

The Climate Crisis and the Science of Resistance

Scientist Rebellion



Outline

- The climate and ecological crises: what we know, where we're heading, what's at risk.
- The human cost of inaction: a genocide unfolding.
- The political crisis. How did we get here?
- Non-violent civil resistance.
 - the practical case
 - the moral case

The Crisis 101

- The greenhouse effect has been known about for ~150 years - some gases trap more heat than others; as we add CO₂/methane to the atmosphere, the Earth heats up.
- The last time CO₂ levels were this high temperatures were 2–4°C higher and sea levels 20–25m higher (Rohling et al., 2009; Jansen et al., 2020). We are on course for 2-3C warming by 2050.
- Temperature increases over land are 2-3x higher than the global average increase (IPCC Report, 2018)
- We are living through the Earth's 6th mass extinction (Living Planet Index 2020), with human impact in the last 50 years comparable to the asteroid which wiped out the dinosaurs. This rate of destruction is still accelerating.
- 1-3 billion humans could be displaced by 2070 (Xu et al. 2020), with global collapse of food networks plausible (Arora 2019) and social breakdown likely to follow (IEP 2020).

Rohling et al., 2009, Nature Geo, 2, p500–504

Jansen et al., 2020, Nature Climate Change, 10, p714–721

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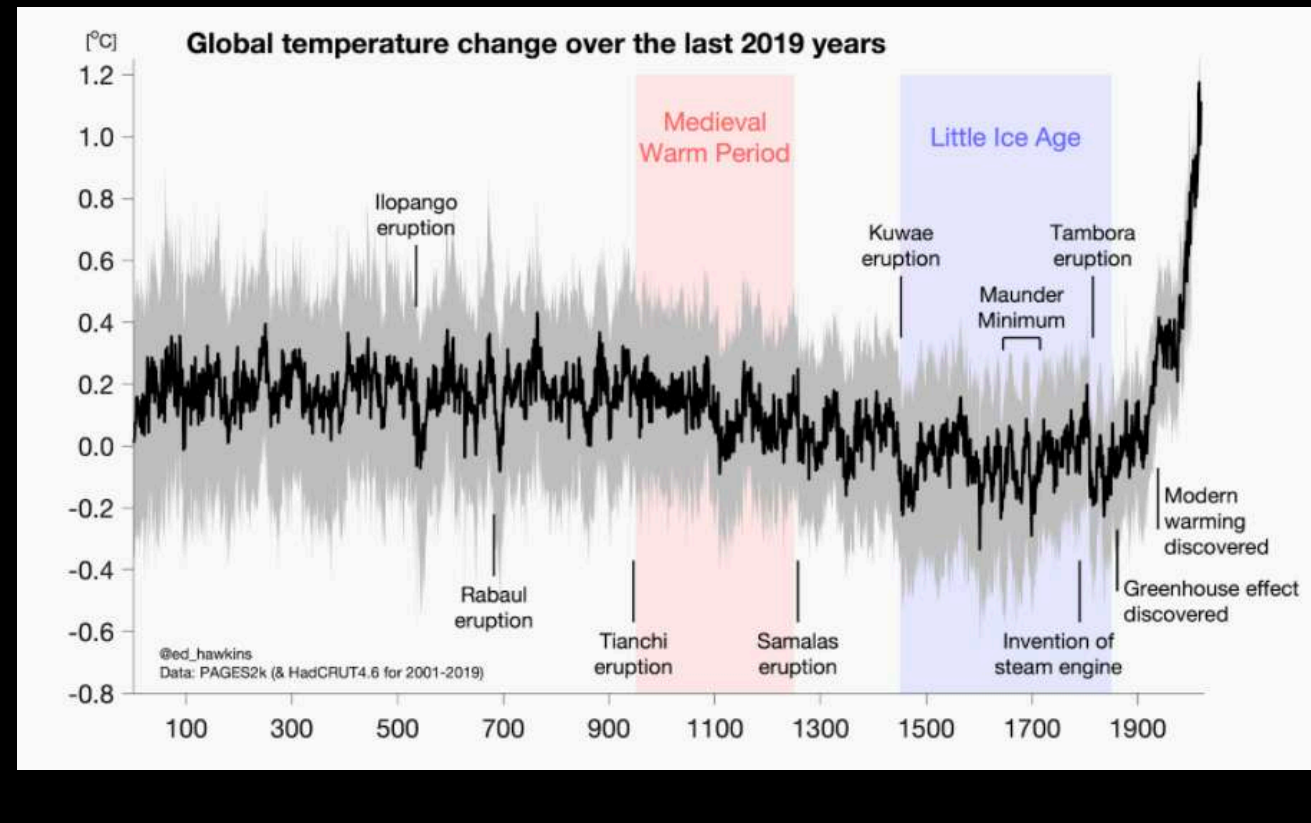
Living Planet Index 2020

IEP Ecological Threat Register, 2020

Xu et al., 2020, PNAS, 117 (21) 11350-11355

Arora 2019, Environmental Sustainability, 2, 95-96

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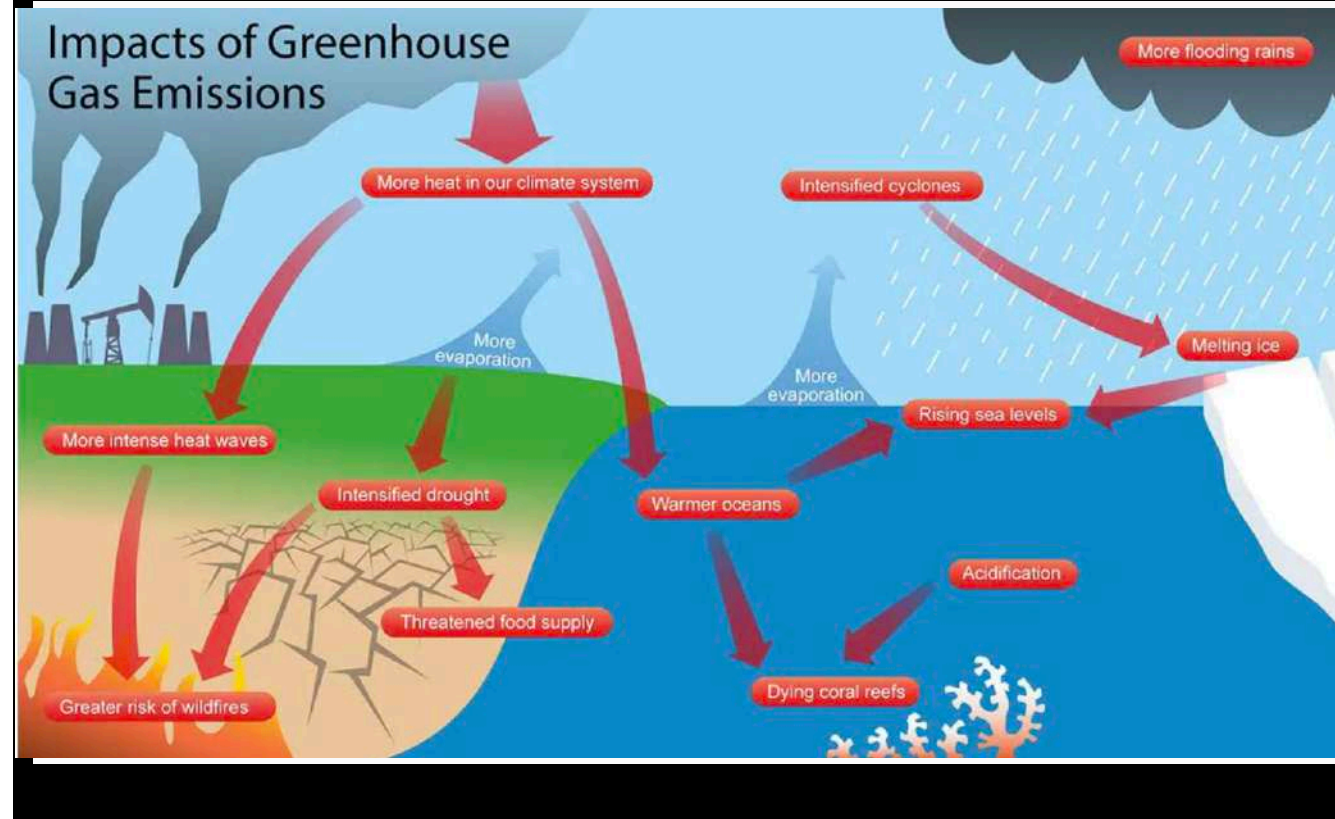
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The Crisis 101

“The startling conclusion is that continued exploitation of all fossil fuels on Earth threatens not only the other millions of species on the planet, but also the survival of humanity itself – and the timetable is shorter than we thought” – Prof. James Hansen

“[at 4C] it’s difficult to see how we could accommodate eight billion people or maybe even half of that” – Prof. Johan Rockstrom

“There is a very big risk that we will just end our civilisation. The human species will survive somehow but we will destroy almost everything we have built up over the last 2000 years” – Prof. Hans Schellnhuber

"The climate emergency is our third world war. Our lives and civilization as we know it are at stake, just as they were in the Second World War." - Professor Joseph Stiglitz

“The climate crisis is the greatest ever threat to human rights. The economies of all nations, the institutional, political, social and cultural fabric of every state, and the rights of all your people, and future generations, will be impacted.” - Michelle Bachelet, UN High Commissioner for Human Rights

