Coloring Climates: Imagining a Geoengineered World

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> Then one winter evening they were sitting on the westernmost bench, in the hour before sunset. … Maya looked up … and clutched Sax by the arm, "Oh my God, look," … Sax swallowed … "Ah," he said, and stared. Everything was blue, sky blue, Terran sky blue, drenching everything for most of an hour, flooding their retinas and the nerve pathways in their brains, long starved no doubt for precisely that color, the home they had left forever. (Robinson, 672-73)

In a scene towards the end of the final book of Kim Stanley Robinson's trilogy on the settling and terraforming of Mars, *Blue Mars*, two surviving members of the first one hundred settlers, now ageing despite their longevity treatments, have got into the habit of sitting looking at the sky. Using color charts, Sax and Maya put names to the new colors that they see slowly emerging in the Martian sky, as the planet is altered in order to make it more hospitable to life. With their senses tuned by months of observation, they share wordlessly the moment when the color of an Earth sky finally appears.

In this essay I will discuss the contemporary sociotechnical imaginary of climate geoengineering. If in the Anthropocene our own planet, as much as any other planet we may come to inhabit, becomes an intended world, one in which the majority of once-natural processes and systems are not just accidentally but *deliberately* shaped by human action, what would be the best word to capture its climates? "Engineered," or "managed?" "Synthetic," "made," or "fabricated?" "Assembled," "composed," or "designed?" Each candidate word has a slightly different resonance and set of micromeanings. In his lecture to the 2008 conference of the Design History Society, Bruno Latour made a case for 'design' as a fruitful way of describing human *poiesis*, making. He suggested that, unlike alternative words such as "building" and "constructing," the notion of design implies a modest, post-Promethean theory of action suitable for a context of ecological crisis. To support his case he highlighted five features of design: its humility; its attention to details; its focus on signs and meaning; its working with what already exists; and its normative distinction between good and bad design. According to Latour, then, the climate of an Anthropocene Earth would—or at least should—not be *made*, or *constructed*, but *designed* ("A cautious Prometheus?").

Yet Robinson's passage above suggests that the word "design" might not be quite the right one to orient our thinking about what it would mean to make climates. In its linguistic origins in the Italian *disegno*, the notion of design was deeply shaped by the rivalry in the early and middle Renaissance between two regional aesthetic approaches to the visual arts, those of Florence (*disegno*, "design") and Venice (*colorito*, "coloring"). To simplify a complex history, the Florentine style emphasised the artist's conceptual mastery and technical skill, while the Venetian style focused more on observation and the conveying of vivid reality. The art of Florence thus typically started with outlines, to which were added individual hues using fresco and tempera paints, whereas the artists of Venice such as Titian—influenced by its maritime openness to the Byzantine East as well as by its damp climate—more typically used oils to build a composition from diffuse patches of colour in relationship to one other.

In *Blue Mars* it is striking that the moment when these two ageing humans are convinced that Mars has somehow reached an Earth-like state is not through temperature readings,

atmospheric gas concentrations, or estimates of biomass but through an experience of color—
and then, not a technical matching of light frequencies but a visceral shock of recognition, the
kind of speechless wonder that the ancient Greeks called *thaumazein*. In the end it is not the
designing of Mars—the measuring of future sea levels, the building of colonies, the
engineering of ecologies—but the emergent coloring of an evening sky that convinces the
body that Mars has become a dwelling place for humans. This is why debates about
geoengineering need to be informed by an environmental humanities sensibility. If humans
ever come to make Earth climates, then we will need an expanded way of thinking about two
things, both of which should inform the other: what it means to make or compose something,
and what it would be like to live in a made or composed world.

