reducing CO<sub>2</sub> annual emissions, rather like cutting back to one pack per day) to a new focus on the extreme weather shifts.

They require removing enough excess CO<sub>2</sub> to actually cool us back to the global mean surface temperatures of the 1960s. But a buying-time strategy may be needed to reduce extreme weather during CO<sub>2</sub> removal project, and one candidate is more quickly cooling the high Arctic with clouds or high haze.

## 2. Emissions reduction, alone, will be “Too little, too late.”



The framing of climate action as an emissions reduction task is like telling a heavy smoker to cut back to one pack a day; *it merely slows disease progression.*

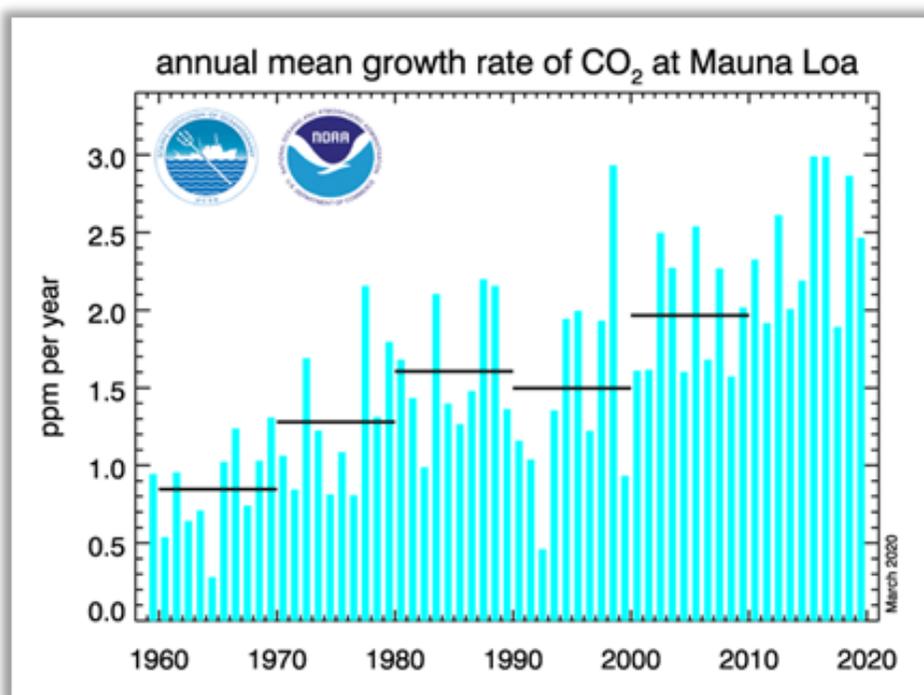
We seldom have any discussion of backing out of the danger zone for extreme weather. Within decades, that will take us straight into “too little, too late” and the massive social consequences of hopelessness. We do not want to go there.

Prevention and treatment often demand different approaches, but that is often not reflected in major international scientific reports about our

climate problem. Civic organizations supporting climate action usually uncritically echo them, focusing solely on rallying the troops to use less.

### Emissions reduction is not working

Most reason, in effect, “Emissions caused the problem. Reducing them ought to fix it.” However true for smog cleanup in the 1970s, CO<sub>2</sub> is not cleaned up by nature as fast as visible air pollution is (a thousand years vs. two weeks). That’s rarely mentioned.



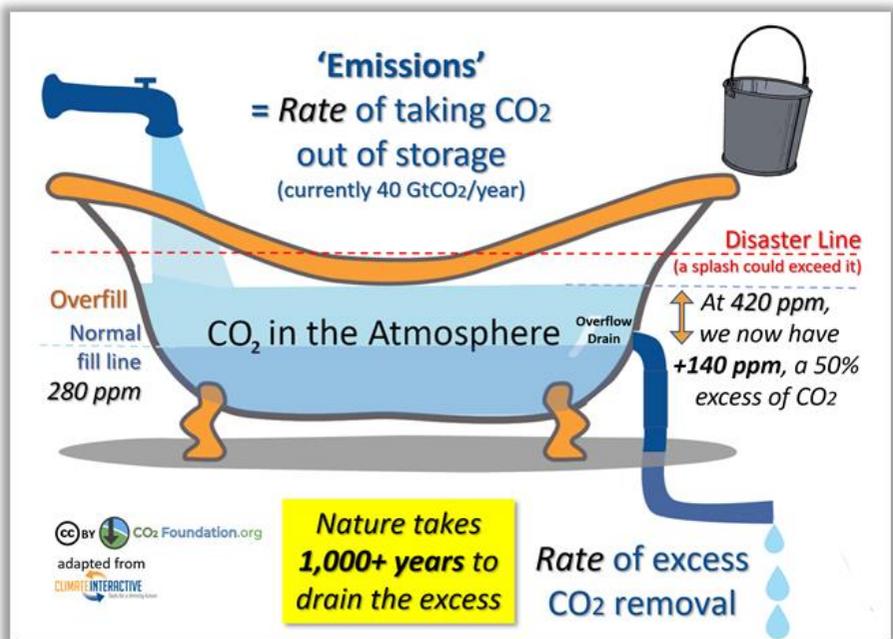
The world-wide bump up in carbon dioxide each year has increased about 50 percent since the turn of the 21<sup>st</sup> century. The annual bump is now three times what it was in the 1960s.

*This acceleration is not progress.*

Future prospects are poor, given A/C

And in the future? About a third of annual emissions now come from the developing countries, soon to need overnight air conditioning to survive heatwaves. They will burn their local fossil fuels to generate electricity to run the extra A/C units, whatever treaties say.

