From New York Times Opinion, this is the Ezra Klein Show.
Hey, it is Ezra.
I am on book leave, but this week, taking a turn at the mic is David Walliswells.
He is a Times Opinion writer.
He's the author of The Uninhabitable Earth, Life After Warming.
And I just think that over the past couple of years, not just his work on climate change and biodiversity loss, but also his work particularly on COVID has been absolutely fantastic.
So I asked him to come on and do a couple shows around these themes.
I hope you enjoy.
From the perspective of the climate, it's been a hellish and disorienting summer.
This June was the hottest June on record.
July was the hottest July on record.
And Phoenix all but one day in July crossed 110 degrees Fahrenheit.
The city's burn units were filling up with people who'd fainted on the street and been burned by the asphalt, which measured as hot as 180 degrees.
Of course, it's not all bad news.
There is genuinely a green revolution underway, and it's moving much faster than what many believed possible just a few years ago.
Emissions haven't yet begun to decline, but renewables are being rolled out at such a pace and at such a low cost that many analysts believe will hit a carbon peak sometime this decade.
Conventional modeling suggests that in just five years, we may have cut our expected warming for this century almost in half.
But that doesn't mean we can declare victory.
Through the last decade, there's also been a flurry of new science showing that climate risks we once expected in some worst case scenarios may instead arrive with much less warming.
And while all of those projections come wrapped in uncertainty, one worrying possibility is that for all that rapid decarbonization, we may not end up on net in a much better place.
Which is all to say that thinking clearly about the state of climate change requires now holding two pretty contradictory seeming ideas in your head at once.
We're finally taking action, and quite rapidly.
But the planet is changing too, perhaps even more rapidly.
To help talk me through where we are today and where we're heading, there's no one I'd want to speak to more than Dr. Kate Marvel, the senior climate scientist at Project Drawdown.
She's just about the best person I know at holding those two different ideas in perspective at once.
As always, you can email the show with your thoughts and guest recommendations at Ezra Klein Show at nytimes.com.
Kate Marvel, welcome to the podcast.
Thank you so much for having me.
So we're talking in early August, which means a lot of the official July temperatures have just sort of come in, and it looks like it was a really hot month.

And I think the data I was looking at this morning said that we broke the previous record for the hottest month ever by 0.33C, which means we didn't just nudge the record up. We broke it by like a quarter of all of the warming that we've ever done in human history just this summer.
So I think in a certain way it looks like a kind of a summer of climate reckoning or climate awakening.
On the other hand, it seems like we sort of did this every summer last year.
We had extreme heat that killed 61,000 Europeans.
We had these dried riverbeds and for all across Europe, in the US too, in China.
And somehow this summer has felt to me at least a little bit different.
How has the summer looked to you?
I mean, the first thing that comes to mind when I think about this summer is how unsurprised I am and how climate scientists were at least mentally prepared for extremely hot temperatures this summer.
And that is because of two things.
That's because of climate change and that's because of the El Nino conditions in the tropical Pacific.
El Nino is a completely natural climate phenomenon that after the seasonal cycle is the primary source of variability in the climate.
It's basically where you get warmer than average temperatures off the coast of Peru in the equatorial
Pacific.
And because the entire earth system is connected, those have reverberations across the globe.
So we've got this El Nino condition, but it's nowhere near as strong as the strongest El Ninos on record in 1998 and 2016.
Which means we think it's contributing less warming at this point than previous ones.
Yes.
And the really significant thing that it's overlaid on top of is climate change.
Just to pull back for a minute, I wanted to ask you a really big picture question, which is, is warming speeding up this summer as we've been going through all of these sort of unusual events and trying to make sense of them.
I've also been a couple of assessments suggesting that over the last decade, maybe the rate of warming is moving up a little, but then there are other people looking at the data and saying it's quite a linear trend.
How do you assess the state of warming and what you think we might expect over the next decade, which is likely to be defined not by dramatic emissions increases, not by dramatic emissions decreases, but probably something like a plateau?
What are we looking at?
Are things getting warmer faster or are we basically moving forward at the same rate we were before?
The short answer is I don't know.
The longer answer is probably 10 years ago, you would probably have been asking me, is warming slowing down?

And that's because following the massive El Nino event of 1998, you could, if you kind of squinted, draw a line across global average temperatures that didn't look like it was rising very much.
You can reassess the data and it looks like it's rising a little bit, but this led to a lot of discourse about the so-called hiatus in warming.
You even had people on the floor of the Senate saying there hasn't been any global warming for 10 years.
Where's your science now?
And the reason for that is that there was a small slowdown in the warming.
These decades can happen.
We can have hiatus decades.
We can have surge decades.
She's just a reminder that these processes that we're talking about tend to play out over very long periods of time.
Because we are humans with the lifespans that we have and because the story of the emissions perturbation is the story that we have, which is depending on how you want to count a century and a half or maybe even just a few decades old, we want to tell stories in really short timeframes, but the climate system doesn't exactly cooperate.
Exactly.
And so there is the role of internal variability where sometimes in the hiatus decades, so following the big El Niño of 1998, we seem to have experienced cooler than average conditions in the equatorial Pacific for an extended period of time, kind of a protracted opposite of El Niño, a La Niña-like state that gave rise to large cloud cover over those regions.
And that was a stabilizing feedback that prevented lots of warming.
Those conditions are now gone.
And so there is an explanation where that is just internal variability.
Sometimes this happens, sometimes the reverse happens.
What for me is a much more interesting question is the different things that were, we call it forcing the climate system, the different external influences that are at play in the climate system.
So there was a pronounced slowdown in warming between about 1940 to about 1980.
A large contributor of that is what we call aerosols.
So pollutants, what sort of normal people think of as pollution, particulate matter that comes off of burning coal plants, burning oil.
That was a seriously huge problem in North America and in Western Europe.
And that not only showed up in health data and the daily lives of people in those regions, but also showed up in the global average temperature.
Because aerosols reflect sunlight, which means that when there are a lot of them out there, less sunlight is cutting to earth and therefore the warming effect is limited.
Not just reflecting sunlight.
So aerosols are also extremely effective at seeding clouds.
So there was that direct effect of aerosols are gas and dust that is blocking the sun, but they are also making clouds, which themselves block the sun.

