## 1NC

### 1NC – T – Tropicality

#### Interpretation: the affirmative must use a lens of tropicality. It’s a prerequisite to ethical space policy discussion.

#### Violation: Vote neg - They don’t forefront a critical geography framing—that reproduces destructive colonial violence against the equatorial margins.

Dunnett, 19—Department of Geography, School of Natural and Built Environment, Queen’s University Belfast (Oliver, “Imperialism, Technology and Tropicality in Arthur C. Clarke’s Geopolitics of Outer Space,” Geopolitics, January 31, 2019, dml)

Approaching concepts of outer space, geopolitics and science through Arthur C. Clarke first requires a broader discussion of relevant debates in postcolonial studies, science and technology studies, and historical geography. Synthesising some of these themes, the anthropologist Peter Redfield’s study of the European space programme aimed to ‘recombine elements of imaginative discourse with technical practise, tracing the trajectory of adventure as it leaves the planet, and highlighting the historical geography of power that runs through the Final Frontier’ (Redfield 2002, 792). This empirically rich work provides a sound theoretical basis for exploring the cultural and political roots of spaceflight in the late modern era, while taking seriously imaginative representations of outer space. Existing studies of outer space in this period have mostly examined, by contrast, the social and cultural ‘impacts’ of the better-known American and Soviet/Russian space programmes, in the geopolitical context of the Cold War (Dick and Launius 2007; Parker and Bell 2009). Redfield connects outer space and empire in two ways: Firstly, through analysing the imaginative geographies of exploration, conquest and adventure that have long characterised spaceflight narratives, and second, in examining the colonial status of the European Space Agency launch site in French Guiana in South America, home of the Ariane satellite launcher rocket since 1979. Other researchers have considered rocket sites in colonial locations such as Hammaguir in Algeria, launch site of the French satellite Astérix in 1965, and Woomera in South Australia, where the British Blue Streak rocket was tested in the 1960s (Gorman 2009; Instone 2010). The development of these sites as centres of imperial techno-science notably came at a time when European empires were disintegrating in spaces across the world, and thereby make effective case studies for examining late-modern connections to the empire of outer space.

An integral argument in critical studies of spaceflight is that space exploration represents a modernist dream that acts as a continuation of empire, implicating discourses of technology-as-progress. In this respect, historian Michael Adas has explained how, in the industrial era, science and technology were seen as ‘measures of human worth’, justifying European colonialism while also acting as the means through which imperial power was exercised (Adas 1989, 3). This pattern has been noted in accounts of technological determinism that frequently characterise narratives of space exploration. For example, the American space programme of the 1960s, specifically Project Apollo, is said to have exemplified and helped proliferate ‘technocratic’ modes of governance in the United States, typified by ‘a utopian attitude towards technology’ as a solution to all the world’s problems (Sage 2014, 57). More recently, ‘NewSpace’ magnates such as Elon Musk and Jeff Bezos have enrolled the language of utopian technological futurism to promote ambitious space ventures such as the colonisation of Mars (SpaceX 2018). Such framings have been described as ‘depressingly ubiquitous’ in portrayals of so-called ‘frontier technologies’, adding to debates on the extent to which technology can be seen as culturally and politically produced, rather than naturalised as a harbinger of progress and modernity (Bingham 2005, 202; Jasanoff and Kim 2015). Critics have typically rejected technological determinism as an effective explanation of societal development, drawing on postmodernist accounts that define a role for the social construction of science and technology (Shapin and Schaffer 1985). Indeed, researchers have demonstrated how spaceflight technology did not emerge naturally at any given place or time, with political and cultural factors influencing substantial geographical and historical disparities in its development (Winter 1983). Further studies have effectively outlined how various popular cultures, including science fiction novels, astronomical art and the public spectacle of rocketry, worked as integral parts of the wider discourse of twentieth-century outer space technology (MacDonald 2008; Redfield 2002; Sage 2008).

Adding further nuance to debates on the relationship between technology and culture, Redfield explains how a combination of political, cultural and geophysical factors led to the selection of French Guiana as the home of the European Space Agency’s rocket launch facility in the early 1970s (Redfield 2000). Notwithstanding its history as part of the French imperial sphere of influence, French Guiana’s significance for European spaceflight operations lies with its geographical location near to the equator, and its eastward-facing coastline. This is because, firstly, equatorial sites benefit from the maximum ‘latitudinal boost’ resulting from the centrifugal forces of the earth’s rotation, and, second, the Atlantic Ocean is made available as a vast testing range, where spent rockets can safely crash back down into the open seas. Furthermore, the equatorial region becomes prized in the geography of spaceport site selection because of its alignment with the prime ‘real estate’ of the geosynchronous orbit, located along a band in space 36,000 km above the earth’s equator (Collis 2009). As Clarke illustrated in 1945, satellites placed in this orbit attain specific value as they remain fixed above any given point on the earth’s equatorial belt, and can thereby be used for reliable global communications services (Clarke 1945). This new perspective was officially recognised in the 1976 Bogotá Declaration, which stated that ‘[t] he geostationary orbit is a scarce natural resource’, over which equatorial states should have national sovereignty (Bogotá Declaration 1976). While signed by a consortium of equatorial states, the declaration remains unratified by the United Nations, highlighting the unequal power geometries involved in outer space geopolitics. Such concerns demonstrate how the study of space launch sites, both actual and anticipated, presents opportunities for researchers interested in the intersections between science and technology studies, critical geopolitics and cultural-historical geographies of the tropical region.

Indeed, while equatorial sites have their own unique advantages for the space industry, postcolonial scholars have demonstrated how tropical spaces have been assigned particular characteristics, drawing on a wider body of work that has addressed the complicity of western culture in discourses of empire (Pratt 1992; Said 1993). Such characteristics relate to opportunities for adventure, the presence of bountiful natural resources, and the danger and excitement of exotic allure. For Richard Phillips, ‘European empires and European masculinities were imagined in geographies of adventure’ in children’s novels such as Daniel Defoe’s Robinson Crusoe (1719), famously set on a fictitious tropical island (Phillips 1997). Twentieth century imaginative spaces of adventure have also been interpreted in relation to geographies of empire, whether in relation to historical figures like T E Lawrence, or fictional archetypes such as James Bond or Tintin (Dawson 1994; Dodds 2003; Dunnett 2009). According to Graham Dawson, ‘the modern adventure tale is imbued with the imaginative resonance of colonial power relations underpinned by science and technology’, while at the same time, adventure becomes ‘balanced with anxiety and desire’ in the colonial context (Dawson 1994, 59, 53). The adventure genre and its associated tropes remain closely connected to narratives of space exploration, as seen in examples such as the 1964 feature film Robinson Crusoe on Mars, or Andy Weir’s 2014 novel The Martian and subsequent film release, whose extra-terrestrial spaces are represented through a combination of masculine endeavour and exotic encounter (Crossley 2010).

Beyond generic conceptions of adventure, research in cultural and historical geography has drawn on the concept of ‘tropicality’ as a way of understanding certain representations and experiences of tropical spaces, that also relate to wider cosmographic frameworks (Arnold 2000). As Denis Cosgrove reminds us, ‘the originating tropics [of Cancer and Capricorn] are celestial rather than terrestrial markers within a geocentric cosmos’ (Cosgrove 2005, 199). They comprise two great circles that delineate the equatorial band of the earth where the sun passes through the zenith directly above at least once a year, as defined by the earth’s axial tilt. It is the interplay between this cosmographic definition of the tropics, and ethnographic and biological understandings of the tropics, which has defined notions of tropicality in the western world. Such framings can be traced to medieval notions of an equatorial ‘torrid zone’ as part of a Ptolemaic theory of world climatic regions (Cormack 1994). While being considered a barrier to human (European) civilization, the equatorial zone has also been seen as a realm where ‘the superabundance of nature was believed to overwhelm human endeavour’ (Leys Stepan 2001, 18). Yet as voyages of discovery opened up previously unencountered spaces to European experience and representation, imaginative geographies of the tropics persisted. Some, for example, have associated ‘paradisal geographies’ with ‘New World islands … as the location of peoples as yet unfallen and as sites of natural richness’ (Withers 1999, 84). Others have recognised the ways in which ‘tropicality has frequently served as a foil to temperate nature’, or as a ‘site for European fantasies of self-realisation’ (Driver and Martins 2005, 3, 4). Tropical spaces have also been associated with forms of modernity, whether in relation to early modern voyages of discovery, or in ‘modernist abstraction[s] of nature’ in twentieth century landscape designs (Leys Stepan 2001, 210). This paper adapts cultural and cosmographical readings of tropicality in the context of late-imperial techno-science to consider a concept of ‘cosmological tropicality’, a sense in which tropical spaces are more intimately aligned with the heavenly movements of the cosmos, and therefore could hold the key to the future of space exploration.

Geographers Felix Driver and Luciana Martins have argued that understandings of tropicality have been largely framed through ‘projections’ of imagined geographies, and that researchers should attempt to understand such representations as they have been produced, negotiated or contested (Driver and Martins 2005, 5). Touching on similar themes, Gerry Kearns’ research on the late-nineteenth-century travels of Mary Kingsley and Halford Mackinder in colonial Africa has investigated the ways in which personal encounters and travel experiences helped shape the identities of British imperial subjects, informing their broader geopolitical outlooks (Kearns 1997). As such, while Clarke’s projections of Ceylon/Sri Lanka are inherently representational, they also relate closely to the tangible, experienced geographies of his life in Ceylon/Sri Lanka, and present the unusual perspective of a western individual who lived on this island for most of his adult life. In approaching Clarke by thinking through his experiences as well as the representational texts he produced, it becomes possible to engage ‘socio-technical’ understandings of the nuanced relationships between technology, society, representation, discourse and experience. Here, drawing from Bruno Latour’s conception of technology as a social and material construction, Nick Bingham has called for a renewed understanding of socio-technical assemblages ‘between diverse people, non-humans and places’ (Bingham 2005, 201). As such, this paper attempts to understand the extent to which Clarke’s projections of outer space technology were shaped by negotiation with, and experience of, the specific geographies of twentieth century Ceylon/Sri Lanka.