Geoengineering and the Disciplines

Geoengineering, or climate engineering, is a prospective suite of techniques to control the
climate in order to counteract the warming effects of raised carbon dioxide levels in the
Earth's atmosphere. Global climate control, as opposed to local, short-term weather control,
was promoted by scientists such as John von Neumann and Edward Teller after World War
II, during a period of heightened technological optimism and global sensibility. But it was an
article by Nobel-prize-winning chemist Paul Crutzen in 2006 and a subsequent Royal Society
report in 2009 that put geoengineering firmly on the research and policy agenda (Crutzen;
Royal Society). Since then, scientific and "grey" publications have grown steadily (Belter and
Seidel; Oldham et al.). Proposals under discussion generally fall into two classes: some
techniques are about extracting CO_2 from the atmosphere, either biologically or chemically;
others are about making the Earth more reflective, whether by spraying sulphate particles into
the stratosphere or brightening tropospheric clouds or the Earth's surface, and thereby
reducing the amount of solar energy getting through to warm the atmosphere.

Geoengineering can provoke strong reactions, for reasons which have deep cultural roots. It
can seem Promethean in the extreme to claim to be able to manage something as vast and
complex as the global atmosphere (Hamilton). Proponents of the idea of a possible "good
Anthropocene," in which humans would aspire to new levels of the Baconian project of the
mastery of nature and an "age of humanity," often include geoengineering as a signature
technology (e.g. Lynas). Geoengineering was shaped by a post-WWII, cold-war, and
ultimately military imaginary (Fleming "The climate engineers"; Fleming *Fixing the Sky;*
Masco), and can feel alienating and anti-democratic in character (Szerszynski et al.). Perhaps
prompted by these concerns, policy debates about geoengineering were quicker to try to
incorporate non-technical or "social" issues than those around earlier technological
controversies (Schäfer and Low).

Yet the research literature is dominated by science and engineering (Oldham et al.), and
although there have been a number of interdisciplinary research projects on geoengineering,
their style of interdisciplinarity has generally meant that natural-science framings of the issue
still dominate (Szerszynski and Galarraga). The critical social-science research that has been
carried out is often motivated by a desire to correct this tendency, by pointing out the danger
of adopting a narrow set of problem definitions and expert-analytical assessment methods
(e.g. Bellamy et al.), or by seeking to widen debates through techniques of public engagement
(for a summary, see Bellamy and Lezaun).

In the humanities, there have been publications about geoengineering in domains such as
ethics (e.g. Jamieson; Gardiner), political theory (e.g. Dalby) and theology (e.g. Clingerman;

Kearnes). Some leading public commentators on geoengineering have themselves drawn on philosophical and historical forms of reasoning to try to deepen the debate (Hamilton; Hulme, *Can Science Fix Climate Change?*). Generally, contributions from the humanities have been deeply suspicious of geoengineering as a sociotechnical imaginary. But some have argued that it opens up a potentially interesting way of thinking about planetary politics, with Nigel Clark suggesting that it offers an opportunity "to imagine a new kind of geologic politics in which identity, citizenship, and governance are construed … in the relation to a dynamic and stratified earth" (Clark, 2831).

What happens when you look at an issue that has been largely framed by science and engineering, using social science techniques, but informed by a humanities sensibility? In the rest of this chapter I will reflect on a line of work that explores geoengineering as the 'making of worlds'—and not just in the sense that it would be the fabrication of climates. Geoengineering would involve us in a deeper complicity in processes of anthropogenic climate change in the guise of promising to halt it, and thereby engender a new kind of relation between humans and the weather (Szerszynski). As Bill McKibben has argued, the meaning of everyday weather events has already changed due to unintended anthropogenic climate change: "Yes, the wind still blows—but no longer from some other sphere, some inhuman place" (McKibben, 44). How much more would that be the case with intentional "climate control"? How would geoengineering color our relationship with the air, and what sort of world would it bring about?

Coloring the Sky

In 2012 Maialen Galarraga and I published a philosophical paper on geoengineering. Using the term 'making' in an inclusive way to describe all forms of *poiesis*, the deliberate en-forming of matter, we tried to approach making as something that has to be grasped as a whole rather than decomposed into a set of technical questions on the one hand and a set of ethical, political or aesthetic questions on the other. We drew on the philosophy of technology to develop three very different accounts of how making takes place, which we called respectively *production* (imposing existing forms onto matter), *eduction* (drawing forms out of the potentiality of matter), and *creation* (creating radically new forms by rearrangements of matter). We argued that each of these models of making implies a particular version of human agents and their responsibility, which in the case of geoengineering we called the "climate architect," the "climate artisan," and the "climate artist" respectively. These are not concrete individual people but archetypes that shape imaginations and actions and thus the way the future unfolds.

