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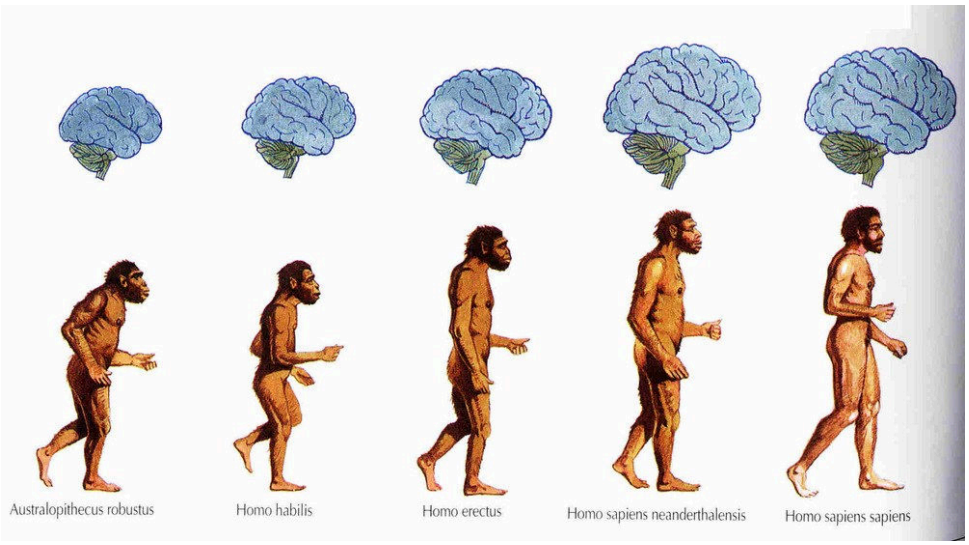
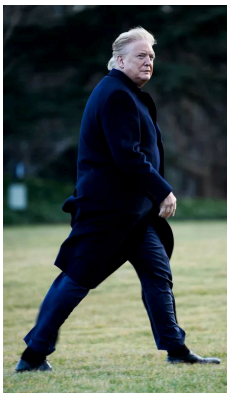
The Superpowers of Math, Science and Engineering, and the Challenges in Predicting Catastrophes





The pinnacle of science in the species Homo was reached with Homo sapiens sapiens. Their descendants were “Homo corruptus greedy”. Those were distinguished from “sapiens sapiens” by their extended waistlines, which they covered up out of shame, and they had a deep disdain for science. Since they believed in alternative facts, they were sawing on the evolutionary branch on which their ancestors had progressed to world dominance. If they caused their own species to go extinct, there would be an important lesson for other species: It is not a good idea to go too far out on your evolutionary limb, if you are overwaist.

The appearance of Homo corruptus greedy is also one of the catastrophes in the Universe that was difficult to predict. It was a “Black Swan” event. How funny! After the first black President appeared in the Oval Office there was the first Black Swan, acting as President.

Some facts about Swans. How do you think that the brain sizes compared between Barack Obama and a Black Swan? Like a pound per ounce?

Dr. Bird says: Don’t mess with the swans. They can be vicious!

Just ask Siri, Alexa, or Google, the only safe social contacts that you have left today.

Homo Erectus and the Birth of Science

The beginnings of math and science for Homo Erectus were most likely intuitive. One of the food sources for HE[1] were nuts. Those could be counted. To follow a healthy 2000 calorie diet they needed a certain number of nuts. Math! And then HE used rocks as tools to crack the nuts. Engineering! HE had to understand how hard he had to hit the shell of a particular nut to crack it ("success"), but not so hard that the shell and the seed inside got "nuked" completely, and the seed was lost as food ("failure"). There was also the possibility that the hit was so soft that the nut did not crack. In that case there was a second chance. In this simple HE every day activity we can already identify a lot of elements that inevitably lead to the creation of science, in a nutshell[2] so to speak:

1. Experimentation: Try different rocks (shape, weight), both to hit[3], as well as for the anvil, and different kinds of nuts.
2. Repeatability: This is a challenge in this experiment. Nuts are individuals[4].
3. Statistical analysis: Given the repeatability challenge, HE will have to apply statistical analysis to make sure his results can be applied more generally, not just on a nut by nut basis. Having a model only for a nut that has been cracked is of limited value. Hindsight 20-20...
4. Success and failure: In science, even failure can be a success. If you can write a paper about it, or a PhD thesis, and get the Government to sponsor your trip to a conference in a far away continent where you can meet other researchers like yourself, and exchange thoughts, or get a virus, bring it home, and spread it, that can also be a success. For you, and the virus.
5. Risk: In the failure case HE lost a nut.[5]
6. Probabilities: Depending on the parameters of rock, anvil, and type of nut, the events of "second chance", "success", and "failure" have different probabilities. HE quickly learned one of the first truths in statistics: The sum of all probabilities was always one. Something always happened. Intuitively that made a lot of sense.

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[1] HE is just an abbreviation for Homo Erectus. I don't want to make any assumption of the gender of my protagonist, his/her gender identity, which bathroom HE uses, which gender is more adept at science, and all this other political correctness and newfangled problem stuff that Homo Sapiens created later, after their focus shifted from survival to mostly keeping everybody busy with entertainment, filing tax returns, and all kinds of other administrative overhead that does not make the world a better place. How I love taking pictures of my doctors' invoices and upload them to a web site so that some bean counter can verify that I spend my pre-tax money on approved medical things and not booze. I guess the Government does not think that drinking is a good form of self medication. The Black Swan (BS) does not appreciate the potential here.

[2] Pun intended!

[3] To distinguish from "A political hit job". Serious science includes lots of footnotes and citations! The political hit job may use lines like "I would like you to do us a favor though" instead of a rock.

[4] If you look around yourself, you may also find a lot of individuals who are nuts! Especially if you did not get the important memo on social distancing (written on 4/2/2020 as we are trying to wrestle down the exponential growth curve of the worldwide Coronavirus explosion). Please spread out and don't spread!

[5] The saying "Measure twice, cut once" is one of the early risk mitigation strategies that HE discovered.

So the first scientific breakthrough in human history was when HE figured out how to crack nuts in a way that maximized “success” (yield), while minimizing “failure” (squashed nuts, or fingers, or both[6]).

Another important step on the early letter of scientific progress was achieved when HE started to count, and measure the objects in his environment. Counting inevitable led to math, and combining this with measurements of his environment was essentially the beginning of science. Early measurements were using references from HEs body, like for example the span[7] or the foot[8]. Some also used their fingers. But because there was a lot of variability in fingers this did not take off. Also, the fingers might have been unavailable because of a hit from the rock. The problem with these units was that they varied from HE to HE. This made it difficult to reproduce scientific experiments with accuracy. Science made a massive step forward when HE was able to standardize the measurement units. In most places. If you are not familiar with the “not invented here syndrome” that frequently got in the way of human progress, here is a good example: Instead of sharing units with all the other countries, a few imperialist countries kept using their own imperial units. Those countries did not want to use the decimal system that had been invented in the Middle East[9] and instead adopted a system that was based on no base. Maybe so that their bulging waistlines sounded numerically less wasted. A waist size of “45” sounds so much better than “114”. The use of incompatible units resulted in crashed satellites and under-fueled imperialist planes when they refueled in Canada. It also led to significantly bigger cars and refrigerators in at least one of the imperialist countries.

Later, after the invention of money[10], HE also learned that a good scientific method can make a lot of money and can be patented so that others cannot copy it. At least that is how Homo sapiens sees it today when they join to create a startup. HE was glad to share his breakthrough inventions, like his units. That allowed the amazing progress that humanity has achieved since HE started to crack nuts. Today, for example, we find very large groups of international

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[6] This would be a “Superfail”. Many young males of Homo greedy will waste a lot of time on Youtube looking for such Superfails, which is one reason for their bulging waistlines. So there is a direct line from the waste of time to the waistline.

[7] The maximum distance between the tips of the thumb and little finger, taken as the basis of a measurement equal to 9 inches.

[8] Thanks for visiting this **foot**note. If you really need help to know what a foot is I can only share with you that it is the first four letters of the word footnote!

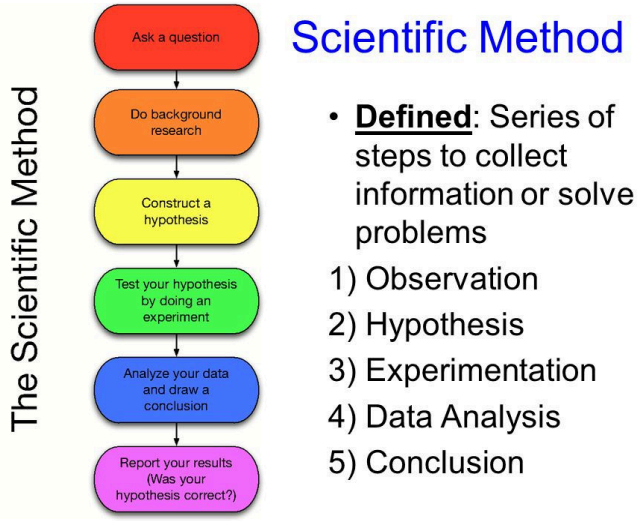
[9] It is not known why these countries disliked the Middle East so much. After all, this was where agriculture had been invented first. Anyway, when they had some control over the Middle East after the second World War, they divided the area in a way that would guarantee its dysfunction for generations to come. They wanted to give their oil companies free reign over the “dirty water”. Divide and conquer!

[10] Early on, the units of money were also derived from HEs body. They would say for example: “This will cost you an arm and a leg”. HE quickly figured out that trading shells, salt, and golden nuggets was better than trading his own arms and legs. At some point they even traded Homo sapiens who had a darker color. Much later they would just exchange pictures of their previous presidents on papers. Even later they created a system where a monetary value was just stored as numbers in an electronic wallet on a computer. When a computer broke down and the owner lost the key to his electronic wallet, the value was often also irrecoverably lost. So this turned out to be another scam on the poorly educated. To not miss out on this fraud, the banks in the imperialist countries also needed to get into the Bitcoin banking scheme.

scientists who build giant particle accelerators to crack single atoms. I guess nuts are too big of a problem these days for Homo sapiens. HE rocked!

The Scientific Method

After HE had solved the problem of cracking nuts, many other questions came to HEs mind.



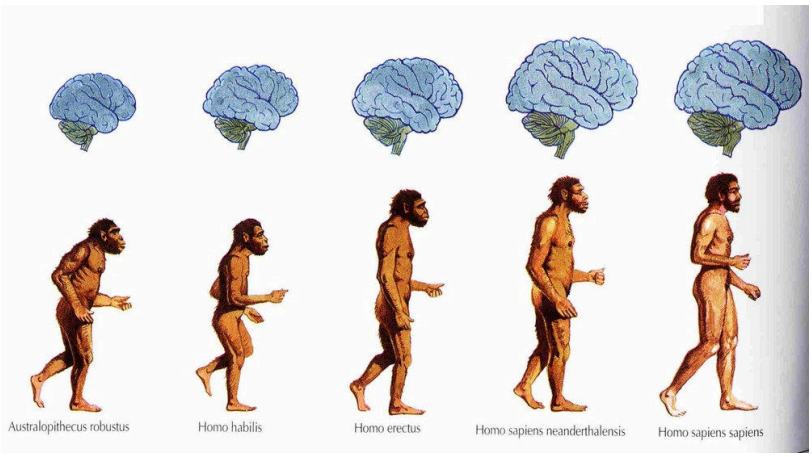
Some natural phenomena around him were hard to explain. For example thunder and lightning were terrifying events that scared HE so much that HE did not dare to experiment with them. HE saw what happened to a tree when it experimented with lightning[11]. So for such extraordinarily powerful things HE created a god that wielded that particular force as an explanation. And god was just “dog”, spelled backwards. There is nothing more powerful than humans’ most trustworthy companion. Some cultures write from right to left, and when they see us praying to a god they might see this as praying to a dog[12]. That may be one of the reasons for so many misunderstandings between religions. Sometimes humans are just getting it backwards. But I digress here, sorry.