In his aforementioned essay on tropicality, Cosgrove warns that, ‘in rehearsing – even with critical intent – the ways in which Europeans so closely and outrageously have bound tropical ethnography into a mutually deterministic embrace with the physical environments of the tropics, we risk perpetuating the silencing of voices speaking from within tropical space’ (Cosgrove 2005, 198). The same could be said of any account that purports to interpret the visions of one Englishman’s fantasy of space exploration in a tropical ‘paradise’. Yet there remains value in ascertaining the ways in which outer space has been connected to earthly imaginative geographies, and how experiences of particular places have informed geopolitical cultures of outer space. While acknowledging the limitations of such an approach, this paper seeks to investigate the extent to which Clarke’s socio-technical constructions of Ceylon/Sri Lanka were formulated with respect to local culture and politics. Tariq Jazeel has, for example, contested the notion of ‘Sri Lankan island-ness’, explaining how the perceived unity of the Sri Lankan state today can be traced to British imperial rule from 1815 to 1948, before which the island had been made up of a number of separate kingdoms since the fifteenth century (Duncan 1990; Jazeel 2009). The replacement of this multi-cultural space with a unitary British imperial island colony was, according to one researcher, reflected in a sense of modernity in the everyday material cultures of local people, while the damaging legacy of the unification can be clearly seen in the destructive civil war that plagued the country from 1983 to 2009 (Wickramasinghe 2009). Such issues are pertinent to understanding the complex interactions that Clarke had with the places and landscapes of Ceylon/Sri Lanka, particularly the understandings of modernity and progress that were central to Clarke’s world-view.

Discourses of space exploration have, in the ways outlined here, been connected to a variety of familiar geographical imaginations concerning empire, adventure and the anticipation of a technologically-driven future. Yet studying Arthur C. Clarke adds the further perspective of experiencing and representing tropical spaces as part of a critical geopolitics of outer space, an exercise that has only received partial critical attention through Redfield’s work on French Guiana. By turning to three phases in Clarke’s life and works we can see how cultures of empire, technological determinism and ‘cosmological tropicality’ are played out in the immediate context of late-twentiethcentury Ceylon/Sri Lanka.

#### That ethical frame outweighs.

Klinger, 19—Frederick S. Pardee School of Global Studies, Boston University (Julie Michelle, “Environmental Geopolitics and Outer Space,” Geopolitics, March 20, 2019, dml)

On Earth, the environmental geopolitics of outer space are inseparable from questions of environmental justice. Environmental (in)justice unfolds across multiple scales through concrete processes: localized and stratospheric emissions from space launches (Carlsen, Kenesova, and Batyrbekova 2007; Jones, Bekki, and Pyle 1995), the placement of outer space related infrastructure in national and global peripheries (Gorman 2007; Mitchell 2017; Redfield 2001), and the use of such infrastructure to advance or thwart environmental destruction (Da Costa 2001; Guzmán 2013; Parks 2012).

Human engagement with outer space enlists industrial economies, global networks of infrastructure and expertise, and the generation and control of information. All of these activities take place in specific sites and are subject to ongoing transformations in territorial governance practices. By locating infrastructures that are securitized, dangerous, and environmentally toxic in remote areas, the state or empire accomplishes two things. It consolidates power in far-flung territories while mitigating against liabilities and security threats that might arise from placing launch infrastructures closer to the metropole. In order to reduce environmental impacts, adequate resources, personnel, and expertise need to be assigned to the task of monitoring and mitigating the regional fallout of rocket launches (Hall et al. 2014). This may not be the case if the site in question has been deemed sacrificable by those with territorial control.

Launches and Their Infrastructures

Reaching outer space requires Earthly infrastructure, which means that space launches have concrete footprints that change according to developments in launch technologies. The placement of outer space related infrastructure on Earth is a question of environmental (in)justice. Which sites are chosen, who is expropriated, and which environments are impacted is subject to strategic geopolitical calculations, which, more often than not, employ classical geopolitical reasoning (Hickman and Dolman 2002; Ingold 2006; Meira Filho, Guimarães Fortes, and Barcelos 2014; NDRI 2006). Launch sites are tightly controlled to reduce the risk of interference or failure, therefore situating launch sites in remote areas is often explained in terms of safety and security (Zapata and Murray 2008). No doubt this is important: rockets are composed of many tonnes of material and combustive fuel, so they must be launched in places where damage from routine as well as potentially catastrophic explosions can be contained. For humans to reach “the final frontier,” they must first find a frontier space on Earth that can be made into an empty space in which controlled explosions can be routine.

Frontiers are seldom as empty as those aiming to conquer them would claim. Where they are not populated by people, they are filled with other sorts of meanings and life forms (Klinger 2017; Tsing 2005). Potential launch sites and testing ranges deemed by government authorities to be simultaneously remote, safe, and suitable to contain the risks of rocket launch must first be made empty of people, with prior land use regimes or territorial claims pushed beyond designated buffer zones (Gorman 2007; Mitchell 2017). Hence the placement of space infrastructure follows colonial geographies of extraction, sacrifice, and risk (Mitchell 2017; Redfield 2001). As Gorman (2007) put it: “because of their distance from the metropole, these places lend themselves to hosting prisons, detention camps, military installations, nuclear weapons, and nuclear waste. All of these establishments, including rocket ranges, have inspired reactions of protest.” These so-called ‘peripheral’ spaces are nevertheless central to their inhabitants and their neighbors, who question the logic of extraglobal conquest in the face of unresolved Earthly injustices.

Consider, for example, the case of the launch site in Alcântara, Brazil, which has been well documented by Araújo and Filho (2006) and Mitchell (2017). Through a close examination of local, national, and international politics, these authors document how the government’s racialized approach to the subsistence communities displaced by space infrastructure deepened structural inequalities. Grassroots opposition to the launch site grew not out of an a priori ideological opposition of poor people to national progress in outer space, as some officials alleged, but rather resulted from the failure to account for the food insecurity generated by state resettlement projects. The resettlement schemes were themselves misinformed by impoverished notions of local livelihoods. Local claims against the deprivations caused by statesponsored space practices have deepened schisms between the military and civilian space programs at the federal government level.

Through the lens of classical geopolitics, these structural inequalities scarcely register, with the result that the ‘crawling’ progress of Brazil’s space program is pathologized as poor management practices symptomatic of an inadequately implemented national development vision (Amaral 2010). Critical geopolitics helps deconstruct the nationalist performativity of such endeavors by considering the political and economic value placed on the spectacle of spaceflight (Boczkowska 2017; Macdonald 2008, 2010; Sage 2016). Feminist geopolitics draws our attention to the racialized and gendered dispossession advanced by the state, through the construction of space infrastructure and exercised through access to land. The fact that environmental and public health impacts were only considered by the authorities after years of mobilization by Black social movements, religious communities, and scholars highlights the ways in which inattention to the local in the pursuit of space power perpetuates environmental injustice, which in turn interrupts national plans for space progress.

Rocket launches affect local and global environments through the construction of infrastructure, the exposure of local environments to toxic residues, and the dispersal of pollutants in land, air, and sea. Rockets are the only source of direct anthropogenic emissions sources in the stratosphere. Ozone-depleting substances (ODS) such as nitrous oxide, hydrogen chlorine, and aluminum oxide are emitted by rockets, and can destroy 105 ozone molecules before degrading (Voigt et al. 2013). The ozone layer prevents cancer and cataract-causing ultraviolet-b waves from reaching the Earth. As of 2013, rocket launches accounted for less than 1% of ODS emissions. As other ODS are phased out under the Montreal Protocol and the frequency of lower cost space launches increases, the proportion and quantity is likely to increase (Durrieu and Nelson 2013; Ross et al. 2009).

Although affluent economies in the northern hemisphere are responsible for most ODS emissions (Polvani 2011; Rousseaux et al. 1999), the geography of exposure disproportionately affects an overall higher population in remote regions and in the southern hemisphere (Norval et al. 2011; Robinson and Erickson 2015; Thompson et al. 2011) because ozone depletion is most serious in regions where high altitude stratospheric clouds are most likely to form: above the polar regions and major mountain ranges (Carslaw et al. 1998; Perlwitz et al. 2008). This is an example of environmental injustice on a global scale, where the global south bears the environmental burden of actions predominately taken in the global north, rocket launches included. In the process, global power relations are reinscribed through the uneven distribution of harm to peripheral and southern bodies, mediated in this case through the redistribution of gases in the stratosphere that increase exposure to solar radiation.

Coming closer to Earth, environmental geopolitics of outer space are manifest in the dispersal of particulate matter into ecosystems surrounding active launch sites. This is more than a strictly local environmental concern, because which spaces are subject to the hazards of launch sites involves careful calculations weighing financial cost, state power, and multifarious territorial interests. With each launch, surrounding areas are showered with toxins, heavy metals, and acids over a distance that varies widely with wind, weather, and precipitation patterns at the moment of lift-off.3 The most researched of these pollutants are hydrogen chloride, aluminum oxide, and various aerosolized heavy metals. Release of these pollutants from rocket launches results in localized regional acid rain (Madsen 1981), plant death, fish kills, and failed seed germination of native plants in launch sites (Marion, Black, and Zedler 1989; Schmalzer et al. 1992).

These effects, and research on them, are mostly concentrated within one kilometer of the launch site. But they have been recorded several kilometers away under certain weather conditions (Schmalzer et al. 1998). Recent studies on the concentration of trace elements in wildlife in areas near NASA launch activities in Florida, USA, found that more than half of the adults and juvenile alligators had “greater than toxic levels” of trace elements in their liver (Horai et al. 2014). Both the subject, and the vague statement of findings, highlights the lack of research into the impacts on downstream human and non-human communities. In contrast to the precautions taken to protect workers in buildings adjacent to facilities where these technologies are developed (Bolch et al. 1990; Chrostowski, Gan, and Campbell 2010), much less consideration is given to communities within the dynamic pollutant shadow of rocket launches.