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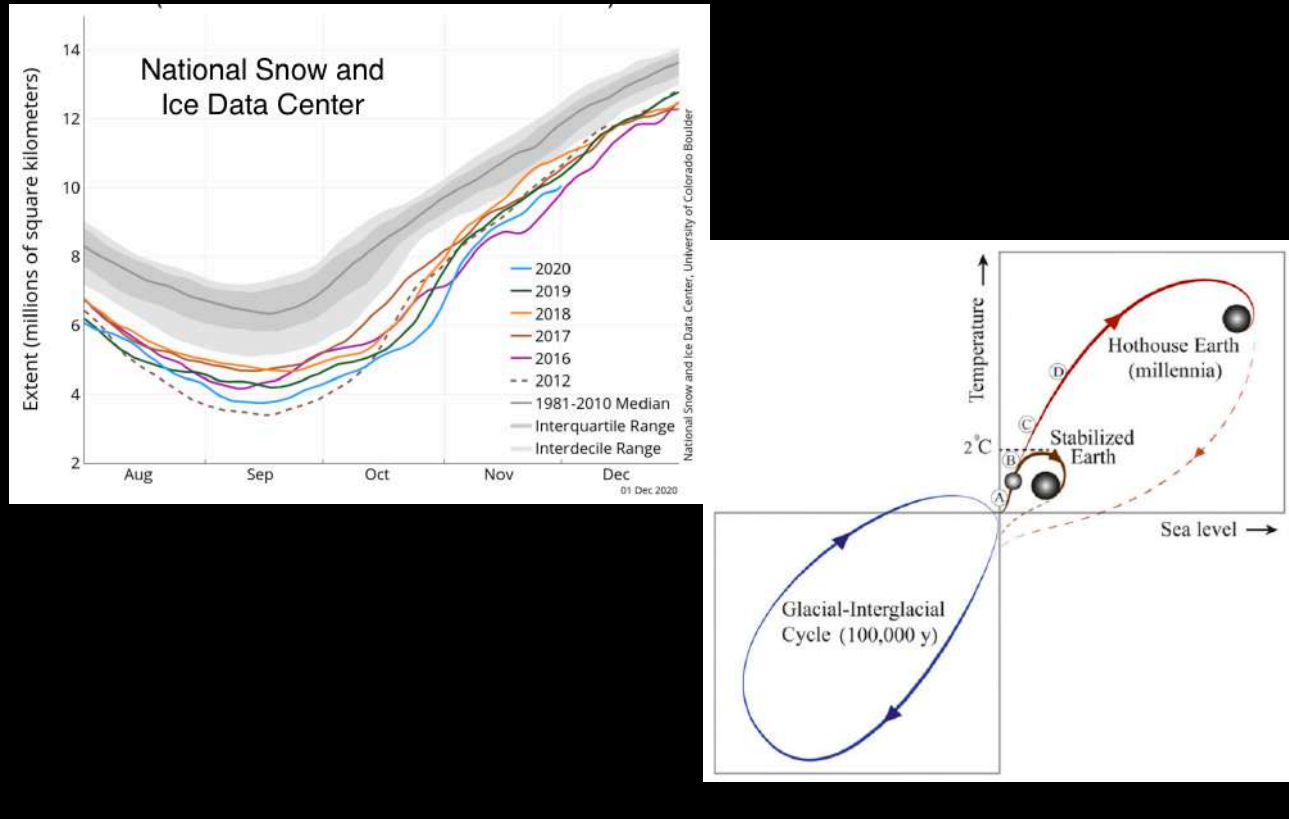
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Non-linear Feedbacks



Feedbacks are natural mechanisms within the climate system which reinforce some process, i.e. accelerate it, once some climate threshold, or tipping point, is crossed. For instance, arctic sea ice has declined dramatically over the last few decades, accelerating in recent years. Ice acts as an excellent mirror, reflecting around 90% of Solar radiation, while water absorbs around 90%. This means that, as the ice retreats, far more heat is absorbed by the polar regions, driving accelerated warming - around 0.4C is added due to disappearing arctic ice (Wunderling et al., 2020). There are dozens of such tipping points known, and likely others not yet recognised. Other prominent examples of feedback sources include:

thawing permafrost (a layer of frozen soil which contains enough carbon and methane to raise global temperatures by perhaps 2C, were it to thaw).

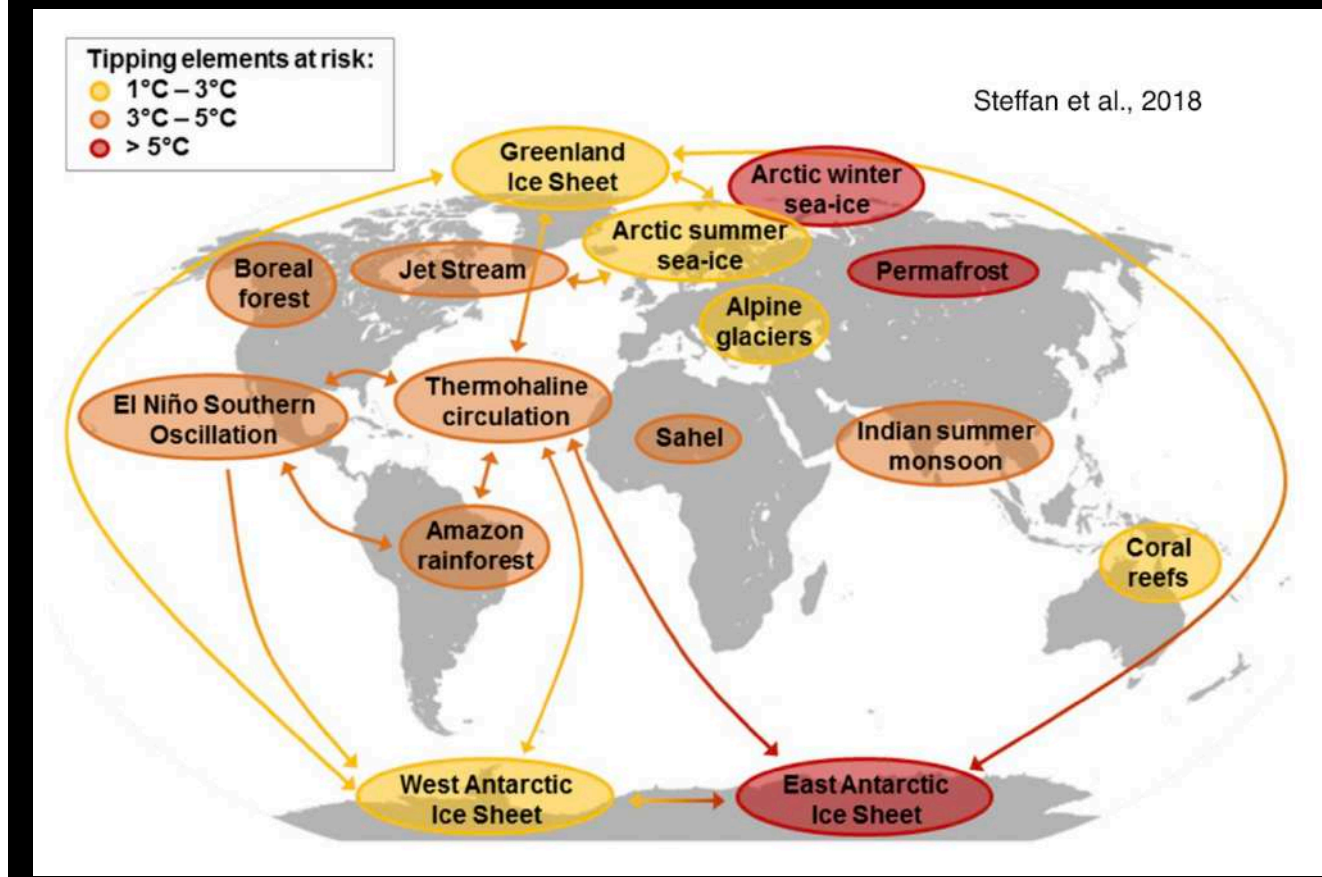
peatland fires (peatlands are boggy regions which store more carbon than all the world's forests).

collapse and subsequent desertification of the Amazon rainforest (the Amazon collapse tipping point is believed to exist at around 20-40% deforestation: it is currently at ~17%.)

ecological destruction (such as the staggering recent loss of coral reefs, or boreal forests, destroying carbon reserves).

There are alarming signs that some of these tipping points have already been reached. One tipping point could trigger another, thus causing a cascade of collapsing environments, driving the planet irreversibly to a far hotter state (e.g. Steffen et al., 2018; Rocha et al., 2018; Lenton et al., 2020). Such an outcome represents an existential threat to humanity. To avoid this future, we must decarbonise as rapidly as possible.

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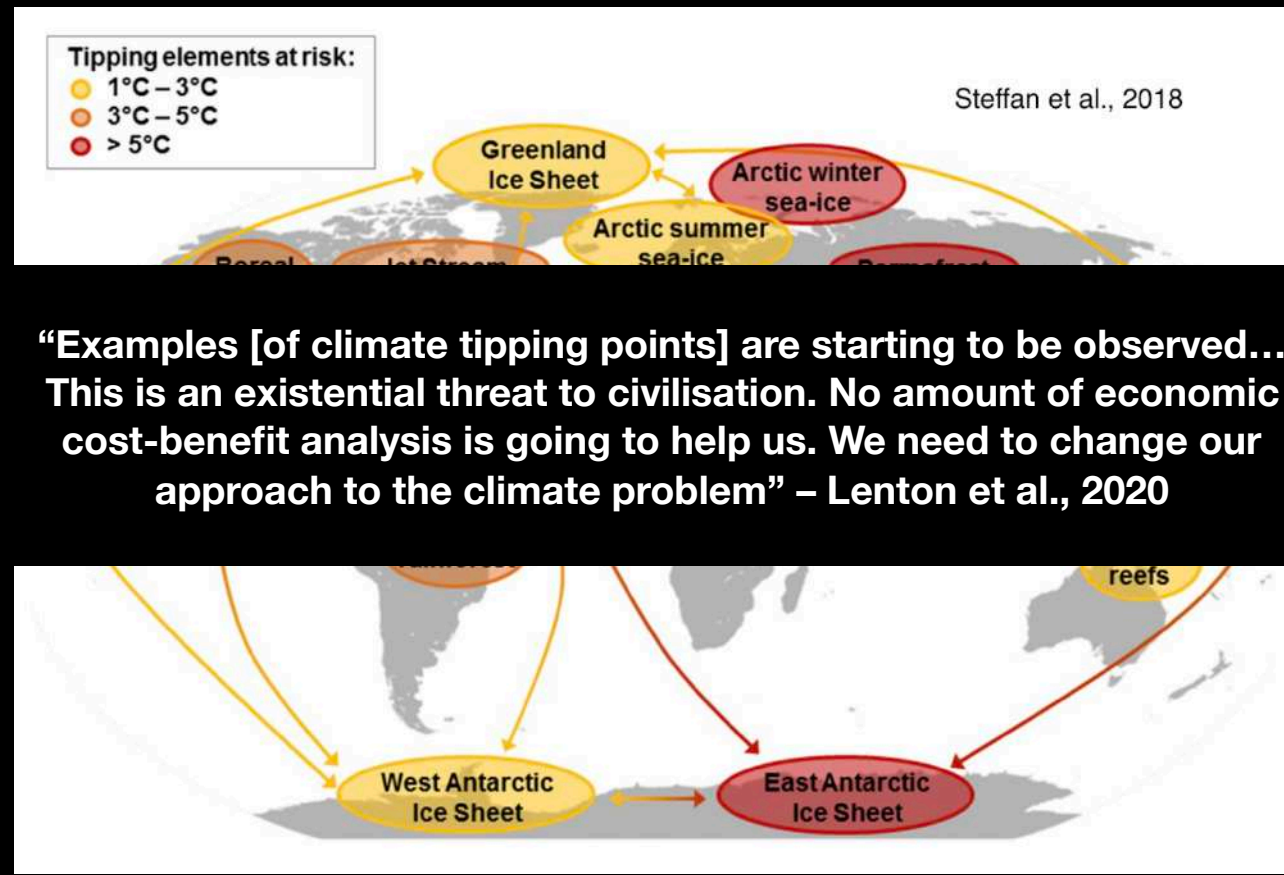
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“Examples [of climate tipping points] are starting to be observed... This is an existential threat to civilisation. No amount of economic cost-benefit analysis is going to help us. We need to change our approach to the climate problem” – Lenton et al., 2020