But it is a global common because of air mixing, and so the local CO<sub>2</sub> doesn't stay local.



Emissions reduction does not remove CO<sub>2</sub>

Today, the continuing emphasis on “use less” without a cleanup is like treating a painful tooth solely with reduced candy consumption. While emissions reduction was the obvious strategy for CO<sub>2</sub> fifty years ago, it is merely a preventative measure (like reducing smoking), not a fix once a disease (like lung cancer) develops.

However, reducing emissions is still needed because that shortens the time until cooling can begin for the drawdown process. It's much like what is known as an *adjuvant* in medicine.

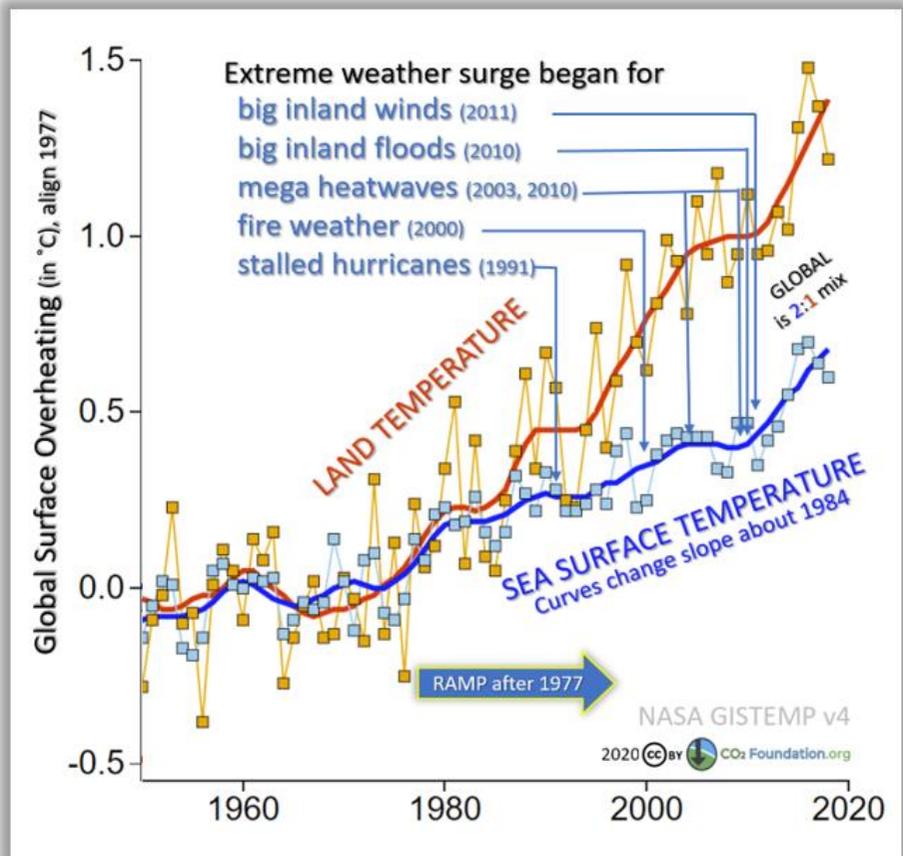
### The Adjuvant

*Emissions reduction* has now become what, in medicine, is called an *adjuvant*, a supplementary treatment that would be ineffective by itself but which can augment a more effective treatment —say, chemotherapy following surgical removal of a large tumor.

A warmer world causes more forest fires, the release of stored carbon adding to annual emissions, which triggers even more forest fires that raise CO<sub>2</sub> further.

Things have changed, but our strategy has not. The U.S., with only five percent of the world's population, managed to create the largest national share of the present CO<sub>2</sub> accumulated excess—and then we ran away from the 2015 Paris Agreement on future emissions.

### 3. Why the Surge in Extreme Weather Created an Emergency.



Some years to remember, when things began changing.

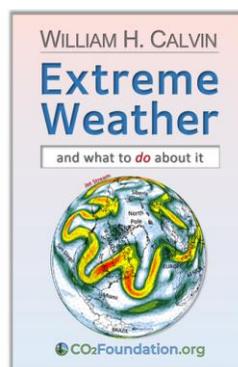
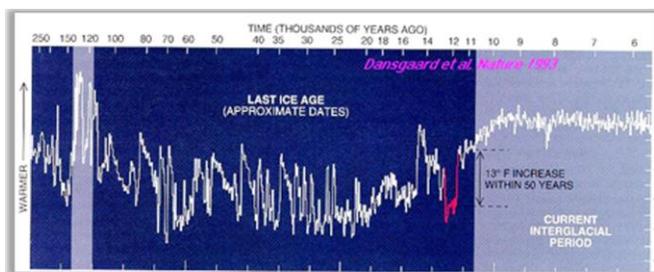
Here I illustrate how the emerging climate crisis would be viewed by those in the medical community who are used to dealing with fuzzy categories and their closing windows of opportunity for effective action.

I hope to provide a better intellectual toolkit for facing up to the climate crisis, largely borrowed from what medical school professors teach med students about dealing with emergencies.

Focus your mind for a moment on the traditional bathroom light switch, where a gradual increase in finger pressure suddenly triggers a flip and a click, flooding the space with painfully bright light. Dimmer switches were invented for a reason.



Climate can flip as well and, so far, we lack a dimmer device to slow down the five-year transition time seen in the ice cores.