So we have pretty good reason to believe that aerosol emissions were masking the warming.
It would have been warmer had those aerosol emissions not been there.
Now, right now, the world is not emitting zero aerosols, even though after clean air legislation in the US and Western Europe, the aerosol emissions from those regions have substantially fallen.
But they've grown elsewhere.
Globally, aerosol burden has declined, but the burden of aerosols has largely shifted.
So we're looking at emissions from South and East Asia right now.
And we expect in the future that those aerosols are going to be cleaned up.
We have already seen air pollution control happening in China in particular.
But as populations notice this, they do not necessarily normalize it.
They demand changes.
They demand action.
And so in industrializing countries, the pattern tends to be that air pollution gets really, really bad as the countries industrialize and then people get really, really angry about it and something is done about it.
So it is an unalloyed good thing that air pollution is projected to fall in the future.
But in terms of the climate impact, we're going to see less of that masking.
We're going to see less stuff in the atmosphere that's reflecting the sun.
And so that is a really, really important problem in the future that even if we got rid of all fossil fuel infrastructure tomorrow, in the short term, we would see a spike in temperature because of that air pollution, which is killing us, but also blocking the sun.
And the size of that spike is there's a lot of uncertainty around it even more than some of the other four things.
But my understanding is that the sort of median estimate is that it's offering about a half a degree Celsius of cooling and that some estimates get quite close to a full degree of Celsius of cooling, which we're not going to be cutting that pollution tomorrow instantaneously, but in a sort of a imaginary model world where you did do that.
You could be dealing with a quite dramatic spike, not just the equivalent of this July, but something like a much larger and more pronounced effect.
And maybe even over the next few decades, seeing as much warming from aerosol reduction is from additional carbon emissions.
Yeah, I do want to be very clear that that is not a reason not to cut aerosol emissions, but it is something that we have to be aware of.
There is a big difference though between aerosols and greenhouse gases in how they get into the atmosphere and what they do once they're there.
So all of the greenhouse gases we're talking about are well mixed in the atmosphere.
So that means it doesn't matter who emits them.
Somebody in America emits them, somebody in China emits them, somebody in Australia doesn't matter.
Every molecule of greenhouse gas put in the atmosphere has the same warming effect, no matter where it comes from.

Aerosols are far more localized.
Their impact depends on prevailing winds, their impact depends on where they are emitted, and they don't live very long in the atmosphere after they're put there.
The way I read a lot of the sort of real-time scientific analysis says that a lot of these anomalies that we've seen this year are within the range of what was possible.
So in that sense, as you say, it sort of confirms some of the predictions and models that we've made, but they're also on the high end.
And I wonder exactly how you think we should think about that pair of facts, that it's not that these events are showing us that our science is off, but it is showing us that we may be, at least in particular areas on particular points, skiing along the high end of what we thought was possible at this level of warming.
There are ways of interpreting that as a comforting set of facts, and there are ways of interpreting it as a discomforting set of facts.
So how do you think about it?
From my perspective as a physical scientist, which I do not expect to be the same perspective as a normal person, but for me, when there is a discontinuity or a disconnect between what the models say and what is actually happening, my first question is why?
Is it just because, well, weird stuff happens sometimes and this just happens to be an event that is unusual?
Or is it some fundamental process that we're missing?
Is there something we don't understand about the science?
And in some cases, we have identified things that we don't understand about the science, and there are a whole bunch of excited scientists trying to work on those problems to try to figure out the thing that we don't know.
I think it is unnecessarily fatalistic to say, oh, is the science right or is it wrong?
I think for me, the important question is what do we understand and what don't we understand and why?
I think that kind of gets us into a broader question about what climate models are supposed to do.
A climate model is supposed to be one not in which the world as we know it actually happens, but it's something in which the world we know it is possible.
And what I mean by that is a climate model is not designed to capture what we call the internal variability of the climate system, the natural random slosh back and forth of air and water that kind of determines day to day weather and even seasonal conditions like an El Nino.
A climate model is not designed to say, in 1998, there was an El Nino, and this year, there is an El Nino, and in three years, there's going to be a La Nino.
A climate model, instead, you can run it over and over and over again.
And every time you run it, the conditions are going to be slightly different.
The slosh of air and water are going to be in a slightly different position.
And so a climate model is not a weather model.
It's not designed to sort of predict short-term conditions or even medium-term conditions.
What they should do is they should reproduce the statistics of these events.

They should get the statistics correct.
And that brings us into kind of a weird place because when we're talking about the statistics of extreme events, when we call them extreme events, we're kind of acknowledging that these things are historically really rare.
It's really hard to get those statistics.
And so we are really reliant on the models to kind of tell us, like, is this expected or not?
How far out of the normal is this?
Is there going to be a normal anymore?
What is that new normal going to look like?
And I think the question of, is it worse than we expected?
That's often quite oversold, I think, in the discussion.
My question to that is, well, did you check?
Because a lot of these record-shattering events, no climate model was able to exactly predict in 2021 in the Pacific Northwest there is going to be a devastating heat wave.
But if you look at the emergence of these record-shattering conditions, climate models pretty much say that they should be happening.
You shouldn't just expect records to be broken.
You should expect them to be shattered.
Yeah.
I mean, one thing it calls to my mind, and I'm reading this literature a little bit more of a distance than you are, is just, it's just striking to me that we're talking about this summer using all these variables, which are much more prominent in the discourse than they were a few years ago.
And that's just like, we are still figuring things out.
We are still learning.
And as a result, it makes me feel like, as we're entering into this time of real transformation, climate transformation, we're also being confronted with this huge amount of uncertainty around everything we know.
We have models that they have confidence intervals, but living that confidence interval means actually living under a lot of uncertainty, because are you going to land at the 5th percentile outcome?
Are you going to land at the 95th percentile outcome?
Those are huge differences, and mentally, we calibrate our expectations on the median projections, but the world is telling us that climate and climate change is actually quite a bit messier than taking a median projection to the bank.
Absolutely.
For a long time, I personally have been really reluctant to talk about uncertainty because it is so easily weaponized by bad faith actors.
So I want to be really clear.
We don't know everything, but we don't know nothing.
There are certain things that we are very, very, very confident in.
Carbon dioxide, methane, nitrous oxide, these are greenhouse gases.