For smaller problems that were easier to grasp, both figuratively and literally, HE developed the scientific method. This was a defined sequence of steps where HE would ask a question, do some background research, construct a hypothesis, conduct experiments to collect data, and then analyzed the data to see if it supported the hypothesis. At the end, HE would report the results of his work. As all HEs shared and remembered the results of their scientific work, there was a growing body of validated knowledge that could be applied to many of their shared problems. By going through a structured process, the quality of the outcome was ensured. By

[11] This is how he discovered fire. Later one particular HE, Mr. Flintstone, found a rock with which he could start fire without having to pray to the dog of fire. Proudly he named the discovered rock after himself and applied for a trademark.

[12] When you go to the supermarket in the US and visit the isle with pet food you can definitely see that dogs have a special place in our heart.

applying the scientific method rigorously HE built up an impressive treasure trove of knowledge and understanding of the Universe that no living organism on Earth had reached before. A lot of time and resources were saved by not repeating the same failed experiments over and over again. Shortly before the species of Homa sapiens sapiens vanished, they had reached the subfamily Homo indulgence. As you can see in the image below, Homo indulgence (HI) also had the characteristically extended waist line of Homo corruptus, and simply enjoyed the spoils of all the inventions that Homo sapiens sapiens had left him[13]. Instead of working hard themselves, HI would let the money work that they had inherited from their parents.



HI had so much money because he used some of it to convince the politicians (Homo corruptus) to create tax cuts for the rich, telling the little taxpayers (Homo exploitus) that all those tax cuts would pay for themselves by creating an infinite amount of extra economic activity. The basic idea was that a tax rate of zero, levied on an economy of infinite size, would create enough tax revenue for all the Government services that Homo exploitus wanted. Defense, healthcare, social security, education, you name them[14]. Well, this was tried several times, with the last two most egregious failures in the Bush[15] and Trump[16] tax cuts.

Had Homo exploitus still known about the Scientific method they would have concluded, based on the previous failures, that the “pays for themselves” hypothesis was BS[17] and was therefore false, and should not be replicated. So they would not have fallen for such bad plans again and

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[13] You might also observe that Homo indulgence drove in the wrong direction and downhill, which might partially explain why they crashed.

[14] Now if you refresh your memory back to High School math: You might remember that you can have a function that approaches infinity like $f_1(x)=x$ get multiplied with a function that approaches zero, like $f_2(x)=1/x$ and still get something when you multiply the two. That is true. $f_1(x)*f_2(x)=x*1/x=1$. So you can see that you can have something ($1) for nothing ($1/x \rightarrow 0$ for $x \rightarrow \infty$). Unfortunately, the people could not figure out how to take care of defense, healthcare, and all the other goodies for $1. They should have looked in the Dollar Store. Unfortunately their leaders did not know about that awesome place.

[15] Economic Growth and Tax Relief Reconciliation Act of 2001

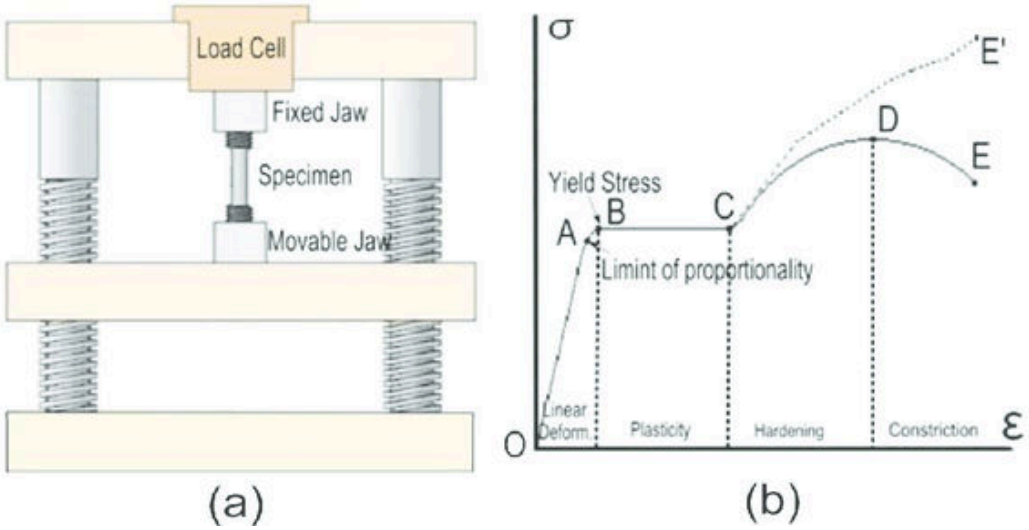
[16] Tax Cuts and Jobs Act of 2017. If they were truthful: “Let’s steal from the kids act”.

[17] Bovine scat. You did not think that I would use a word here that would have to be bleeped on NPR if I ever get the opportunity to read this there, did you? I love NPR and am a Sustaining Member. I am a fan of sustainability. I like that they are not making propaganda and spew alternative facts to drum up their business to collect more advertising dollars in contrast to many other media companies like FOX “News” (quotations mine, you may guess why).

again. But since Homo corruptus had made sure that Homo exploitus did not know the scientific method any longer[18], these failing methods were implemented over and over. It is not clear if this was done to make the rich, who were already doing very well, even richer, or to destroy the trust in and finally the Government itself. In the end all of these happened. The net result of these failures was that the country essentially stole from their children by leaving a HUGE pile of debt, held by other countries. It left the country woefully underprepared for their final recession. So their children ended up working like slaves for those other countries to pay back all the money that Homo indulgence had spent to enjoy his life. Like the true business man that Homo corruptus was, he solved this problem like all significant previous problems in his life, when he became president for the remainder of his life. He declared the country bankrupt and started to print an endless pile of Black Swan Dollar Bills with a face value of zero. These were used to repay all the debt and the country started with a clean slate. Like always before, the rich people who had hard assets did very well in this process. Their debt was wiped clean. Homo exploitus on the other side of that balance sheet saw all their savings wiped out.

Linear Models

After the above introduction into HEs early start into math, science, and engineering I like to show you a specific example of an experiment to highlight the benefits of linear modeling, and the limits of it. This will be helpful when we look at the models that Homo sapiens builds to predict catastrophes.



The picture above shows a strain testing machine (a) where a specimen can be exposed to a defined strain ε, and the stress (force) σ in the material is measured. The stress-strain diagram on the right (b) shows an example of how the stress σ changes for a given ε for a material like a construction steel. For small ε values the relationship between stress and strain is linear, i.e. it can be expressed as $\sigma = E \cdot \varepsilon$.

[18] Trump in Nevada, 2/24/2016: “I love the poorly educated”.

Here you can already see one particular beauty of linear modeling. The behavior of the material from zero strain to point “A” can be described by just one parameter, the Young’s modulus E[19]. In this region the material responds elastically to the strain, and the deformation is completely reversible when the strain is reduced.
In many applications materials are only used in this region. That makes mathematical modeling fairly easy, and math provides a lot of powerful analysis methods in linear algebra that can be used to solve such problems. Similar linear relationships exist in electrical engineering where Ohm’s law describes the relationship between voltage (U) over and current (I) flowing through a resistor (R): U=R·I. You can see immediately that this problem is analogous to the strain example. Therefore, all the analysis methods that are used for linear circuit analysis can also be used in mechanical analysis. You can say that linear algebra is the leatherman tool of engineering for linear problems. There are many beautiful aspects in linear behavior like for example superposition. If we know the stress σ_1 due to a strain ε_1 and the stress σ_2 due to ε_s then we can easily calculate the resulting stress $\sigma=\sigma_1+\sigma_2$ when we apply the sum of the two strains. A different way to express this behavior is that the strain will double when the stress doubles.
In electrical engineering, linearity enables powerful dynamic analysis for periodic signals with Fourier transformations. Instead of solving the problem in the time domain, engineers can solve them in the frequency domain where a time varying function simply becomes a complex number.

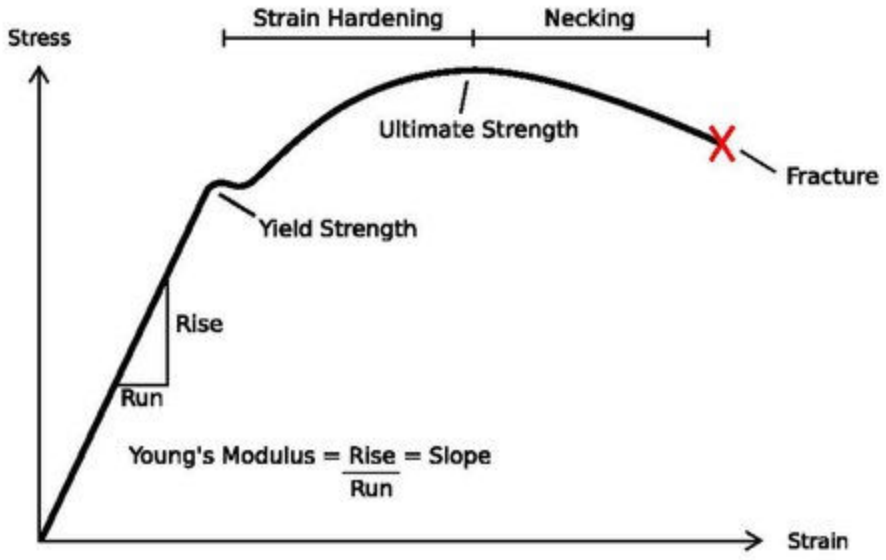
	Linear algebra	Relation algebra	Name
(a)		$\ulcorner R ; R = R$	
(b)		$\ulcorner R ; \ulcorner R = \ulcorner R$	
(c)	$\vec{\Sigma}(AB) = \vec{\Sigma}(A\vec{\Sigma}B)$	$\ulcorner(Q ; R) = \ulcorner(Q ; \ulcorner R)$	Locality
(d)	$\vec{\Sigma}A\vec{\Sigma}B = \vec{\Sigma}A \cdot \vec{\Sigma}B$	$\ulcorner Q ; \ulcorner R = \ulcorner Q \cap \ulcorner R$	
(e)	$\vec{\Sigma}(\vec{\Sigma}AB) = \vec{\Sigma}A\vec{\Sigma}B$	$\ulcorner(\ulcorner Q ; R) = \ulcorner Q ; \ulcorner R$	Import–export
(f)	$\vec{\Sigma}(A + B) = \vec{\Sigma}A + \vec{\Sigma}B$	$\ulcorner(Q \cup R) = \ulcorner Q \cup \ulcorner R$	Distributivity
(g)	$\vec{\Sigma}\vec{\Sigma}A = \vec{\Sigma}A$	$\ulcorner\ulcorner R = \ulcorner R$	Idempotence
(h)	$\vec{\Sigma}(A^\dagger) = (A\overleftarrow{\Sigma})^\dagger$	$\ulcorner(R^\smile) = R\urcorner = R\urcorner^\smile$	
(i)	$\vec{\Sigma}(A^\intercal) = A\overleftarrow{\Sigma}$	$\ulcorner(R^\smile) = R\urcorner$	
(j)	$A\mathbb{T} \cdot B = \vec{\Sigma}AB$	$Q ; \mathbb{T} \cap R = \ulcorner Q ; R$	
(k)	D is diagonal $\Leftrightarrow \vec{\Sigma}D = D \Leftrightarrow D\overleftarrow{\Sigma} = D$	$t \subseteq \mathrm{I} \Leftrightarrow \ulcorner t = t \Leftrightarrow t\urcorner = t$	

[19] Named after Thomas Young, (1773-1829) who was also described as “The last man who knew everything”, i.e. he had mastered all the knowledge of his time.
https://en.wikipedia.org/wiki/Thomas_Young_(scientist)
After Young, humanity had to wait a long time until a similar completely knowledgeable individual appeared. “The Chosen One”, Donald J. Trump, became the 45th President of the United States in 2016. He knew more than all the Generals and all the Scientists in the US Government. He was an expert in all fields and trades. Or so he made all his poorly educated followers believe. His biggest accomplishment was that he kicked down the last fragile strands of resilience in the global ecosystems that could have been leveraged to reverse the catastrophe of global warming. During the Trump administration, the only buck that stopped on his desk were all the taxpayer dollars he was charging the US Government to keep him safe on his properties while he was golfing. Trump also had well educated followers, but they were going along with the corruption for tax cuts and conservative judges.

