

Geoengineers are no longer the unchallenged *prima donnas* of their climate engineering operas.

SKYGUARDS' INTERVENTION REPORT in the CAMBRIDGE SCIENCE SRM 2015
ENGINEERING THE CLIMATE - CAMBRIDGE UNIVERSITY 12-14th MARCH

RESUME

SRM 2015 was one more climate engineering event paid for with public money, aimed at promoting geoengineering with a "touch of class". The objective of the organisers was to advocate a risky product to be "handled with care", while pushing forward research and deployment as the impending responsible action to "save" the world from climate change disasters. The message is clear; geoengineering is the only way out. Even if missions were cut to zero **now** we still need to cool down the planet. For the first time, geoengineers openly acknowledge the need for field trials in both hemispheres using different types of materials, including nano-particles. Nothing was said about who decides where, what materials or when. The impact of geoengineering programmes in human health and biota, the precautionary principle, the lack of legal framework for geoengineering, the right of society to know, the need for an objective public debate, or the informed consent of citizens was not up for discussion either. Those were issues mainly raised by the few activists present in the event. One point in favour of the organizers was the allowance for activists' intervention in lunchtime sessions of ten minutes. The gathered audience was surprisingly numerous. Ongoing geoengineering proofs presented by activists were rejected by the most arrogant of all scientists present, David Keith, on the basis of non scientific evidence.

Geoengineers have for a long time been the unchallenged *prima donnas* in the operas of academic and scientific debates on climate engineering, to which civil society hasn't been invited. However, they must now learn to accept how activists are opening spaces of frontal opposition to geoengineering without complex scientific methods but on the grounds of common sense and fundamental human rights. Geoengineers such as Keith and Caldeira had found the formula to address this unwanted problem of "intrusion". When answering our questions they tagged us of chemtrailists, as a way to discredit our views as being conspiratorial, even though we never used this inappropriate term. So we asked them to objectively explain why when they talk about geoengineering it infers science and when we talk about geoengineering it means conspiracy. Is it a *lapsus mentis* or is it bad faith? Mr. Caldeira apologized. Problem solved.

Although the legitimization of decision to deploy SRM was not vindicated in this event by any scientist unlike in the Climate Engineering Conference in Berlin 2014th, we made it clear that we, the people, will never accept legitimacy of anyone not elected by us, underlining the undemocratic path followed by decision takers in this matter of universal concern, being developed and implemented with disregard for the global community. We can assume therefore that civil society has been betrayed on this key matter by its political representatives, its institutions and its scientists. Consequently there is a lot of healing and a lot of work ahead if we are to recover the trust needed to build a better and just future for all. This point of trust was the subject of the debate that took place that evening with the title "Climate Engineering: who can we trust?" These requests were especially vindicated on the part of Lady Mitchel Hall and Amyrta Sen.

We publicly asked geoengineers if yes or no, was their work covered by the Protocol of Privileges and Immunities of the United Nations. Their silence was rather eloquent! Taking advantage of the coffee breaks we also enquired to know what they expected from the Paris Climate Summit next winter. The answer was almost identical: *nothing concrete could be expected because the agreements that matter are not reached in events of that kind which are just for show*. However the overall impression is that geoengineering will be legalized in a few months before social pressure becomes much stronger by raising the awareness of the international citizens' community and by being clear that the legitimization of a decision by scientists will never be accepted by society. Politicians and scientists teamed together will release the information that SRM trials are being done in order to save the planet from climate change... The question is how we, as a society, are going to challenge a new legal frame that violates human rights and will account for the destruction of the planet? Also how we can proceed as a whole to demand accountability from governments, scientists and all sectors involved, including United Nations Agencies, universities and the military?

SKYGUARDS' INTERVENTION REPORT

Background of the SRM – 2015 event

The Climate Engineering Conference organized by the Cambridge University under the title SRM 2015 was mainly meant as a discussion for the results of the SPICE project (Stratospheric Particle Injection for Climate Engineering). This government-funded geoengineering research project, aimed to assess the feasibility of injecting sulfur particles into the stratosphere from a tethered balloon for the purposes of solar radiation management.

The SPICE project, £1.6m, run from October 2010 to March 2014th, was undertaken by the University of Bristol, the University of Cambridge, the University of Oxford and the University of Edinburgh. On its official web it states the following: *Solar Radiation Management (SRM) has been proposed as a form of climate engineering that could be rapidly deployed to reduce global mean temperatures. SRM techniques include stratospheric aerosols, cloud brightening, space-based reflectors and surface albedo enhancement. These techniques attempt to offset some of the effects of increasing greenhouse gases, namely by reducing absorption of solar radiation. SRM does not address the root cause of climate change, and does not eliminate the urgent need to reduce global carbon dioxide emissions. Apart from the scientific uncertainty surrounding SRM, there are ethical, political and social issues that also need to be addressed.*

SPICE was first delayed in 2011 to gain more public engagement with better transparency, and then cancelled altogether in May 2012. Dr. Matthew Watson, director of the project, gave two reasons for the cancellation: (a) involved scientists owned patents for similar technology, presenting a clear conflict of interest. (b) concerns were raised about the lack of government regulation of such geoengineering projects. Although the field testing was cancelled, the lab-based elements of the project continued.