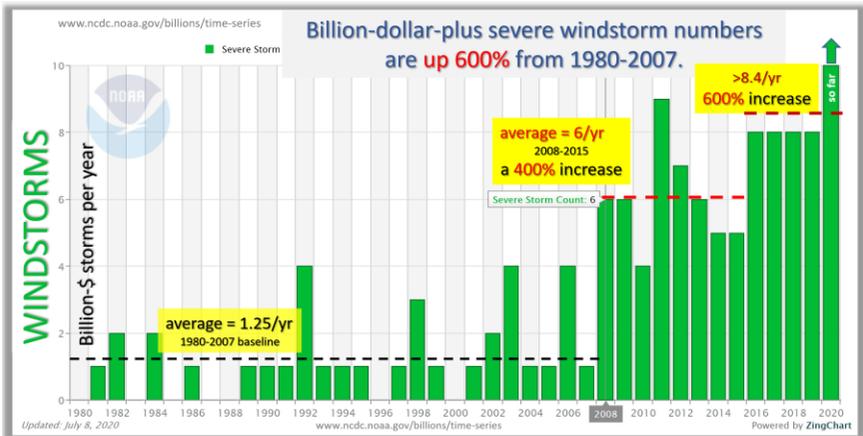
Up is warm and wet; the steps down are into a cool-dry climate. The transition time can be as little as five years. This graph is from the North Atlantic, but it has since been seen in world-wide records.

Yet we keep assuming the overheating is like pushing a dimmer switch, where results are linearly proportional to the push.

But for five types of extreme weather, something did flip between 1991 and 2011. It was regime change. This changes everything— now we need to actually back up, cooling via taking the excess CO<sub>2</sub> out of circulation.

## The Big Five

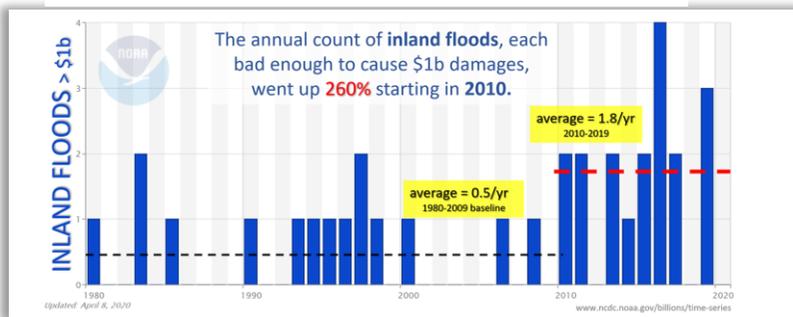
The extreme weather of the last twenty years has featured *five sustained surges*, where an aspect of extreme weather suddenly got much worse. None have flipped back.



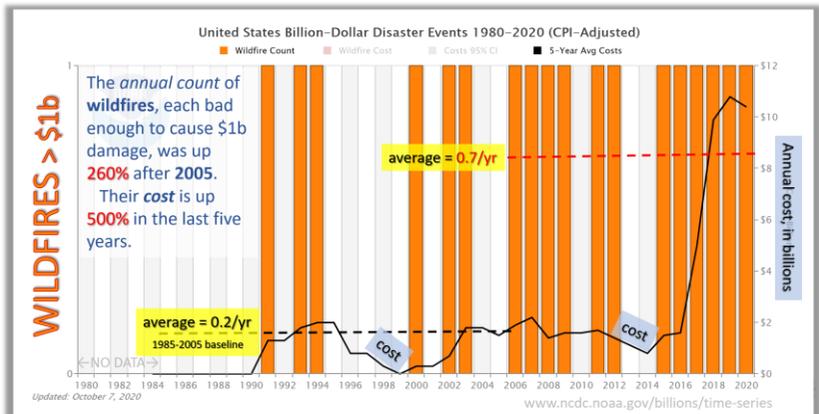
**1. Severe windstorms** (billion-dollar-plus events are up 600% from 2008). This count does not include TCs/hurricanes.



A "wet" downburst in New Mexico.