To summarize: Linearity makes accurate modeling easy. Math provides very powerful tools to solve many linear modeling problems[20] very elegantly. There is a lot of beauty in math. But it takes an education to appreciate this. It is not coded into HEs DNA like his desire to kiss beautiful women[21].

Nonlinear Modeling

Looking back at the stress vs. strain diagram we see that the beautiful region of linearity has it's limit. The material enters the nonlinear regions of its behavior.



First, strain hardening with irreversible changes inside of the material occurs. Then necking appears, when the cross section of the test rod narrows. Finally, the probe will fracture in a catastrophic failure. The details of this failing behavior depend on the material and detailed material science of the probe. Understanding the properties of materials in the nonlinear zone is very important for a society that relies on advanced technologies. Think about the crumple zones in your car that protect you during a crash by absorbing energy when they get permanently deformed. Even in the linear zone there can be metal fatigue that limits the number of strain cycles that a material can handle, before it is slowly weakened by cracks that propagate forward until a component fails catastrophically when the remaining intact material reaches its fracture stress. Think about airplanes and bridges that have to operate safely while weakened by high traffic loads and possible corrosion. I am not an expert in this particular area, but can appreciate the effects and their importance[22].

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[20] If you like to take a look under the hood, I suggest you visit https://www.student-circuit.com/learning/year2/signals-and-systems-intermediate/properties-of-lti-system/

[21] If you want to know more about the things that HE is attracted to when his reptilian DNA rules over his cortex, you might want to research what "45" said in the infamous "Access Hollywood Tape". https://en.wikipedia.org/wiki/Donald_Trump_Access_Hollywood_tape

[22] If you have more detailed related questions, the Internet provides a lot of resources. Or just ask the Black Swan who has mustered the subject with his gut. He will gladly spill this on you.

For modeling in the nonlinear zone, scientists and engineers have developed powerful computer analysis systems that enable them to predict the behavior of the structures that they design, and optimize them for specific applications. However, in general the accuracy of the models becomes much more dependent on minute changes in the material composition of the probe, and the point of catastrophic failure may vary significantly between different probes of the same material from different manufacturing badges. This is the key insight that we want to take away from nonlinear modeling. The exact trajectory after the well behaved linear zone is difficult to predict especially with limited information on the material, and the point of catastrophic failure has a large uncertainty. So here my advice for Homo sapiens indulgence: If you decide to go out on your evolutionary limb, make sure that you have a safety rope, and the safe working load of that rope is chosen proportional to your waistline. Otherwise, when your evolutionary branch cracks, your safety rope is likely to crack as well. In that case, I will send you my heartfelt thoughts and prayers. Like you always did when a large number of you was killed by a gun nut[23] from your own tribe.

Modeling Catastrophes: Hurricanes

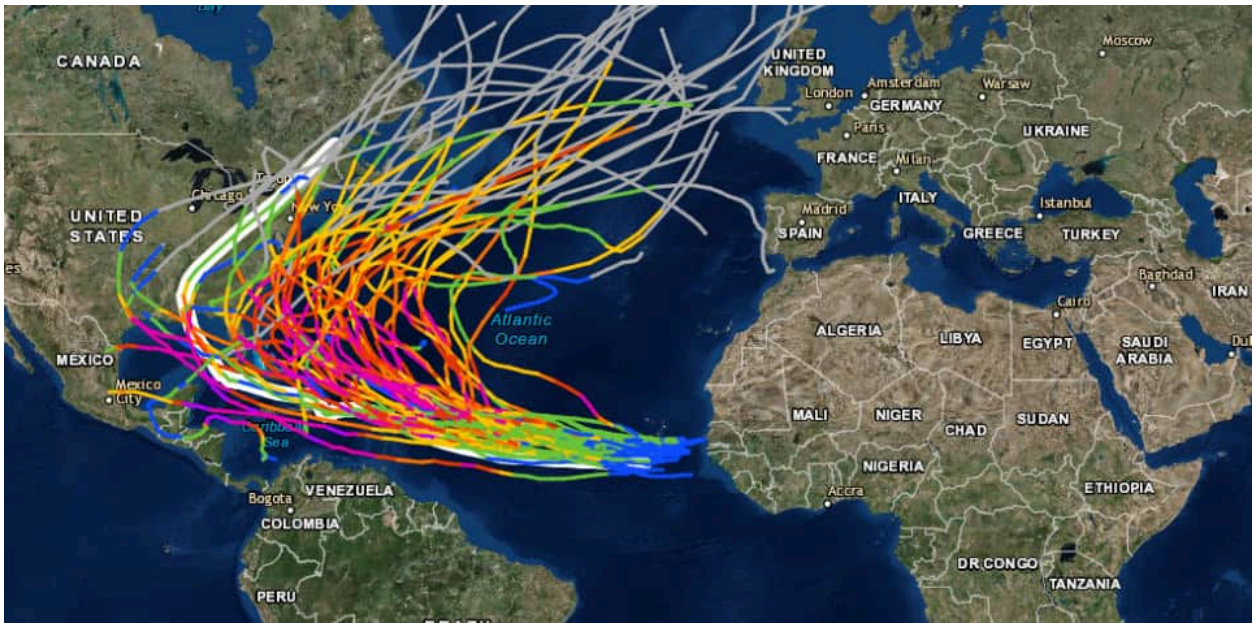
Now that we have established a shared basis on the challenges of predicting the behavior of nonlinear and complex systems under extreme conditions, I want to take a look at a few specific examples, starting with hurricanes.

To make sure that the following information is free of alternative facts, I would have liked to run it by the Federal Government's sitting[24] expert on extreme weather modeling, Mr. "Only I can fix

[23] This is another one of those nuts you could not crack.

[24] Like a duck. On a second thought, I think any duck knows more about hurricanes and bad weather than "The Chosen One" from wing-on experience. So my heartfelt apologies to all the ducks, especially the

it". Unfortunately, he was too busy mismanaging his latest catastrophe[25]. Therefore, I have to rely on my general scientific education as an electrical engineer (PhD[26]), backed up by my common sense. I spare you the output of my gut, like the sitting Government expert would not hesitate to do. He spills it all the time on primetime TV. The picture above is actually a neat snapshot of what was wrong in the Trump administration and its attitude to the scientific method. It should be preserved in a time capsule, in case no witness testimony survives the next truly global catastrophe on the horizon[27]. Instead of falsifying an incorrect hypothesis they falsified the data with a sharpie to fit the false hypothesis. Then they claimed that the incorrect prediction was validated by the sharpie data. Talking about getting it backwards. Make-believe science was at the core of Homo indulgences downfall. Facing the truth is hard! Making your own alternative facts is cheap, but will possibly get all of us killed. Bigly. Once in a while I feel it is good to use the words from "The One who has the best words". You know, the "Chosen One".



Looking at hurricane modeling in more detail: Since Homo sapiens has developed satellites and more and more powerful computer systems over the past decades, combined with data

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soul of the one that I saw yesterday (4/4/2020) dead at the curb. This sad memory just came back. Under the capable leadership that we enjoy now we will follow you very soon!

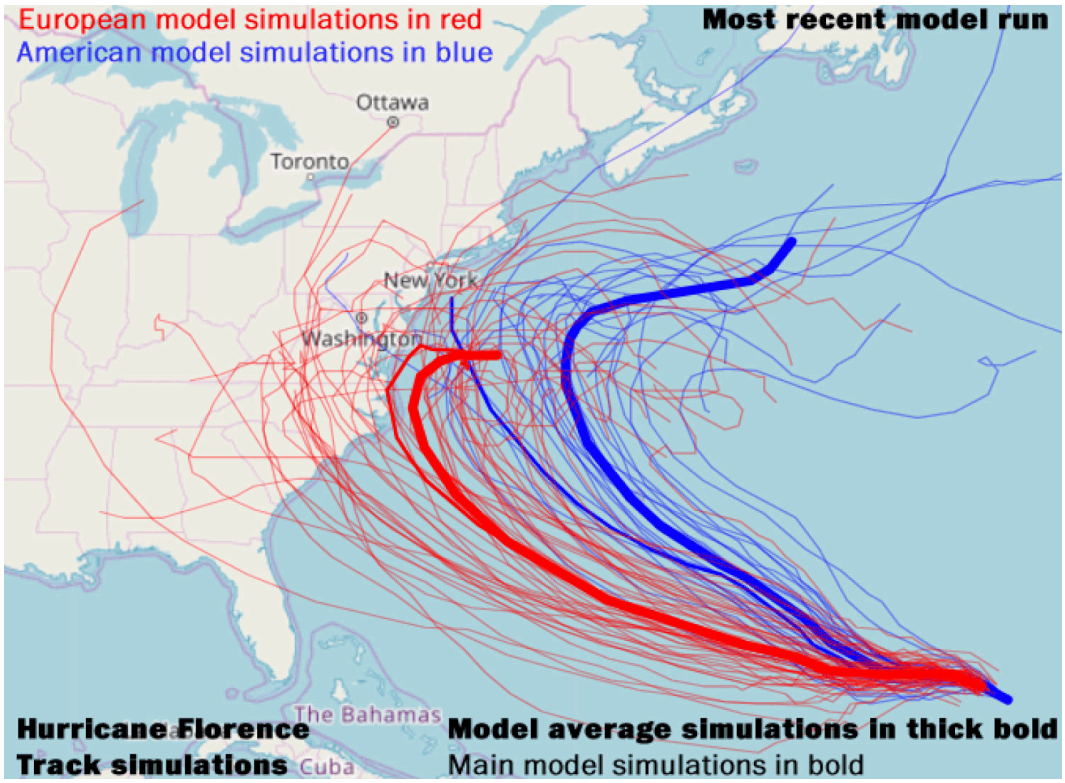
[25] After ignoring the exponential explosion of Coronavirus for a couple months, "The Chosen One" has now recommended that we all wear face coverings like burkas, bandanas, etc., to reduce the spread of the virus. And this in the country that developed the nuclear bomb 80 years ago and sent men to the moon more than 50 years ago. What a decline! We truly have reached the point where JFK's saying "Don't ask what your country can do for you, ask what you can do for your country!" is more than fitting. Our country can not even provide face masks for the doctors and nurses on the frontline of the Coronavirus fight, thanks to the "Expert on Everything" being asleep while the alarms from the US Intelligence Agencies were blaring in January. Bandana up!

[26] You may not be familiar with the following abbreviations: BS=bovine scat; MS=more scat; PhD=piled high and deep. So I have done my share of piling it up.

[27] Global warming, the Chinese hoax according to Mr. "Only I can fix it".

collection by brave pilots[28] who regularly fly into the eye of the hurricanes, we have a pretty good understanding of how hurricanes develop, how they grow, what drives their strength, and how they end.

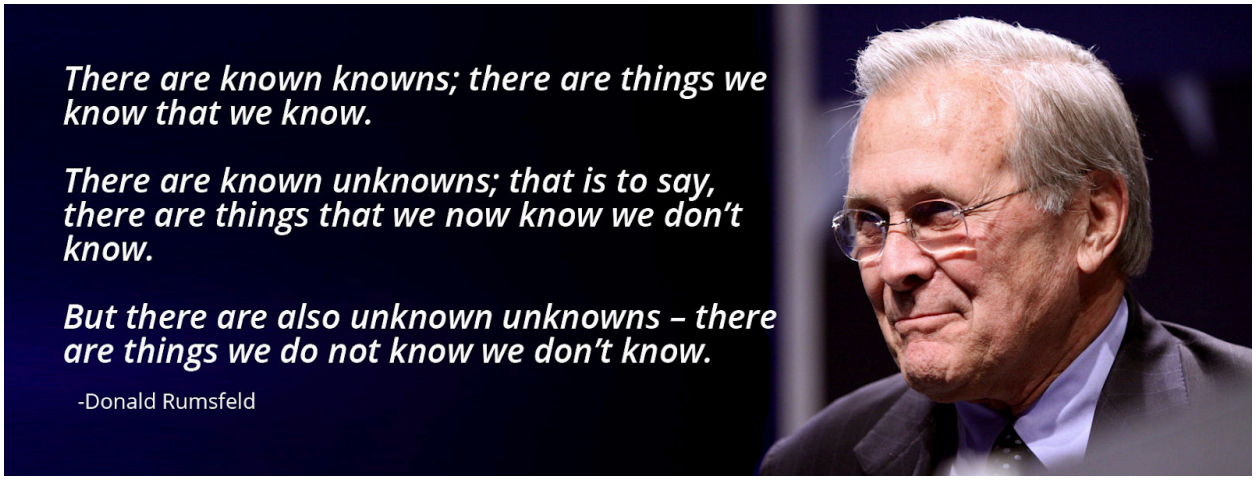
On the map on the previous page you can see the Category 4 and 5 hurricane tracks from 1851-2016 in the East Atlantic ocean basin, thanks to NOAA[29]. Based on all the data from previous hurricanes, scientists have developed sophisticated models that are used to predict the path and strength of a hurricane into the future. This is critical to be able to evacuate areas that are threatened to be hit by the storm. So accurate hurricane prediction is truly a question of life or death. We should keep this in mind when we think about the contributions of scientists to our society, and compare their compensation to the compensation of members of Homo athleticus who are very good at throwing balls through hoops and get compensated extremely well by Homo indulgence for their impressive artistic acts.