It seems unbelievable that such a bunch of bright academics, while developing the theoretical body of the project, hadn't considered from the beginning a conflict of interests, the need for public engagement, transparency, ethical, political or social issues, the impact of those projects on climate, on regional weather, on ecosystems and on human health, or, for that matter, the lack of government regulation on the subject. But it is a good example of the perversion of science, of how science works by turning its back to common sense, to the precautionary principle and to the service of humankind.

There was an obvious political interest by not giving a believable and sound reason for cancellation. It has to do with how civil society responded to the SPICE project with more than 60 organizations asking for cancellation in a matter of hours after making it public. Rejection is the response on the part of society. It showed geoengineers and politicians what to expect of the social community, when informed, about their plans and prospects to engineer the climate and all that goes along with it.

The actors of SRM 2015

About one hundred scientists and academicians congregated for the SRM 2015 event, all supporters of geoengineering, with a couple of exceptions who played both sides simultaneously alerting of the risks but yet insisting on the need to continue research. They all sat like disciplined students in the conference theatre, their questions designed only to pinpoint technical disagreements. At times many sessions seemed to be purely a peer review show. This event was much less balanced than the Berlin Conference in 2014th with less civil society participation groups. But we ended up seeing the same faces on the part of experts. One feels like it is a big family sticking together out of need... The conference was well organised, the different types of SRM interventions were held in consecutive sessions so we didn't have to miss any of them. On the plus side, the organizers of the event maintained at all times a simple but highly reliable service to participants. Our thanks to all of them, with special recognition to Hugh Hunt, Olaf Corry and Kirsty Kou.

Why security measures in an academic event?

The Campus context was calm in appearance but big security measures took place at the entrance of the building. – This is new and it feels weird. Has this something to do with activists against geoengineering coming into the academic debates? It could well be. Although our presence was almost symbolic this was the first time we were scheduled to participate officially. However it is wrong to perceive activists as aggressive people from which they must be protected and we proved them wrong. Actually it was quite the opposite, Mr. David Keith openly manifested his aggressiveness towards the activists, as he claimed that he felt especially targeted in some FaceBook posts over which we have no responsibility.

In this perspective, on Saturday March 14th at 12 in the afternoon there was programmed an anti-geoengineering protest by a group of activists from the U.K. We were told that if we joined them we couldn't come back to the building. I personally told the rest that this was unacceptable and that we should talk to organizers and make them change their mind. Our great friend Harry Rhodes made this possible and some activists went out to thank those outside for their support and for organizing this protest. David Keith also went out to meet with them and behaved in a very aggressive way. It is meaningful that the video illustrating this moment has been cancelled in Youtube.

Climate models take over the floor. But is that science?

Concerning the development of the subject of SRM, modelling and charts took over the floor during the two days. The excess was really overwhelming to the point that some speakers decided to question the reliability of models. The ironic answer was: "Models are always wrong but some are useful". In this case we agree with the reputed American geoscientist Marvin Herndon ¹ who says: *In my view the making of models, based upon arbitrary assumptions, on the other hand, is not science. Furthermore, models are computer programs that generally begin with an assumed end result which is then attained by selecting variables and assumptions that yield the sought end result. Some models can prove useful, but they do not lead to scientific discoveries.* Mr. Herndon also states that *Science should not simply be an academic discipline without reference to the human community or Earth's biota, but should aim to improve the well-being of life on our planet.* This is exactly what we have been demanding of scientists in these climate engineering conferences.

The disregard of scientists for the human community in this domain is alarming. In fact at moments it was difficult not to judge the whole event as a big boys' game. There they were, the so called geoengineers, talking with a forensic distance about intervening in the natural climatic patterns of our planet with all the risks that it implies. They offered no hope or alternative whatsoever. Stating that even if we cut emissions to zero right now, geoengineering would have to take place in order to cool down the planet. In this perspective the AMEG - Artic Methane Emergency Group, as usual, doesn't miss a chance to claim full deployment of geoengineering now! We simply refuse to believe that there aren't any other kind of scientists other than these who can provide us with a cooler planet through SRM, without the need to cut emissions!