They make the earth warmer.
You put more of them in the atmosphere, you are going to see warming.
That's not something that really any serious scientist disputes.
That's just very, very basic physics.
Then when it comes to, well, what does that actually mean?
What does it mean to live in a world that's getting warmer?
Again, there are some things that we are incredibly confident in because they're just basic physics.
Warmer air is thirstier air.
You are getting more evaporation from the surface of the earth.
That water has to go somewhere, and so on average, precipitation rates increase as well.
At the same time, we know that warm air can hold more water vapor, so the carrying capacity of air for water vapor increases by about 7% for every degree Celsius we warm.
What that means is that when we do have these heavy downpours, there is more water to dump on us.
That's something that we understand really, really well.
But then what does that mean for rainfall in a particular town, a particular area?
That's where we start really running into the limitations of our knowledge,
the limitations of models in general.
That's because the earth is an incredibly complex interconnected system,
and that complexity can make it really, really difficult to make solid, firm projections.
A lot of times uncertainty is seized upon because people think, oh, it's uncertain.
Well, it could be terrible, but it could also be great, and so it'll probably be fine.
And I think it's really important to be clear that we have ruled out fine.
It's not going to be fine.
Warming is going to have consequences, and uncertainty is not our friend,
because if we had that degree of certainty, if we knew, sea levels will rise exactly this amount,
and then they will stop, and warming will stabilize at exactly this amount, and it will stop.
We would be able to make rational adaptation decisions.
They would be difficult, they would be costly, but we would be able to make those decisions.
Because there is that fundamental uncertainty in the system,
that's impeding our ability to make decisions and to adapt to what's coming and what's already here.
One thing I think about is science always has uncertainty built into it,
but it's also just this crazy uncertainty experiment that we're running
by moving the planet's climate into a new climate system,
in which there are going to be a lot of similarities and continuities,
but there are going to be some things that are really different.
And so there's beyond the sort of basic scientific humility of like acknowledging uncertainty,
there's also just, you know, we're running this experiment for the first time,
and we have very good educated guesses about where it will lead us.
But it's the risk of running an experiment like this at all,
is that there are going to be some things that surprise us.
When you and I last spoke, it was about a year ago,
and it was for a piece I was doing about kind of the narrowing window of climate futures.

So a lot of apocalyptic things, a lot of apocalyptic futures seems, you know,
relatively speaking, less likely, although we can rule them out entirely.
And as you just said a minute ago, a lot of the, everything's going to be fine,
soft landing futures were also looking pretty unlikely, if not impossible.
One of the other people I spoke to for that piece was Catherine Hayhoe,
and she said something to me that I've been thinking about a lot this summer,
which was, you know, we've definitely done a lot in decarbonization
to reduce the upper limit of our expected warming,
or thinking we're going to see less warming than we thought was likely five years ago.
That's great.
But we're also learning a lot about when climate extremes arise,
when really big impacts might hit us hard,
and mostly we're learning that those are happening sooner and faster
than we might have thought five or 10 years ago.
And you see a sort of similar story unfolding in the tipping points discourse,
where the people who have been most worried about tipping points
used to talk about them as risks at higher levels of warming,
and are now talking about them as risks at lower levels of warming,
maybe even at levels of warming, like the one we're at right now.
And I wonder if that is how you see the really big picture here,
that even as we're doing quite a lot to take control
of global average temperature rise through decarbonization,
not enough but a lot,
we're also learning about how messy and risky life at even lower temperatures would be.
I agree. I think a lot of times people are tempted to see a Paris Agreement warming target,
like two degrees Celsius or 1.5 degrees,
which is the high-ambition warming target,
which a lot of people are really focused on right now.
Those targets are not very meaningful scientifically.
The Earth doesn't really know the difference between 1.5 and 1.6.
So, a lot of times people think,
well, tipping points will definitely be triggered
if we cross a particular threshold.
And that goes back to the question of uncertainty.
I don't have enough certainty. I don't have enough science.
Nobody does, to be able to say,
we are safe if we limit warming to a particular level.
The flip side is also true.
We are not doomed if we exceed 1.5.
We are not doomed if we exceed two.
If we blow past a particular target,
I think the UN messaging is correct,
that it's every tenth of a degree that matters.