In the map above you can see predicted hurricane track ensembles for hurricane Florence. Since the future of the model depends on a lot of data, and some of that is not known with good accuracy, the scientists run their models with variations of the input parameters to get a feel how the general future trend of the system might be. You can see that there is a “European model”, and an “American model”. Many times they create significantly different predictions in the longer range. Historically, sometimes the European model is a better predictor of the future, and sometimes the American model. From my gut, I would say that the difference of these models is

[28] Without bone spurs.
[29] Not to be confused with Noah, who built the arc. We may need one, soon, when the oceans rise again. Mental note to self: Find Noah!

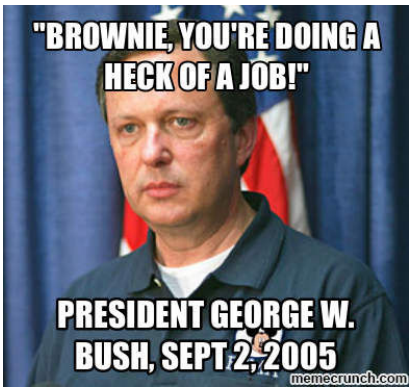
created by specifying the input parameters in metric units for the European model, or imperial units for the American model.
Based on my scientific education, I know this is not the true reason. Based on my professional experience, and my own experience of writing modeling software for non-linear circuit behavior, I know that the difference could also be in a few program bugs in either, or both, of these complex modeling systems that are run on large complex supercomputers. Complex software always has bugs. In very complex programs that model very complex phenomena these bugs tend to grow when later generations of programmers are trying to fix bugs when programs are poorly documented and were written in programming languages that are not hip any longer[30]. Imagine you had to fix typos on the Codex Hammurabi. In that sense, bugs in programs behave like bugs in real life. You give them an ecosystem where they can live and they will inevitably multiply. Today, many people just want to program in Java, just because that is what they drink.[31] It is also the language that powers the Internet. I just noticed that the Internet essentially runs on the same source of energy as its programmers! Coffee! This explains the correlation between Starbucks and the technology stocks!
Now I do not want to badmouth the modeling work of the meteorologists here. Predicting data out to many days ahead is very hard. As engineers we learned that it is always better to interpolate. However, if you think a little longer about it, this rule of prudence destroys the value of hurricane prediction. Extrapolation is essential! Fortunately, when we look a couple days ahead, the predictions provide super valuable guidance for disaster preparation in the likely path of the storm.
The inevitable presence of bugs in computer programs is actually an excellent segway[32] into the difficulty of predicting the size and human death toll of a particular catastrophe.



[30] When I started my EE education I had to learn a little bit of Fortran 77. I really appreciate that I did not have to program computers with punch cards during my career.
[31] In the end, our bodies become what we eat. Keep this in mind when eating too many of McDonalds' burgers. Have you ever wondered why "the Donald" loves MacDonalds? Well it says it is for him on the box! Engineers who do modeling have another important principle that applies in this context. GIGO: Garbage in, garbage out.
[32] Not the scooter!

You might be familiar with the “unknown unknowns” that, famously, Donald Rumsfeld[33] wrote about in his snowflakes. Such unknown unknowns create large uncertainties in the size of American Carnage that Donald Trump promised to stop, but which he ended up accelerating by his “ignorance is bliss” approach to anything of substance in life. I hope that they are keeping Rumsfeld’s snowflakes in a good freezer in the Pentagon so that they cannot add to sea level rise when Washington gets really hot.

A good example for the impact of unknown unknowns in modeling of catastrophes is Hurricane Katrina in 2001. The initial models predicted that New Orleans would escape a major disaster by a hair. The Hurricane surge was predicted to stay below the protection levels of the levees that were built by the Army Corps of Engineers. Unfortunately, there was an unknown weakness of critical levees in the city. They collapsed and caused large portions of the city to flood, creating a humanitarian disaster that cost about 1200 lives in New Orleans, and rendered large parts of the city uninhabitable for years. Maybe we would have better outcomes if we would use life engineers instead of corpses? Just a thought.



The Republican attitude towards Government is captured very well in the fact how the FEMA Director was praised for his bumbling activities by President G.W. Bush before the true size of the disaster became apparent[34]. Using political appointments to give jobs to unqualified party hacks, or industry loyalists, is an excellent way to hollow out Government and make the impact of natural disasters exponentially larger. The progress of Homo sapiens was based on professionalism like the scientific method, not tribalism, and corruption.

There are a few important lessons that Homo indulgence could learn from the rich record of natural and man-made catastrophes that we have watched or recorded in history. Building your home below mean sea level is risky. It can be done with good science and technology as we can see in the Netherlands, using the European model. But humans will never be able to make complex systems that are completely fail-safe. Group think and limited imagination of what could go wrong, will always leave exposure. Plus the contractors skimming away cement for other projects on the side. And the Mafia, helping themselves and their friends in that process. Nuclear power stations that have a lot of safety features will fail[35]. It is not a question of if, but when. Starting a war to settle the deaths of a terror attack will ultimately create many more deaths, and likely will not solve the underlying problems and grievances. In the end, Homo sapiens’ technology is no match for nature’s forces when they reach their extremes. Of our ingrained responses of fight or flight to danger, flight seems to be the only path to survive.

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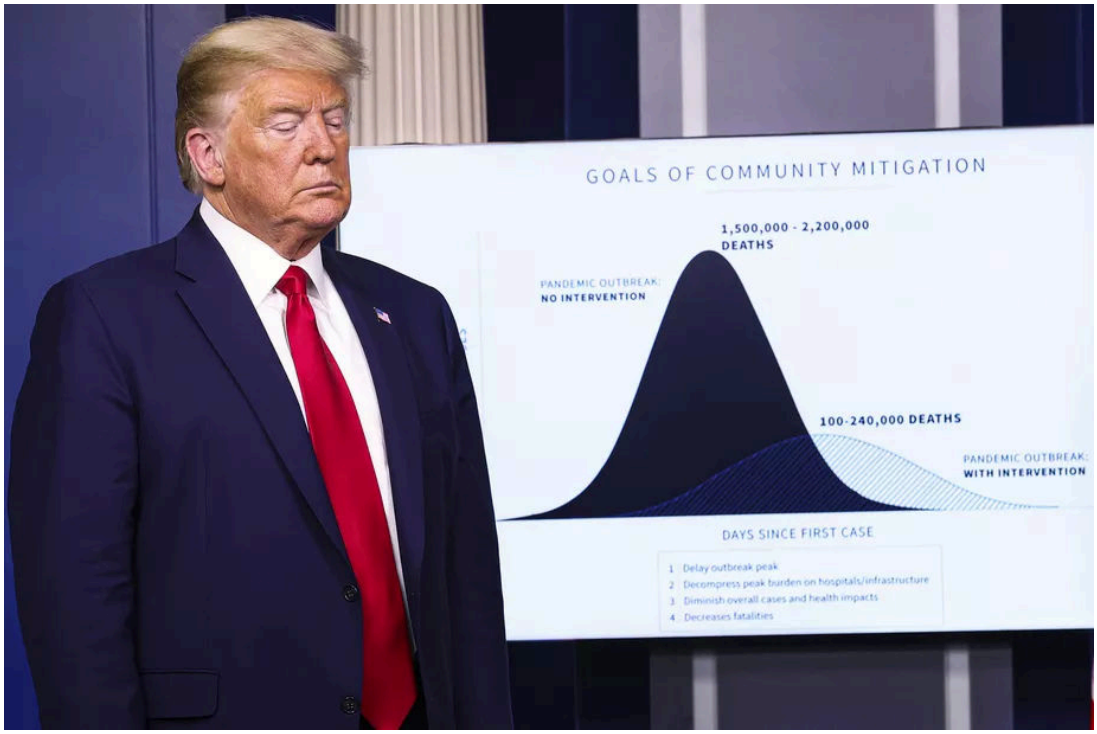
[33] He also created a Superfail of a human tragedy by his contributions to push the US into a war against Iraq to fight alternative facts weapons of mass destruction in 2001. The war has cost way too many lives and holy US$, the only metric that we (US) accept to measure happiness. Lives are considered insignificant when they are domestic collateral damage to the exercise of second amendment superrights.

[34] https://en.wikipedia.org/wiki/Hurricane_Katrina

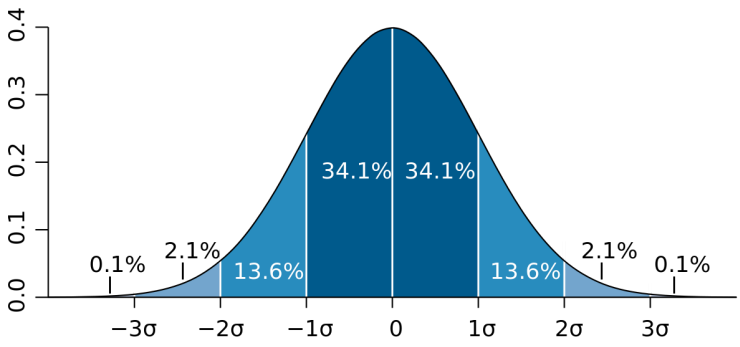
[35] Three Miles Island, Tchernobyl, Fukushima.

Modeling Catastrophe: Coronavirus

With our broadened perspective about how catastrophic failures occur, and how their size can exceed our worst modeling expectations due to nonlinear behavior, catastrophic failures of components, and unknown unknowns, I like to shift our focus now to the current Coronavirus crisis.



You may have seen the White House graph above, showing the predicted deaths of the pandemic Coronavirus outbreak without[36] and with interventions[37]. Looking at the graphs, I have to say that they do not instill a lot of confidence in the quality of the underlying model.



$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$$

[36] No social distancing, business as usual.
[37] Social distancing, only essential businesses are active, while we all wear burkas and bandanas.

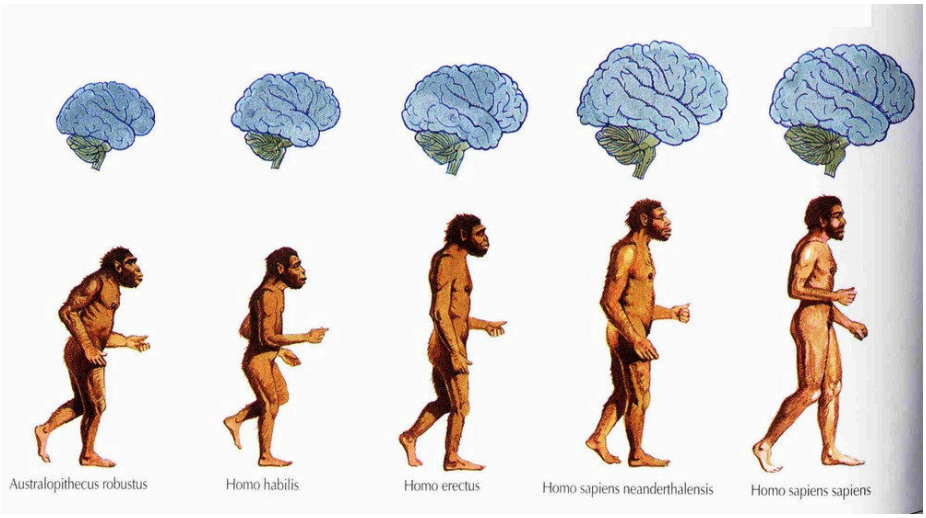
To give you my reason for this assessment I show you the Wikipedia graph of the Normal Distribution[38] on the previous page, below the student who is presenting his model. He looks quite uncomfortable, doesn't he?
I let you do your own eyeballing here, but to me the Whitehouse graphs look like two stretched and scaled Normal Distributions. Perfect match!