Geoengineers admit the need for geoengineering field trials

As the next climate summit approaches on the horizon the messages from geoengineers become more explicit and urgent. These statements are what common people have been denouncing for over a decade: ongoing geoengineering programmes. They state that 'Geoengineering has to be implemented in the northern and southern hemispheres in order to maintain an intervention balance...and is now accepted that trials must be done in selected places with various materials in a search for efficiency'. Ken Caldeira went as far as to admit a provision for nanoparticulate dispersal... One activist, Harry Rhodes, asked Mr. David Keith if he knew that mercury in the polluted environment was one thousand times more toxic in the presence of alumina producing enormous health problems. What would you say? He was sharing the podium with Dr. Matthew Watson and left...to come back a few minutes later and assert that it is something to be checked!

Civil society interventions

Concerning the presentation on the part of civil society two interventions of 15 minutes were scheduled: Lookup.org from the U.K. and Skyguards. These interventions took place in a different room not easy to identify, but contrary to the Berlin situation, there was an audience. As the moment arrived the time allowance was reduced by one third in order to 'facilitate' questions. Ian Simpson from Lookup.org started first and centred his presentation on very technical aspects of the Airbus plane A320 design and the addition of pylon pipes for aerosol spraying purposes. The intervention on our presentation was obviously political, restricting us to conveying our information within a fifteen minute interval. Given this on the spot time reduction, I had to decide within seconds what to leave out whilst displaying all the prepared slides.

Skyguards' presentation

I thought it was important to explain who we are, what we are and what we are not, in order to clearly mark our position in face of scientists and academicians. Skyguards was presented as Civil Society Platform born to address climate manipulation/geoengineering issues and defend citizens' interest at all possible levels: research, educational, corporate, institutional, political, legal, etc.

We are not climate change sceptics or climate change believers. We believe that the climate change debate is distorted by political vested interests, resulting in propaganda. This applies to BOTH sides of the mainstream debate on climate change, "sceptics" and "believers" alike. Both behave in a cynical way or are being used against their better knowledge to promote hidden agendas. And neither side has considered in their studies the impact on climate change of military and civil weather and climate manipulation programmes implemented over the past 60 years.

We are here to participate in the academic debate on climate manipulation and establish a direct contact with geoengineers to overcome the actual gap in order to express our concerns to them and present evidence of ongoing SRM, also to address in this event a set of questions and demands.

The frame

Climate engineering is the most dire issue, after the atomic bomb, endangering the planet's survival. In spite of this fact, the debate is being confined to scientific and academic circles and the controversial decision of intervening in the natural climate systems is being taken at behind the backs of the concerned millions inhabitants of this world by people that have no legitimacy to do so.

Geoengineers are claiming that legitimization on the grounds of extreme weather episodes, failure of CO2 mitigation measures and the fact that political institutions are not backing up geoengineering programs **openly** for fear of paying a political price.

Who is legitimated

In democratic societies this legitimization is in the hands of citizens that elect their representatives through convened electoral processes. Based on this fact we, citizens, will never recognize legitimacy to anyone not elected by us. And yes we will make our politicians pay the price for having taken part in this insanity behind our backs and will make them accountable for it.

Civil Society Representation

In a context of deliberate disregard for citizens over geoengineering, some social scientists have decided to become the interface between society and geoengineers, allocating to themselves the representation of civil society.

In this respect we would like to assert that we do not accept to be represented by them. Civil society does not need intermediaries and is mature enough to represent and defend its own interests.

Time has come to rectify this undemocratic approach on the part of institutions and scientists, allowing civil society to participate in academic debates as peers, to express citizens' concerns, experiences and demands on these matters. It seems that the Cambridge University conference is the first one to rectify this. We thank you for that and hope next time civil society will, have a place on the real agenda of interventions, not in off time sessions.

To express civil society concerns & present evidence of ongoing SRM

It is widely known, geoengineers talk about geoengineering as a hypothetical technological fix to cool the earth in case needed, without any field trial and therefore they do not admit to ongoing SRM programmes or dimming of the sun in the terms expressed by Crutzen, Keith, Caldeira, or Teller, the latter being a climate warming sceptic.

Climate manipulation is like a pregnancy, you can only deny it for so long... until facts override arguments. In real life and reported by civil society the fact is that SRM programmes are being deployed widely open:

(PICTURES SHOW of geoengineered skies from different cities in the world)

I was told that time was over and the questions time must take place...

Questions made to us

Mr. David Keith intervened right away, not to ask anything but in use of his scientific arrogance he stated furiously that we the "chemtrails activists" are insulting him personally by telling things that are not true. Insisting on the fact that if we wanted to be taken seriously we have to come here with scientific proofs. The answer was to ignore his accusations out of place and focus on the subject: **Do you think that we can present our scientific proofs in 10 minutes? Please be serious Mr. Keith.**

Mr. Matthew Watson intervened to say that they will be glad to collaborate with civil society organizations and referred to their social study in the Oxford University... The answer was that we welcome collaboration but we do not want to be represented by them. Concerning their study, as we have told him in Berlin, - 15 people, 8 hours of work and the use marketing tools -, cannot be considered a social study. At the most it serves to draw different profiles of peoples attitudes towards geoengineering that can be use by promoters of geoengineering on their PR programmes to overcome social resistance to it.