But going back to your question of when might we expect these tipping points to be breached, that's something that keeps a lot of scientists up at night.
So, the scientific definition of a tipping point is
something that you cross that you can't get back
within time scales relevant to human lives or human civilizations.
So, some of the tipping points that we're really worried about
have to do with the circulation of the atmosphere or the ocean.
That's something that is very, very worrisome.
Well, talk us through a little bit maybe about each of those
and what it would look like to cross those thresholds
and be on the other side of a tipping point.
Sure. So, let's talk a little bit about what the ocean actually does for us.
The ocean is incredibly important in the climate system.
It's obviously a near infinite source of water.
That's where water gets evaporated from,
that then gets turned into clouds and rain and goes back.
It also is really, really effective at taking up both carbon and heat.
So, the oceans taking up about 25% of anthropogenic carbon dioxide emissions.
That's not for free.
A lot of that is going into acidifying the ocean.
The ocean is also very effective at taking up heat.
It's absorbing the equivalent of five nuclear bombs,
a second of kind of anthropogenically added heat,
heat that humans have put in the atmosphere.
And another way of just thinking about that first,
just to jump in for a second is it's something like 90% of the extra heat
that global warming goes into the ocean,
which means they're getting nine times as much of an impact
as we're getting on land, the oceans.
That's like... Yeah, the ocean does a lot.
The ocean also moves quite a lot of heat around in the climate system.
The currents that have names, the currents that we think about,
are generally surface currents, things like the Gulf Stream.
Those are driven by the winds and the rotation of the Earth.
And the Gulf Stream and other surface currents will exist no matter what we do.
They will exist as long as the Earth is round and rotating.
But those surface current systems are superposed on a deeper, longer term circulation,
which we call the thermohaline circulation.
And that is really driven by not wind, but density.
So what happens when water flows north to the Arctic,
for example, in the Atlantic?
Eventually, a lot of it forms sea ice.
The left behind water that doesn't form the sea ice is saltier.

It's cold, it's dense, and that makes it sink.
So at the bottom of the ocean, we have this sort of river of failed ice
that is flowing and it's flowing southward.
Eventually, that water upwells, it comes to the surface again, and it closes that loop.
So we have this density-driven ocean conveyor belt that moves over hundreds
or thousands of years water around the Earth's oceans.
And when the circulation of that gets messed up,
we could expect to see large disruptions to things like precipitation patterns.
We have really good evidence that in the 70s and 80s,
pollution, particulate matter, what we call aerosols from Western Europe
and North America actually cooled the North Atlantic.
And there is a lot of evidence that links that to a migration of the rainband,
especially over the Sahel in Africa.
So that is just kind of an example of how, again, interconnected everything is.
Other things scientists are thinking about are disruptions to the arrivals
of the seasonal monsoons, much like the rainfall in the Sahel that I discussed.
The monsoons are very seasonal and enormous swaths of the world population
is dependent on monsoon rain-fed agriculture.
So any disruption we have to the monsoon could have massive,
massive humanitarian consequences.
And that's only the circulation category of tipping points we might see.
And those are systems that if they move into a new phase,
we would expect to not recover on the timescale of centuries, right?
It would take longer than that.
So then how does that change the way that you think about the broader story?
I mean, one thing I've, as I've been reckoning with a lot of this material
that's occurred to me is that we have so much science and so much science communication
about climate change impacts this century.
But thinking about tipping points really does sort of pull your mind a little bit
further into the future and force you to think about climate change as a millennial kind of event.
How do you balance those two perspectives in your mind?
Like because there are plenty of things that like, you know,
may result in relatively manageable climate futures over the course of the next 50 years,
but over the course of the next five centuries or 10 centuries will be much more disruptive.
I mean, sea level rise is probably the most obvious of those.
But how do you balance those two different timescale perspectives living,
living in the present where we're making decisions,
living a little bit in the medium term future where we think about the sort of consequences
of those decisions for our children and their grandchildren.
And then in the much deeper future where we're like thinking about a world
that's probably in ways totally independent of climate,
very transformed from the one that we know today.
You can ask a question.

What is the warming commitment that we've already locked in,
even if we zeroed out emissions tomorrow?
If we zeroed out emissions tomorrow,
the consensus among most of the models is that warming would stop.
You would have a balance between two effects.
So the ocean would continue to warm up.
But at the same time, the natural carbon cycle would start to slowly remove
some of that carbon that's accumulated in the atmosphere.
And the net effect of those is essentially no more warming.
And this is one of the reasons why getting to net zero is so important.
It's not just because it actually allows us to stop warming.
It could over the course of a century or so would allow us to undo some of it too, in theory.
Net negative would probably undo it.
Because again, at net zero, you've got this natural drawdown
of some of the CO2 in the atmosphere.
But at the same time, you've got the ocean still responding.
And so the compensation of those is not that warming decreases, but warming stops.
In order to get warming to decrease,
you generally need to do something extra to take CO2 out of the air,
whether those are enhancing land or ocean natural sinks or engineering a sink.
So sucking CO2 out of the air somehow.
But then the question is, okay, well, if warming stops whenever we stop emitting,
does that mean climate change stops?
And the answer is no, because we are still not finished
responding to the warming that has already occurred.
So even if we did zero out emissions tomorrow,
and even if we froze the temperature at 1.2 degrees Celsius above pre-industrial temperatures,
the Earth system is not done responding to that.
And so we expect to see some amount of sea level rise
into the far, far future as a result of that.
So that's kind of one way of answering your question.
We are not committed to further warming.
We can stop anytime we want to,
but we are not yet done responding to the warming that's occurred already.
I've seen estimates for the amount of additional warming that would be required
to keep carbon concentration stable,
which is to say to prevent the carbon cycle to draw down that carbon
and keep warming going as opposed to even stopping it
at something like one to two gigatons a year.
And maybe that's not precisely right.
There's uncertainty around that.
But it just is really striking to me that the Canadian wildfires we've seen this year
have already emitted more than a gigaton of carbon.