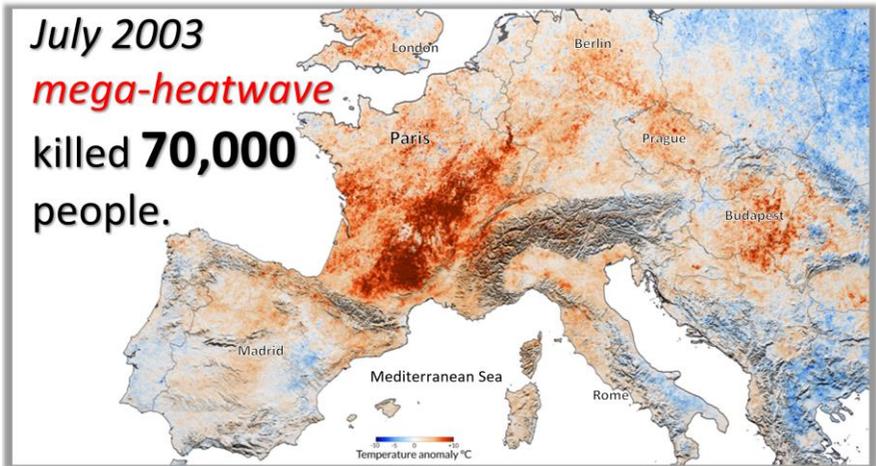


**2. Inland floods** (billion-dollar-plus events are now up 260% from 2009). Again, not including TCs/hurricanes.

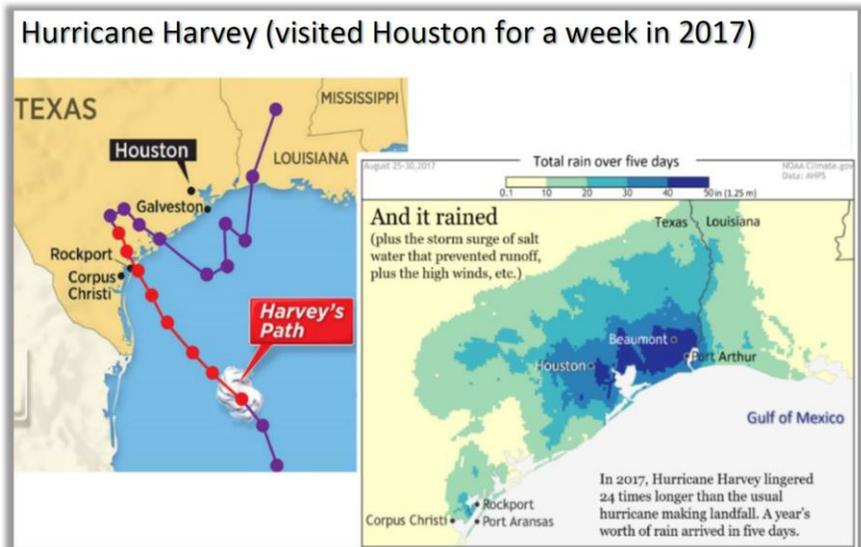


NOT SHOWN: The annual count of **all** wildfires (no billion-dollar threshold this time) did not change.

**3.** There was a 260% increase in big **fire weather** episodes after 2000.



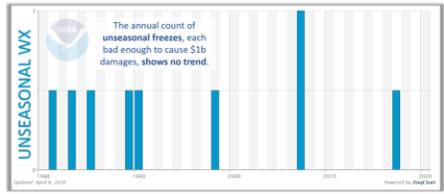
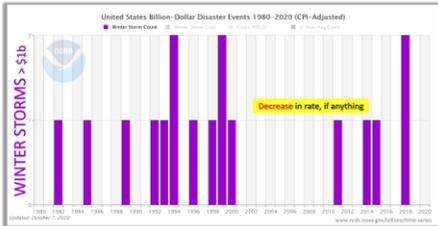
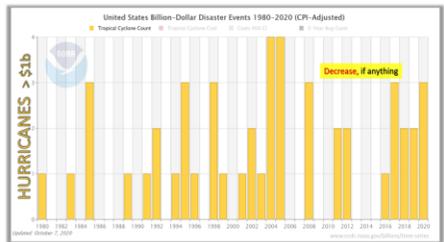
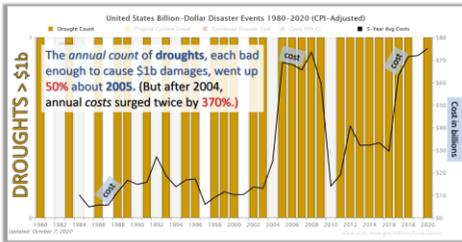
4. Two **mega heatwaves** so far; the 2003 mega in Europe killed 70,000 people; the 2010 mega in Russia killed 56,000; the 2010 mega in Russia killed 56,000 and set off the bread riots of the 2011 "Arab Spring" by ruining crops.



5. **Stalled hurricanes** like 2017 *Harvey*, which stuck around Houston for five days, rather than passing over in five hours. A year's

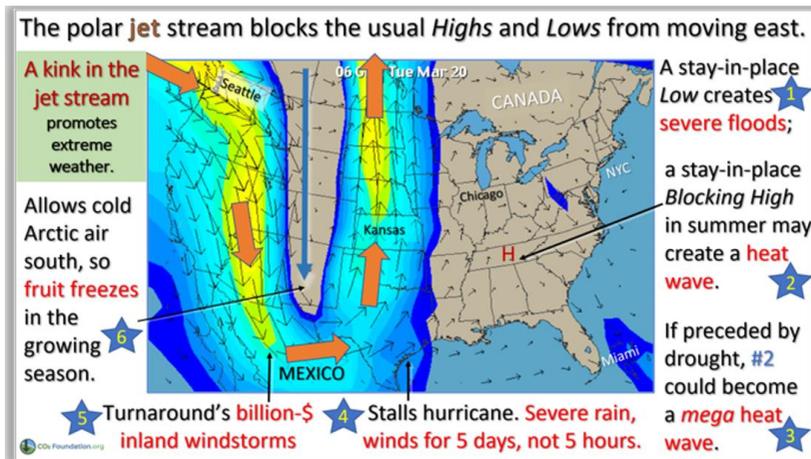
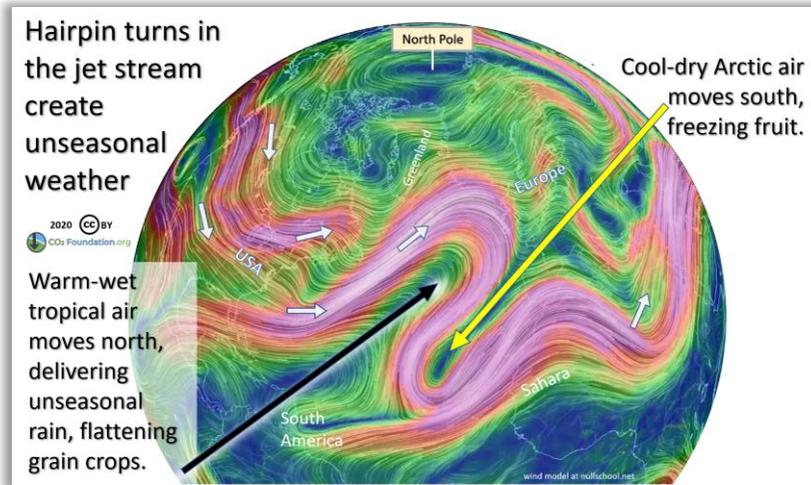
worth of rain arrived in five days and the onshore winds kept it from running off.