To me, it would be very surprising if detailed models for the Coronavirus pandemic would create data that looks exactly like a normal distribution.
Now, if you go to the Wikipedia page, you will find the following: "Normal distributions are important in statistics and are often used in the natural and social sciences to represent real-valued random **variables whose distributions are not known**." (emphasis mine). I can see some Sorcerer's Apprentice ("The Apprentice"), non-math genius White House staffer being tasked to come up with a "good", i.e. acceptable death count, and one that would be horrible, and produce a scientific graph for these two cases. Let's assume they found this answer for their unknown random variables probably on Wikipedia. If this is not the case: Dear White House, please show your work. My son in middle school has to do that, too, if he wants to pass. An essential part of the Scientific Method is that the modeling details get shared so that others can reproduce the data, scrub it, and independently verify it.
Is it too much to expect that the White House, the pinnacle of the last Superpower on Earth, performs at middle school level? Wouldn't it be awesome if there were some wizards, like Gauss, running these models today for us to help us make good decisions? Not just some clueless kid copying his answers from a web page to an unrelated question and trying to pass? If we rely on the Kardashians, the Trumps, and Kanje West to move Homo sapiens forward, I have very little hope we have a chance as an intelligent species.

Before discussing my own back-of-the-envelope modeling calculations here, I want to present a non-emotional, long term view of the current challenge from a mathematicians perspective. For that, I need a protagonist who is an outsider, and emotionally not connected to me or my family. Or to you and yours.
Since a few of you have shown that you are willing to kill the messenger, or a bunch of school children who just want to learn to become a productive member of society, I want to make very clear that I am not a heartless sociopath. To the contrary, I cannot understand how 30,000 gun

[38] It was discovered by Carl Friedrich Gauss, a German math wizard who lived from 1777 to 1855 and contributed mightily https://simple.wikipedia.org/wiki/Carl_Friedrich_Gauss to Homo sapiens' ascension. You see, Germans have actually contributed a lot to our accumulated knowledge. So as a people, they should also be remembered for the many positive contributions from their sons and daughters like Johannes Gutenberg, Albert Einstein, Max Planck, Werner Heisenberg, Otto Hahn, Lise Meitner, Gustav Ludwig Hertz, Alexander von Humboldt, Fritz Haber, Alfred Wegener, Gottfried Wilhelm Leibniz, Carl Bosch, Wilhelm Röntgen, Emil Fischer, Max von Laue, Paul Ehrlich, Johannes Kepler, Arnold Sommerfeld, Max Delbrück, Hans Bethe, J. Robert Oppenheimer, Hermann von Helmholtz, Emmy Noether, Robert Koch, Robert Bunsen, and many more. Those pursued the truth and not riches. So when you think about the Germans, don't just think about the few bad apples who created a lot of chaos, carnage, and alternative facts, like Karl Marx, Adolf Hitler, and Donald J. Trump. Hitler was actually Austrian, but the Germans are fully guilty to have their tribalism exploited to start the second World War and commit the horrific Holocaust.

fatalities, year after year, is an acceptable price to pay for the right to bear arms which originated from having the right to a well regulated militia so that the soldiers of the king could not go and plunder the properties of the king's subjects at will. Therefore, I chose the Creator[39] here. He has been following our ascent since the Big Bang, and does not interfere in our actions. To represent his non-emotional viewpoint here on Earth, I take Homo brutus sociopaticus. You can see him in the picture below. He is an outsider who was selected by close to a majority of US voters in the 2016 election. In a Black Swan, or BS event attributable to nonlinear mechanisms like Gerrymandering and the Electoral College. His followers have shown that they do not mind if a few eggheads get cracked to remove the special interests stranglehold on Washington (Administration lingo for the ongoing corruption they practice with their friends), or that the rights of Congress and the Constitution get trampled on[40]. With this explanation, I hope you agree with me that I found the *perfect* representation to channel the heartless Creator's view in my discussion. Like that *perfect* phone call from 7/25/2019.



So here it goes: Today, the global human population is growing by about 1.2% per year. Therefore, if 1.2% of humans die due to Coronavirus, this would be recovered in a year. So this is no existential crisis. For the US that would translate to 3.8 Million deaths, which is significantly higher than the 2.2 Million "worst case" model that was presented by the Trump administration. Is that horrible? Every year we have 3 Million people dying anyway. On average wo do not live for 100 years. So by giving a "buy one, take one free" deal to the devil, that would be a deal that most consumers in the US would dig[41] if it came on a coupon.

If 5% of the world population die (corresponding to 16 Million US fatalities) it would take the world population temporarily back by about 4 years. There was nothing wrong in 2016, so even this level of death would not be a truly existential threat that the Creator would worry about. It would be painful at an individual level. In a group of twenty, on average nineteen would have to dig one grave and say farewell to number twenty. That seems manageable. The extraordinary

[39] Download "The Power of Exponential Growth and the Coronavirus" from www.TheTruthWithHumor.com to learn more about how I see the Creator and its role in the Universe. He is watching US!

[40] If the executive branch is unaccountable to the people and their representatives, we have a king already. Where are the well regulated militias to protect us from his marauding forces?

[41] Pun intended.

fertility of Homo sapiens combined with medical progress can easily overcome a singular severe population reduction. We can triple our numbers in a generation! To paraphrase G.W. Bush here: Coronavirus? Bring 'em on![42]
To give you a historic perspective here: In WW2 the survival statistics for the young men flying bombers in the Royal Air Force faced the following odds: 51% killed in action, 12% killed or wounded in non-operational accidents, and 13% became prisoners of war or evaders. Brave young men faced those odds to save their society. What are you willing to do for your country? Homo Erectus for sure faced battles with his enemies once in a while where losing 50% of their population was "so much winning"! Losing meant the tribe was wiped out.

After discussing these considerations to put the Trump Death rates into a rational perspective, from an existential point of view, I now like to look at models for a potential death toll.
Ultimately the death toll will be driven by the infectious properties of the virus and our own behavior. The first one is reasonably understood after observing its work in China, Italy, Spain, and all the other places that it has already reached. The second one, our behavior, is unknown, but can be changed by the Government. Some of the States started social distancing much earlier than others. That will lead to different outcomes. The Coronavirus is a STD[43], not to be confused with STDs[44], that gets passed along during casual social interactions[45] like handshakes, hugs, or the use of shared everyday objects (doorknobs, faucets, the coffee maker in the office, you name it). After entering the body, the virus hijacks some of our cells to replicate, and then spreads to more and more cells, and finally to several other people. Rinse, repeat, EXPLODE!
Maybe 80% of the virus victims will only show minor symptoms, like we see during a common cold or flu. That makes it very hard to detect and differentiate from the regular nuisance colds that visit most of us multiple times per year. As such, with insignificant testing so far, thanks to the belated start[46] and low test throughput, there is a large unknown number of virus carriers all over the country who are spreading the virus further in any environment where social distancing is not strictly followed. This is one of the known unknowns that we have to take into account.
For 20%, the symptoms may become so severe that they require medical care, with perhaps a total of 10% requiring ventilators. If ventilators are available and the healthcare system is working well, ultimately 1% of the infected may die because of the virus. There has been an

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[42] https://www.huffpost.com/entry/bring-em-on---the-fifth-a_b_110233
[43] TLA (Three Letter Acronym) for Socially Transmitted Disease
[44] Sexually Transmitted Disease
[45] Mr. "Only I can fix it" is known for even handling his sexual relationships pretty casually. I hope he always used his PPE. https://money.cnn.com/2016/10/14/media/trump-stern-vietnam-stds/index.html. Funny how this remark about "45" actually ended up as footnote 45. Sometimes the planets align in mysterious ways. Cool! At this point this document gets an administrative rule that allows to only add a footnote before this spot when another one is removed. Welcome to the battle against the footnote creep!
[46] If news reports are correct, the US refused to adopt an early available Coronavirus test by the WHO. Who, you ask? The World Health Organization. This is one of these international organizations which are disdained by the Trump Administration and their America First principles. Instead they wanted to create their own test. A classical case of no-invented-here syndrome. Precious time was lost.

estimate from Germany that 70% may ultimately contract the virus if the spread cannot be contained. The US population is 327 Million.
How should we think about the role of the health care system in this problem? It is like protective armor where a certain number of people can take cover and be protected. Once the number of patients reaches health care capacity, all additional patients essentially face the same odds as they would face in a country without a healthcare system. That means that in the case where the pandemic explodes unabated, most people will only have their own immune system helping them. Thanks to evolution it is pretty powerful, but as the above numbers show, up to 20% of the infected population could be in serious trouble.
Let's put these numbers together for
Scenario 1 (healthcare system meets all needs): US population times infection rate (70%) times death rate (1% of infected) => **2.29 Million** deaths. Comparing this number to the Administration's "non intervention" range of 1.5 Million to 2.2 Million you can kind of see how those numbers might have been created on the back of an envelope. And then somebody added the Normal Distribution graph to it to make it look scientific. Please note that I pulled my above percentages out from following the "fake" news media without any deep dive, and without deploying my own scientific superpowers.

Scenario 2 (how can we meet the administrations lower numbers): To get to 100 thousand to 240 thousand deaths we might assume that the virus only infects about 7% of the population, which seems to be an extraordinary successful containment after the virus had essentially two months to spread around undetected. Without being an infectious disease expert, this feels pretty optimistic, but I would be happy if we could achieve that. This trajectory will take extraordinary measures to put the economy into a healing coma for months.

Scenario 3 (Overload and breakdown of the medical system): In this scenario, I like to explore how something similar to the broken levees in New Orleans during Katrina might happen to all of US during the Coronavirus crisis. Specifically, looking at the assumption in Scenario 1 that the healthcare system will meet all needs, this appears highly optimistic, while we listen to the news coming from New York. The insufficient number of ventilators puts 10% of the infected at severely increased risk. A large portion of them might die. A second factor is the lack of sufficient PPE[47] for doctors and nurses. Every time that they face a patient who might have Coronavirus with insufficient PPE they are playing an infection lottery. Even if the probability for getting the virus from a single patient is only 5%, their luck to not get the virus after one day with twenty patients is down to 35%. After 7 days (I don't know if the doctors will get weekends off to maintain work life balance, which they should) their odds to not get the virus will be less than 1/1000. So it seems very likely that sooner rather than later all the healthcare workers will contract the virus, with many of them requiring ventilators themselves. And a number of them will be dying as has been seen in the countries that started earlier. So we could see a significant constriction of the healthcare system capacities in many places that are hit hard by the virus as the healthcare workers are fighting for their own survival. In this scenario

[47] TLA for Personal Protective Equipment

we may see a large portion of the 20% who need medical care, but cannot get it, become fatalities. Now we are talking about a significant percentage of the 20% of 70% of the population at risk. That could be a significant portion of **45 Million** people.

Scenario 4 (adding knock-on effects due to the breakdown of the medical system): With the healthcare system knocked out, and hospitals now a hotbed for Coronavirus transmission, anybody who needs emergency care for other reasons during this catastrophe is at great risk to contract coronavirus, on top of the problem that brought him to the hospital in the first place. Other procedures may also be halted, which would have major side effects for the involved patients. That may significantly increase the death rate again. I don't want to plug down a number. There are too many parameters to do this in a single paragraph. That is why we have experts. I also do not want to create a panic.

Scenario 5 (accounting for a sicker overall US population): The assumption that 20% of the infected population may require medical care could be optimistic in light of its overall less than optimal health (overweight, high blood sugar, high blood pressure, etc). A chronically sick population creates a large economy, but is no good defense force against a viral pandemic. As Donald Rumsfeld said. You fight a war with the army you have, not the army you wish you had. Like elections, the lack of preparation has consequences. Dismantling preparations inherited from your predecessor[48] is sabotage and should be considered treason. Penny wise, pound foolish. What could go wrong?