And we're not expecting those to happen every single year,
but the idea that we can be sure that if we manage our emissions as aggressively as we can,
that there aren't going to be some surprises like those Canadian fires
that are contributing additional carbon
and preventing us from drawing down what's in the atmosphere already,
that seems quite scary.
That brings up another potentially scary thing,
which is the idea of a carbon cycle feedback.
So as you pointed out, things that live on the surface of the planet,
either in the ocean or on the land,
take carbon dioxide out of the atmosphere by photosynthesis to make themselves grow.
A forest takes carbon dioxide out of the atmosphere,
not because it loves us,
not because it wants to absolve humans of what we do,
but because it needs the carbon dioxide to grow,
like trees exist to exist.
And when they are done existing,
they are done sequestering that carbon dioxide.
And if we bank on trees to take the carbon dioxide out of the atmosphere for us,
what happens when we make it too hot for certain types of trees to survive?
There's a lot of worry, speaking of tipping points,
that the Amazon rainforest and other tropical rainforest
could switch from being a net sink of carbon dioxide,
removing it from the air to a net source of carbon dioxide.
And so these carbon cycle feedbacks,
how are living things on the planet going to respond to increased warming?
Those are big wildcards.
The uncertainties are large.
It's almost never a good story.
None of the models are projecting a significant uptick
in the ability of the biosphere to remove carbon in the future.
So that kind of gets back to should we do that experiment?
And I think no.
I don't want to know what the carbon cycle feedbacks are.
I don't want to know how sensitive the earth is to doubled carbon dioxide.
I don't want to know the answer to any of these research questions that I'm interested in.
I don't think we should do that experiment.
One of the things that has always struck me about your writing and your thinking,
not just your scientific work, but in your sort of more assayistic work,
is how much you do center the sort of the human elements.
There's these climate dynamics that are going on.
Some of them we understand quite well, others a little bit less well,
but we have a pretty good sense of the broad trajectory of climate change.

We may even have a relatively good sense
of where the energy transition is going.
But all of that is like interacting and interfacing with the world
that we have built socially, politically, economically,
through culture, through infrastructure.
And in addition to the climate experiment we're running,
we're also running this other quite messy experiment,
which is like how does a planet warmed by say two degrees or two and a half degrees
interact with the civilization that we built under conditions of zero degrees of warming.
And even putting aside like whether the infrastructure works or doesn't,
how does it interact with our politics and our economics to be responding to
and adjusting to a world that's as distorted or contorted as a world
of two or two and a half degrees would be.
I wonder if you could talk a little bit about that,
about the human element, how you think we're doing on that front,
politically, culturally, psychologically.
Are we making the right sense of the changes that we're seeing out in the world?
Are we confused about it?
Like are there things that you think the public should better understand
or you wish the public would better understand about what is being asked of us as people
in addition to what we're doing to the planet itself?
I think I am probably the worst person in the world to ask that question of
because I am a physicist, right?
Like it is my job to understand how air and water move around in the system.
And air does exactly what physics tells it to do.
It's really easy to understand.
It always does the same thing.
It fits inside an equation really well.
There are uncertainties that come from the fact that there's a lot of air,
there's a lot of water, there's a lot of land.
It's all interacting.
But fundamentally, those things do what you tell them to do
because they are obeying the laws of physics.
People do not do what you tell them to do.
That's why I find them fascinating,
but that's also why I don't understand them
and I don't make any pretense to having any sort of special insight
or moral superiority to tell people what to do.
I do find people very interesting though,
and I do find past examples of how people have reacted
to past climate change to be completely fascinating.
So in between the 1300s, 1400s to about the 1700s,
in the Northern Hemisphere, we seem to have experienced

relatively cool conditions, something that's sometimes called the little ice age.
The best attribution science now sort of thinks that was due to a mixture
of some circulation changes in the North Atlantic
and primarily a series of really powerful volcanic explosions
which blocked the sun cooled down the planet, at least partially.
And if you look at the history, especially in Europe,
of the little ice age, things start getting real weird.
You start seeing an increase in religious conflict.
You also start seeing an increase in witch burnings.
And a lot of times the witches that are getting burned
are getting burned or hung or executed or accused
because of something they have done to the weather.
They have raised a storm.
They have killed the crops.
They have made the winds blow.
They have done something.
And it's really fascinating to look at the linkages
between the weather getting weird and these cultural impacts that come out of it.
Now, do I think that climate change is going to lead to an increase in witch burning?
No.
But it does show how climate change happens in the world that we've built for it.
And that's something that is impossible to fit in an equation.
It's impossible to have a model that's at all meaningful
that says that, well, as carbon dioxide concentrations increase,
the number of old women who are going to be accused of witchcraft is also going to increase.
That's not something that makes any sense, but that really does show
the fundamental unpredictability of human beings and human civilizations
in the face of adversity.
Sometimes there is conflict, people fight each other.
Sometimes there is collaboration.
Which one of those is more likely to happen?
Well, I think both are going to happen in the future.
And I think it's really impossible to have a grand unified theory of a species
that's so deeply weird as we are.
Yeah, I want to talk a little bit in a minute about the suitability of the world
as we have built it for the climate that we are entering into.
But before we get to that, I just wanted to pick up on a couple threads from that last answer.
I was just reading an article in The Economist about the heat waves and in it,
they drew on this work by Marshall Burke and Saul Scheng and Edward Miguel
about the relationship between climate and conflict,
which suggested that as global average temperatures got hotter,
we might see some significant additional conflict,
mostly at the interstate and civil war kind of level.