In Kazakhstan, Russia, and China, researchers have begun examining the effects of the highly toxic liquid propellant, unsymmetrical dimethylhydrazine (UDMH), which has been in use since the dawn of the space age. It has noted carcinogenic, mutagenic, convulsant, teratogenic, and embryotoxic effects (Carlsen, Kenesova, and Batyrbekova 2007), and it has been found to cause DNA damage and chromosomal aberrations in rodents living near the Baikonur cosmodrome in Kazakhstan (Kolumbayeva et al. 2014). Despite these known hazards, methods to detect UDMH at the trace concentrations at which toxic effects begin to manifest in humans do not yet exist (Kenessov, Bakaikina, and Ormanbekovna 2015), meaning that there is no knowledge of how this circulates in the environment, bioaccumulates up the food chain, or could potentially be sequestered through soil or plant filtration. The lack of technology or methodology to adequately track the dispersal of hazardous pollutants that have been used for decades in the surrounding environment illustrates another aspect of environmental injustice: the preference on the part of political and economic elites to create spaces of waste rather than allocate adequate resources to maintain safe and non-toxic environments.4

Not specifying an agent is a voting issue – wrecks counterplan competition, disad links and skews neg fairness by letting the 1ar shift in the future.

New affs are a voting issue for predictability and clash – they get infinite prep time to frontline an aff which makes negating impossible bc they’re always ahead which kills any educational benefit to the aff.

### 1NC – CP – EIA

#### Text: The appropriation of outer space by private entities via Large Satellite Constellations based in the United States is just. The appropriation of outer space by all other private entities via Large Satellite Constellations in Lower Earth Orbit is unjust.

**The United States federal government should submit an environmental impact assessment of an asteroid retrieval mission with china to the UN Office of Outer Space Affairs for public comment, modification, and approval. The United States federal government should implement the approved version of the submitted proposal.**

**Counterplan competes and creates the least environmentally damaging version of the aff.**

William R. **Kramer**, PhD Polisci/Futures Studies @ U of H Manoa, Currently HDR Inc. Extraterrestrial Environmental Analyst, **’14**, “Extraterrestrial environmental impact assessments A foreseeable prerequisite for wise decisions regarding outer space exploration, research and development” Space Policy 30 (2014) 215-222

To be most effective, all spacefaring nations and enterprises would voluntarily participate in assessing their extraterrestrial environmental impacts prior to undertaking actions in space. A hypothetical chronology of such a process might include: (1) Impact assessments are prepared by the action proponent and submitted to an impartial international panel or board; (2) The panel determines the assessment's sufficiency; (3) The assessment is published in an electronic or other format accessible to the public followed by a comment period; (4) The action proponent addresses comments and submits responses to the panel; (5) The panel publishes its approval or concerns; (6) The action proceeds, is **modified or is abandoned**; and (7) should the action proceed, periodic reports of the action's progress and impacts are filed for future reference in a digital format to allow broad access. The process would support the spirit of both **NEPA** to “fulfill the responsibilities of each generation as trustee of the environment for succeeding generations” (42 USC x4331(b)(1)) and Article 4(1) of the Moon Agreement's directive that “due regard shall be paid to the interests of present and future generations.” Given the likelihood that all states would appreciate the need for maintaining extraterrestrial environments and landscapes for both future research and exploitation, pressure from peer states and space industries may be sufficient to **encourage a trend of compliance**.

Such a review and approval system (perhaps similar to NEPA's relationship with the Council on Environmental Quality and its oversight function) could be attempted within the structure of the UN, such as within the **UN Office of Outer Space Affairs**. The spirit of an extraterrestrial environmental assessment program would be likely to fit within the mandate of the organization. However, amending the Outer Space Treaty or otherwise developing an administrative UN capacity to achieve the goals proposed in this paper would require a level of international commitment and cooperation that may be both lengthy and difficult to achieve. Spacefaring nations and international organizations are already invited to submit annual reports on their space activities and research to the UN Committee on the Peaceful Uses of Space, **so a precedent for reporting exists.** **Presently, however, reports tend to document positive actions and research, not details of extraterrestrial environmental impacts**.

**Extinction. EIA is key to preserve space resources, stop resource wars, and extra-terrestrial environmental damage.**

William R. **Kramer**, Hawaii Research Center for Futures Studies @ University of Hawaii, **'17**, In dreams begin responsibilities – environmental impact assessment and outer space development, ENVIRONMENTAL PRACTICE, VOL. 19, NO. 3, 128–138

**Benefits of extraterrestrial environmental impact assessment** Most publications regarding outer space resources maintain that those resources are nearly limitless, and many business models for exploitation do not imagine that resources on Mars, for example, will ever be exhausted (Lewis, 1996; Zubrin, 1996; Renstrom, 2016). Ever is a long time. While the statement may be figuratively true for some mineral ores that may last through an individual company’s project timeline, it is not necessarily true for long-term planning. **There will likely be competition for the rarest (most valuable) minerals**. Without some form of planning and regulation, they may be extracted in an inefficient and environmentally damaging manner and be **quickly depleted** (as exemplified by hydraulic mining for gold on Earth, which wasted much of the resource and resulted in extensive environmental damage) (Merchant, 1998).

How might resources be put to their highest and best use unless regulated? Both the Moon and Mars have water ice which will be **crucial for human survival**, but water also has lucrative industrial uses; it is potentially the raw material for manufacturing both rocket fuel and oxygen. **Conflicts over resource allocation** may be better addressed during an **assessment process** that seeks to balance highest and best use with discovery and first use. Who gains access to specific areas for mining becomes more problematic in that the Outer Space Treaty does not allow “ownership” of extraterrestrial territory; there is no guarantee that companies such as those listed previously will gain access to the most productive sites. The China National Space Administration is planning to place a crew on the Moon by 2024, so **competition for the best sites will be intense** (Kramer, 2015b; China Digital Times, 2012).

Space industries generally are not considering that their proposed actions may preclude alternative uses such as scientific research and human settlement. There will be a stream of not yet imagined uses that could be adversely affected or foreclosed. Many of the same conflicts between land use and human habitation experienced on Earth may emerge on extraterrestrial sites. On the Moon, for example, there are preferable sites for collecting solar energy. These “peaks of eternal light” are areas nearly always or constantly exposed to sunlight at the poles. They are very limited in both distribution and size (Elvis, Milligan, and Krolikowski, 2016). If a mining operation were to determine such areas suitable for their operations, or if mining created a constant plume of dust that would diminish the effectiveness of solar panels, how might such a situation be resolved?

Should potentially dangerous industries such as fuel manufacturing or storage be located near living areas? Would hydraulic fluid pipelines be closely monitored for leaks that may affect subsurface ice deposits mined for drinking water? How might vibrations from detonations affect unrelated structures or scientific instrumentation, such as telescopes? And how might a search for life, whether extinct or still living, be affected by human presence and our trail of bacteria and organic wastes? Humans’ biological pollution of Mars, for example, may greatly affect the results of any search for extraterrestrial life there (Kramer, 2009; McKay, 2009). Peter Doran of the Planetary Protection Subcommittee of the NASA Advisory Council offered, “The big issue with all missions to Mars is we don’t want to create a situation where we are impacting future life-detection science. Picture humans … walking around shedding microbes everywhere we go. Space suits as we know them do not take care of this problem (Mack, 2016).”

### 1NC – K – Security

#### Security discourse naturalizes reactionary appeals to structural violence as correctives to epistemological failure.

Karatziogianni and Robinson, 17—University of Leicester AND independent scholar (Athina and Andrew, “Schizorevolutions versus microfascisms: The fear of anarchy in state securitization,” Journal of International Political Theory Vol 13, Issue 3, 2017, dml)