Scenario 6 (adding severe social unrest): If we are not compassionate with our fellow neighbors who lost their work because their work is not essential[49], then the breakdown of civil society can yet add another layer of American Carnage to this Armageddon. Remember the "Only I can fix it" and "American Carnage stops right here" lines from Trump's inaugural speech when you see this slow paced disaster roll down over the US and the World. We have to keep in mind that there are many places in the world who will be hit even harder because of food shortages, lack of space for social distancing, and even less adequate medical care.

Looking at these scenarios, I get a feel that the country could face a very painful future until a working vaccine is available. Tens of Millions could die! The low symptom spreading property of the virus makes it a perfect agent to spread stealthily around the country before it is identified, and targeted containment efforts could be launched. The lack of timely testing results is hampering containment efforts completely. So the best strategy appears to be the diligent use of strict social distancing in small family units until the virus essentially burns itself out inside of the families, without reaching others. But the hospitals may still become exchanges where the virus

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[48] https://www.npr.org/sections/goatsandsoda/2018/02/12/585119417/trump-proposes-deep-cuts-in-detecting-disease-outbreaks-worldwide

[49] Did you hear the sigh of relief of the gun sellers? According to many Republicans these provide "essential services". On second thoughts, it may be compassionate to put Granny out of her misery when there are no ventilators. Major "Hot Lips" Houlihan, please bring the assault rifle to the ER!

can reach new victims if somebody in the family needs critical care. It seems unlikely that the spread of the virus can be stopped after it has reached so many people and places. Homeless people, and we have a lot of them, have so many other challenges that regularly washing hands and keeping social distance is impossible. That means their communities will stay incubators for the virus and there will be a lot of little glowing embers all over the country waiting to ignite the next exponential wave when the fire walls get lowered. This may only stop once most of the forest has burned, i.e. a majority had the disease, or we get vaccinated.

What can you do? Do the best you can to not get sick during this time. Everybody, including the people who may be lucky to only get mangeable symptoms, must do their best to prevent further spreading of the virus. Containment is the only responsible path forward. And show solidarity with the non-essential workers who will lose their jobs for a long time. Very few people have the resources to take a sabbatical year from work. The rich people will have to chip in! This is really about preserving our advanced society.

And to conclude this section: The above described scenarios will develop to various degrees in different places. The final death count will depend on the mix of these scenarios, and their probabilities. Think about the hurricane map. At this time we do not know the detailed path over the next year, the strength of the winds, and which regions will be hit how hard. All this depends on us changing our everyday life behaviors to maintain our society suspended in hibernation for the long term, and reopen for business after the virus is eliminated.
Ask yourself what you can do for your country! Stay at home and help those who need help. Money can be replaced, people not as easily[50].
And use your time to think about the next catastrophe you or your children will have to handle. It will be worse, unless we act now decisively on a global scale!

Modeling Catastrophe: Global Warming

In my view, the next true existential challenge for Homo sapiens will be the battle against climate change. A solution to prevent a major catastrophe will require global cooperation of all people at an unprecedented level. There is only one atmosphere, so we cannot wrap this problem into an SEP[51] field. If we try to wrap global warming into a SEP field we better learn

[50] Replacing numbers of people is actually not so difficult. Your crafty Government operators could release a software virus in the contraceptives manufacturing department of Johnson and Johnson. Like in Iranian enrichment centrifuges. By the time this will be discovered we may be back at full strength. No prescriptions required. So we can do this even with fewer medical doctors left after the Coronavirus disaster. But losing well educated experts is much harder to fix. It takes more than 3 minutes to create those. Closer to 30 years. With this thought, how about we start to appreciate and maintain some of our experts in Government? Or are we happy to have the caveman throw the nuclear football through the hoop?

[51] ”An SEP is something we can't see, or don't see, or our brain doesn't let us see, because we think that it's somebody else's problem.... The brain just edits it out, it's like a blind spot. If you look at it directly you won't see it unless you know precisely what it is. Your only hope is to catch it by surprise out of the corner of your eye.” Douglas Adams, Hitchhiker’s Guide to the Galaxy.

how to survive as hitchhikers in our galaxy[52]. I know that many of us are very busy fighting the short term challenges in our lives. It is difficult to think about long term consequences of our actions with such short term pressures. And most of us are also not climate scientists. So how do we judge the doomsday messengers on climate change vs. the happy talkers?

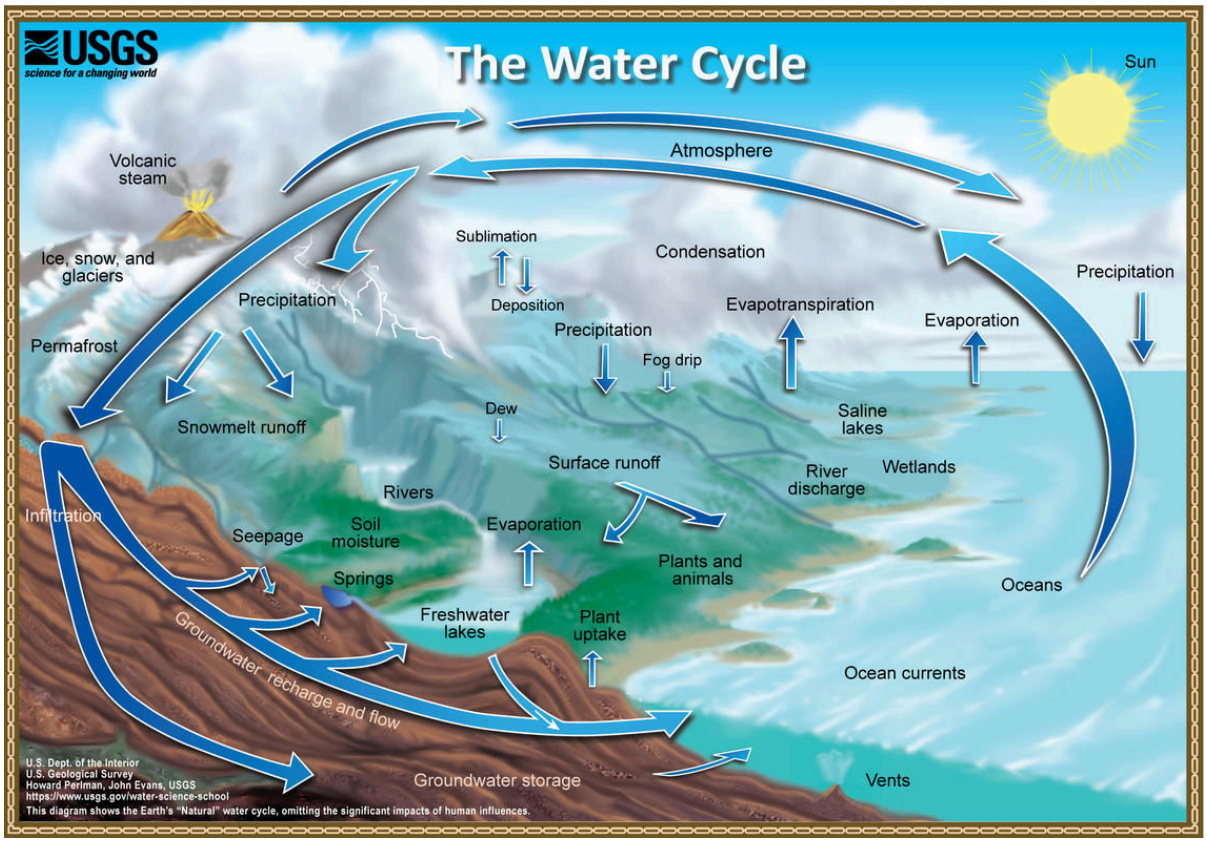
I like to share my point of view on this problem. Maybe it helps you to come to a conclusion for yourself. Let's review the following important aspects one by one:

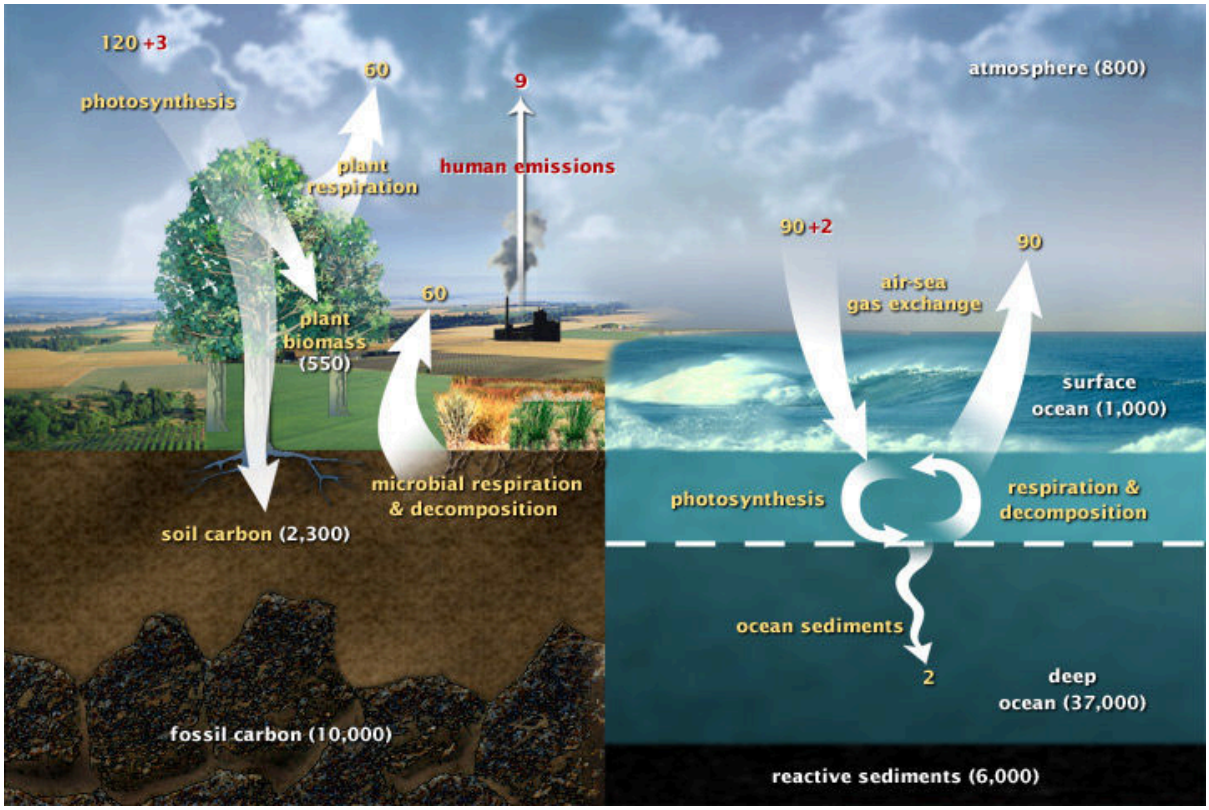
1. Complexity of the involved systems and mechanisms
2. Positive feedback
3. Is there credible data that there will be a problem?
4. Are there simple facts that explain the direction of change?
5. Do we have experience with this problem?
6. Is there a second chance?
7. Motivation of the messengers
8. Is there a credible solution?