While this part took place I played a short video showing dense fibres falling from the sky...

Questions and requests made to geoengineers

We were told that time was over but I insisted that I wanted to ask some questions and pose some requests to geoengineers. Compelled by time I could only pose these two questions:

We came to know that geoengineering programmes are being implemented covered by the Protocol of Privileges and Immunities of the United Nations. Are geo-engineers working under the Protocol of Privileges and Immunities of the United Nations or a similar one?

In spite of historical evidences of weather being used for military objectives since 1954 under the assumption that "The nation that first controls the weather will control the world", military research programmes on weather warfare are left out of the equation by scientists involved in climate change debate. Why? – No answers were given to this questions.

Civil Society requests transparency in the process taking place and a serious public debate on ethics, impacts of SRM in nature and in public health, winners and losers of geo-engineering, legal framework and respect of the precautionary principle. Not to say participation in all relevant meetings, debates and policy decisions.

We can resume that civil society has been betrayed on this key matter by its political representatives, its institutions and its scientists. So there is a lot of healing and a lot of work ahead if we are to recuperate the needed trust to build a better and just future for all. Lets do it from now. – This highlighting of this undemocratic path and disregard for civil society, the need for a democratic public debate and the need to recuperate society trust was the subject of debate that took place that evening with the title “Climate Engineering: who can we trust?” These requests were specially vindicated on the part of Lady Mitchel Hall and Amyrta Sen.

Cofeebreak questions to geoengineers

In between sessions we approached David Keith and Ken Caldeira to propose to them regular meetings with civil society representatives before or after events of this kind, without cameras, in order to establish a constructive debate given the impossibility to do it in the frame of conference interventions. Keith didn't accept, saying that if we wanted to talk to him we should go to his office in Harvard... Ken Caldeira would be willing to do it.

Another question we posed to Mr. Keith in three different occasions was about how many million tons of CO₂ would be dispersed in the atmosphere by all the planes needed to deploy SRM globally? How does this fit with the assessment that CO₂ is the cause of global warming? The first answer was that the total amount would mean 1% of the global air traffic load. The second answer he talked about 2% and the third answer was that planes used in the SRM programs have nothing to do with the ones we know and with only 40 planes flying very high, the job could be completed on a global scale. These discrepancies in answers make it obvious that he was lying and not willing to tell the truth. To the question concerning if there are studies about the impact in nature and in public health of SRM deployment with the different materials considered, we received no answer whatsoever.

I asked for some feedback on the pictures shown in our presentation and for the fibre fallout video. Keith said that those were condensation trails. I told him that he was wrong and we could prove it. Many of those pictures have been taken with a humidity of 30%, totally incompatible with the formation of contrails. He shrugged his shoulders and left. Our scientists are not prepared to face dissenting arguments based on data that they do not control.

At the same time we were approached by a young lawyer from Kentucky (Keith's friend). He said that he didn't know anyone in that room that wouldn't agree to our exposition, but that we might consider changing the last part which in his opinion reduce our credibility.. He was referring to the pictures show! Our answer was that those pictures do not harm our credibility but the credibility of those that are negating the fact that SRM is not taking place.

Civil society challenges geoengineers

Due to the fact that civil society is participating in the academic international events, symposiums and conferences on climate engineering, firmly challenging this otherwise criminal “scientific” proposals, geoengineers are becoming more and more uncomfortable. So it seems as if they have decided to counteract this legitimate lobbying action on the part of civil society by publicly discrediting antigeoengineering activists accusing them of being conspiratorial with the help of a “yellow” mass media who are totally devoted to serve power brokers instead of providing public information.

On February 22, paving the way for the Cambridge SRM event, one such journal, The Washington Post, published an article entitled “How a group of conspiracy theorists could derail the debate over climate policy” ² In this article is quoted: “A very tiny subset of the chemtrails activists could have a more chilling effect on the field of geoengineering, Keith worries. He notes that he continually receives nasty emails and voice messages from *chemtrails* believers, and he has even received multiple threats of violence that have prompted him to contact the police”.

This is a nasty way to deal with legitimate antigeoengineering activism! Mr. Keith not only accuses activists of conspiracy but also of being aggressive. Does bad science therefore create bad reactions? The historical immunity of science and scientists getting away with murder has to come to an end. While we condemn any aggressive behaviour on the part of anyone, activists or scientists, one must understand the law of action and reaction at a behavioural level. If scientists practice criminal science, the kind of science that doesn't serve mankind but the opposite, they are responsible and accountable for any outcomes and must be prepared to face criminal charges and be judged by an international court created to that end.. - But that is another debate.