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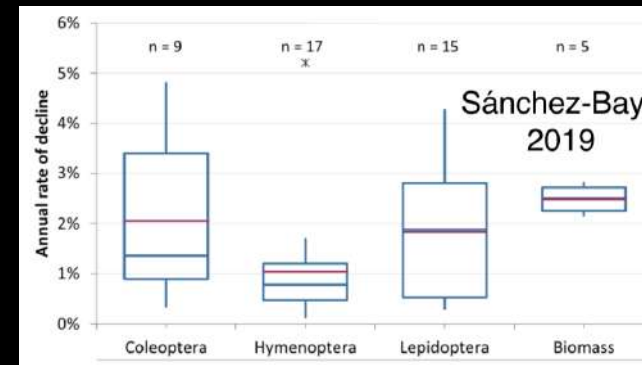
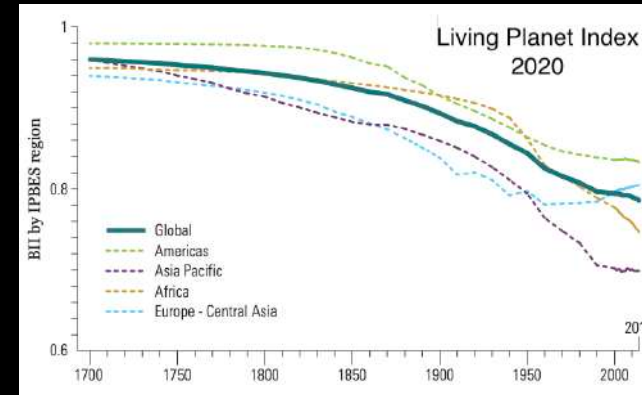
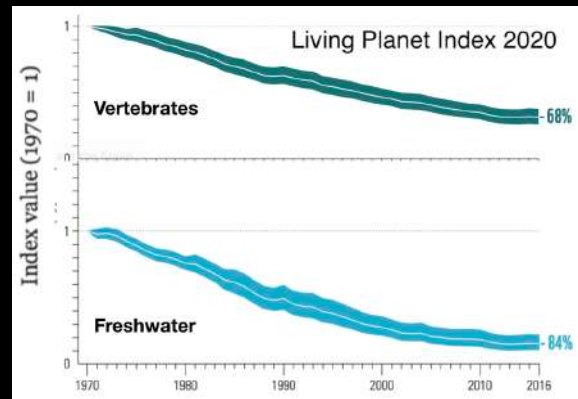
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The Ecological Crisis



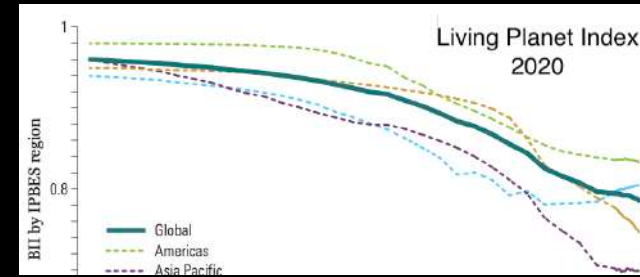
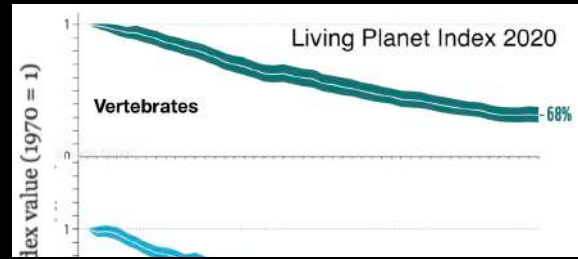
The biomass of mammals, birds, fish, reptiles and amphibians have declined by ~70% in the last few decades. Wild animals account for just 4% of the animal biomass today, with the other 96% made up of humans (36%) and their livestock (60%). This animal decline varies by region: in South America the decline is closer to ~90% according to the LPI.

The reasons for this are primarily: habitat destruction, over-farming/hunting, and global warming and climate destabilisation (this is highly non-linear - animals (including humans) have thresholds beyond which they cannot survive because their bodies dry out, they cannot keep cool enough to continue metabolism etc. Single heatwaves can have devastating impacts, so as the climate heats more mass-dying events occur).

Insect biomass declines imply most will be gone in a few decades, with declines of over 75% in a number of geographically-limited studies (e.g. Hallmann et al., 2017; Lister et al., 2012) since ~1980, and 40% of insect species facing imminent extinction according to a review of 73 studies (Sanchez-Bayo 2019), catastrophically threatening agriculture and ecosystems. Extrapolating from observed rates of decline shows that we only have 20-40 years before populations collapse. The loss of insects has impacts which are hard to overstate, since they form the base of food pyramids. The reasons for their loss are primarily habitat destruction, modern farming practices such as pesticide use, which can have extremely deleterious effects on insects, and climate heating/destabilisation.

Ocean populations face similar catastrophe. Overfishing is an enormous issue (and utterly unnecessary - by leaving parts of the ocean free of fishing, studies show that these sanctuaries spill out into fishable waters and improve yields, so imposing restrictions actually increases productivity), but is just one part of the problem. Heating and acidification are two others. One recent study found that 70% of radiolaria (a family of plankton) were unable to geographically shift fast enough to avoid extinction in a previous period of rapid climate change (far less rapid than today, and less extreme than the total expected climate shift), instead going extinct (Trubovitz et al., 2020). Plankton form the basis of virtually all marine life, provide the vast majority of the world's oxygen (i.e. are a huge carbon sink), suggesting huge parts of the ocean's ecosystem are under unprecedented threat directly from global warming. Again, the impact of the breakdown of oceanic ecosystems would be catastrophic.

The Ecological Crisis



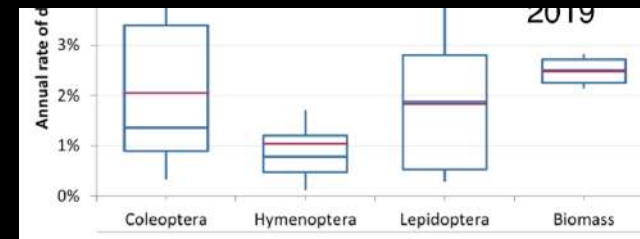
“This isn't just about losing wonders of nature. With the loss of even the smallest organisms, we destabilise and ultimately risk collapsing the world's ecosystems - the networks that support the whole of life on Earth.” - Sir David Attenborough

How one heatwave killed 'a third' of a bat species in Australia

By Frances Max
BBC News, Sydney
© 12 January 2019

WEATHER

Birds falling 'dead' from trees in heat



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The Human Consequences

- Drought & heat stress
- Starvation
- Inundation
- Migration
- Social collapse
- Syrian civil war case study