These are the five types of extreme weather that qualified under my arbitrary criterion of increasing at least 200% in either recurrence rate or severity. Big drought increased, but only by 50%.



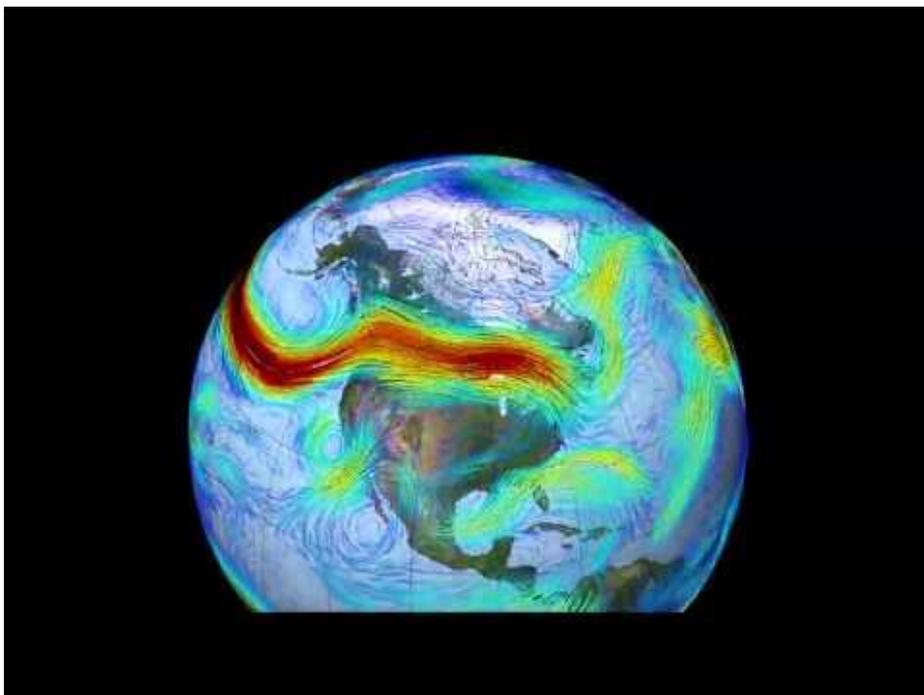
The annual count of all US billion-dollar TCs/hurricanes seems unchanged. The decline in big winter storms and unseasonal freezes may be from the warming.

# Jet stream loopiness



A hairpin turn is especially effective at setting up various types of extreme weather.

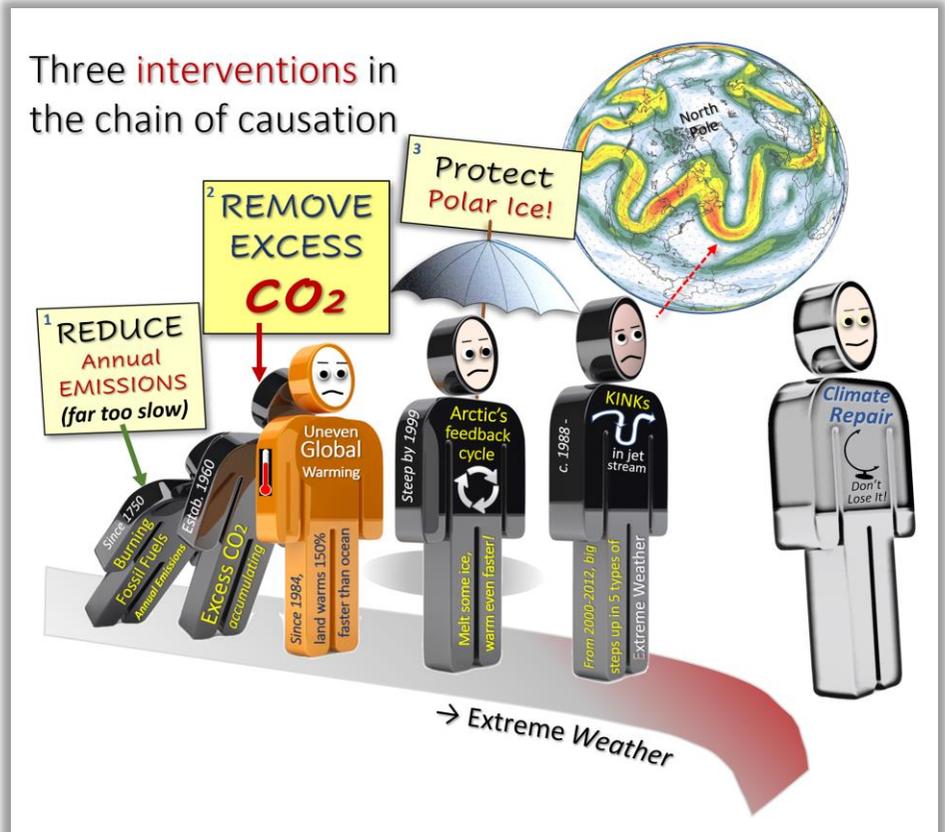
The five big extreme weather surges are all expected consequences of the long jet stream loops, though they may also have other causes. The polar jet stream follows the path of the rising air curtain that is produced by northbound warm-moist air colliding with southbound Arctic air near the surface.



[https://www.youtube.com/embed/C\\_HiBj0teRY?rel=0&fs=1&modestbranding=1&rel=0&showinfo=0](https://www.youtube.com/embed/C_HiBj0teRY?rel=0&fs=1&modestbranding=1&rel=0&showinfo=0)

This shows the polar jet stream's path during June of 1988, the second of the four heatwave months that killed about 10,000 people in the U.S. Midwest and in Canada. Note the detached hairpin ends spinning down separately. The standing wave drifts east, unless it encounters a blocking high. Then it buckles into a hairpin turn, a few hundred km across.