It is quite true that as a consequence of the lack of political transparency, deliberate disregard for people and provision for public debate on such a serious matter for mankind as geoengineering, a portion of society is unfortunately using very inappropriate terms referring to it as *chemtrails*. A term without a verb that doesn't explain anything, designed to preventively impede all social action and reaction; a term that has been conveniently classed as conspiratorial to discredit those who use it and those who don't but firmly oppose geoengineering, like us.

Using such a term that by its own nature prevents us from raising awareness, from creating public opinion and from relating to scientists or academic institutions where the actual debate on our future is taking place. By using such a term we don't show much critical spirit or for that matter much basic emotional intelligence. The term doesn't work and must be discarded.

It is true that if we want to win this battle we must first destroy this well designed semantic strategy and use the terms scientists use. But is also true that Geoengineers have been for a long time the unchallenged *prima donnas* in the operas of academic and scientific debates on climate engineering, to which civil society hadn't been invited. However, they must now learn and be prepared to accept how activists are opening spaces of frontal opposition to geoengineering in these debates, without any complex, not on the grounds of scientific methods but on the grounds of common sense and fundamental human rights.

Keith and Caldeira thought they had found the formula to address this unwanted problem of "intrusion". In their answer to our questions they tagged us of *chemtrailists* in order to discredit our views as being conspiratorial, even though we never used such an inappropriate term. But we were not ready to consent to this so we asked them to explain objectively why when they talk about geoengineering it infers science and when we talk about geoengineering it means conspiracy. Is it a *lapsus mentis* or is it in bad faith? Mr. Caldeira apologised. Not so Mr. Keith who showed a very arrogant and paranoid behaviour all along. Problem solved.