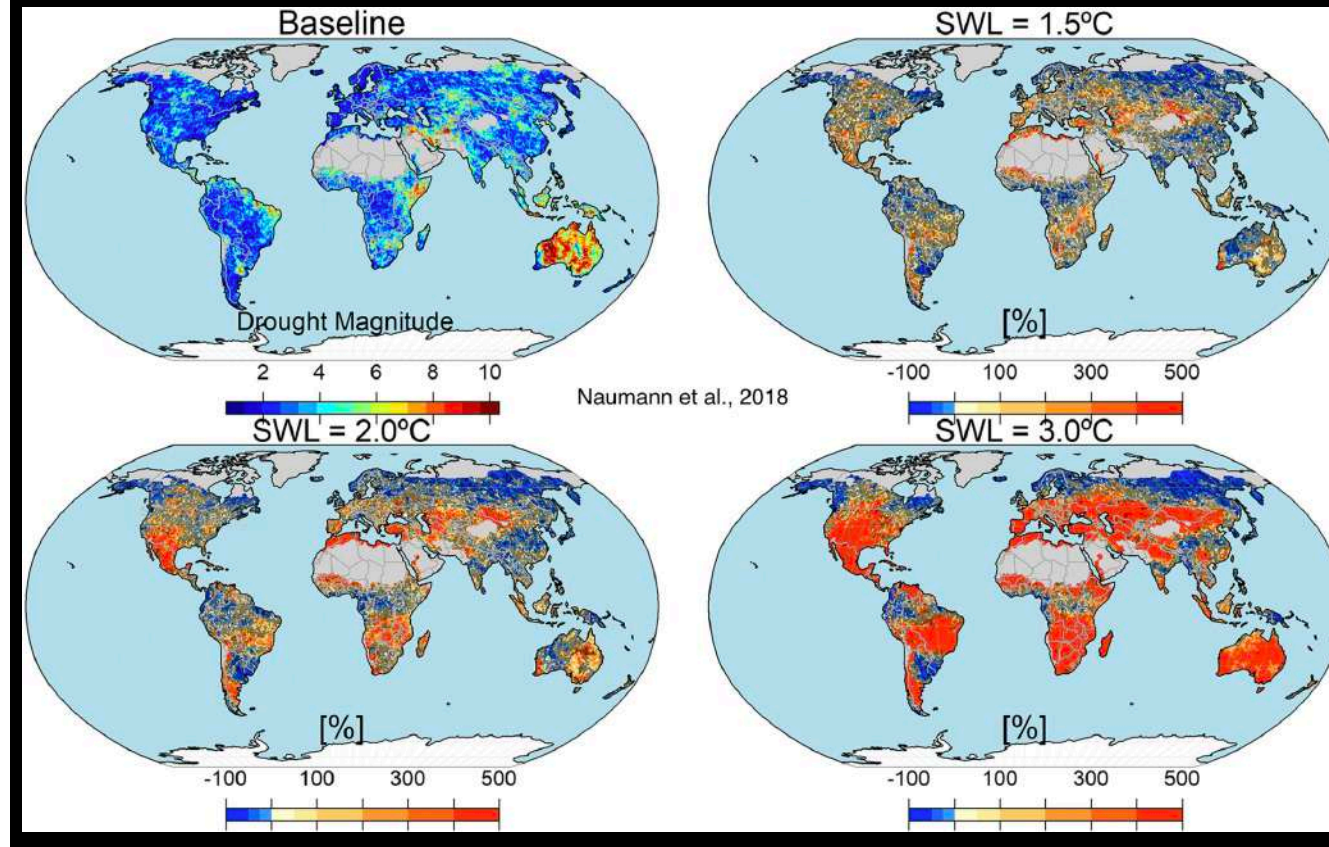
Average drought durations of 10 months expected at 3C warming (global average), and far longer in many regions (e.g. 5 years in northern Africa) (Naumann et al., 2018). The knock-on effects of this are enormous. Ecosystem breakdown, agricultural failure, social unrest, war - all correlate strongly with drought. 5.4 billion people are projected to live in extreme water stress by 2040, more than double the number today (IEP 2020) Under a business as usual scenario, ~3/4 of the world's population face deadly heatwaves, with billions suffering this daily (Mora et al. 2017).

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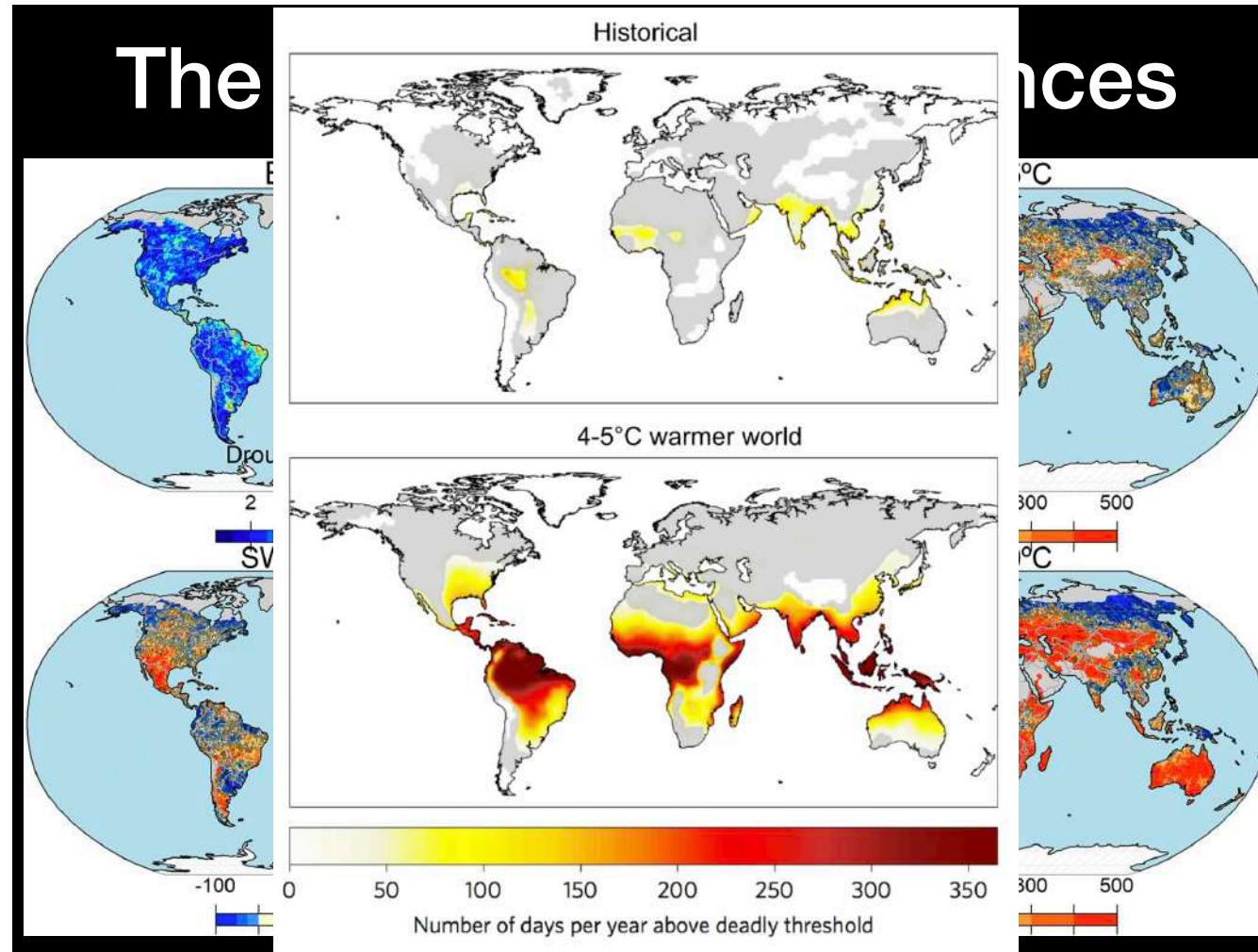


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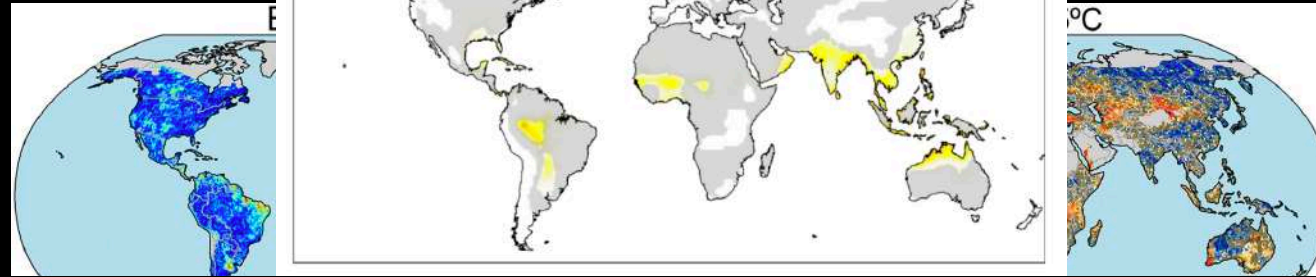
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“There is a growing sense of panic in those who really understand what a 4°C world might be like.” - Prof. Will Steffen

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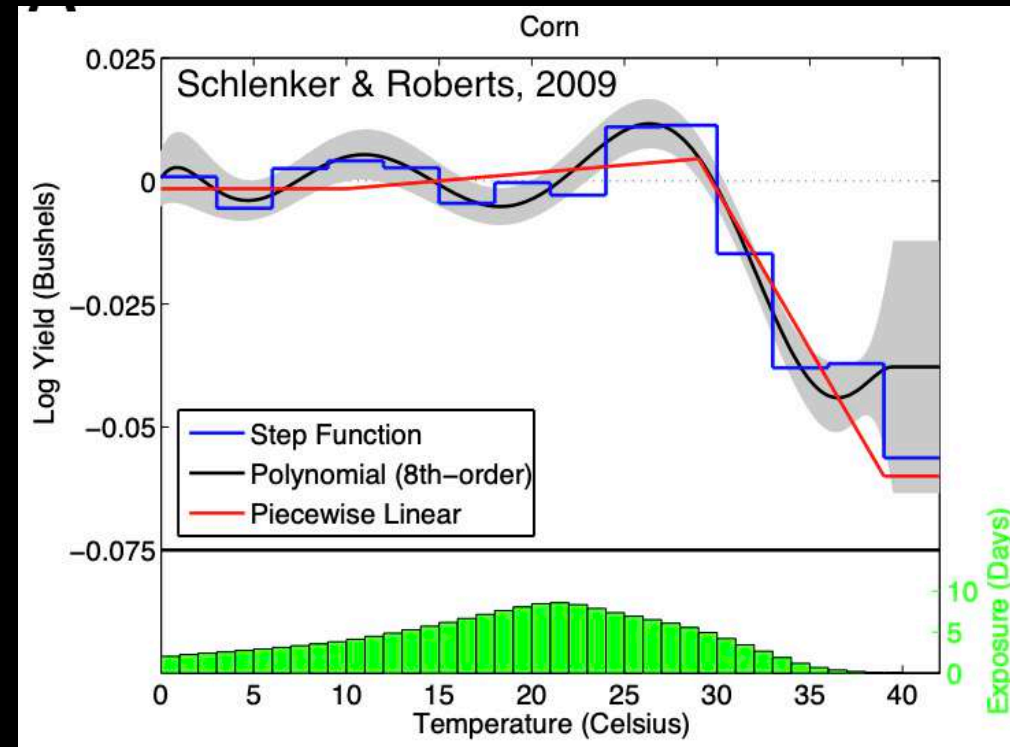
Food networks today are globalised - in the past, one drought or heatwave may cause a local famine, but today foods are imported, ameliorating this. The risk becomes as such: if there are simultaneous droughts/heatwaves across major food-producing regions, there could be global declines in the availability of food, pushing up prices (well correlated with social unrest and breakdown), causing hunger and possibly mass starvation.