Applying this analysis to the present day, we analyse the securitisation discourse of ‘new threats’ as a statist response to the uncertainty and fear brought on by the proliferation of opposing network forms of organisation. This response is a statist form of terror attempting to fix network flows in place. The scarcity arising from capitalist/statist resource grabs and fear resulting from state terror ensure responses to this structural violence by reactive networks, while paradoxically also exacerbating reactive tendencies within social movements, creating a spiral of terror, and the very situation of global civil war which Hobbesian/Realist IR theory – reliant on the schema of states struggling for power in an anarchic international system – attempts to ward off. Furthermore, this argumentation is based on a distinction between states and network movements, on one hand, and between two types of network, on the other. Elsewhere, we have conceptually divided networks into the affinity-active network form and the reactive network form (Karatzogianni and Robinson, 2010). These derive from the distinctions between active (or schizoid) and reactive (or paranoiac) forces or desires in a Deleuze/Nietzsche synthetical theory (Karatzogianni and Robinson, 2010). Reactive forces are associated with closure of meaning and identity. Active desire subordinates social production to desiring production. Active forces are associated with difference and transformation: ‘only active force asserts itself, it affirms its difference and makes its difference an object of affirmation’ (Deleuze, 2006: 55–56). Active forces are connected to affirmative desire and reactive forces to nihilistic desire; affirmation and negation are ‘becoming-active’ and ‘becoming-reactive’, respectively (Deleuze, 2006: 54). For Deleuze (2006), active forces are primary, as without them reactive forces could not be forces (2006: 41). Reactive force can dominate active force, but not by becoming active – rather, by alienating and disempowering it (Deleuze, 2006: 57). In Nick Land’s (2011: 277) terrific take, revolutionary and anti-fascist politics lies in resisting capital’s molar projection of its death. That is the key and the contrast with fascist desire: Revolutionary desire allies itself with the molecular death that is distributed by the signifier; facilitating uninhibited productive flows, whilst fascist desire invests the molar death that is distributed by the signifier; rigidly segmenting the production process according to the borders of transcendent identities. While open space is a necessary and enabling good from the standpoint of active desire, it is perceived as a threat by the state, because it is space in which demonised Others can gather and recompose networks outside state control. Hence, for the threatened state, open space is space for the enemy. It is a space of risk, which needs to be mitigated. Given that open space is necessary for difference to function, since otherwise it is excluded as unrepresentable or excessive, the attempts to render all space closed and governable involve a constant war on difference, which expands into the fabric of everyday life. Horizontal networks flow around the state’s restrictions, moving into residual unregulated spaces, gaps in the state’s capacity to repress, across national borders, or into the virtual. Networks tend to take a reactive form when exposed to a hostile context. Similarly, Bourdieu (1998) argues that neoliberalism strengthens reactive networks by demoralising and producing emotional turmoil (1998: 100), while Bauman (2000) links paranoiac social forces to insecurity. Baudrillard (2010) argues in The Agony of Power that every extension of hegemony is also an extension of terror: ‘Terror is multiplied by the grotesque profusion of security measures that end up causing perverse autoimmune effects: the antibodies turn against the body and cause more damage than the virus’ (2010: 94). Within this context, our discussion focuses on unravelling the interplay between security/insecurity, active/reactive, schizorevolutionary/microfascist and autonomous desire/fear management in contemporary agency, state (in)security and resistance movements. The key point is that reactive microfascist (in)security fear management discourses represent a distinct standpoint of the state, and not an orientation to protecting civilians or non-state actors. It represents an attempt by the state, to seize control of society, so as to operate social relations according to its own guiding principles. It is thus fundamentally against the interests of non-state social groups and networks. Or as Reid explains, ‘Deleuze does not simply mean that nomads employed warfare against the actual existing states they encountered but that they used war as a means to fend off the emergence of a state apparatus within their own societies’ (Reid, 2003: 63). Here, the difference is between forms of war that are codified by the state and ‘absolute war’ defying state codification (Reid, 2003: 74). The following section theorises the state in existential crises to set up the fear of anarchy in securitisation critique. The state in existential crisis The statist idea of ‘anarchy’, as seen in Hobbes (1996 [1651]), is actually a misperception of the affirmative power, the ‘power-to’, of social networks and social movements. The state misperceives insecurity and disorder whenever its own perceptions do not yield an appearance of order. As Bergson (1998) argues, disorder is a false concept. It is a false perception arising from the recognition of a type of existence undesirable to or incompatible with one’s own interests or needs. Disorder, therefore, is simply undesired order, from a certain point of view. Reality can be defined as disorderly relative to a particular project or set of practical needs. If disorder is relative to a point of view, then the point of view used in statist definitions is the state’s own. The state perceives chaos or (bad) anarchy, not because there is no order, but because this order is incompatible with the state’s own existence. For instance, Singer (1971: 232) describes ‘anarchy’ in the statist sense as ‘one of the most fashionable words of our time’, trotted out whenever those in power feel challenged. What was seen as anarchy in France in 1968, in Russia in 1917 and in many other situations is really a question of dual power (Singer, 1971: 233–234). Dual power is parallel power – or power of non-state forces – brought to crisis point. It is a necessary part of social transformation. The effect of refusing to recognise dual power is the dehumanisation of adversaries. The state goes back 5000 years, and features of its basic logic have persisted from its earliest form to the present (Dean and Massumi, 1992). Deleuze and Guattari (1987) theorise the state primarily as a repressive, ‘antiproductive’ force. The state seeks to regulate speed, erecting barriers in the way of migratory packs (Deleuze and Guattari, 1987: 386). It fragments the ‘parts’ from each other to create a formal and empty unity (Deleuze and Guattari, 1983: 212). Hence, the state is a machine for overdetermining, blocking and subjugating social relations through violence (Deleuze and Guattari, 1996: 254–255). State violence is ‘a violence that posits itself as pre-accomplished, even though it is reactivated every day’ (Deleuze and Guattari, 1987: 447). ‘The State machine and the machine of repression produce antiproduction, that is to say signifiers that exist to block and prevent the emergence of any subjective process on the part of the group’ (Guattari, 1984: 34). In addition to its own parts such as bureaucracies, it reintegrates the existing social segments as ‘organs of production’ (Deleuze and Guattari, 1983: 198), appropriating reality into its own system (1983: 210). Hence, the state does not originate but captures social flows and assemblages, decomposing their horizontal connections along the way. Societies, like people, end up torn between the two poles of active and reactive – the deterritorialising flows and the Urstaat (Deleuze and Guattari, 1983: 260). These poles parallel what elsewhere are portrayed as the two poles of desire, the schizorevolutionary and microfascist, or active and reactive poles. This decompositive view of the state is shared by insurrectionist and autonomist authors. For instance, Gilles Dauvé (2000) argues that the substance of the state resides not in institutional forms, but in its unifying function. The state ensures the tie which human beings cannot and dare not create among themselves, and creates a web of services both parasitic and real. (2000: 28) The irony of a recent British law which defines gathering together in a public place as ‘anti-social behaviour’, whereby the state poses as the source of society and guarantor against the ‘anti-social’, when in fact it pursues and flourishes in the destruction of the social, demanding personal direct submission without intermediaries. The state is thus a source of constant social conflict, but blames this conflict on others: people engage in various activities without the state’s permission, the state intervenes and then blames the people for the resultant fight (Ward, 1982: 137). In Hardt and Negri’s (2004) terms, ‘Modern sovereignty … does not put an end to violence and fear, but rather puts an end to civil war by organizing violence and fear into a coherent and stable political order’ (2004: 239). Think of Prime Minister Theresa May’s rhetoric after the London Bridge attacks and 36 hours before the polls opened before the 8 June 2017, General Elections in the United Kingdom: And I mean doing more to restrict the freedom and the movements of terrorist suspects when we have enough evidence to know they present a threat, but not enough evidence to prosecute them in full in court. And if human rights laws stop us from doing it, we will change those laws so we can do it. (Mason and Dodd, 2017) A similar theory of the state as viewing social life as risk can be found in Virilio. For him, the military class struggles against the ‘badly-defined collection of freedoms, risks and uncertainties’ of spontaneity in an environment (Virilio, 1990: 14), seeking to eliminate chance and contingency from social relations (1990: 18–19). War is the origin of totalitarianism, because it has become an attempt to deny others’ dialogue, the chance to rework perspectives, instead seeking to control the adversary by redefining their space (Virilio, 1990: 17). In Virilio’s (1990: 73) terms, the role of security discourse is to suppress the distinctness of civilian society and place it under military command. Today’s warfare is ‘logistical’. It does not simply fight an enemy on an existing terrain, but seeks to rearrange space so as to prevent the enemy from acting (Virilio, 1986 [1977]: 117–118, 145). Applied against the military’s own society, this leads to ‘endocolonialism’, or the internalisation of colonial power. Virilio (2000 [1998]: 14) portrays everyday life as colonised or polluted by military ways of seeing, expressed through technologies such as surveillance cameras and disconnected images. Security scares become a kind of ‘orgy’ allowing the release of otherwise repressed emotions (Virilio, 1990: 68–69). Anarchy and state securitisation The state seeks to make societies ‘legible’ (Scott, 1999: 2). In doing so, it simplifies them both analytically, by ignoring the complexity, and materially, by imposing the categories it uses to simplify in practice (Scott, 1999: 33, 81–82). Such simplifications represent techniques for grasping a large and complex reality; in order for officials to be able to comprehend aspects of the ensemble, that complex reality must be reduced to schematic categories. The only way to accomplish this is to reduce an infinite array of detail to a set of categories that will facilitate summary descriptions, comparisons, and aggregation. (Scott, 1999: 77) States, argues Scott, seek to turn ‘the population, space, and nature under their jurisdiction into the closed systems that offer no surprises and that can best be observed and controlled’ (Scott, 1999: 82). This is the matrix from which securitisation emerges. It is arguably a re-emergence of the ‘reasons of state’ studied by Foucault (2004) and Scott (1999). Furthermore, Scott argues that such practices serve state, not social, interests. States simplify to serve state – not social – functions. This is similar to Foucault’s (1984) argument that biopower seeks to render bodies useful for power (1984: 269). For example, the state seeks simplification so it can tax and conscript, and to head off rebellion (Foucault, 1984: 2). The state lens brings into focus ‘certain limited aspects’ of society which happen to interest the state (Foucault, 1984: 11). State simplification is ‘necessarily schematic’ and thus ‘ignores essential features of any real, functioning social order’ (Foucault, 1984: 6). The formal scheme ends up parasitic on everyday life to sustain it. Illegibility is relative to the state perspective. What seems illegible to the state is often entirely legible to locals within the context. For example, a complex set of customs of land ownership, redistribution and mutual obligation effectively meets peasants’ needs, but is utterly incomprehensible to state lawmakers. Plasticity and adaptability are advantages for peasants, but problems for the state (Foucault, 1984: 33–34). Securitisation is the pretext par excellence for both kinds of simplification. Practices such as lockdowns and roundups ignore, violate and overwrite the density of the social spaces on which they are imposed and the needs and desires of those who inhabit these spaces. Risk management, for instance, simplifies complex lives into risk profiles based on aggregates, which might be irrelevant to the case at hand. This is the source of the recurring scandals of civilians being raided, searched or interrogated based on random algorithmic data calculations (for a critique on digitisation and social justice data activism, see Eubanks, 2011; for securitisation, digital activism debates, see Karatzogianni and Gak, 2015; Karatzogianni and Robinson, 2014). State simplification renders swathes of social life as a Lacanian Real. In each case, ‘a whole world lying “outside the brackets” returned to haunt [the] technical vision’ (Scott, 1999: 20), many of which are consequences of the state’s tunnel-vision (Scott, 1999: 21). In the case of securitisation, this returning Real appears as the uncontrollable ‘black holes’ and spiralling insecurity of the current period, as well as the failure of state initiatives such as the Iraq war. In the war on terror, ‘black holes’, or illegibility, are seen as risk or insecurity (Innes, 2008), zones of potential terrorism, crime, drug trafficking, human rights abuses (such as female genital mutilation(FGM)) and so on. As this assumption renders social life illegible, it leads to a cascading retreat into gated spaces. At root in this process of state terror is the pernicious fantasy of an entirely legible social order, fitting exactly with the state’s perceptions – in other words, the denial of all autonomy to social forces. Legible, ‘securitised’ space is fantasmatically ‘terrorist-free’.