The ***climate architect*** is our name for the picture of the maker of climate that currently dominates the contemporary discourse of geoengineering. The climate architect is an idealised, imagined figure who 'designs' in advance the form that they want the climate to take; who can identify the process whereby they can provoke the climate to take it; and who can carry out that process and bring the matter of climate into the desired form (for more on this model of making, see Simondon, *L'Individu et sa genèse physico-biologique, 48-9;* Protevi, 8). This way of thinking about making climates is encouraged by the centrality of computer models in climate science, including geoengineering research, which has the effect of rendering climate as pure information *in silico*—as form stripped of matter. This dematerialised, formal climate can then be imagined as something that can be recombined with matter and thus made actual.

But it is a mistake to imagine that a predetermined form can be imposed onto the metastable climate system. In Gilbert Simondon's well-known analysis of brick-making, the process of en-forming the clay with the help of a mould is dependent on the clay having been purified—for example, by removing any clots or stones that would act as "parasitic singularities" and disrupt the process of en-forming (Simondon, *Du mode d'existence des objets techniques, 42*). Yet the climate, continually in formation, cannot be purified in this way. The uncertainties in climate models are not mere 'noise' to be erased, but the result of potentialities intrinsic to the way that the atmosphere maintains and develops its form over time, in interaction with incoming solar energy and the other dynamic 'compartments' of the Earth including the biosphere.

So secondly, we discussed an alternative way to imagine the making of climates, not "production" but "eduction": coaxing out the latent forms in matter. The imaginary figure who would make climates in this way, the ***climate artisan***, would focus less on the final form to be taken by the climate than on the process whereby the en-forming of climate takes place. Adopting a greater humility towards the desires and tendencies of the more-than-human world, both biotic and abiotic, out of which climate occurs as a collective achievement, they would allow the 'form' of the made climate to emerge out of their interactions with matter. They would thus emphasise recursive learning, and treat computer models not as "truth machines" which reveal the future but as experimental arenas in which the beginnings of a "feeling for climate" might be cultivated.

But we suggested that even the artisanal approach has its limitations. As ideal types, neither the climate architect nor the climate artisan is oriented towards the radical novelty that making climates might entail. So we developed a third figure, the ***climate artist***. This was a deliberately provocative move, in that a climate artist might become a 'climate auteur', even more hubristic than the climate architect about their capacity to design every feature of a geoengineered world, while also being unconstrained by the demands of technical effectiveness. But we tried to avoid this by loading onto this third figure an even greater set of responsibilities – not just to the final form of a made climate, or to the matter out of which it would be composed, but also to the way that major technological innovations like geoengineering can fundamentally alter the human condition. In our normative typology the climate artist would thus approach the making of climates as an act of "creation" in the sense used by Cornelius Castoriadis. For Castoriadis, "producing" artefacts in the sense discussed above is not really making anything new but merely imitating, because it is simply re-producing existing forms (Castoriadis, 197). It is only if we create a new form or *eidos* that genuine novelty or "ontological genesis" occurs. Understanding making as creation also requires us to understand time as genuinely historical; just as some works of art inaugurate a new way of looking at the world – and even at earlier works of art – according to Castoriadis each new form of society is the emergence of a new *eidos*, or societal imaginary—a radically new way of organising thought and action. Being a "climate artist" would thus involve not only an artisanal awareness of the need to collaborate with one's material, but also an artistic awareness that making climate would inevitably involve creating *climatically novel states*—climates and therefore biomes with no historical analogues—and also *historically novel states*: a new kind of society, with a new articulation of the atmosphere and how we relate to it.

The implications of this are profound. Both the climate architect and the climate artisan as we have imagined them assume that it is possible to maintain some kind of continuity and consistency between a goal formed in advance and the final achievement of a made climate.