23% of total cropland accounts for ~70% of the world's maize and wheat production and ~85 of the rice production (Food and Agricultural Organization of the UN, Statistics Division 2016). So the question is not just one of how much temperatures rise, but where heatwaves occur each year. Remember, average temperature increases over land are 2-3 times higher than the global average. Research in this area is relatively novel, but simultaneous droughts/heatwaves could cause "multi-breadbasket failures", in which the world's food supply runs far short of demand. The probability of this increases as global temperatures increase.

In the words of Dr Aled Jones, Director of the Global Sustainability Institute: "Based on plausible climate trends, and a total failure to change course, the global food supply system would face catastrophic losses, and an unprecedented epidemic of food riots. In this scenario, global society essentially collapses [by 2040] as food production falls permanently short of consumption."

Figures: 1) rapid decline in yields beyond critical temp. 2) % of crops in the world experiencing >5 days above its critical temperature. Hatfield & Prueger 2015 recreate these conditions in a lab and find 80-90% declines in crop yields when the crops experience several days of extreme temperatures.

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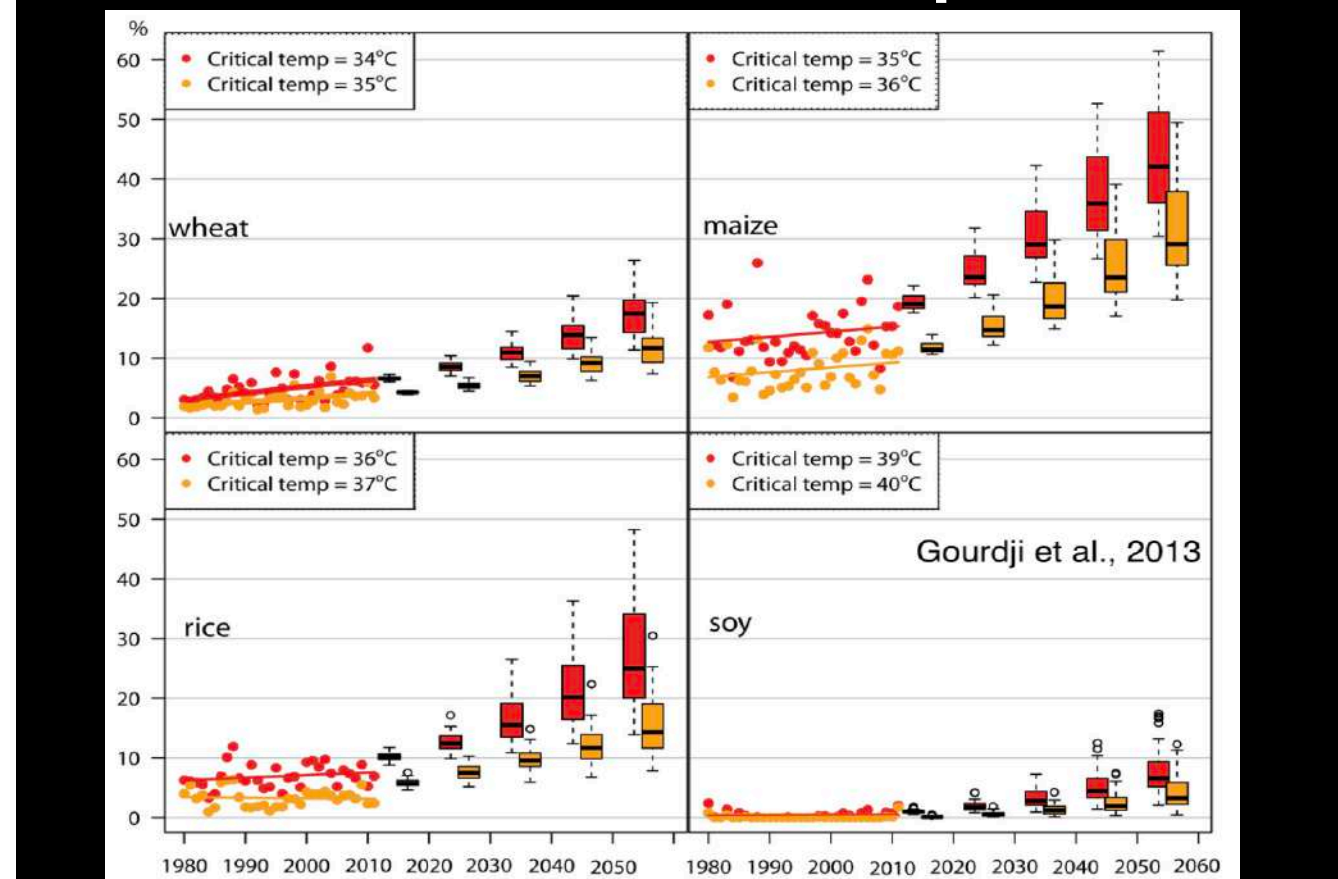
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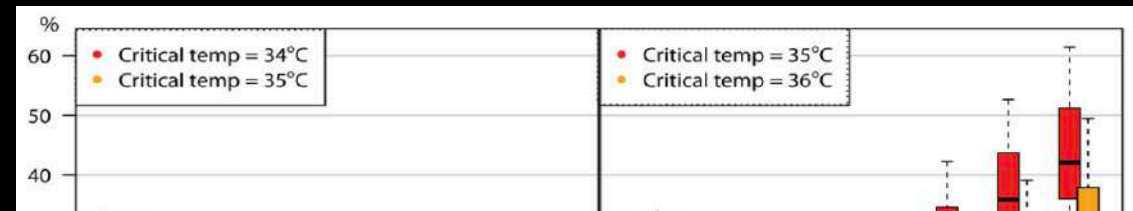
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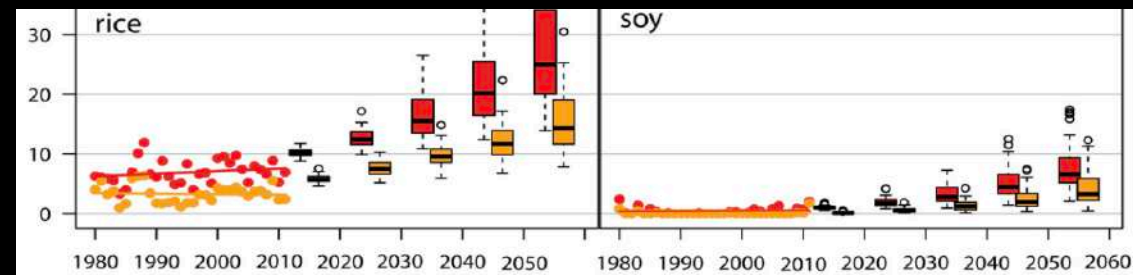
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Replace the image with some locally relevant map from, e.g., here: <https://ss2.climatecentral.org/>

1-3m sea level rise plausible this century (Bamber et al., 2019; NOAA 2017). ~10% of the world's population live <10m above sea level, 250 million people live <1m above sea level. Some island nations would be eradicated by 1-3m rise.

Rising seas exponentially increase the frequency of floods, historic floods occurring every year by 2050 (Taherkhani et al., 2020).

For a sea level rise of 0.5m, over 570 low-lying coastal cities will be impacted, 800 million people at risk from the impacts of rising seas and storm surges (UCCRN Technical Report 2018).

Outlook: hundreds of millions likely displaced in the next few decades.

Bamber et al., 2019, Ice sheet contributions to future sea-level rise from structured expert judgment, PNAS, 116, 11195 – <https://doi.org/10.1073/pnas.1817205116>

NOAA Technical Report NOS CO-OPS 083, 2017, Global and regional sea level rise scenarios for the United States – https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf

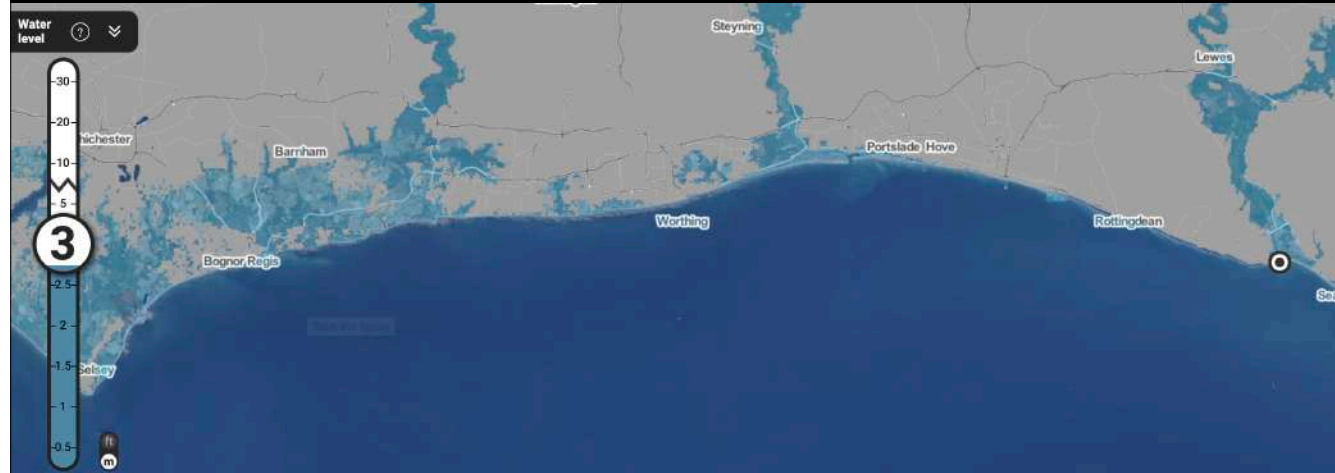
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The Human Consequences

- Drought & heat stress



- Syrian civil war case study

Replace the image with some locally relevant map from, e.g., here: <https://ss2.climatecentral.org/>

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Outlook: hundreds of millions likely displaced in the next few decades.