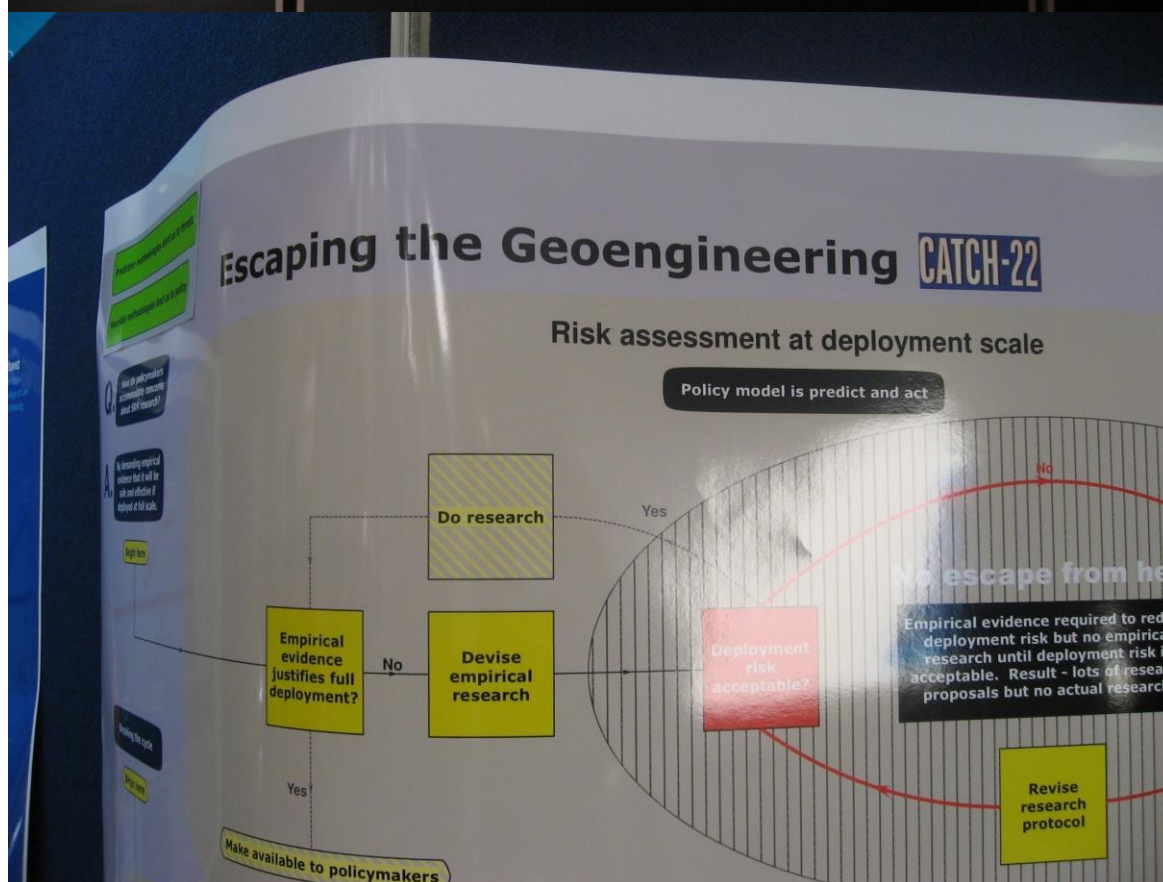
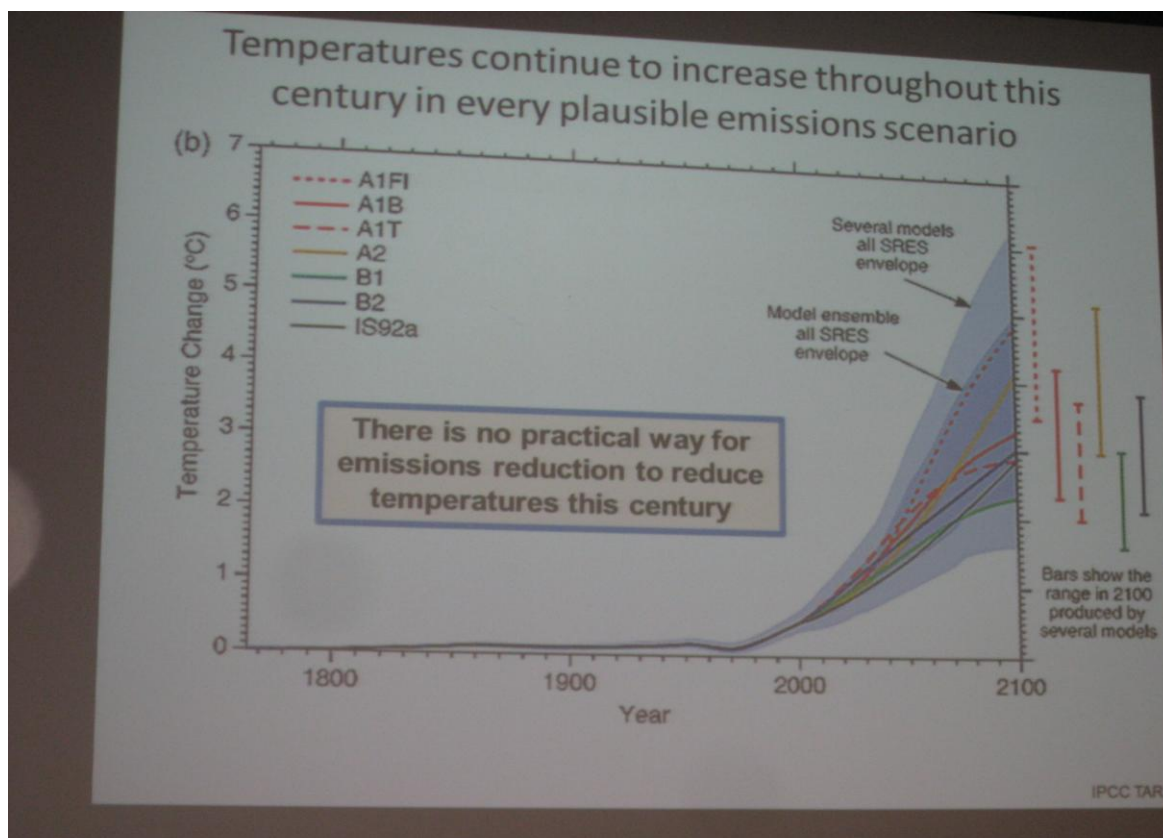
What about Paris?

One of our most repeated questions to many scientists was about what to expect in the Paris Climate Summit next winter. The answer was almost identical: nothing concrete could be expected because key agreements are not reached in events of that kind which form a necessary show. However the overall impression is that as social pressure becomes stronger and the legitimization of SRM decisions by scientists will never be accepted by society, geoengineering will be legalized in a few months. Politicians and scientists teamed together will release the information that SRM trials are being done in order to save the planet from climate change... The question is how we as a society are going to challenge a legal framework that violates human rights and will be accountable for the destruction of the planet? How can we proceed as a whole to demand accountability from governments, scientists and all sectors involved, including United Nations Agencies, universities and the military?

¹ Some reflections on science and discovery - CURRENT SCIENCE, VOL. 108, NO. 11, 10 JUNE 2015 1

² http://www.washingtonpost.com/?nid=top_pb_wplogo January 22

SOME PICTURES OF MEANINGFUL POSTERS



Simulating a Climate Engineering Crisis

Climate politics simulated by students in Model United Nations

the New York guardian
winner of the Pulitzer prize

14.10.2022

China blacks out the Sun

China plans a climate experiment and causes international tensions. France summoned a meeting of the UN-Security Council.