And The Economist was saying just looking at the anomalous temperatures in July,
we might see like 50% more conflict than we would see otherwise without that warming.
And I emailed Marshall and said,
well, I know your data was like based on long-term average trends.
Like is this a fair leap to make?
And he said, well, we're actually updating it for monthly averages
and the numbers aren't very different.
So I wouldn't be surprised if that was actually how it netted out.
And that is absolutely astonishing to think about even in the range of possibilities here.
But it also brings to mind all of these other questions about how we talk about
the attribution of really complicated events and episodes to climate change or not.
How do you think about how to talk about that complicated web of causality
and how do you think the world as a whole is doing and understanding
just how complicated those dynamics really are?
I think we need to acknowledge that we're not going to get the comfort of this false binary.
We're not going to be able to say climate was the only factor,
but that doesn't mean it's not a factor.
Take, for example, wildfires.
Wildfires are dependent on many different things.
They're dependent on the weather, hot, dry conditions.
They're dependent on the amount of fuel.
They're dependent on ignition, so either lightning or human action,
and they're dependent on suppression.
The damage they do really depends who's living in harm's way.
And not all of those things are amenable to description by physics.
I focus a lot on the physical causes because that's my job.
That's my expertise.
But when we talk about wildfires, let's take, for example,
even though we're here on the East Coast, we've had impacts from Eastern Canadian wildfires.
Let's talk about wildfires in the West because the science is much more robust
when we talk about wildfires in Western North America.
We do know that the hot, dry conditions that are more conducive to fire,
fire weather, those are getting much more likely.
We also have reason to believe that we're going to see much,
I guess, swingier precipitation, really, really wet wet seasons,
really, really hot and dry, dry seasons.
That has implications for fuel.
If you have a really, really wet winter,
you could have a lot of vegetation growing and that vegetation is going to dry out
in the summer and burn.
So those things are kind of amenable to description via equations.
We can say, this is our knowledge of physics.
This is how it's changing.

But what does that mean in terms of the ability or the desire of humans to venture into forests and build campfires or have gender reveal parties or whatever?
You are looking at the culmination of not just current policy choices, but a long history of policy choices.
Who gets to live on that land?
Who gets driven off that land?
Who gets to make these decisions?
And again, I can't put it in a climate model, but it doesn't mean that it's not vitally, crucially important.
Yeah, wildfire, I think, is a really powerful example for a number of reasons.
But one of the things that I always find myself thinking about is hearing occasionally from people who say, we shouldn't worry all that much about the trends in wildfire because fires used to be much more pervasive in the American West 500 years ago, 200 years ago.
And that's true.
There was more burning in those forests in the past, but also there were not 40 million people living in California.
There were probably less than 1 million.
And the way that we think about those risks has a huge amount to do with those 40 million people, not just the fires themselves and whether 2020 was merely the worst season in 130 years, or whether it was the worst season in 500 years.
And even in a relatively steady climate trajectory where things are getting kind of predictably worse, our experience of that climate may still involve quite a lot of shock moments because the world that we've built out in the infrastructural world, but also our political systems, our emotional infrastructure, all of that is calibrated to climate conditions we've already left behind.
And as a result, there's going to be some episodes in which we can tolerate some amount of additional warming and some higher impacts and risks.
But then at a certain point, that gets broken.
If you think about sea level rise and floods and a small flood wall can protect some high days of flooding, but then you've got to really, even just the last foot can have a completely devastating impact on the city,
I wonder how you think about that set of questions, like the degree to which we are all of us living on assumptions from an earlier climate era, how much we have to do to navigate the new world full of more climate risks and how far along in that process we are at a policy level, but also at an emotional sort of intellectual level.
So first of all, no adaptation is not really an option anymore.
We have no choice but to adapt to the changing climate because climate change is already here.
I was watching a documentary the other day and it was kind of old.
It was about 15 years old.
And I was so struck by the fact that they were using polar bears to illustrate climate change.
And I was thinking nobody really does that anymore because it's so obvious that this is not a problem that just affects polar bears.

This is a problem that is affecting us and it's something that we are going to have to prepare for.
At the same time, you sometimes hear this very glib like, oh, we're rich, we'll just adapt, especially in wealthy countries.
And there is no just to the adaptation because, first of all, if you don't reach net zero, if you don't stop climate change, it's a constant moving target, adapt to what?
On the other hand, adaptation means something really, really drastic.
It means relocation of communities.
It means maybe abandoning really beloved areas.
It is an extraordinary undertaking that doesn't mean that it's not necessary.
That doesn't mean that it's not possible.
But I don't think we should be glib about it at all.
Along the way there, there's also the risk, I think, that as we see more and more intense impacts start to adapt to some degree, we also adapt by normalizing and by acclimatizing to things that we would have considered unworkable and unlivable conditions not that long ago.
And I think our experience with wildfire smoke here is pretty illuminating, which is to say, like, there were people who worried about smoke impacts from fires five years ago in California, but most people worried about property damage and lives lost and towns being destroyed.
Then starting in 2020, when we had these really eerie images from San Francisco, really bad toxic air days, I think the public started to worry a bit more about smoke and public health impacts.
But those of us living in the East Coast were like, well, that's crazy Californians.
They're dealing with that.
That's well beyond what I could tolerate in my own life.
And then we had a few days, depending on how you want to count, a few days or a few weeks of really bad air here.
And almost like by the second or third day, the emotional calibration at least of people I knew was like, well, I guess this is going to be a thing now.
It wasn't to treat this impact, which five years ago we would have thought of as totally intolerable as still intolerable.
It was to incorporate that into our understanding of the next 10 or 15 years of our lives.
And there's a way in which that's quite healthy, because probably it is going to be a feature of at least our worries, if not coming every summer, but it also tells us something about how quickly we're redefining our standards for a comfortable climate capable of sustaining human flourishing and how differently we're defining those terms in order to allow ourselves some safe operating space emotionally for living in that world.
I'm actually going to disagree with you because what is a podcast without a good fight?
So I actually think we cannot normalize this and we have to push back really, really hard.
When you say cannot, you mean that it's beyond our capacity or do you mean that we have to resist it?
Oh, we have to resist it.
We have to resist it.
And I think there has been a strain in climate storytelling of fatalism.
And sometimes that fatalism is coupled with, well, humans are bad and terrible.