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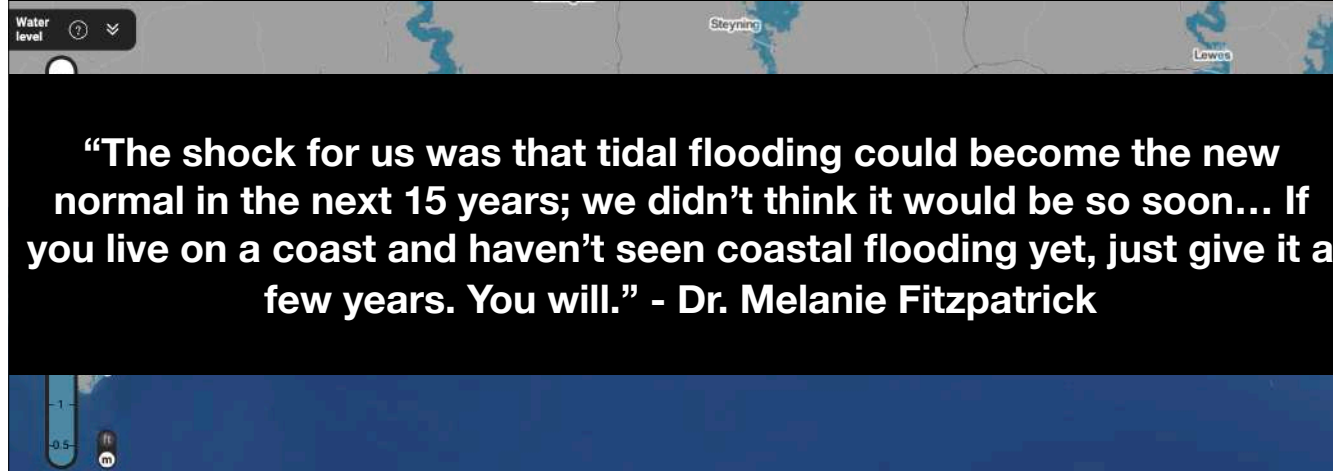
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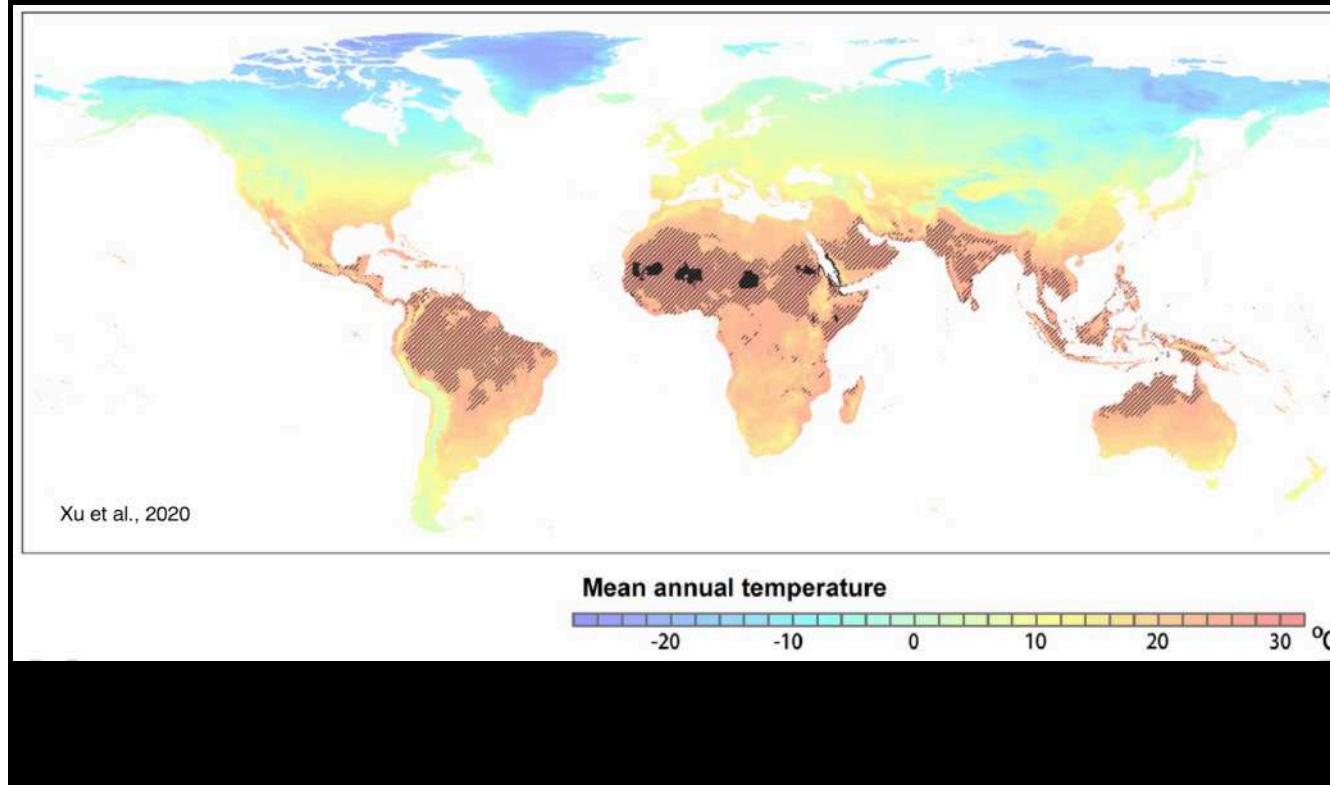
The Human Consequences

- Drought & heat stress
- Starvation
- Inundation
- **Migration**
- Social collapse
- Syrian civil war case study

Xu et al., 2020 shows the areas with Mean annual temperature >30C covering the black regions (~1% of the Earth's surface today), increasing to cover ~20% of the world by 2070. These regions contain 3.5 billion people. Historically, humans have never survived other than in small numbers in such hot climates. This paper predicts 1 billion migrants per additional degree of warming. Combining this with sea level rise, drought and food shortages implies migrations of billions of refugees created within decades.

Xu et al., 2020 <https://www.pnas.org/content/117/21/11350>

The Human Consequences



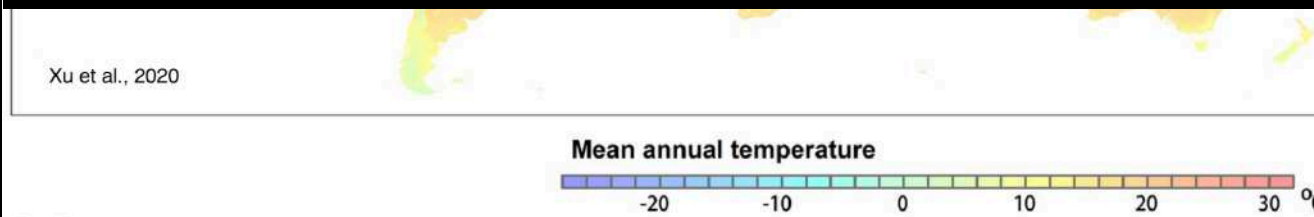
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The Human Consequences



What we are talking about is extended world war. People would move on a massive scale. Hundreds of millions, probably billions of people would have to move.” - Prof. Lord Nicholas Stern



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The Human Consequences

- Drought & heat stress
- Starvation
- Inundation
- Migration
- **Syrian civil war case study**

The Syrian civil war demonstrates each of these factors: the worst drought on record preceded the conflict - very unlikely to occur without global warming (Kelley et al., 2015) - about 75% the crops failed and farmers lost 80% of their livestock in the northeast (IEP 2020). Drought and hunger exacerbated tensions, war broke out, 100,000s dead, and the world's worst refugee crisis followed: 5 million people displaced fed the rise of the far right across the world. This case study shows how climate breakdown can drive social collapse. Severe drought, hunger, forced migration will grow dramatically over coming decades - what will this do to the global community? How would the world respond to a billion refugees, from a hundred countries?

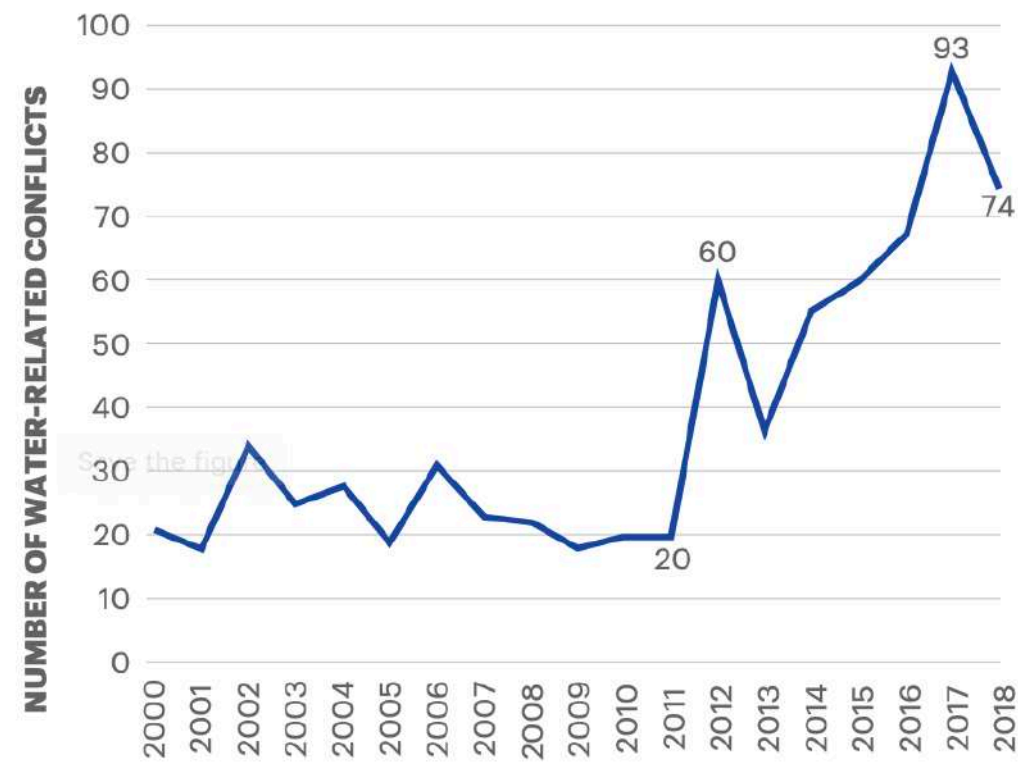
Many scientists now think that social and civilisational collapse in the near future is the most likely outcome of climate breakdown, with 500 scientists recently stating as much \ref

Figure: the incidence of water-based conflict is already steeply rising.

