

OBSERVATIONS

Some signposts as to why we see this area as important, underserved, and ripe.

April 1815 – Mount Tambora erupted in Indonesia. Huge quantities of dust + aerosols were released into the atmosphere. In the year following: the average global temperature dropped by 0.4–0.7 °C; Europe experienced its coldest summer in the last 250 years. Famine + economic disruption followed.

How could we respond if something similar happened again?

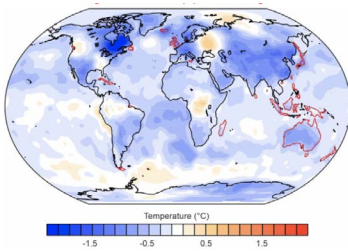


Fig 1

Current trends in global temperatures driven by human activity suggest we're on course to exceed 1.5 °C above pre-industrial levels within 10-20 years, and 3-4 °C by 2100.

The buffering capacity of the oceans will lead to a significant time lag between emission and maximal warming effect.

Global surface temperature change relative to 1850-1900

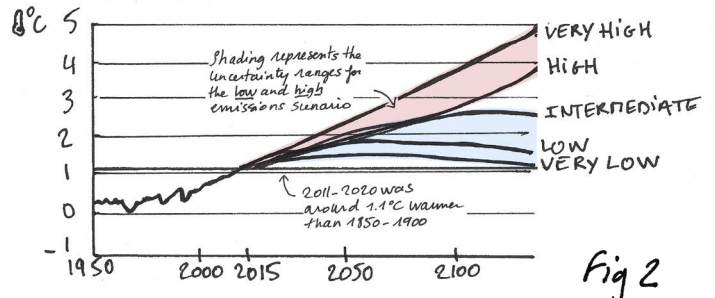


Fig 2

Mark's (incomplete) risk register of potential climate tipping points, assuming 3-4 °C warming above pre-industrial levels by 2100. In many cases, the likelihood and potential effects of such events are only poorly constrained. Likelihood and impact scales: 1 = very low; 5 = very high.

EVENT	LIKELIHOOD	EFFECTS	IMPACT	MARK'S RISK RATING
West Antarctic ice sheet melts	4	Global sea levels rise by ~1.5m by 2150 and 5m by 2500	5	Extreme
Atlantic meridional overturning circulation collapses	3 (by 2070)	NW Europe cools by 10 celsius	4-5	Very high
Methane release from permafrost	2-4?	Dramatically accelerated heating	4	High?
Dieback of Amazon rainforest	3 (by 2070)	Global precipitation patterns disrupted	3	Medium
Yellowstone Supervolcano erupts	1	Mass extinction via volcanic winter	5	Medium

Any trials of climate and weather control technologies should rely on close engagement with governments, policy makers and the public. Governance and policy are likely to become major geopolitical issues.

Could we develop the capability to intervene + prevent, rather than only react?

What standards and protocols should we adopt for safe trials of such technologies? How should the impacts on local communities and the natural environment be accounted for + measured?

The development and testing of hardware for controlling the weather and climate remains massively underserved.

Very few trials of any technologies for weather or climate control have taken place.

What technological options are there that are workable, scalable, ethical and for which the benefits outweigh the drawbacks?

What civil engineering and improved land use solutions might there be for controlling the climate at local and global scale?

Surely there are more options than just stratospheric aerosol injection or cloud brightening?

The economic cost of extreme weather events is significant (and rising), and the potential economic gains of developing technologies for control of the climate and weather **are likely to be considerable.**

In contrast total global spend on climate engineering research over the last fifty years has been minimal

Global insured losses from storms, floods and wildfires (\$ billion)

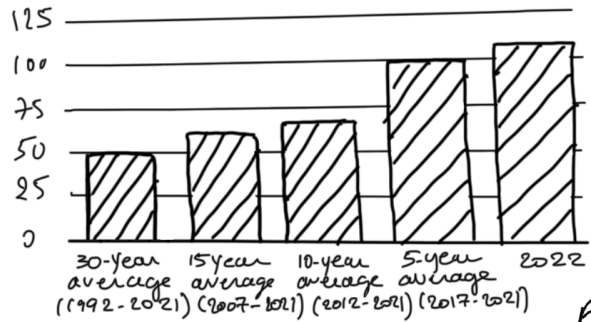


Fig 3

What role could financial institutions and markets play in climate control? Could 'climate cooling credits' incentivise progress?

We are already conducting passive climate engineering experiments. In 2020, new rules led to an abrupt drop in global sulfur dioxide emissions from shipping. Sulfur dioxide forms aerosols that reflect sunlight, producing a net cooling effect.

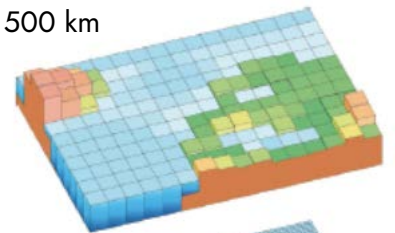
By 2050, the effect of removing sulfur dioxide from shipping fuel has been predicted to increase global temperatures by roughly the same amount as two additional years of carbon dioxide emissions at current rates.

The resolution and accuracy of climate and weather prediction models has increased dramatically in recent years.

Fig 4

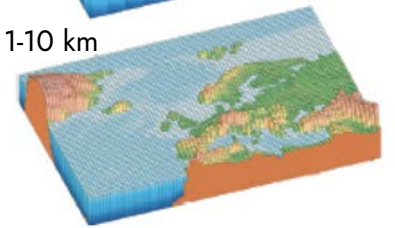
1970s

Resolution = 500 km



Today

Resolution = 1-10 km



The scale of such "unintentional" climate interventions provides perspective for small, carefully-controlled trials of climate and weather management methods

Additional warming expected as a result of lowering sulfur content of shipping fuel

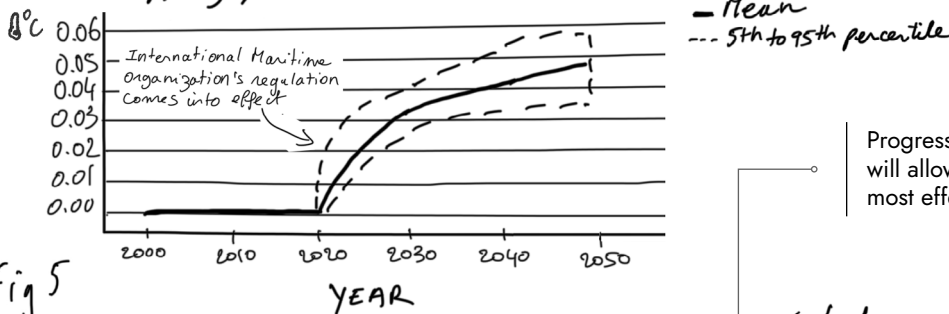


Fig 5

Progress in simulation and monitoring capabilities will allow for increasingly robust evaluation of the most effective and responsible options.

With a trusted, reliable, and responsible climate and weather control toolkit, interventions could be accurately predicted beforehand at both local and global scales, opening up possibilities for proactive management and mitigation strategies.

What possibilities would that open up? Mitigating severe weather events like droughts and hurricanes? Stopping the Arctic ice cap from melting? Greening the deserts? Terraforming other worlds?