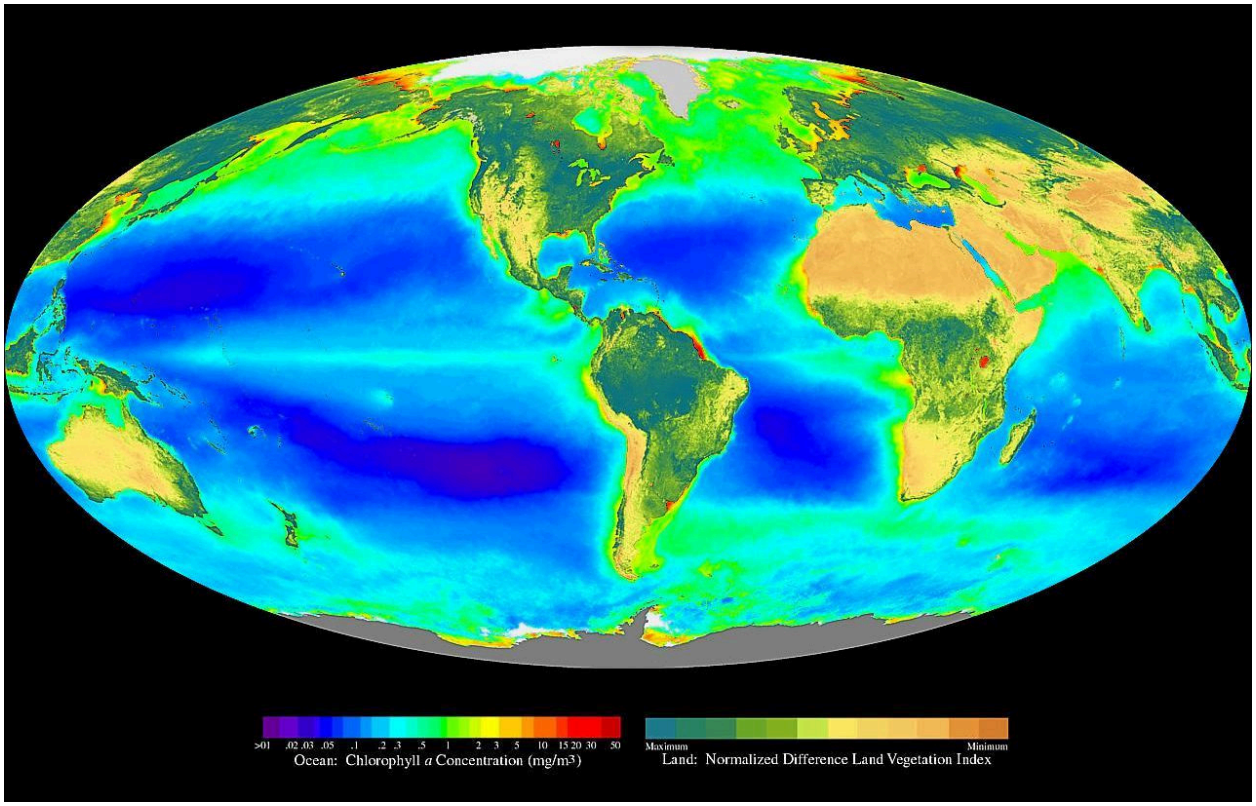
1. Complexity

When we look at questions of climate change we have to look at the long term future of the global water cycle, the carbon cycle[53], changes of the global biosphere, and humans' technological and behavioral development. Just to provide you some visual stimulation to think about the complexities in each of these four domains, I pulled out a few related images to these systems from the Internet. Each of these global systems is extremely complex by itself. Making long term predictions that cover a few decades by building a model for these heavily interrelated systems and mechanisms is much much harder than weather modeling for a hurricane that is a small regional event in the global atmosphere that we try to predict for only a few days. With quite a bit of uncertainty when we project just a few days out.
When I think about building a simulation model for this problem, a model that will predict the future accurately in all its aspects, I think this is an impossible task. So as far as complexity goes, this is probably the hardest problem that Homo sapiens has faced. Ever. Way harder than those first nuts that started HEs scientific thoughts. Unfortunately, many of our decision makers appear to function at a mental level where they would probably crack more of their fingers than nuts if they had to solve even just small problems.

[52] If you like, I could sell you a nice acre on Mars.
[53] https://en.wikipedia.org/wiki/Carbon_cycle

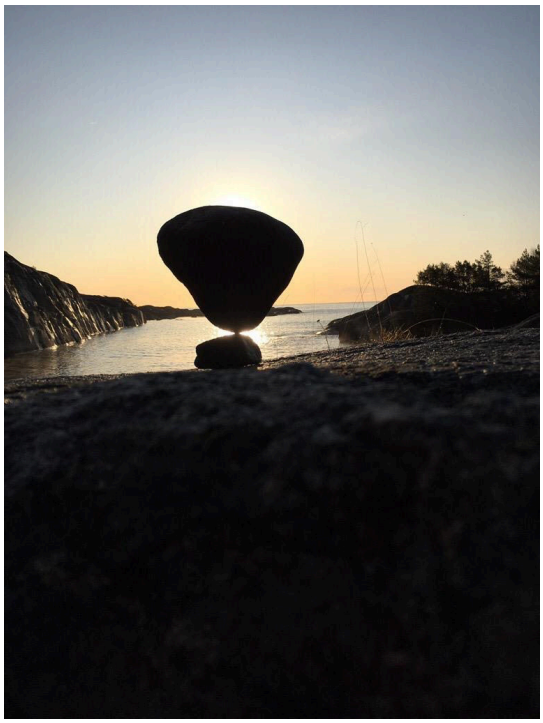

USGS
science for a changing world
The Water Cycle
Sun
Atmosphere
Volcanic steam
Ice, snow, and glaciers
Sublimation
Condensation
Deposition
Precipitation
Precipitation
Evapotranspiration
Evaporation
Precipitation
Permafrost
Precipitation
Fog drip
Dew
Snowmelt runoff
Saline lakes
Surface runoff
River discharge
Wetlands
Rivers
Infiltration
Seepage
Soil moisture
Evaporation
Plants and animals
Springs
Oceans
Freshwater lakes
Plant uptake
Groundwater recharge and flow
Ocean currents
Groundwater storage
Vents
U.S. Dept. of the Interior
U.S. Geological Survey
Howard Perlman, John Evans, USGS
https://www.usgs.gov/water-science-school
This diagram shows the Earth's "Natural" water cycle, omitting the significant impacts of human influences.


120 +3
photosynthesis
60
9
atmosphere (800)
plant respiration
human emissions
90+2
90
air-sea gas exchange
60
plant biomass (550)
surface ocean (1,000)
microbial respiration & decomposition
photosynthesis
respiration & decomposition
soil carbon (2,300)
ocean sediments
2
deep ocean (37,000)
fossil carbon (10,000)
reactive sediments (6,000)



2. Positive feedback

When we start to look at the details of the water cycle related to temperature and global ice masses, we quickly find that there are positive feedback mechanisms in the system. As an example for a system with positive feedback you can see a marginally stable system in the picture on the next page. When the rock is pushed a little bit, it will start an accelerated fall.



Similarly, when the Arctic ice shelf melts, the ocean water that is exposed attracts heat that the ice used to reflect into space. The warming water then causes more ice to melt which becomes a self amplifying process. You can easily find data that shows how drastic the arctic ice has receded in the past few decades.

A second significant positive feedback mechanism exists in the carbon cycle. The permafrost soil in the tundra stores vast amounts of methane that is about 28 times as powerful as CO_2 in its heat retention effect in the atmosphere. Once the soil thaws, the methane is released in the atmosphere, causing more heating and then more permafrost soil to thaw and an accelerated emission of methane.

In the biosphere, a model would have to predict how life on Earth will change to adapt to rapidly changing environmental conditions. Which species will die out. Which will thrive. And for human behavior and its predictions the model would have to forecast the stock market for the next 60 years and how our democracy is going to develop. Does anybody know who will be US president[54] in 2021? Even I, with my current 20-20 vision, cannot figure that out. I hope, I can impress my point here how unpredictable the future is when so many nonlinear mechanisms and even emotional, tribal actors are involved. Such positive feedback mechanisms make the prediction of such complex systems over time very very difficult. But in the context of global warming these mechanisms make the response of the system more vicious and at some point these positive feedback dynamics can take over and flip the system into a new stable point at a much higher global temperature. Which would be very negative from humans' perspective[55].

The system that we are simulating here is infinitely more complex than the metal probes in the strain-stress test that we discussed earlier. And even for these metal probes predicting the exact strain where the probe ultimately snaps is very difficult.

Finding one scientist who will in the end have actually correctly predicted the future level of sea level rise at time 2100 will be easy. As long as the range of their predictions overlaps the datapoint there will be a lucky winner of that lottery. But that is not much different from monkeys throwing darts at a dartboard to predict where the Dow Jones Industrial Index will be in 2100.

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[54] At this point we don't even know which of these old geezers who are running for office will survive the Coronavirus. Another known unknown.

[55] You may ask yourself why scientists call feedback positive when the net result is negative. Well, you may ask yourself the same question when you get your positive Coronavirus test. If you could even get one with all the delay that occurred.

Do you think the modeler who gets the sea rise level correct will also predict the correct level of the DJIA, and which companies are in there?[56]
Thinking about all these complexities, I conclude that the future that far out is essentially unpredictable. Even after living through reality to that point in the future, when people look back they still will have a hard time to assemble the truth and what caused what. History is rewritten as it happens. We can already see how the Black Swan is trying to hide his initial bumbling on the Coronavirus by creating alternative facts.
So what is the value of building such models then, you may ask?
Well, we can create some fairly simple models that show us some of the features of the future with enough accuracy that we could be collectively motivated to change our wasteful[57] way of life because we agree that this is not an environment that we as a species were cut out to handle happily[58].
To be specific: We have a pretty good idea how much water is stored as ice in Antarctica and Greenland[59]. That lets us make a reasonable model how far sea levels may rise when all that water melts.
Do you think that the people of New York would be willing to change their lifestyle if they knew that their current way of life will have to happen under water in the foreseeable future? Well, we see right now that they are willing to change a lot when 1% of them are threatened by death due to the Coronavirus. So there is hope that humans could be willing to change to avoid their own doom if somebody could convince them that this is where they are headed, or rather mislead.

3. Credible data that there will be a problem

To convince myself that we are currently in an already extreme and significantly worsening state with respect to CO_2 in our atmosphere the following graph is very useful. It shows the CO_2 concentration moving within a limited range between 175ppm to 300ppm for 800 thousand years, to then go on a ballistic trajectory, crossing 400ppm recently, climbing on a path to a predicted 550ppm or possibly even 900ppm. The changes between 175ppm and 300ppm are related to the change of Earth's rotational axis vs. the plane of its trajectory around the sun.