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Institute for Economics and Peace 2020 - https://www.visionofhumanity.org/wp-content/uploads/2020/10/ETR_2020_web-1.pdf

The Human Consequences



Source: Worldwater, IEP Calculations

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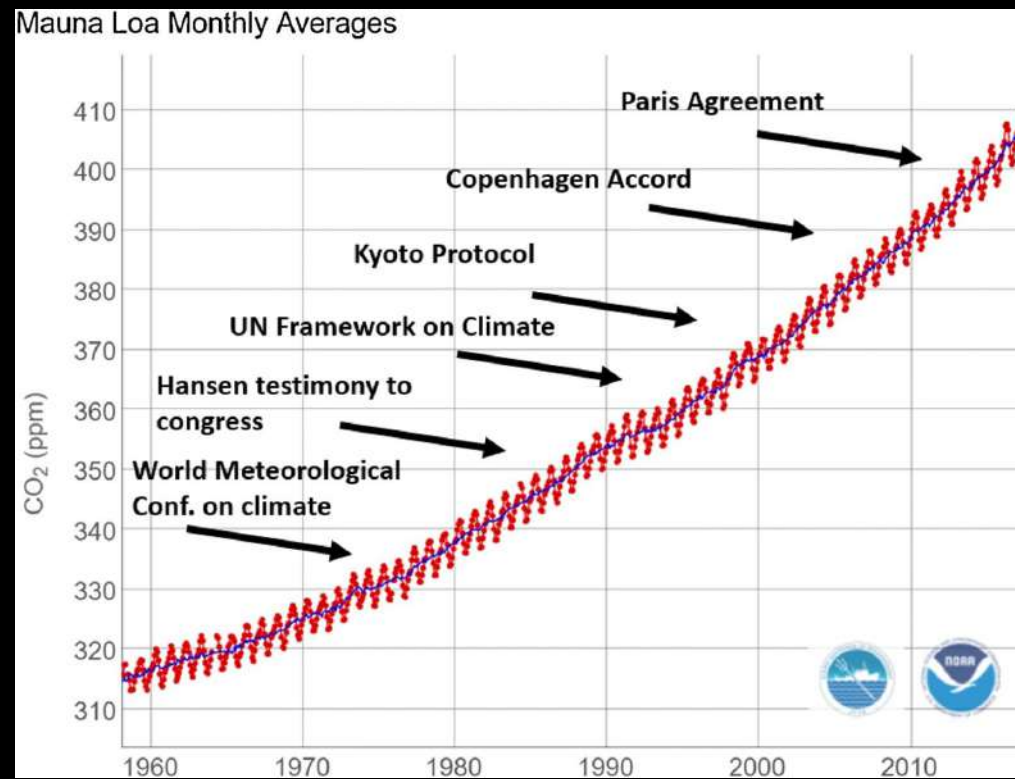
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The Political Crisis

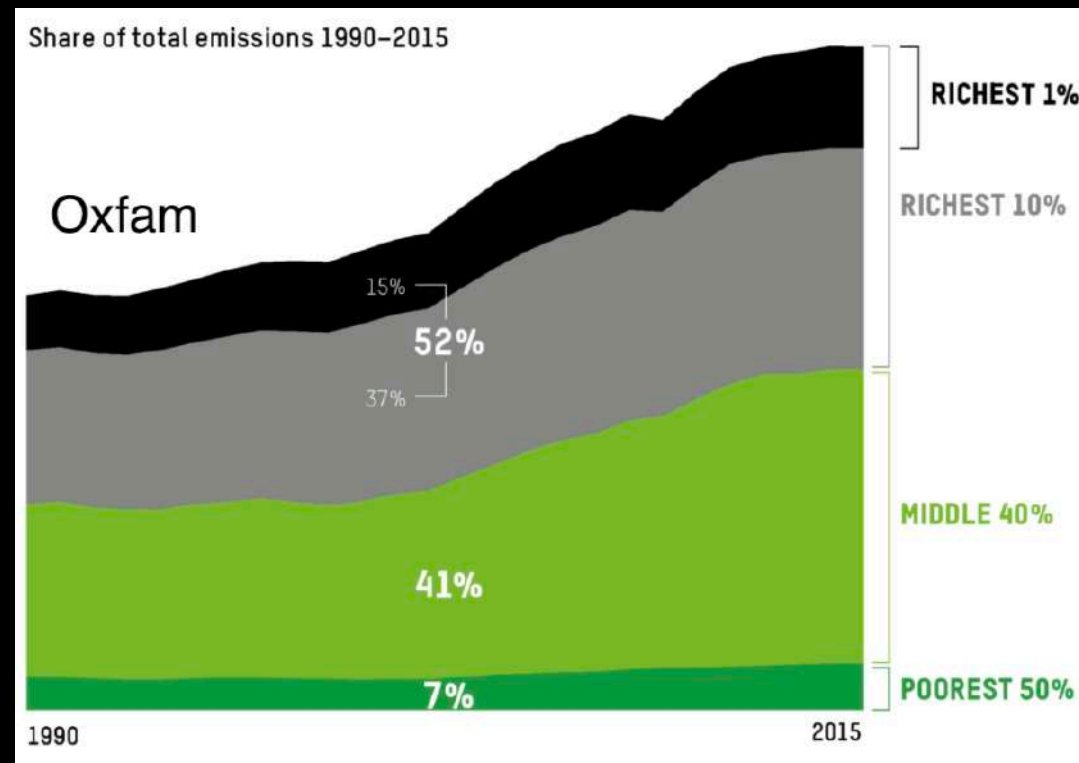


Regardless of scientific warnings, international commitments, changing attitudes and culture, emissions have continued to rise at an accelerated rate. The paradigm in which scientists write papers, talk to media, advise government - hold the hand of the powerful to try to illicit a rational response - has categorically failed.

Furthermore, educational establishments have morphed into structures which enable this destruction. Sciences are funded around the world far more than any other discipline, not because states and private funders have a deep appreciation of the value of empirically-discerned truth - clearly when the truth is inconvenient it is ignored - but because it is understood that scientific progress and technological development go hand in hand, while technological innovations form the bedrock of a growth-led economy. Students are encouraged to go into science not so that they can better understand the world, but so that they can get a well paid job - to advance their individual prospects at all cost. Jobs in the financial sector. Jobs in the military industrial complex. Jobs in the fossil fuels industry. (The general trend is that the more harmful the work is, the better paid it is, while essential workers are undervalued and underpaid.)

The paradox of modern science is revealed: with the best of intentions, we demand increased funding and support for science so that we can ever-better understand and predict what the future holds; simultaneously, we tacitly ensure that that future is nightmarish. But here-in lies our power: science and scientists are utterly essential to the functioning of modern society. If we withdraw our support for that order of society, through non-violent civil disobedience, it is likely to fall.