#### The alternative is a discursive challenge to epistemic frames – this opens critical space for the creation of insurgent epistemologies.

Karatziogianni and Robinson, 17—University of Leicester AND independent scholar (Athina and Andrew, “Schizorevolutions versus microfascisms: The fear of anarchy in state securitization,” Journal of International Political Theory Vol 13, Issue 3, 2017, dml)

Securitisation also goes hand-in-hand with insecuritisation, or the creation of everyday fear to provide pretexts for control (Bigo, 2000: 330). Securitisation involves framing-out any claims, demands, rights or needs, which might be articulated by non-state actors. Such actors are simply disempowered, and either suppressed and ‘managed’ or paternalistically ‘protected’. Securitisation tends to seek to control others by reducing or constraining their agency (e.g. situational crime management, which removes opportunities for crime), without engaging with others as actors in their own rights. The frame is fundamentally monological, recognising no actors other than a managerial elite. Securitisation does not represent a response to an increase in existential threats to the state. Rather, it is a discursive shift towards framing all social problems and differences as ‘security’ issues or ‘risks’ that has created an illusion of expanding dangers. American unipolar dominance has led to shifts towards asymmetrical and unconventional warfare (Freedman, 1998: 15; Kilcullen, 2009: 25–26). The discourse of ‘new threats’ frames issues such as armed opposition or ‘terrorism’, organised crime, arms proliferation and environmental problems as security issues (Gasteyger, 1999: 77). As a result, the field of security studies ‘risks losing all focus’ (Freedman, 1998: 53). Securitisation creates a field where certain social actors can expand their roles. It merges and de-differentiates militarism against external enemies and internal social regulation (Bigo, 2000: 320). The resultant military functions may be carried out by the military, the police or other social agencies, which are handed securitised tasks (for example, teachers, doctors and social workers commanded to implement Prevent duties). The expanded scope of the term ‘security’ has irritated traditional security scholars, who see such issues as relatively insignificant compared to interstate rivalry (Mueller, 2004: 110; Todd, 2004) or even as pretexts for interstate hegemony (Mastanduno, 2007). Furthermore, many of these ‘new’ issues are not ‘new’ at all (protest, armed rebellion, organised crime and environmental damage have histories longer than capitalism), but newly securitised, sometimes connected to increased scope or internationalisation. Securitisation is primarily a framing issue – a question of the understanding of and appropriate response to social problems, and the capture of resources among different state agencies. Securitisation effectively places the entire field of illegibility under the remit of the military/police apparatuses. On a global scale, failed states are seen as a threat to the United States or even as ‘engulf[ing] the rest of the world’ (Eizenstat et al., 2005: 135). The approach typically blames local societies or states for ‘failure’, ignoring the political-economic context (Jackson, 2000: 296; Zartman, 1995: 5) and replacing international dependency issues with internal capacity issues (Hill, 2005: 149). Furthermore, it has been alleged that the category is unclear and selectively deployed (Boas and Jennings, 2007: 478). In this sense, Virilio (2012), the revelationary, in The Administration of Fear, talk of fear as a world and the management and administration of fear instead of confronting fear fundamentally: Fear is now an environment, a surrounding, a world. It occupies and preoccupies us. Fear was once a phenomenon related to localised, identifiable events that were limited to a certain timeframe: wars, famines, epidemics. Today, the world itself is limited, saturated, reduced, restricting us to stressful claustrophobia: contagious stock crises, faceless terrorism lightning pandemics, ‘professional’ suicides… Fear is a world, panic as a ‘whole’. (2012: 14) Framing social problems as ‘new threats’ leads to militarised responses to social problems. The blurring of boundaries between state security and social problems leads to a zone of indistinction (Agamben, 1998) in which anyone can become the enemy, the exceptions applying in wartime or in colonies are applied across the state’s terrain, and any area can become like a camp at any moment (1998: 112). Lundborg (2016) explains Agamben’s concept of the virtual – how life is potentially expendable and how this is to be resisted with the refusal to draw lines: ‘the lines that determine who is included and excluded through the actualization of the sovereign ban’ (2016: 265). For example, the securitisation of migration detracts from humanitarian and political-economic frames, drawing Agamben’s lines, and leading to violent, repressive responses (Bigo, 2000; Buonfino, 2004), as is currently evident in the French state’s responses to the jungle in Calais. Abolished in late 2016, it has been a battleground between active and reactive networks: local anti-refugee and pro-refugee protests have occurred reflecting the stand-off between opposing actors in the European refugee and migrant crisis. Zygmunt Bauman’s (2000) analysis of the relationship between securitisation and consumerism neatly summarises our analysis here. In Bauman’s (2000) argument, communities gate themselves off in a residue of an old utopia of a good society, which is without worry because of its basic sameness (2000: 92). Such a community is defined by what it excludes rather than what it contains and becomes ‘more secure but less free’ (Bauman, 2000: 94). What it refuses, in particular, is any kind of dialogue or negotiation across difference, and therefore any public interest or public sphere arising from negotiation (Bauman, 2000: 100). This vision of community destroys any possibility of life in common. The more difference is excluded, the more threatening it looks (Bauman, 2000: 106). Spaces that remain are marked by the ‘redundancy of interaction’ to their functioning (Bauman, 2000: 105). Bauman (2000) analyses securitisation as flight from contact with difference (2000: 105), rooted in neoliberal regimes of fluidity and uncertainty (2000: 108). Evans (2010) ups the ante by arguing that a new virtual economy of affect is at work in combination with a pre-emptive virtualisation of terror ‘in which the self-propelling tendencies to provoke the virtual cause, will, through revealing its most catastrophic potential, set out the new conditions of the real’ (2010: 9). State terror produces network terror At the intersection of the threatened state and the sources of its anxiety lies the collapse of marginal integration and ‘addition of axioms’ in neoliberalism. Capitalism has been clenching its fists on the world for some time, yet many spaces and people are falling through its fingers. The formal sector of the economy is shrinking, leaving behind it swathes of social life marginalised from capitalist inclusion. Much of the global periphery is in effect being forcibly ‘delinked’ from the world economy as inclusion through patronage is scaled down due to neoliberalism. For instance, ‘Sub-Saharan Africa has almost dropped out of the formal international economy’ (Mann, 2005: 55–56). Religious, militia and informal economic organisations have replaced the state on the ground across swathes of Africa, and ‘whole regions have now become virtually independent, probably for the foreseeable future, of all central control’ (Bayart et al., 1999: 19–20). These spaces are the locus of the state’s fear of ‘black holes’ where state power breaks down and insurgents can flourish (Innes, 2008; Korteweg, 2008).

### 1NC – Case – Turn

#### Extinction is inevitable from future technology — nanotech, our simulation gets shut down, AI, biotech, particle accelerators, and black swans

Bruce **Sterling**, 6-1-20**18**, "When Nick Bostrom says “Bang”," WIRED, https://www.wired.com/beyond-the-beyond/2018/06/nick-bostrom-says-bang/

4.1 Deliberate misuse of nanotechnology

In a mature form, molecular nanotechnology will enable the construction of bacterium-scale self-replicating mechanical robots that can feed on dirt or other organic matter [22-25]. Such replicators could eat up the biosphere or destroy it by other means such as by poisoning it, burning it, or blocking out sunlight. A person of malicious intent in possession of this technology might cause the extinction of intelligent life on Earth by releasing such nanobots into the environment.[9]

The technology to produce a destructive nanobot seems considerably easier to develop than the technology to create an effective defense against such an attack (a global nanotech immune system, an “active shield” [23]). It is therefore likely that there will be a period of vulnerability during which this technology must be prevented from coming into the wrong hands. Yet the technology could prove hard to regulate, since it doesn’t require rare radioactive isotopes or large, easily identifiable manufacturing plants, as does production of nuclear weapons [23].

Even if effective defenses against a limited nanotech attack are developed before dangerous replicators are designed and acquired by suicidal regimes or terrorists, there will still be the danger of an arms race between states possessing nanotechnology. It has been argued [26] that molecular manufacturing would lead to both arms race instability and crisis instability, to a higher degree than was the case with nuclear weapons. Arms race instability means that there would be dominant incentives for each competitor to escalate its armaments, leading to a runaway arms race. Crisis instability means that there would be dominant incentives for striking first. Two roughly balanced rivals acquiring nanotechnology would, on this view, begin a massive buildup of armaments and weapons development programs that would continue until a crisis occurs and war breaks out, potentially causing global terminal destruction. That the arms race could have been predicted is no guarantee that an international security system will be created ahead of time to prevent this disaster from happening. The nuclear arms race between the US and the USSR was predicted but occurred nevertheless.

4.2 Nuclear holocaust[winter]

The US and Russia still have huge stockpiles of nuclear weapons. But would an all-out nuclear war really exterminate humankind? Note that: (i) For there to be an existential risk it suffices that we can’t be sure that it wouldn’t. (ii) The climatic effects of a large nuclear war are not well known (there is the possibility of a nuclear winter). (iii) Future arms races between other nations cannot be ruled out and these could lead to even greater arsenals than those present at the height of the Cold War. The world’s supply of plutonium has been increasing steadily to about two thousand tons, some ten times as much as remains tied up in warheads ([9], p. 26). (iv) Even if some humans survive the short-term effects of a nuclear war, it could lead to the collapse of civilization. A human race living under stone-age conditions may or may not be more resilient to extinction than other animal species.