### 4. How physicians think about emergencies



The chain of causation leading to extreme weather.

First of all, physicians are always dealing with a chain or web of causation. In emergency medicine, the initial focus is not on the **root cause** of the patient's problem, the way climate science focuses on fossil carbon put back into circulation. It is about **knock-on**

**problems:** immediate life threats, such as internal bleeding and shock.

Our climate problem has secondary threats such as extreme weather, which may threaten civilization on a *much faster time scale* than does the underlying overheating.

## The physician's mental check list

*Which parts of the physician's mental check list would a "climate doctor" want to consider adapting?*

Here is a mental checklist showing how the physician usually proceeds, together with my evaluations when applied to climate:

Beforehand, sensible **anticipations:** for winds and heat waves, burying power lines and creating battery backup for A/C; rebuilding infrastructure to resist floods; and relocating people out of flood plains and coastlines. Stockpiling—but also economic modeling for emergencies, planning we should have done *before* the pandemic's 2020 recession.

- A. **Protect** the patient from the usual causes of terminal downhill slides. This is commonly called "**stabilizing the patient.**" An example: the public works construction in the 1930s likely prevented civil disorder in the Great Depression. For both our pandemic and the climate, *INADEQUATE*.
- B. **Diagnosis.** Recognize what is wrong. For climate, the working diagnosis since 1980 is a global-scale overheating caused by the atmospheric accumulation of CO<sub>2</sub>, contributed by the annual emissions of fossil fuels. *SUCCESS*, but attacking the root cause via emissions reduction is now too slow.
- D. **Prognosis.** To evaluate urgency and motivate action, guess where things are heading. Climate models are good for estimating slow climate change over a century, but *they are only beginning to address*

*the dynamic aspects that can create climate flips within a decade.*  
**PARTIAL SUCCESS.**



- E. **Rule out other problems.** Repeatedly search for knock-on climate problems, analogous to shock and internal bleeding, that could provoke a fast track to disaster. There's a motto in emergency medicine: "Think fast. And then think again." For climate, *ONLY BEGINNING.*
- F. **Formulate a plan of action** and explain it to get consent. For climate, *INADEQUATE.* Like most diets, emissions reduction has failed; the annual bump-up in CO<sub>2</sub> from emissions is now 50% greater than before 2000. We must now focus on a quick cleanup of the existing CO<sub>2</sub> accumulation, as in using a kidney dialysis machine to quickly clean up an aspirin overdose from the circulating blood.
- G. Finally, before discharging the patient, try to **prevent a recurrence**, as in persuading a patient with asthma to stop smoking. *Emissions reduction is an exact parallel for climate. LIMITED SUCCESS.* But note that addressing the longer term is the last thing to do on the doctor's mental checklist; most of the list was concerned with keeping the patient alive—to make the long-run relevant.

*PARTIAL SUCCESS.* We have had fifty years of climate education efforts but something is preventing effective climate action even by the

knowledgeable—perhaps the stay-in-your-seat *spectator mindset for the surreal*, where gunshots on stage don't cause you to phone 911.

## 5. Avoiding Collapse.

In this new era of *climate instability*, don't make the mistake of thinking that climate will change *gradually*.



We now need a paradigm shift away from focusing on the next fractional-degree temperature rise (merely reducing CO<sub>2</sub> annual emissions, rather like cutting back to one pack per day) to a new focus on the extreme weather shifts; they require removing the excess CO<sub>2</sub> to actually cool us.

And, in the meantime, some cooling of the high Arctic may be needed via reflecting summer sunlight. That will not cool globally but it may calm the new extreme weather that comes from jet-stream excesses.

Are our leaders successfully warning us of imminent danger? The scientific leaders try, but people may compare our latest +1.5°C scientific warning to the occasional hotter summer or to a mild fever. They opine, “That’s not much. What’s the big deal? Just wait and it will go away”—not realizing that nature takes such a long time to do the CO<sub>2</sub> cleanup job. We must do the cleanup ourselves—and the new extreme weather says we must do our cleanup very quickly.

*Fifty years of trying to warn people using the creep of small numbers is enough.* It is time to lead with other indicators of trouble. I’d suggest leading with the *maintained* shift in extreme weather. Those escalation

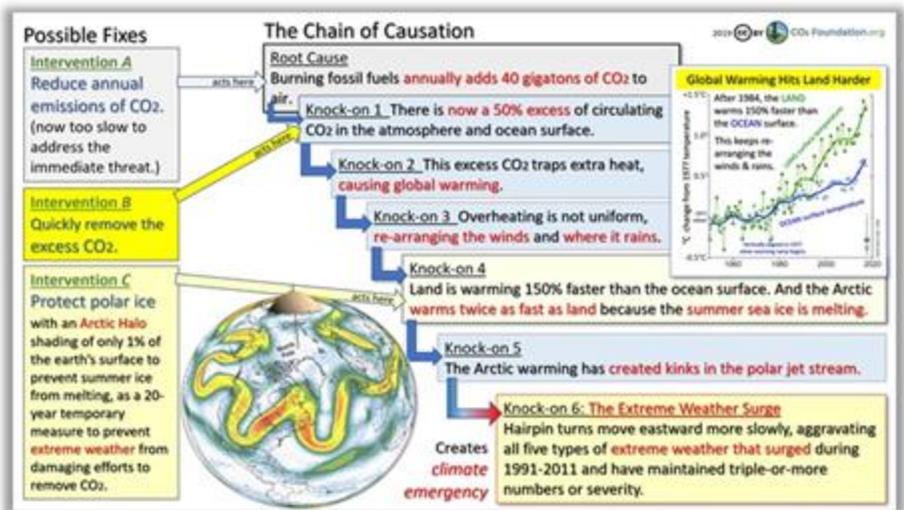
numbers are big. And they are recent. Many have felt them; we do not have to imagine a fractionally warmer future.