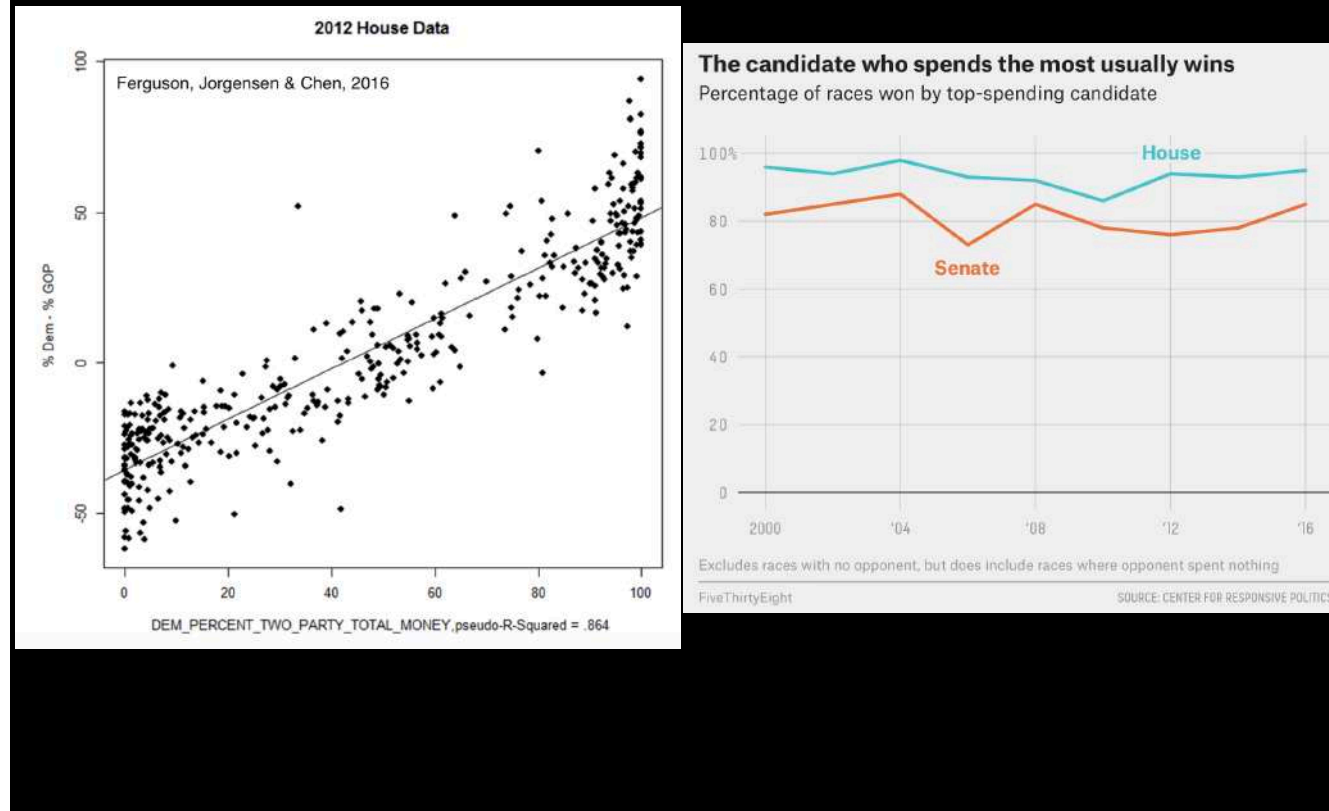
The Political Crisis



Population growth is often invoked as a key driver of the climate emergency. As shown here, the world's poorest (where essentially all population growth occurs) are responsible for virtually no emissions. Overpopulation can contribute to issues such as land use, water consumption etc., but still the overwhelming contribution comes from the richest. This is easily understood when you consider that at the current rate of population growth (which is in decline in reality), it would take around 100 years for the population to double in size. Meanwhile, a "healthy" economy, according to financial institutions like the world bank, doubles in size every 20 years.

The primary drivers of ecological and climate breakdown are politico-socio-economic - targets of growth at all costs, facilitated by throwaway consumerism, individualisation promoting socially irresponsible choices etc. For most of human history, we have not threatened to destroy the world: only in the last few centuries, with the proliferation of capitalisms, have we raced to the precipice. Clearly, there are other organisations of human society which can function sustainably. If something is unsustainable then, by definition, it must end; the only choice we must make is whether it ends intentionally or by systemic collapse.

The Political Crisis



Two figures showing how money corrupts politics. The left figure shows relative money spent on the x axis vs vote percentages on the y axis. The same trend is found in all elections dating back to 1980 in the US: the candidate who spends the most virtually always wins. Although these studies are specific to the US the conclusions apply more broadly, and these studies do not account for the role of media ownership and bias (a more generic issue). As wealth inequality grows (as has happened since the '80s in the west), democracy becomes further undermined. Political parties are loathe to upset big funders, because they know it will likely cost them power; members of a party are often loathe to upset party elites because it will cost them leadership opportunities, therefore power.

Beyond the role of money in determining who gets elected, there is the issue of how money influences decisions of policymakers after elections. Large companies employ rafts of lobbyists, whose job is flatter politicians with gifts, opportunities, and favours to try to sway their decisions. This is not commonly described as corruption, but is practically-speaking near-indistinguishable from it. There are a plethora of examples of legislation pulled directly from lobbyist proposals - consider providing local examples of this type of corruption. The Center for International and Environmental Law produced a good review of the disinformation and political corruption by fossil fuels companies, as one example (CIEL 2017).

The solution proposed by XR is to form citizens assemblies - a jury duty-style system, where people are pulled quasi-randomly from society, educated by a variety of experts in different fields, debate the issues with each other, and serve a fixed-term to decide on the policy direction of government. This sidesteps the forms of corruption outlined above, while tending to ensure that decisions made benefit 'ordinary' people, rather than the social group from which the political class tends to be drawn. The general population tends to be more progressive than government officials (in western liberal democracies at least), and this has been reflected in the decisions of CAs formed to date (see e.g. <https://citizensassembly.co.uk/>).

Non-Violent Civil Disobedience

- **What is non-violent civil disobedience?**
- Why is it effective?
- Some historical examples
- An empirical perspective

Violence permeates society: it is the ultimate means by which power is exerted and control enforced - whether by war, overtly violent repression, incarceration or otherwise. When resisting a far more powerful foe, engaging on their terms is unlikely to succeed: non-violent struggle has been utilised across radically different cultures and societies, in different political contexts and historical periods.

Non-violent civil disobedience is the act of non-cooperation with some system or regime by social, economic, and political means. It takes many forms, including marches, strikes, boycotts, occupations, hunger strikes, direct action (e.g. blockades, criminal damage). Non-violence as political activity does not require a principled ethical rejection of violence (though is clearly consistent with such an ethic), but is a pragmatic form of resistance practiced by many different groups through time, with very different philosophical perspectives.

Non-Violent Civil Disobedience

- **The act of non-cooperation with some system or regime by social, economic, and political means**
- **NVCD includes marches, strikes, teach-ins, boycotts, occupations, hunger strikes, direct action (e.g. blockades, criminal damage) etc.**
- **Non-violence is a pragmatic form of resistance, to be differentiated from an ethical principle of non-violence.**
- **Non-violent protest should also be distinguished from peaceful protest, since it can be highly disruptive and can cause forms of harm (e.g. economic)**

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Non-Violent Civil Disobedience

- **Prominent successful examples include the Suffragette movement in the UK, the Civil Rights Movement in the US, and the Indian Independence Movement**
- **Modern examples include the Arab Spring, Occupy Movement, Black Lives Matter, and environmental movements like Extinction Rebellion**
- **Non-violent resistance is on the rise, with around 100 non-violent civil disobedience campaigns since 2010, around double the number in previous decades.**

Non-Violent Civil Disobedience

- What is non-violent civil disobedience?
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All governments require the consent of the populations they rule: this is as true in democracies and autocracies alike. This requires some perception of legitimacy, and the cooperation and assistance of citizens and institutions. If this legitimacy is eroded, through the disobedience of even relatively small sections of society, regimes can find themselves surprisingly fragile.

Non-violent resistance is around twice as effective in achieving its aims as violent resistance (depending on context - in many cases it is far more than twice as likely to succeed). Non-violence is effective in large part precisely because it is juxtaposed with the violence of forces arrayed against them. It is easy to justify violence against violent actors; incarceration, repression and other assaults on non-violent protestors erodes the legitimacy of the state, often causing a backfire effect which brings more people to the movement, strengthening rather than diminishing it.

Furthermore, violent struggles tend to consist overwhelmingly of young men, but non-violent struggles mobilise far wider sets of society, including women, the elderly and the young. Not only does this improve the effectiveness through wider reach and capacity, but it increases the chance of a backfire effect and of defections by state actors. Indeed, women's participation is a strong predictor of success in non-violent struggle.

Finally, violent struggles, when successful, tend to establish violent societies. Successful non-violent campaigns correlate highly with improved conditions in the new society (e.g. increased stability, democracy, freedom).

For a practical guide to non-violent resistance strategy, see Sharp, 2003, *There Are Realistic Alternatives*, The Albert Einstein Institution – <https://www.aeinstein.org/wp-content/uploads/2013/09/TARA.pdf>

Non-Violent Civil Disobedience

- **Non-violent tactics can mobilise far broader sects of society, and are seen as more legitimate (rather than mobilising overwhelmingly young, able-bodied males – the wide-spread participation of women is a strong predictor of campaign success)**
- **Repression of non-violent campaigns is likely to backfire, driving people into the movement (including defections from state actors) and reducing the legitimacy of the system which they seek to change or overthrow**
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“It’s time to participate in non-violent political movements wherever possible [...] Impossible isn’t a fact, it’s an attitude” - Christiana Figueres, Former Executive Secretary of the UN Framework Convention on Climate Change

“The activists of Extinction Rebellion are leading the way in confronting this immense challenge, with courage and integrity, an achievement of historic significance that must be amplified with urgency.” - Noam Chomsky

“It’s not at all surprising that people in this urgent situation feel they have got to take non violent direct action. They’ve got to find a way of putting the case for the human race before those in power.” - Dr Rowan Williams (Archbishop of Canterbury)

“What’s the use of having developed a science well enough to make predictions if, in the end, all we’re willing to do is stand around and wait for them to come true?” - Prof. Sherwood Rowland

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Non-Violent Civil Disobedience

- Non-violent resistance is around twice as effective in achieving its aims as violent resistance.
- Virtually no regime has survived the mobilisation of 3.5% of the population at the campaign's peak, while movements which mobilise just 0.1% are successful almost half the time.

Peak Popular Participation (%)	Number of Observations	Success Rate
At least 3.5 %	18	88.89 %
1 % - 3.5 %	41	60.98 %
0.25 % - 1 %	92	45.65 %
0.06 % - 0.25 %	95	45.25 %
0.015 % - 0.06 %	66	24.24 %
0.0035 % - 0.015 %	44	9.09 %
less than 0.0035 %	24	4.17 %
missing data	9	33.33 %
<i>significance level</i>		<i>p < .003</i>

¹² Chenoweth & Belgioioso 2019.

Stephan & Chenoweth, 2008, Why Civil Resistance Works, The Strategic Logic of Nonviolent Conflict, International Security, 33, 1, 7 – https://www.belfercenter.org/sites/default/files/legacy/files/IS3301_pp007-044_Stephan_Chenoweth.pdf

Chenoweth, 2019, Women's Participation and The Fate Of Nonviolent Campaigns, One Earth Future Foundation – <https://dx.doi.org/10.18289/OEF.2019.041>

Conclusions

- The natural world is being annihilated at a rate only seen once every ~100 million years
- Melting ice, thawing permafrost, burning peatlands and forests, collapsing ecosystems etc. threaten to destabilise the environment, driving the world irreversibly to a hot state, alien to human civilisation
- The human consequence of such an outcome is likely to be mass-deaths by starvation and dehydration, billions displaced, the genocide of some nations, social unrest and collapse, and war
- Non-violent civil disobedience is an extremely effective means of rapidly transforming society for the better: it is likely the best chance we have of avoiding an apocalypse.