4.3 We’re living in a simulation and it gets shut down

A case can be made that the hypothesis that we are living in a computer simulation should be given a significant probability [27]. The basic idea behind this so-called “Simulation argument” is that vast amounts of computing power may become available in the future (see e.g. [28,29]), and that it could be used, among other things, to run large numbers of fine-grained simulations of past human civilizations. Under some not-too-implausible assumptions, the result can be that almost all minds like ours are simulated minds, and that we should therefore assign a significant probability to being such computer-emulated minds rather than the (subjectively indistinguishable) minds of originally evolved creatures. And if we are, we suffer the risk that the simulation may be shut down at any time. A decision to terminate our simulation may be prompted by our actions or by exogenous factors.

While to some it may seem frivolous to list such a radical or “philosophical” hypothesis next the concrete threat of nuclear holocaust, we must seek to base these evaluations on reasons rather than untutored intuition. Until a refutation appears of the argument presented in [27], it would intellectually dishonest to neglect to mention simulation-shutdown as a potential extinction mode.

4.4 Badly programmed superintelligence

When we create the first superintelligent entity [28-34], we might make a mistake and give it goals that lead it to annihilate humankind, assuming its enormous intellectual advantage gives it the power to do so. For example, we could mistakenly elevate a subgoal to the status of a supergoal. We tell it to solve a mathematical problem, and it complies by turning all the matter in the solar system into a giant calculating device, in the process killing the person who asked the question. (For further analysis of this, see [35].)

4.5 Genetically engineered biological agent

With the fabulous advances in genetic technology currently taking place, it may become possible for a tyrant, terrorist, or ~~lunatic~~ to create a doomsday virus, an organism that combines long latency with high virulence and mortality [36].

Dangerous viruses can even be spawned unintentionally, as Australian researchers recently demonstrated when they created a modified mousepox virus with 100% mortality while trying to design a contraceptive virus for mice for use in pest control [37]. While this particular virus doesn’t affect humans, it is suspected that an analogous alteration would increase the mortality of the human smallpox virus. What underscores the future hazard here is that the research was quickly published in the open scientific literature [38]. It is hard to see how information generated in open biotech research programs could be contained no matter how grave the potential danger that it poses; and the same holds for research in nanotechnology.

Genetic medicine will also lead to better cures and vaccines, but there is no guarantee that defense will always keep pace with offense. (Even the accidentally created mousepox virus had a 50% mortality rate on vaccinated mice.) Eventually, worry about biological weapons may be put to rest through the development of nanomedicine, but while nanotechnology has enormous long-term potential for medicine [39] it carries its own hazards.

4.6 Accidental misuse of nanotechnology (“gray goo”)

The possibility of accidents can never be completely ruled out. However, there are many ways of making sure, through responsible engineering practices, that species-destroying accidents do not occur. One could avoid using self-replication; one could make nanobots dependent on some rare feedstock chemical that doesn’t exist in the wild; one could confine them to sealed environments; one could design them in such a way that any mutation was overwhelmingly likely to cause a nanobot to completely cease to function [40]. Accidental misuse is therefore a smaller concern than malicious misuse [23,25,41].

However, the distinction between the accidental and the deliberate can become blurred. While “in principle” it seems possible to make terminal nanotechnological accidents extremely improbable, the actual circumstances may not permit this ideal level of security to be realized. Compare nanotechnology with nuclear technology. From an engineering perspective, it is of course perfectly possible to use nuclear technology only for peaceful purposes such as nuclear reactors, which have a zero chance of destroying the whole planet. Yet in practice it may be very hard to avoid nuclear technology also being used to build nuclear weapons, leading to an arms race. With large nuclear arsenals on hair-trigger alert, there is inevitably a significant risk of accidental war. The same can happen with nanotechnology: it may be pressed into serving military objectives in a way that carries unavoidable risks of serious accidents.

In some situations it can even be strategically advantageous to deliberately make one’s technology or control systems risky, for example in order to make a “threat that leaves something to chance” [42].

4.7 Something unforeseen

We need a catch-all category. It would be foolish to be confident that we have already imagined and anticipated all significant risks. Future technological or scientific developments may very well reveal novel ways of destroying the world.

Some foreseen hazards (hence not members of the current category) which have been excluded from the list of bangs on grounds that they seem too unlikely to cause a global terminal disaster are: solar flares, supernovae, black hole explosions or mergers, gamma-ray bursts, galactic center outbursts, supervolcanos, loss of biodiversity, buildup of air pollution, gradual loss of human fertility, and various religious doomsday scenarios. The hypothesis that we will one day become “illuminated” and commit collective suicide or stop reproducing, as supporters of VHEMT (The Voluntary Human Extinction Movement) hope [43], appears unlikely. If it really were better not to exist (as Silenus told king Midas in the Greek myth, and as Arthur Schopenhauer argued [44] although for reasons specific to his philosophical system he didn’t advocate suicide), then we should not count this scenario as an existential disaster. The assumption that it is not worse to be alive should be regarded as an implicit assumption in the definition of Bangs. Erroneous collective suicide is an existential risk albeit one whose probability seems extremely slight. (For more on the ethics of human extinction, see chapter 4 of [9].)

4.8 Physics disasters

The Manhattan Project bomb-builders’ concern about an A-bomb-derived atmospheric conflagration has contemporary analogues.

There have been speculations that future high-energy particle accelerator experiments may cause a breakdown of a metastable vacuum state that our part of the cosmos might be in, converting it into a “true” vacuum of lower energy density [45]. This would result in an expanding bubble of total destruction that would sweep through the galaxy and beyond at the speed of light, tearing all matter apart as it proceeds.

Another conceivability is that accelerator experiments might produce negatively charged stable “strangelets” (a hypothetical form of nuclear matter) or create a mini black hole that would sink to the center of the Earth and start accreting the rest of the planet [46].

These outcomes seem to be impossible given our best current physical theories. But the reason we do the experiments is precisely that we don’t really know what will happen. A more reassuring argument is that the energy densities attained in present day accelerators are far lower than those that occur naturally in collisions between cosmic rays [46,47]. It’s possible, however, that factors other than energy density are relevant for these hypothetical processes, and that those factors will be brought together in novel ways in future experiments.

The main reason for concern in the “physics disasters” category is the meta-level observation that discoveries of all sorts of weird physical phenomena are made all the time, so even if right now all the particular physics disasters we have conceived of were absurdly improbable or impossible, there could be other more realistic failure-modes waiting to be uncovered. The ones listed here are merely illustrations of the general case.

#### War is inevitable---BUT, the longer we wait, the worse it gets.

Seth **Baum &** Anthony **Barrett 18**. Global Catastrophic Risk Institute. 2018. “A Model for the Impacts of Nuclear War.” SSRN Electronic Journal. Crossref, doi:10.2139/ssrn.3155983.

On the other end of the spectrum, the norm could be weaker. The Hiroshima and Nagasaki bombings provided a vivid and enduring image of the horrors of nuclear war—hence the norm can reasonably be described as a legacy of the bombings. Without this image, there would be less to motivate the norm. A weaker norm could in turn have led to a nuclear war occurring later, especially during a near-miss event like the Cuban missile crisis. A later nuclear war would likely be much more severe, assuming some significant buildup of nuclear arsenals and especially if “overkill” targeting was used. A new nuclear war could bring a similarly wide range of shifts in nuclear weapons norms. It could strengthen the norm, hastening nuclear disarmament. Already, there is a political initiative drawing attention to the humanitarian consequences of nuclear weapons use in order to promote a new treaty to ban nuclear weapons as a step towards complete nuclear disarmament (Borrie 2014). It is easy to imagine this initiative using any new nuclear attacks to advance their goals. Alternatively, it could weaken the norm, potentially leading to more and/or larger nuclear wars. This is a common concern, as seen for example in debates over low-yield bunker buster nuclear weapons (Nelson 2003). Given that the impacts of a large nuclear war could be extremely severe, a shift in nuclear weapons norms could easily be the single most consequential effect of a smaller nuclear war.

#### Nuke war won’t cause extinction---BUT, it’ll spur political will for meaningful disarmament.

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Although nuclear war is the oldest of these technogenic threats to civilization and human survival, and although important steps to restraint, particularly at the end of the Cold War, have been achieved, the nuclear world is increasingly changing in major ways, and in almost entirely dangerous directions. The third “bombs away” phase of the great debate on the nuclear-political question is more consequentially divided than in the first two phases. Even more ominously, most of the momentum lies with the forces that are pulling states toward nuclear-use, and with the radical actors bent on inflicting catastrophic damage on the leading states in the international system, particularly the United States. In contrast, the arms control project, although intellectually vibrant, is largely in retreat on the world political stage. The arms control settlement of the Cold War is unraveling, and the world public is more divided and distracted than ever. With the recent election of President Donald Trump, the United States, which has played such a dominant role in nuclear politics since its scientists invented these fiendish engines, now has an impulsive and uninformed leader, boding ill for nuclear restraint and effective crisis management. Given current trends, it is prudent to assume that sooner or later, and probably sooner, nuclear weapons will again be the used in war. But this bad news may contain a “silver lining” of good news. Unlike a general nuclear war that might have occurred during the Cold War, such a nuclear event now would probably not mark the end of civilization (or of humanity), due to the great reductions in nuclear forces achieved at the end of the Cold War. Furthermore, politics on “the day after” could have immense potential for positive change. The survivors would not be likely to envy the dead, but would surely have a greatly renewed resolution for “never again.” Such an event, completely unpredictable in its particulars, would unambiguously put the nuclear-political question back at the top of the world political agenda. It would unmistakeably remind leading states of their vulnerability It might also trigger more robust efforts to achieve the global regulation of nuclear capability. Like the bombings of Hiroshima and Nagasaki that did so much to catalyze the elevated concern for nuclear security in the early Cold War, and like the experience “at the brink” in the Cuban Missile Crisis of 1962, the now bubbling nuclear caldron holds the possibility of inaugurating a major period of institutional innovation and adjustment toward a fully “bombs away” future.