Current extreme weather threats could crash the economy and leave us too battered to get our act together for effective action.

This alone demands a change in strategy. We now need stronger climate medicine in the form of a CO2 cleanup.

There is a big lead time for doing something *effective* about climate change—i.e., actually *backing us out of the danger zone*.

The window of opportunity for backing out of the danger zone may be as short as the next ten to twenty years.



Because of prototyping and ramp-up, it will take at least eight years to get started cooling, and we don't know how fast climate troubles will decline as the CO<sub>2</sub> comes down. This makes an immediate start even more urgent.

Prevention and treatment often demand different approaches, but that is often not reflected in major international scientific reports about our climate problem. Civic organizations supporting climate action usually uncritically echo them, focusing solely on rallying the troops to use less.

Most reason, in effect, "Emissions caused the problem. Reducing them ought to fix it." However true for smog cleanup in the 1970s, CO<sub>2</sub> is not cleaned up by nature as fast as visible air pollution is (a thousand years vs. two weeks). That's rarely mentioned.

Today, the continuing emphasis on "use less" without a cleanup is like treating a painful tooth solely with fewer soft drinks. While emissions reduction was the obvious strategy for CO<sub>2</sub> fifty years ago, it is a preventative measure (like reducing smoking), not a fix once a disease (like lung cancer) develops. Climate disease is already here.

Things have changed, but our strategy has not.

As the finale, the proposed treatment plan, both the treatments for the acute problems (here, the [Governors' Design Initiative to Repair Climate](#)) and the parallel approach to the long-term (the more familiar decarbonization).

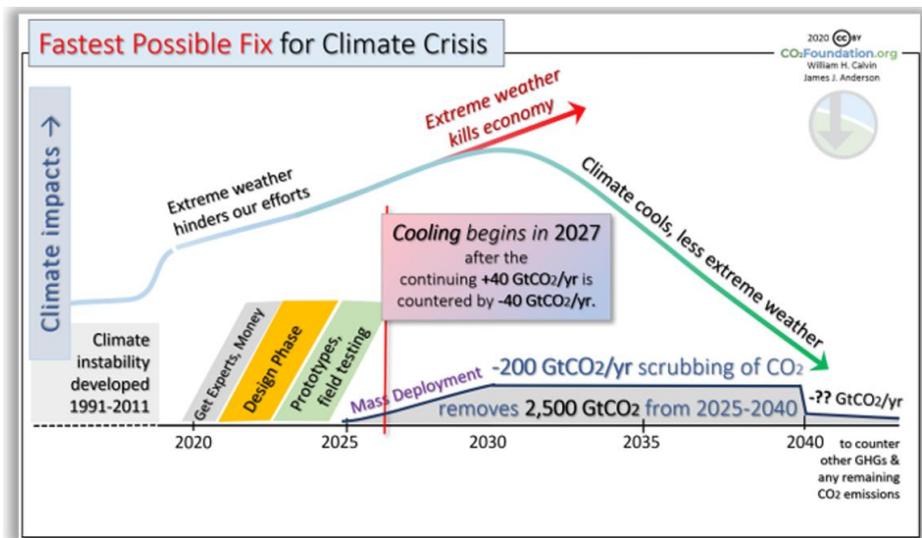
## Why we now need a "Manhattan Project 2.0"

One must survive the short run in order to make the long run relevant—that's the focus in *Emergency Medicine* and their mindset is what addressing the climate crisis now requires.

There is a big lead time for doing something effective about climate change—*actually backing us out of the danger zone* rather than merely slowing down the collapse of civilization.

We need to annually take about 40 gigatons of carbon dioxide out of circulation to draw down the insulating blanket of greenhouse gases.

*How to do it* is another story, but for any method, here is the needed timeline for a project complete by the year 2040.

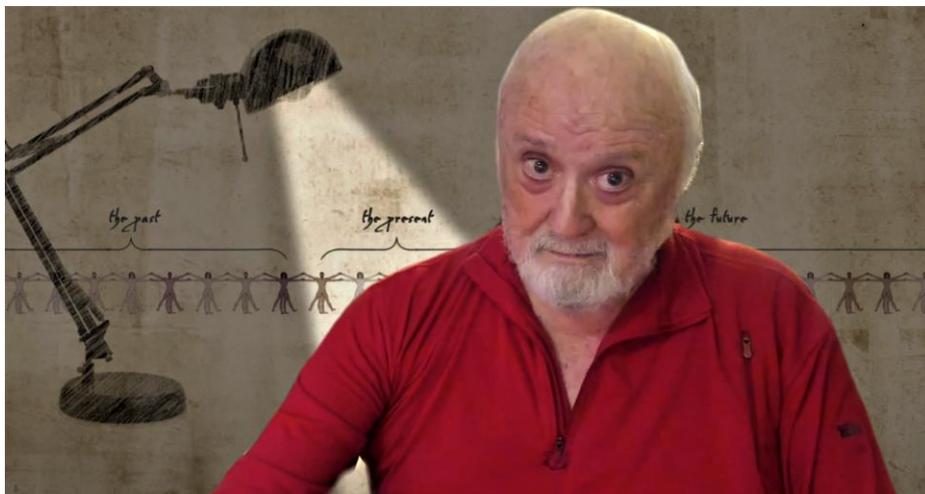


This **20-year** project is the fastest that I can imagine, for doing **2,500 GtCO<sub>2</sub>** of cleanup. Were we to take **40 years** to finish it, and emissions continued at +40 GtCO<sub>2</sub> each year, we would have to remove **700 GtC** and suffer **40 years** of extreme weather surges (and their wars, economic crashes, etc.) threatening the project.