And this is our divine judgment, our punishment.
Sometimes it's scolding, like you are terrible and this is your punishment and I have to live with it and I hate you.
And sometimes it's just very sort of fatalistic.
There's nothing we can do about climate change.
We're just going to have to live like this for the rest of our lives.
When the Cuyahoga River caught on fire, the air quality was terrible in New York, but that would have been kind of a moderately bad day, not that much different than normal, you know, in my parents' lifetime.
And that was normalized for a long time until it wasn't, until it became clear that there were solutions.
Now, I don't want to say that any particular single piece of legislation can ever solve all of the problems, but the Clean Air Act of 1970, which was not passed by a wonderful, loving man who loved humanity and the environment.
That's not how you describe Richard Nixon.
No, it is not.
But, you know, there was a confluence of factors.
There was increased scientific understanding of where this problem was coming from and what we could do about it.
There was popular pressure.
The first Earth Day was 1970, lots of people out on the streets marching, school groups, church groups, and there was a president who saw an opening, not because he was a lovely, warm, fuzzy, wonderful person, but because the conditions made this possible.
And I think there are a lot of stories of environmental success in the record.
None of them are perfect analogies for where we are.
That's what it means to be living in the future.
We are not living in a story that has ever happened before.
I'm sorry, that's just what it means to be alive.
But I think we cannot normalize this.
We cannot say the climate is just going to change and we're going to blow past all of these targets and it's just going to get worse and worse and worse.
I think we have to demand, this is bullshit.
We don't like this.
We don't want to live like this instead of accepting it.
Well, I think as a sort of political goal and value set, that's totally admirable.
But when I think about, for instance, the way that people in Florida or California are responding to the end of insurance for their homes, we're not seeing a mass exodus.
In fact, we're still seeing to some degree in some parts of the state's real population growth.
We're seeing tons of people flooding to the parts of the U.S.
where climate impacts are expected to be most intense and maybe that's a sign of optimism about our ability to redesign our future to allow us to live in those conditions.
But it also seems like not necessarily the most rational response to a climate we know is changing and suggests that on the whole at a population level, even as we're endeavoring

to limit warming and endeavoring to make a future that's more livable, we're also coming to accept climate outcomes that a decade or a generation ago would have seemed quite horrifying to many of us.
I mean, I think we have no choice, but you say accept, I say continue to live through.
I don't know precisely what the boundary between acceptance and merely continuing to exist is.
Yes, these are conditions that are happening.
The skies in New York were orange earlier this summer.
In Phoenix, it's been over 100 degrees for however long.
These are conditions that are happening.
I think that it is completely appropriate to demand that they not happen.
We can't demand no global warming.
We're already at 1.1, 1.2 degrees above pre-industrial temperatures.
We can't put that cap back in the back.
We can't say we want no global warming, but we can say we want to limit global warming and we want sensible adaptation measures.
Both of those things are incredibly tall orders, but that's what politics is for.
We want to live in a society.
We want there to be buildings built.
We want there to be roads.
We want there to be subways.
All of those things are way, way bigger than any one person can deliver, but we want them, so we have them.
I think we need to say this is not acceptable, this is not normal, and things have to change.
When you take off your physicist hat and put on your politics hat, how do you assess the state of climate politics in the US and more generally around the world?
I mean, obviously, we're moving faster than used to be the case.
There's more general consensus about the fact of the problem than the necessity of taking some action in response to it than even just five years ago across the world,
but we're still falling short of the goals and targets that we collectively set for ourselves, even as some of those targets start to seem less safe than they might have seemed five or 10 years ago.
How do you think about the state of politics as it relates to this challenge?
How do you calibrate your own sense of where we are and where we're headed?
I have scrupulously avoided having a politics hat.
I don't want one.
What I can say from my personal experience is I have noticed a sea change.
Five, 10, 15 years ago, there was only one story that ever got told about climate change, and it was, is it happening?
Let's get all of these scientists who say it is and this one guy says it's not.
All right, let's have them fight.
I understand where that came from, the urge to inject conflict and drama into what's fundamentally a really, really difficult thing to wrap your mind around.
Sometimes it would be scientists fighting with Guy in a Suit.

Sometimes it would be like, look at this sad polar bear.
It's going to die and it's all your fault because you're a bad person.
But those were really the only stories that ever got told.
And in, I want to say 2018, because that was the release of the UN's 1.5 degree special report, which mea culpa I was grouchy about.
I thought it was fan fiction.
I thought, well, there's no way we're going to limit warming to 1.5 degrees.
Why are you doing this?
And, you know, like, oh boy, what the world needs is another report.
Great, let's do that again.
And for reasons that I don't understand, I was so wrong.
I was so wrong about how that was going to be received.
I was so wrong about how that would land and it started something.
It's the same year that Greta started striking the foundation of XR,
the sit-in of Sunrise.
Sunrise, talk about tipping points.
That's not something that I was able to anticipate.
And now I almost never get asked, is it real?
I almost never get asked, well, what does climate change mean and why should I care?
Instead, I get asked the really good questions about uncertainty, about what's happening, about how we can prepare, about what we can do.
And for me personally, the fact that we are talking about what we can do is really exciting because all I ever wanted to be in the climate debate and climate politics was irrelevant.
And I am really, really rapidly, as a scientist, approaching that point
where I am not the first point of contact.
If you're writing a climate story, you don't necessarily go and talk to a scientist and say, oh, hey, is this real? Is this really happening?
You're going to go and you're going to talk to somebody who works in renewable energy.
You're going to talk to an electrician.
You're going to talk to somebody trying to craft climate policy.
You're going to talk to an entrepreneur.
And now there are so many more stories to be told about climate.
And that's something that is a massive, massive sea change for me.
Yeah, I mean, I think you're being too modest about being irrelevant, even speaking on behalf of climate science, because I do think that there are these really important questions about exactly what it means, the difference between two and two and a half degrees,
particular impacts in local, like there's a huge amount for science to tell us.
I do think we're living in a different world now where we do see the machinery of decarbonization actually finally getting going.
We're starting to see that show up in our understanding of and our projections for the future.
All of that's extremely exciting.
But I worry a little bit that the story of progress and decarbonization
is crowding out some of these other challenges and these other difficulties,