But the climate artist would recognise that the creation of a new *eidos* produces a historical rupture, a new context in which ways of thinking and forming intentions can be utterly transformed. Seeing geoengineering as creation means that it could never simply be judged as a means to an end, and thus as capable of being deemed "successful" or "unsuccessful" by criteria set in advance in the way that is envisaged by most scientists and policy actors. Instead, its deployment would have "changed the end in changing the means" (Latour, "Morality and Technology", 252); it would create a new kind of society, in which geoengineering would take on new meanings, be put to new uses, and be judged in new ways, and in which the very nature of climate, the sky, and the weather for us would be altered. This is where the sensibilities of *colorito* become relevant. Just as the great *colorito* paintings of the Renaissance, or the skies later painted by Turner, are concerned less with extensive outline and shape and more with intensive atmosphere, so too would the climate artist as we imagined them be concerned not so much with the achievement of specific climate parameters as with wider features of society, culture and subjectivity in a geoengineered world. To reflect on these aspects of climate engineering one has to move, as it were, from Florence to Venice, from tempera to oils.

Reflecting (on) the Sky

If Sax and Maya were to look at the sky of a geoengineered Earth, what would they see? Perhaps stratospheric aerosol injection would have turned the deep blue skies of rural areas into a Parisian-style white haze—but also have made dramatic fiery sunsets like the Krakatoa-induced one painted by Edvard Munch in *The Scream* entirely routine. Perhaps continuous sprays of seawater droplets would have turned the grey stratocumulus clouds that flank western-facing continental coastlines a dazzling white—or, more disturbingly, the leaden monsoon skies of South Asia may have become less common. But let us also expand our gaze beyond the literally visual: what of the wider 'colors' of a geoengineered world? What kind of people and societies would live under and be illuminated by these altered skies? And might they view *all* weather events differently? I explored such questions in a project with the science and technology studies scholar Phil Macnaghten, in which we adapted public engagement methods in order to explore questions about the governability of geoengineering in the context of a collective, phenomenological exploration of what it would be like to live in a world shaped by geoengineering.

This approach was informed by the philosophy of technology and art as discussed above, but also by historical and sociological insights about technological change. Major shifts in technology are not simply the insertion of a new tool into an existing society; they change that society, subtly or drastically altering what people want and feel entitled to, and how social practices and social relations are organised (Nordmann). If you change the *means*, you can change the *ends* (Latour, "Morality and Technology"). We thus felt that asking the public what they thought about adding geoengineering to the existing world would be the wrong question, one which was likely to get us a familiar but misleading answer. By adding geoengineering to the world, you are likely to change that world in a profound way.

We carried out seven focus-group discussions in three UK cities in December 2011, each lasting three hours, and each with six to eight participants sharing a particular set of lifeworld characteristics. What first emerged was a phenomenon that is familiar from other studies of public attitudes to new technologies—"conditional acceptance." Participants expressed a reluctant acceptance of research into geoengineering as a necessary evil, given the geopolitical realities around emissions-reduction negotiations. But they were only happy for

this research to go ahead if they were given reason to have greater confidence in climate science, in geoengineering research, in geoengineering governance structures, and in wider political institutions.

We then asked our participants to put those conditions of acceptance—and the dominant imaginaries of key scientists, policy-makers, civil society actors involved in geoengineering debates—to a plausibility test by imagining future geoengineered worlds. Drawing on earlier experiments with storytelling techniques in public engagement about the future (Roberts), participants were encouraged to imagine the worlds that might be brought about by these technologies—their political economy, their institutions, their inhabitants, their lifeworld. Thus, rather than asking them to accept or reject the implicit imaginaries of policy makers and scientists, they were encouraged to carry out their *own* imaginings; and rather than simply picturing geoengineering as being added to the world that is, they tried to render the interconnected colors of a geoengineering world.

In such a world, in which the reality of geoengineering had percolated through to many aspects of society and culture, the "climate architect" imaginary of policymakers became implausible. In a geoengineering world, the existing problems identified with the public meanings of climate mitigation—alienation, dependence on science, and truth claims that are seen as at odds with the everyday experience of the limits of human knowledge and control (Wynne)—were intensified. And the possible side effects of geoengineering that were highlighted were not confined to the realm of the physical; our visioning exercises enabled us to paint a picture of a world in which immense challenges were being posed to the institutions of liberal democratic politics.