Gradual overheating, secondary to excess CO<sub>2</sub> from emissions, is no longer the correct focus for understanding the risk we now face from climate disruption.

Because of the *surges* in extreme weather a decade ago, we are already in *climate emergency* territory, where fast tracks to disaster must be forestalled.

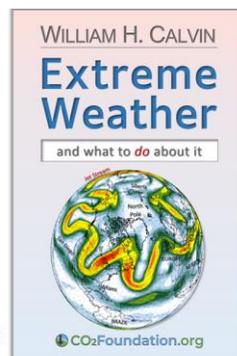
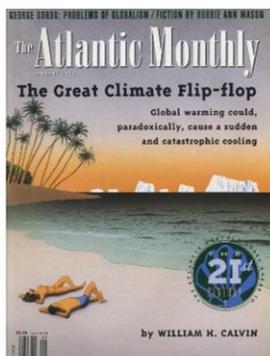
## Author info card



William H. Calvin

I am neither a proper climate scientist nor a proper science journalist. Rather, I am a basic scientist (Ph.D. in Physiology & Biophysics) in the neurosciences, coming from a physics background. I learned how to think about complex systems like climate by researching the many layers of human brain mechanisms; I did my first stochastic modeling back in 1966. My best theoretical work, on how cerebral circuitry could provide a basis for a Darwinian quality-improvement process, can be found in my *Cerebral Code* book (MIT Press 1996).

I have been hanging around a medical school since 1962 (on the faculty since 1966, now a professor emeritus at the University of Washington), long enough to pick up many of the principles that my colleagues teach in other specialties. To better understand emergency medicine, I have been taking (and re-taking) continuing medical education courses in recent years.



Because I also write books about science for general readers, the editor of *The Atlantic* undertook in 1997 to persuade me to write them an article on abrupt climate change; it became the cover story for their January 1998 issue.

There is more at [WilliamCalvin.org](http://WilliamCalvin.org). Email [wcalvin@uw.edu](mailto:wcalvin@uw.edu).

## ABSTRACT card

Our climate *problem* has turned into a climate *emergency*, largely because of **surges in extreme weather** in the first decade of the 21<sup>st</sup> century. That is the first half of this presentation—*What's the emergency?*

Next I focus on the **mindset of emergency medicine physicians** that we will need to adapt.

The finale is about *urgency*, **the timescale now needed for a climate fix**, one fast enough to prevent the collapse of civilization.

Here I will illustrate how the emerging climate crisis would be viewed by those in the medical community who are used to dealing with fuzzy categories and their closing windows of opportunity for effective action. I hope to provide a better intellectual toolkit for facing up to the climate crisis, largely borrowed from what medical school professors teach med students about dealing with emergencies.

There are now greater concerns than when the global overheating ramp hits 1.5°C or 2.0°C. Focus your mind for a moment on the traditional bathroom light switch, where a gradual increase in finger pressure suddenly triggers a flip and a click, flooding the space with painfully bright light. Dimmer switches were invented for a reason.

Climate can flip as well and, so far, we lack a dimmer device to slow it down. Yet we keep assuming the overheating is like pushing a dimmer switch, where results are linearly proportional to the push. But for five types of extreme weather, something did flip. It was regime change. This changes everything— in some cases it even makes statistics of past weather worthless.

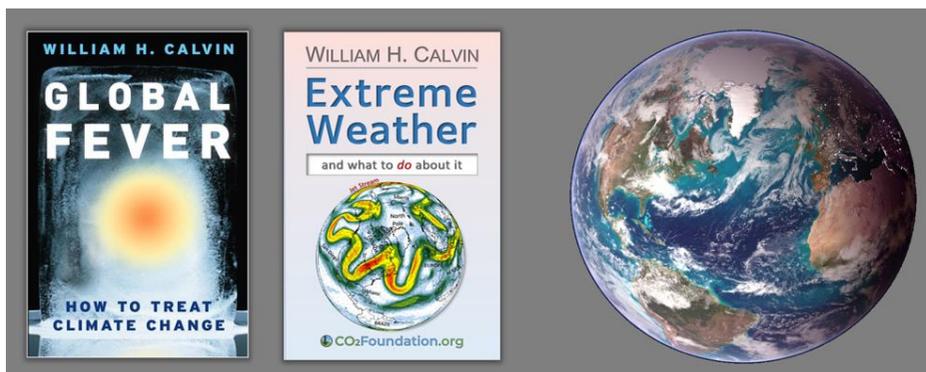
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[www.ncdc.noaa.gov/billions/time-series/](http://www.ncdc.noaa.gov/billions/time-series/)

There is a good “bathtub simulator” for accumulating emissions at  
[www.climateinteractive.org/tools/climate-bathtub-simulation](http://www.climateinteractive.org/tools/climate-bathtub-simulation) which will allow one to  
see just how little most “climate solutions” affect the temperature  
outcome.

Abrupt climate shifts: [www.ncdc.noaa.gov/abrupt-climate-  
change/Heinrich%20and%20Dansgaard%E2%80%93Oeschger%20Events](http://www.ncdc.noaa.gov/abrupt-climate-change/Heinrich%20and%20Dansgaard%E2%80%93Oeschger%20Events)



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