#### Superior studies- theirs are confirmation-bias laden and repeatedly disproven

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Nuclear Winter burst on the academic scene in December 1983 with the publication of the hypothesis in the prestigious journal Science. It was accompanied by a study by Paul Ehrlich, et al. that hinted that it might cause the extinction of human life on the planet. MCANW stands for Medical Campaign Against Nuclear Weapons. Photo via Wellcome Images. The five authors of the Nuclear Winter hypothesis were labeled TTAPS, using the initials of their family names (T stands for Owen Toon and P stands for Jim Pollak, both Ph.D. students of Carl Sagan at Cornell University.) Carl Sagan himself was the main author and driving force. Actually, Sagan had scooped the Science paper by publishing the gist of the hypothesis in Parade magazine, which claimed a readership of 50 million! Previously, Sagan had briefed people in public office and elsewhere, so they were all primed for the popular reaction, which was tremendous. Many of today's readers may not remember Carl Sagan. He was a brilliant astrophysicist but also highly political. Imagine Al Gore, but with an excellent science background. Sagan had developed and narrated a television series called Cosmos that popularized astrophysics and much else, including cosmology, the history of the universe. He even suggested the possible existence of extraterrestrial intelligence and started a listening project called SETI (Search for Extraterrestrial Intelligence). SETI is still searching today and has not found any evidence so far. Sagan became a sort of icon; many people in the U.S. and abroad knew his name and face. Carl Sagan also had another passion: saving humanity from a general nuclear war, a laudable aim. He had been arguing vigorously and publicly for a "freeze" on the production of more nuclear weapons. President Ronald Reagan outdid him and negotiated a nuclear weapons reduction with the USSR. In the meantime, much excitement was stirred up by Nuclear Winter. Study after study tried to confirm and expand the hypothesis, led by the Defense Department (DOD), which took the hypothesis seriously and spent millions of dollars on various reports that accepted Nuclear Winter rather uncritically. The National Research Council (NRC) of the National Academy of Sciences published a report that put in more quantitative detail. It enabled critics of the hypothesis to find flaws – and many did. The names Russell Seitz, Dick Wilson (both of Cambridge, Mass.), Steve Schneider (Palo Alto, Calif.), and Bob Ehrlich (Fairfax, Va.) (no relation to Paul Ehrlich) come to mind. The hypothesis was really "politics disguised as science." The whole TTAPS scheme was contrived to deliver the desired consequence. It required the smoke layer to be of just the right thickness, covering the whole Earth, and lasting for many months. The Kuwait oil fires in 1991 produced a lot of smoke, but it rained out after a few days. I had a mini-debate with Sagan on the TV program Nightline and published a more critical analysis of the whole hypothesis in the journal Meteorology & Atmospheric Physics. I don't know if Carl ever saw my paper. But I learned a lot from doing this analysis that was useful in later global warming research. For example, the initial nuclear bursts inject water vapor into the stratosphere, which turns into contrail-like cirrus clouds. That actually leads to a strong initial warming and a "nuclear summer."