The Chinese government prepares an experiment in the earth atmosphere and aims to shield the earth from sunlight. Using military aircraft, China plans to spread particles in the atmosphere, which should reflect some incoming sunlight and cool down the earth. According to French intelligence service information, Chinese scientists and military forces are preparing such a project. France summoned a meeting of the UN Security Council, as it fears an incalculable risk for the global climate.

Furthermore, it wants the council to take position on this topic. It is likely that France tries to enforce a resolution against the Chinese plans. The rapid positioning of France might be a sign of power struggle, as the French government sees itself as a global power and wants to defend this

- It had to be playable in the *rules of Model United Nations*
- It should help to understand both *international negotiations* in general and problems of *CE politics* in particular

Realization

played three times with students from Political Science



Delegations of the Simulation

Permanent members	Non-permanent members	Visitors
China	Germany	Scientist
France	Ghana	ETC group (NGO)
Great Britain	Grenada	
Russia	India	
USA		

Paper under review: Matzner, Nils; Herrenbrück, Robert (2015): Simulating a Climate Engineering Crisis. Climate politics simulated by students in Model United Nations. *Simulation & Gaming*.

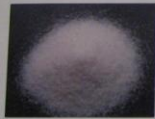
Stratospheric Aerosol Injection with Alternative Aerosols

Anthony C. Jones, James M. Haywood, Andy Jones

Alternative Aerosols

Historically, Stratospheric Aerosol Injection (SAI) schemes have been associated with sulphate aerosols due to the natural analogy of volcanic eruptions. However, Budyko (1974) originally proposed that alternative aerosols could be used instead of sulphate in order to reduce the unwanted side-effects of SAI. Potential candidate aerosols for SAI include minerals such as Titania, Alumina or Silica, and light-absorbing aerosols such as Black Carbon (Ferraro et al., 2011).

Research since Budyko has shown that the relative benefits of using alternative aerosols could include greater light-scattering per mass of aerosol (Pope et al., 2012), reduced ozone depletion (Tang et al., 2014), and reduced hydrological cycle impact due to less longwave-absorption (Ferraro et al., 2014). However, as yet there have been no multi-decadal simulations of alternative-aerosol injections to establish how the climate responds in the long term to a continuous forcing. Initiation of SAI would require a sustained injection in the long-term to avoid the termination effect (Jones et al., 2013), the magnitude of which would depend on the mass of aerosol injected (Keith & MacMartin, 2015).



Ammonium Sulphate



Titania

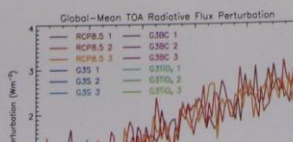


Black Carbon

Multi-Decadal Simulations with a GCM

In order to compare the climate effects of SAI with alternative aerosols, we have conducted 80-year integrations using the Hadley Centre climate model HadGEM2-CCS. The atmosphere component of the model has 60 vertical levels up to 84km and a horizontal resolution of 1.25° latitude by 1.875° longitude.

We have used a similar experiment design to the GeoMIP 'G3' experiment (Kravitz et al., 2012), where

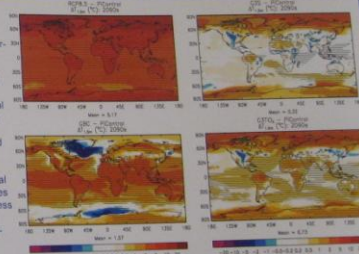


Climate Impacts

2090s Temperature Anomaly¹

Despite some residual warming, the global-mean near-surface air temperature is significantly reduced with respect to RCP8.5 in all 3 SAI scenarios.

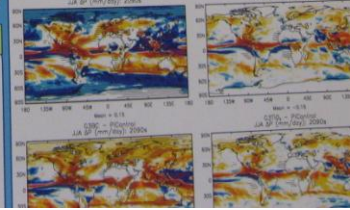
In the G3BC scenario, residual warming is more prominent in the tropics (2-5K) than at the poles, due to competing cloud and snow-albedo feedbacks. Conversely, in the G3S and G3TiO₂ scenarios, the residual warming is greater at the poles than the tropics, as there is less sunlight to be reflected at higher altitudes, hence GHG-warming dominates.



2090s JJA Precipitation Anomaly¹

The G3S and G3TiO₂ scenarios both show a JJA precipitation reduction of similar magnitude (~0.15mm/day globally average) to the corresponding precipitation increase in the RCP8.5 scenario. Upper-tropospheric warming in the G3BC scenario increases the hydrostatic stability of the atmosphere, further reducing precipitation.