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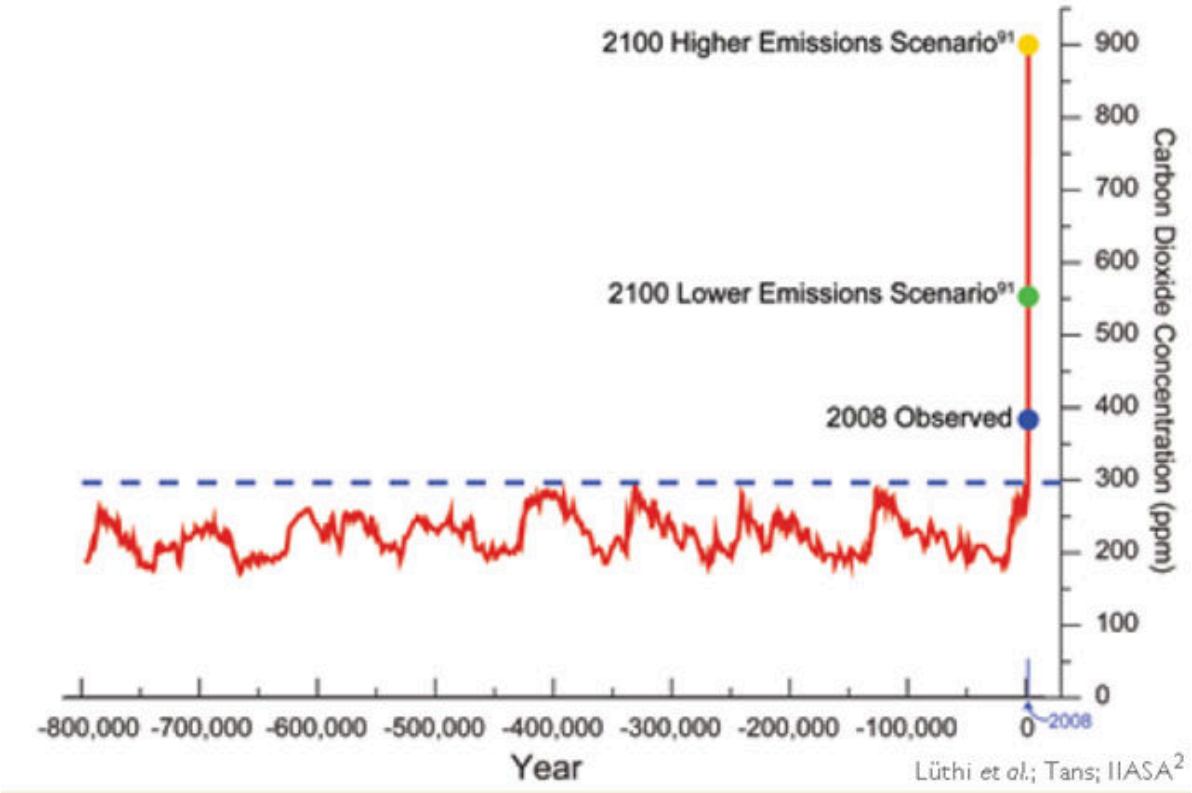
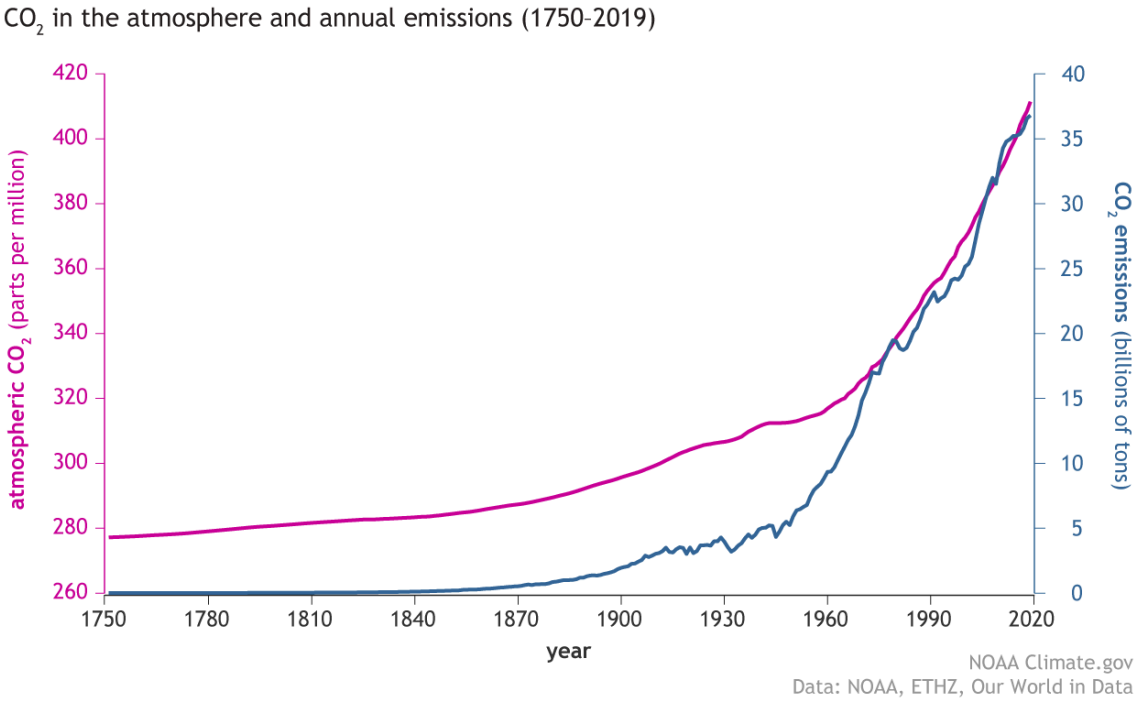
[56] I hazard here my own prediction. Since health care in the US has been growing faster than the overall economy for many years, the healthcare sector will take over most of the economy and dominate the stock market. The Coronavirus crisis also shows that we are willing to spend many trillions of $US to prevent a non-existential health crisis from the coldhearted Creators view.
[57] Or waistful?
[58] I care about my children and the future they and their children will inherit. Do you? Well, if you are one of the “America First” crowd, you are most likely also of the “me first” mindset. They steal from our children by pushing irresponsible tax cuts that will never pay for themselves. Who in the White House built those financial models?! Probably the same guy who is now predicting 100 thousand deaths from Coronavirus.
[59] If you ask yourself why all the ice is on Greenland and not so much on Iceland, that is a very good question. It seems when these places were named, somebody created some alternative facts, maybe to sell these. The places, not the facts. Maybe there was a real estate developer and scam artist in the Viking community who wanted to sell the most beautiful plots of green land to his compadres back in Denmark? I wonder where his DNA appeared later. I have a hunch. If I would tell you that the US president wants to buy Greenland you would probably think that I am nuts. But maybe he does believe in global warming after all, and he plans where he can rebuild Mar-a-Lago when Florida is all under.



So where is the recent breakout coming from?



Zooming into the graph, we see that this sudden increase coincides with the beginning of the industrial revolution when Homo sapiens started to dig coal and then later started to use other fossil fuels like oil at a rapidly growing pace. I have not heard a better explanation for this rapid increase in CO_2 from the people who deny a human cause to this problem. Now Homo sapiens is skidding down on his evolutionary branch, barely able to hold on because it is slippery from all the oil and the lobbyists that apply it liberally to the best Government they can buy.

4. Are there simple facts that explain the direction of change?

With the knowledge that increased CO_2, plus other greenhouse gases like methane[60], trap more heat on Earth, global warming is a logical consequence. And that is what the recent global temperature records show. Pretending that this does not exist whenever there is a winter storm in Washington DC cannot dispel this fact and appears rather silly. Applying the scientific method requires honesty to ourselves.

5. Do we have experience with this problem?

Hurricane models have massively improved over recent decades with the exponential growth of supercomputer capacity and speed, and many hurricanes that were available to improve models and algorithms.
To the contrary, we have seen exactly zero global warming events. So the chance of predicting this accurately is zero, too. But as stated earlier, simple aspects of the problem, like sea level rise, can be predicted reasonably well in their magnitude. And in their urgency. We have limited time to stop this trend before the negative effect of positive feedback kicks us over the edge.

6. Is there a second chance?

If we do nothing there is no second chance to get Earth back into the current Garden of Eden[61] state. The damage of a runaway climate catastrophe will be very long-lasting and may destroy human civilization as we know it. Think about teens of thousands of years of misery because our bodies did not evolve for the climate that we will have created. Sure, there may be a few Homo “formerly known as” sapiens cracking some nuts with rocks, but that would be a sad affair after all the gifts we received from our hard working and deep thinking ancestors. What a giant screwup of an inheritance that would be![62]

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[60] Also emitted by human activity like natural gas exploration and life stock production.
[61] In significant distress!
[62] This would be a much more gigantic screw up than squandering a few hundred $US millions - inherited from your father - in multiple bankruptcies, after cheating the public of the inheritance tax you should have paid. Me first!

7. Motivation of the messengers

It is pretty obvious why fossil fuel producers want to deny that there is a problem. How stupid do they think we are?[63]
I believe that activists like Greta Thunberg are not in this for the money. They see a problem and cannot believe how the pampered, complacent majority is driving their gas guzzling SUVs in the giant drive of the lemmings over the cliff. Guided by leaders who are enriching themselves without regard to the future of all our children.

8. Is there a credible solution?

We are currently behaving like the man who jumped off a skyscraper. After falling for a few seconds he reaches the second floor and thinks: “So far all is well! There is no man-made problem here.” If the man has a parachute it may be too late to deploy. But if he had a super fast airbag he may still be able to initiate an emergency landing so that he can survive the crash. Collectively, Homo sapiens have reached the second story and the impact may happen very soon. We missed deploying parachutes decades ago when global warming was first identified as a future problem. Special interests prevented us from taking action. Now it will take more

[63] Unfortunately, there is ample evidence that many of us can get fooled into making bad decisions for ourselves. Why would people vote for a party that wants to take away their healthcare? Good healthcare, like education for everybody, is an investment into our future. Smart and healthy human beings are our number one resource. Well, that party against healthcare loves the poorly educated...

dramatic measures to save all of US. Do we have an airbag? I think we do. There are two critical elements:

1. Technology.
   I like to give you a very specific example here. The last time we bought a car in 2015 we could have afforded to pamper ourselves with a nice little German luxury sedan. Instead, we invested this money into an American car, the second generation Chevy Volt Plug-in Hybrid, and a set of solar panels[64]. My mindset was to pamper Earth more than us. Now we have driven more than 100k Miles at an average fuel use of 200 MPG thanks to 80% of driving on electricity. Compared to driving around in a minivan we only need 10% of the gasoline that we would be wasting otherwise. If all of us start to focus on our survival as Homo sapiens instead of how to pamper ourselves or our children to death[65] we can still execute a convergence to a sustainable path forward. Even if all the technological solutions do not yet exist today it is better to hit the brakes rather earlier than later.
2. The willingness to change our behaviors.
   The technology changes will only help if everybody pulls in the same direction. A Government that reduces fuel efficiency standards is a true abomination and evil! Bringing back the incandescent light bulb does not make America great again. It shows that our Government is run by people who do not see and care about our future as an intelligent species. I hope that the Coronavirus experience will teach us that it is possible to live without jetsetting all over the globe. Instead of competing with the Joneses on who has the bigger car, and travels more often internationally we need to compete for efficiency and the minimization of energy use and waste. Do more with less. Be smart, not a CO_2 fart!

[64] For more details on all the savings please visit https://www.djtpresidentiallibrary.com/Solar-PHEV

[65] literally!

Earth needs a new movement

Looking at the growing CO_2 emissions and impending catastrophe, I realize that Earth needs a new movement. Not the rotation around its axis, or the elliptic orbit around the Sun[66] that Johannes Kepler derived by applying Newtonian mechanics. Those are parameters that even the Black Swan who is currently starring in a role playing a US President in the White House, after succeeding as “The Apprentice”, or the Republican Party and their “Drill Baby Drill” friends, cannot screw up. That would take a real star to change. Being overweight is not enough for that. It takes something in the class of the solar mass to change those. Mr. “Only I can fix it!” is on the record of saying, off the record, but on video: “When you are a star they let you do it!”. Now, he is only one of those little starlets with a star on the Hollywood Walk of Fame where a lot of people would just like to leave a little scat to show their appreciation for his significant contributions to the impending doom of Homo sapiens sapiens.
He[67] claims that he created a movement under the MAGA label.

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[66] If you still believe that the Earth is flat, or that the Earth is the center of the Universe, please put your book on intelligent design on the side and look at all the new knowledge your fellow human scientists have found based on the scientific method.
[67] Not HE!

I am convinced that Earth urgently needs a movement now that is bigger, MUCH MUCH BIGGER than MAGA! I am pondering all these thoughts riding around in beautiful, almost empty [68] Crystal Cove State Park in Southern California, on my mountain bike, on Earth that we must cherish, rolling over its crust, on a fire road[69], on the late Sunday afternoon of April 5th, 2020. And then it hits me:

MEGA!

Make Earth Great Again!
Earth first! Mars later!
This is BIG. 10^6!

And the Creator saw Christian and thought that this could be MEGA MEGA COOL!
Or **10^{12} Cool** for you, my fellow nerds!

- It would stop global warming before it becomes a catastrophe that would take tens of thousands of years to recover from. If ever.
- It would ensure a sustainable path forward for Homo sapiens sapiens and it's amazing knowledge accumulation and technological mastery.
- It would ensure that the ice bears could keep using their white coats, and that they did not have to illegally immigrate into the country of the grizzly bears, where they would experience discrimination because of their white fur color. Until they melted together with the grizzlies, making cute little swiss coffee bear cubs.
- It would ensure that the beautiful corrals in the oceans would not die by the increased acidity from dissolved CO_2, and could recover their amazing structures and colors.
- It would save countless cities close to the ocean from regular inundation.
- It would ensure that excessive long distance travel did not provide rapid deployment paths for lethal viruses.
- It would save lots of people from a lot of misery.
- **It would save the only known Garden of Eden in the Universe!**

Ask yourself: What can you do for Earth? For our childrens' future! We can do it!

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[68] One nice aspect of the closure of our Parks for all vehicle traffic to the parking lots, to ensure social distancing, has been that the visitor traffic is way down. It is awesome to be there with only a few people who arrive by bike or on foot. Almost like Adam and Eve before Eve took the apple.
[69] A preparation for a fire disaster! Those will come back again soon, thanks to climate change.

Quo Vadis Homo Sapiens?

We have a choice!
Left or right?






Life or extinction?

Do we want to be known as the generation that burned and trashed paradise?

Or can we be the generation that leveraged unprecedented technology, global communication, and collaboration, to bend the curve of humans' exponential growth and seemingly unending appetite onto a sustainable path forward?

Godspeed Homo sapiens!