that we are excited to be on the march to net zero,
even if it's going to be in 2070 as opposed to 2050.
And we're excited to be making impossible the scariest climate futures
that some of us worried a lot about a few years ago.
But that doesn't mean that the challenges aren't real and right in front of us,
and may even prove quite catastrophic when all of a sudden done.
And I wonder how you think about those questions at a sort of storytelling level,
which is we obviously need to be talking about both of these things at once,
the things that the climate is telling us about,
how different and likely how much harder life will be because of climate changes,
but also everything we're doing to take control of those challenges,
both through limiting warming and through adapting.
But finding that balance feels to me like pretty hard,
and maybe it feels hard to me because I'm just on a roller coaster about it
and in one month I feel one way and one month I feel the next way about it.
How do you think about it?
Yeah, again, as a kind of a storytelling level.
I think all I can do is answer for myself.
So I don't feel one particular way about climate change.
I feel many different ways about climate change.
Some days I'm very excited.
I'm very kind of joyful by looking at all of the work that's being done.
Sometimes I'm really afraid.
Sometimes I'm really, really angry.
And I think that's completely appropriate and normal and natural
to hold all of these things in my head.
Going back to your question before about the timescales,
I want to kind of invert that question because that's the way that I think about this a lot.
So there's a really negative story you could tell where even if we get everything right,
even if we reach net zero in 2050 like we're supposed to,
and all of these amazing technologies come online,
and we rebuild our entire energy system, our transportation system,
we really transform our farm system, we do everything right.
We're not really going to be able to tell climate wise for decades.
The best case scenario from a climate perspective is just less bad than it would be otherwise.
And that's because it takes a really, really long time for these changes to kind of percolate
through the system for you to distinguish the signal from the noise.
So it's going to take decades to say, oh, we're in the good place as opposed to the bad place,
or not the good place, the less bad place.
But if you look at the near term benefits, you get rid of a coal fired power plant
and immediately the next time it rains, that washes out all of the gross particulate matter
pollution that coal plant put in the atmosphere.
So you get cleaner air almost immediately.

That starts to show up in mortality morbidity statistics really, really, really quickly.
And just to put a pin on it for the listeners, those numbers are horrifyingly large.
Some estimates in the millions annually dying from the pollution from fossil fuel burning.
The estimates that I've seen say air pollution is a factor in 11% of deaths worldwide.
We're talking millions and millions and millions of preventable deaths.
So air pollution is a killer.
Air pollution is disgusting.
And air pollution is not something that we have to live with.
You know, if I wanted to use the lingo, I'd say that is a co-benefit of climate solutions.
But that is a massive near term benefit.
And there is a large research literature that says that we're going to see less infant mortality.
We're going to see if we do this, we're going to see less mortality morbidity.
We're going to see people living longer, healthier lives.
We're also going to see increases in things like labor productivity.
Now, if we adopt various other climate solutions, we get co-benefits in terms of
better biodiversity.
Not cutting down forests is a climate solution.
And that's going to have co-benefits that show up much, much, much quicker than any climate benefit.
And so if you invert that, and I think about this a lot.
So in the IPCC report, there is a figure of a child born in various years on the climate
that they will experience as they grow older.
I want to take that figure and I want to kind of invert it and think about if we take these climate actions, what are the positive benefits that can accrue and when do they start accruing?
So if we limit warming to 1.5 C, our great grandchildren are going to thank us for avoiding
more catastrophic sea level rise.
But if we do that, we ourselves, not our children, not even ourselves in 10 years,
we are going to experience those benefits of cleaner air immediately.
There's going to be more people alive now.
And I think that's something that's really worth doing personally.
Well, I think that's a really great place to end.
And since you're a repeat guest, you would know that as you come on the show,
you're supposed to come with three book recommendations for the audience.
What are your books?
My first book recommendation is actually not a book.
It is a short story.
In fact, it's such a short story that it's about a paragraph long.
And it's called On Exactitude in Science by Jorge Luis Borges.
And it is the perfect distillation of the process of modeling, of trying to represent nature by something smaller and more tractable.
My second book recommendation is kind of off the wall one.
We talked about the little ice age and we talked about witch burning and the little ice age.
Turns out that British monarch James I published a paper on how to identify and deal with witches

because he was really obsessed with witches being the king in the middle of the little ice age.
And he was previously the king of Scotland.
He was brought down when Elizabeth I died.
And so if you are a playwright and you want to appeal to this kind of Scottish weirdo who's in charge, who's really obsessed with witches, what are you going to write?
And so that's where Macbeth comes from.
And I have been rereading that in preparation for some things that I'm writing about the little ice age.
And I'm just really struck by these themes of guilt and also really struck by the extent to which the witches in Macbeth are manipulating the weather.
And so I think that is a really interesting view into a world in a different climate than the one we are in right now.
And my third book is not out yet, but it's available for pre-order.
And sort of to preface this, I have a lot of problems with climate fiction.
I find a lot of it to be kind of unnecessarily apocalyptic or very preachy.
And it's just not something that I like to consume off hours.
And so there is a book, which I've been fortunate enough to read a preliminary draft of.
It's called Troubled Waters.
It's a novel by Mary Anais Hegler.
And it's just a warm and beautiful and complex story about a southern black family wrestling with the climate crisis.
Kate Marvel, thanks for coming on the program.
Thank you so much for having me.
This episode of the Ezra Klein Show was produced by Roland Hu, fact-checking by Michelle Harris with Mary Marge Locker and Kate Sinclair.
Our senior engineer is Jeff Geld.
Our senior editor is Roger Karma.
The show's production team also includes Amapha Agawu and Kristin Lin.
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