We summarised and expanded on these in a subsequent paper (Szerszynski et al.). We argued firstly that with geoengineering the attribution of cause and effect, and of liability and accountability, would be impossible to carry out in any definitive way, putting strains on the international system and further politicising scientific knowledge in ways that would impact on the broader politics of climate change (see Hulme, "Climate intervention schemes" for an imaginative rendering of a possible geoengineered future). Secondly, we suggested that, because the emerging "social constitution" of geoengineering—its implied social relations—would be global in scale and technocratic in character, it would be experienced as incompatible with democratic control. Thirdly, we argued that, in the transition to a world of 'made' climates, the relationship between intention, deployment, and consequences would always be unstable: a new, geoengineered and geoengineering world would be one with new senses of possibility, in which geoengineering technologies would be used for new purposes such as improving agricultural yields or undermining regimes, leading to new kinds of conflict and controversy. Fourthly, we suggested that geoengineering would become conditioned by economic forces, with artificial markets, promissory, "vision-based" dynamics and "bubbles" of hope and hype, generating further problematic effects on the practice and authority of science. The novelty of a geoengineered world when fully imagined thus lie not just in the geophysical realm, nor in the felt subjective experience of the weather, but also in the geopolitical sphere.

Conclusion

We have seen that geoengineering raises complex issues about the unfolding of sociotechnical futures, ones for which a narrow "climate architect" imaginary is inadequate. Yet in the mainstream debates about geoengineering, it is still that very imaginary which

prevails. If we genuinely want creatively to explore the space that geoengineering has opened up for new forms of politics suitable for living on a dynamic planet, we will have to develop a broader palette of imaginaries. For a start, we will need to explore more artisanal techniques of climate alteration, with very different implied social relations – for example, locally implemented and easily reversible "soft geoengineering" techniques such as building soils and increasing the reflectance of cities (Olson), or more "enchanted" options such as rewilding landscapes and creating biophilic cities (Buck). But we also need a sense of climate responsibility with deeper and richer hues, a wider culture of climate artistry.

Where can we find the sort of cultural politics of climate-making that could generate the reflections that we need? Geoengineering has featured in popular news media, but coverage has been limited both in scale and in the range of narratives and metaphors deployed (Luokkanen, Huttunen and Hildén). In wider popular culture it has received more sustained and complex treatment. It figured prominently in the 1982 graphic novel *Le Transperceneige* (Lob and Rochette), later translated into English and adapted as the 2013 film *Snowpiercer* (Bong), though this focused more on the (in this case disastrous) possible after-effects of geoengineering. The kind of judgements that would be involved in real-time climate modification itself have been foregrounded in a number of interactive games. In the computer game *Fate of the World* (Red Redemption), players can try out various options including geoengineering in order to reduce or adapt to global warming over the period of two centuries (Red Redemption). In the transmedia role-playing game *Bluebird*, sponsored by the Australian Broadcasting Corporation in 2010, Bluebird was the name of a "rogue" geoengineering project initiated by fictional billionaire "Harrison Wyld;" players were able to live life for six weeks as if geoengineering was really happening and could engage in the struggle between the "Go Bluebird" PR campaign and the "Stop Bluebird" group set up by whistlebower "Kyle Vandercamp." Artists such as Bigert & Bergström, Karolina Sobecka and Weather Permitting have also produced works that raise more open-ended questions about what a geoengineered world would be like.

If we do ever come to make climates, it will never be the simple commanding of matter, since it will entangle us even more deeply in the endless becoming of the more-than-human world. Making climates will thus have to be a form of what Tim Ingold calls "textilic" rather than "architectonic" making, "a weaving of, and through, active materials" (Ingold, 93). But it will also have to be sensitive to the ontological dimension of making climates, which will necessarily be more than the mere rearrangement of existing elements; it will be the creation of a new world, in which the very nature of air as "matter-that-takes-form" will have been altered. We may never be able to "design" a planet—but we may yet come to "color" one—and, if so, we should learn to do it well.

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