In the 2090s, 39% of the Earth surface experiences significant JJA precipitation changes in the RCP8.5 scenario with respect to the 1980-1999 baseline, compared



Physical particle characterisation

Material	Type	Density at 293 K (g/cm³)	S _{BET} (m²/g)	Porosity (cm³/g)	Zeta Potential mV	Mean
Alumina	alpha	3.98	16.1 (±0.7)	0.09	+28 (±2)	
Titania	P25	4.26	9.3 (±0.9)	0.43	+34.5 (±0.4)	
Titania	rutile	4.2	9.6 (±0.8)	0.03	+4.8 (±0.5)	
Titania	anatase	3.9	9.5 (±1.2)	0.02	-33.3 (±0.8)	
Silicon carbide	alpha	3.217	9.5 (±0.1)	0.04	+0.1 (±0.5)	
Diamond	synthetic	3.52	7.0 (±0.3)	0.07	-0.2 (±0.5)	
Quartz	Fused powder	2.66	5.2 (±0.7)	0.02	-26.9 (±0.5)	

Table 1: Particles surface area (S_{BET}) was obtained via BET nitrogen physisorption experiment, porosity via nitrogen sorption isotherms and mean diameter and zeta potential was measured with the dynamic laser and confidence intervals were determined by Student's t test at 95% with 5 degrees of freedom.

Results: Acidity change after ozone depletion

strength of surface acidity

SRM Governance - W

Too often, SRM is examined as if stratospheric sulphate injection (SSI) - and to an extent cloud whitening - are the only proposals on the table. But many other proposals exist and will emerge. In order to clarify deployment & governance options we need systematic approaches to classify the combined physical and social dimensions of all such proposals. Sketched below is one such approach, developed within the historical evolution of governance.

1. Governance evolves - new structures are built on the old as permitted by the politics at the time of the innovation (see Joseph Camilleri and Jim Falk, *Worlds in Transition: Evolving governance across a stressed planet*, Edward Elgar, London, 2009 - [Fig 1]). The direction of evolution is towards increased complexity. It can be thought of as cutting across jurisdictions from the local to global in three overlapping governance arenas [Fig 2].

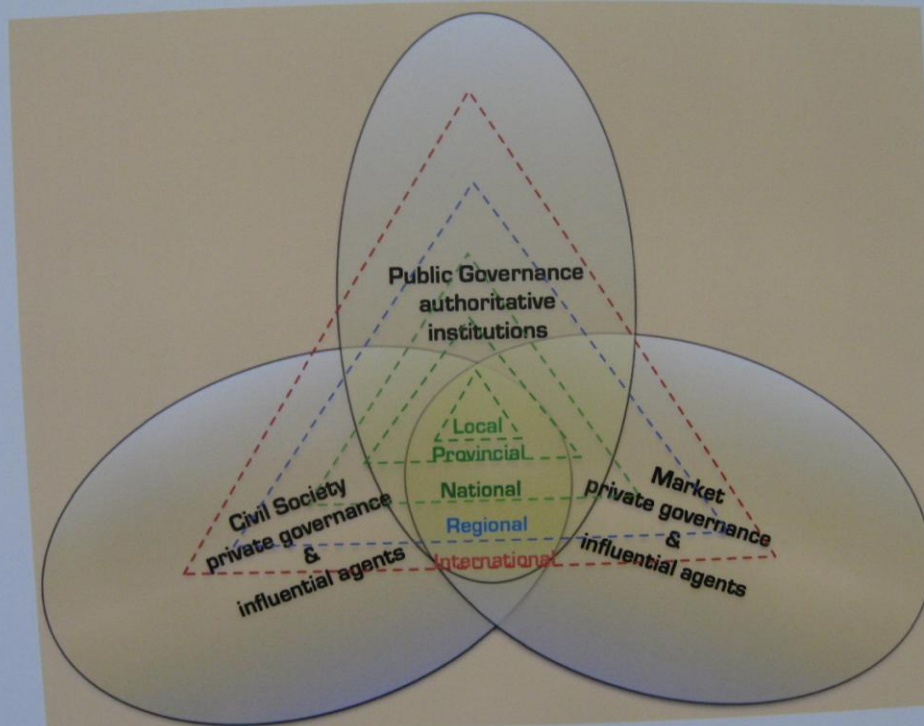
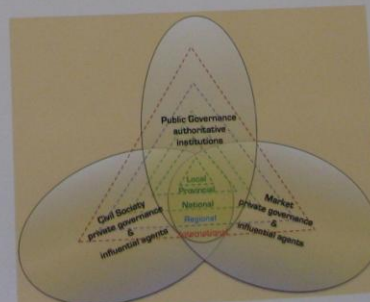
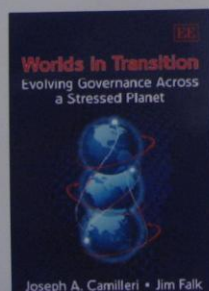


Fig 2. Governance arenas