#### Industrial civilization wouldn’t recover.

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Imagine that the world as we know it ends tomorrow. There’s a global catastrophe: a pandemic virus, an asteroid strike, or perhaps a nuclear holocaust. The vast majority of the human race perishes. Our civilisation collapses. The post-apocalyptic survivors find themselves in a devastated world of decaying, deserted cities and roving gangs of bandits looting and taking by force. Bad as things sound, that’s not the end for humanity. We bounce back. Sooner or later, peace and order emerge again, just as they have time and again through history. Stable communities take shape. They begin the agonising process of rebuilding their technological base from scratch. But here’s the question: how far could such a society rebuild? Is there any chance, for instance, that a post-apocalyptic society could reboot a technological civilisation? Let’s make the basis of this thought experiment a little more specific. Today, we have already consumed the most easily drainable crude oil and, particularly in Britain, much of the shallowest, most readily mined deposits of coal. Fossil fuels are central to the organisation of modern industrial society, just as they were central to its development. Those, by the way, are distinct roles: even if we could somehow do without fossil fuels now (which we can’t, quite), it’s a different question whether we could have got to where we are without ever having had them. So, would a society starting over on a planet stripped of its fossil fuel deposits have the chance to progress through its own Industrial Revolution? Or to phrase it another way, what might have happened if, for whatever reason, the Earth had never acquired its extensive underground deposits of coal and oil in the first place? Would our progress necessarily have halted in the 18th century, in a pre-industrial state? It’s easy to underestimate our current dependence on fossil fuels. In everyday life, their most visible use is the petrol or diesel pumped into the vehicles that fill our roads, and the coal and natural gas which fire the power stations that electrify our modern lives. But we also rely on a range of different industrial materials, and in most cases, high temperatures are required to transform the stuff we dig out of the ground or harvest from the landscape into something useful. You can’t smelt metal, make glass, roast the ingredients of concrete, or synthesise artificial fertiliser without a lot of heat. It is fossil fuels – coal, gas and oil – that provide most of this thermal energy. In fact, the problem is even worse than that. Many of the chemicals required in bulk to run the modern world, from pesticides to plastics, derive from the diverse organic compounds in crude oil. Given the dwindling reserves of crude oil left in the world, it could be argued that the most wasteful use for this limited resource is to simply burn it. We should be carefully preserving what’s left for the vital repertoire of valuable organic compounds it offers. But my topic here is not what we should do now. Presumably everybody knows that we must transition to a low-carbon economy one way or another. No, I want to answer a question whose interest is (let’s hope) more theoretical. Is the emergence of a technologically advanced civilisation necessarily contingent on the easy availability of ancient energy? Is it possible to build an industrialised civilisation without fossil fuels? And the answer to that question is: maybe – but it would be extremely difficult. Let’s see how. We’ll start with a natural thought. Many of our alternative energy technologies are already highly developed. Solar panels, for example, represent a good option today, and are appearing more and more on the roofs of houses and businesses. It’s tempting to think that a rebooted society could simply pick up where we leave off. Why couldn’t our civilisation 2.0 just start with renewables? Well, it could, in a very limited way. If you find yourself among the survivors in a post-apocalyptic world, you could scavenge enough working solar panels to keep your lifestyle electrified for a good long while. Without moving parts, photovoltaic cells require little maintenance and are remarkably resilient. They do deteriorate over time, though, from moisture penetrating the casing and from sunlight itself degrading the high-purity silicon layers. The electricity generated by a solar panel declines by about 1 per cent every year so, after a few generations, all our hand-me-down solar panels will have degraded to the point of uselessness. Then what? New ones would be fiendishly difficult to create from scratch. Solar panels are made from thin slices of extremely pure silicon, and although the raw material is common sand, it must be processed and refined using complex and precise techniques – the same technological capabilities, more or less, that we need for modern semiconductor electronics components. These techniques took a long time to develop, and would presumably take a long time to recover. So photovoltaic solar power would not be within the capability of a society early in the industrialisation process. Perhaps, though, we were on the right track by starting with electrical power. Most of our renewable-energy technologies produce electricity. In our own historical development, it so happens that the core phenomena of electricity were discovered in the first half of the 1800s, well after the early development of steam engines. Heavy industry was already committed to combustion-based machinery, and electricity has largely assumed a subsidiary role in the organisation of our economies ever since. But could that sequence have run the other way? Is there some developmental requirement that thermal energy must come first? On the face of it, it’s not beyond the bounds of possibility that a progressing society could construct electrical generators and couple them to simple windmills and waterwheels, later progressing to wind turbines and hydroelectric dams. In a world without fossil fuels, one might envisage an electrified civilisation that largely bypasses combustion engines, building its transport infrastructure around electric trains and trams for long-distance and urban transport. I say ‘largely’. We couldn’t get round it all together. When it comes to generating the white heat demanded by modern industry, there are few good options but to burn stuff While the electric motor could perhaps replace the coal-burning steam engine for mechanical applications, society, as we’ve already seen, also relies upon thermal energy to drive the essential chemical and physical transformations it needs. How could an industrialising society produce crucial building materials such as iron and steel, brick, mortar, cement and glass without resorting to deposits of coal? You can of course create heat from electricity. We already use electric ovens and kilns. Modern arc furnaces are used for producing cast iron or recycling steel. The problem isn’t so much that electricity can’t be used to heat things, but that for meaningful industrial activity you’ve got to generate prodigious amounts of it, which is challenging using only renewable energy sources such as wind and water. An alternative is to generate high temperatures using solar power directly. Rather than relying on photovoltaic panels, concentrated solar thermal farms use giant mirrors to focus the sun’s rays onto a small spot. The heat concentrated in this way can be exploited to drive certain chemical or industrial processes, or else to raise steam and drive a generator. Even so, it is difficult (for example) to produce the very high temperatures inside an iron-smelting blast furnace using such a system. What’s more, it goes without saying that the effectiveness of concentrated solar power depends strongly on the local climate. No, when it comes to generating the white heat demanded by modern industry, there are few good options but to burn stuff. But that doesn’t mean the stuff we burn necessarily has to be fossil fuels. Let’s take a quick detour into the pre-history of modern industry. Long before the adoption of coal, charcoal was widely used for smelting metals. In many respects it is superior: charcoal burns hotter than coal and contains far fewer impurities. In fact, coal’s impurities were a major delaying factor on the Industrial Revolution. Released during combustion, they can taint the product being heated. During smelting, sulphur contaminants can soak into the molten iron, making the metal brittle and unsafe to use. It took a long time to work out how to treat coal to make it useful for many industrial applications. And, in the meantime, charcoal worked perfectly well. And then, well, we stopped using it. In retrospect, that’s a pity. When it comes from a sustainable source, charcoal burning is essentially carbon-neutral, because it doesn’t release any new carbon into the atmosphere – not that this would have been a consideration for the early industrialists. But charcoal-based industry didn’t die out altogether. In fact, it survived to flourish in Brazil. Because it has substantial iron deposits but few coalmines, Brazil is the largest charcoal producer in the world and the ninth biggest steel producer. We aren’t talking about a cottage industry here, and this makes Brazil a very encouraging example for our thought experiment. The trees used in Brazil’s charcoal industry are mainly fast-growing eucalyptus, cultivated specifically for the purpose. The traditional method for creating charcoal is to pile chopped staves of air-dried timber into a great dome-shaped mound and then cover it with turf or soil to restrict airflow as the wood smoulders. The Brazilian enterprise has scaled up this traditional craft to an industrial operation. Dried timber is stacked into squat, cylindrical kilns, built of brick or masonry and arranged in long lines so that they can be easily filled and unloaded in sequence. The largest sites can sport hundreds of such kilns. Once filled, their entrances are sealed and a fire is lit from the top. The skill in charcoal production is to allow just enough air into the interior of the kiln. There must be enough combustion heat to drive out moisture and volatiles and to pyrolyse the wood, but not so much that you are left with nothing but a pile of ashes. The kiln attendant monitors the state of the burn by carefully watching the smoke seeping out of the top, opening air holes or sealing with clay as necessary to regulate the process. Brazil shows how the raw materials of modern civilisation can be supplied without reliance on fossil fuels Good things come to those who wait, and this wood pyrolysis process can take up to a week of carefully controlled smouldering. The same basic method has been used for millennia. However, the ends to which the fuel is put are distinctly modern. Brazilian charcoal is trucked out of the forests to the country’s blast furnaces where it is used to transform ore into pig iron. This pig iron is the basic ingredient of modern mass-produced steel. The Brazilian product is exported to countries such as China and the US where it becomes cars and trucks, sinks, bathtubs, and kitchen appliances. Around two-thirds of Brazilian charcoal comes from sustainable plantations, and so this modern-day practice has been dubbed ‘green steel’. Sadly, the final third is supplied by the non-sustainable felling of primary forest. Even so, the Brazilian case does provide an example of how the raw materials of modern civilisation can be supplied without reliance on fossil fuels. Another, related option might be wood gasification. The use of wood to provide heat is as old as mankind, and yet simply burning timber only uses about a third of its energy. The rest is lost when gases and vapours released by the burning process blow away in the wind. Under the right conditions, even smoke is combustible. We don’t want to waste it. Better than simple burning, then, is to drive the thermal breakdown of the wood and collect the gases. You can see the basic principle at work for yourself just by lighting a match. The luminous flame isn’t actually touching the matchwood: it dances above, with a clear gap in between. The flame actually feeds on the hot gases given off as the wood breaks down in the heat, and the gases combust only once they mix with oxygen from the air. Matches are fascinating when you look at them closely. Wartime gasifier cars could achieve about 1.5 miles per kilogram. Today’s designs improve upon this To release these gases in a controlled way, bake some timber in a closed container. Oxygen is restricted so that the wood doesn’t simply catch fire. Its complex molecules decompose through a process known as pyrolysis, and then the hot carbonised lumps of charcoal at the bottom of the container react with the breakdown products to produce flammable gases such as hydrogen and carbon monoxide. The resultant ‘producer gas’ is a versatile fuel: it can be stored or piped for use in heating or street lights, and is also suitable for use in complex machinery such as the internal combustion engine. More than a million gasifier-powered cars across the world kept civilian transport running during the oil shortages of the Second World War. In occupied Denmark, 95 per cent of all tractors, trucks and fishing boats were powered by wood-gas generators. The energy content of about 3 kg of wood (depending on its dryness and density) is equivalent to a litre of petrol, and the fuel consumption of a gasifier-powered car is given in miles per kilogram of wood rather than miles per gallon. Wartime gasifier cars could achieve about 1.5 miles per kilogram. Today’s designs improve upon this. But you can do a lot more with wood gases than just keep your vehicle on the road. It turns out to be suitable for any of the manufacturing processes needing heat that we looked at before, such as kilns for lime, cement or bricks. Wood gas generator units could easily power agricultural or industrial equipment, or pumps. Sweden and Denmark are world leaders in their use of sustainable forests and agricultural waste for turning the steam turbines in power stations. And once the steam has been used in their ‘Combined Heat and Power’ (CHP) electricity plants, it is piped to the surrounding towns and industries to heat them, allowing such CHP stations to approach 90 per cent energy efficiency. Such plants suggest a marvellous vision of industry wholly weaned from its dependency on fossil fuel. Is that our solution, then? Could our rebooting society run on wood, supplemented with electricity from renewable sources? Maybe so, if the population was fairly small. But here’s the catch. These options all presuppose that our survivors are able to construct efficient steam turbines, CHP stations and internal combustion engines. We know how to do all that, of course – but in the event of a civilisational collapse, who is to say that the knowledge won’t be lost? And if it is, what are the chances that our descendants could reconstruct it? In our own history, the first successful application of steam engines was in pumping out coal mines. This was a setting in which fuel was already abundant, so it didn’t matter that the first, primitive designs were terribly inefficient. The increased output of coal from the mines was used to first smelt and then forge more iron. Iron components were used to construct further steam engines, which were in turn used to pump mines or drive the blast furnaces at iron foundries. And of course, steam engines were themselves employed at machine shops to construct yet more steam engines. It was only once steam engines were being built and operated that subsequent engineers were able to devise ways to increase their efficiency and shrink fuel demands. They found ways to reduce their size and weight, adapting them for applications in transport or factory machinery. In other words, there was a positive feedback loop at the very core of the industrial revolution: the production of coal, iron and steam engines were all mutually supportive. In a world without readily mined coal, would there ever be the opportunity to test profligate prototypes of steam engines, even if they could mature and become more efficient over time? How feasible is it that a society could attain a sufficient understanding of thermodynamics, metallurgy and mechanics to make the precisely interacting components of an internal combustion engine, without first cutting its teeth on much simpler external combustion engines – the separate boiler and cylinder-piston of steam engines? It took a lot of energy to develop our technologies to their present heights, and presumably it would take a lot of energy to do it again. Fossil fuels are out. That means our future society will need an awful lot of timber. An industrial revolution without coal would be, at a minimum, very difficult In a temperate climate such as the UK’s, an acre of broadleaf trees produces about four to five tonnes of biomass fuel every year. If you cultivated fast-growing kinds such as willow or miscanthus grass, you could quadruple that. The trick to maximising timber production is to employ coppicing – cultivating trees such as ash or willow that resprout from their own stump, becoming ready for harvest again in five to 15 years. This way you can ensure a sustained supply of timber and not face an energy crisis once you’ve deforested your surroundings. But here’s the thing: coppicing was already a well-developed technique in pre-industrial Britain. It couldn’t meet all of the energy requirements of the burgeoning society. The central problem is that woodland, even when it is well-managed, competes with other land uses, principally agriculture. The double-whammy of development is that, as a society’s population grows, it requires more farmland to provide enough food and also greater timber production for energy. The two needs compete for largely the same land areas. We know how this played out in our own past. From the mid-16th century, Britain responded to these factors by increasing the exploitation of its coal fields – essentially harvesting the energy of ancient forests beneath the ground without compromising its agricultural output. The same energy provided by one hectare of coppice for a year is provided by about five to 10 tonnes of coal, and it can be dug out of the ground an awful lot quicker than waiting for the woodland to regrow. It is this limitation in the supply of thermal energy that would pose the biggest problem to a society trying to industrialise without easy access to fossil fuels. This is true in our post-apocalyptic scenario, and it would be equally true in any counterfactual world that never developed fossil fuels for whatever reason. For a society to stand any chance of industrialising under such conditions, it would have to focus its efforts in certain, very favourable natural environments: not the coal-island of 18th-century Britain, but perhaps areas of Scandinavia or Canada that combine fast-flowing streams for hydroelectric power and large areas of forest that can be harvested sustainably for thermal energy. Even so, an industrial revolution without coal would be, at a minimum, very difficult. Today, use of fossil fuels is actually growing, which is worrying for a number of reasons too familiar to rehearse here. Steps towards a low-carbon economy are vital. But we should also recognise how pivotal those accumulated reservoirs of thermal energy were in getting us to where we are. Maybe we could have made it the hard way. A slow-burn progression through the stages of mechanisation, supported by a combination of renewable electricity and sustainably grown biomass, might be possible after all. Then again, it might not. We’d better hope we can secure the future of our own civilisation, because we might have scuppered the chances of any society to follow in our wake.

#### Rigorous climate simulations prove that hydrophilic black carbon would cause to atmospheric precipitation – results in a rainout effect that quickly reverses nuclear cooling

Reisner et al. 18 (Jon Reisner – Climate and atmospheric scientist at the Los Alamos National Laboratory. Gennaro D’Angelo – Climate scientist at the Los Alamos National Laboratory, Research scientist at the SETI institute, Associate specialist at the University of California, Santa Cruz, NASA Postdoctoral Fellow at the NASA Ames Research Center, UKAFF Fellow at the University of Exeter. Eunmo Koo - Scientist at Applied Terrestrial, Energy, and Atmospheric Modeling (ATEAM) Team, in Computational Earth Science Group (EES-16) in Earth and Environmental Sciences Division and Co-Lead of Parallel Computing Summer Research Internship (PCSRI) program at the Los Alamos National Laboratory, former Staff research associate at UC Berkeley. Wesley Even - Computational scientist in the Computational Physics and Methods Group at Los Alamos National Laboratory. Matthew Hecht – Atmospheric scientist at the Los Alamos National Laboratory. Elizabeth Hunke - Lead developer for the Los Alamos Sea Ice Model (CICE) at the Los Alamos National Laboratory responsible for development and incorporation of new parameterizations, model testing and validation, computational performance, documentation, and consultation with external model users on all aspects of sea ice modeling, including interfacing with global climate and earth system models. Darin Comeau – Climate scientist at the Los Alamos National Laboratory. Randy Bos - Project leader at the Los Alamos National Laboratory, former Weapons Effects program manager at Tech-Source. James Cooley – Computational scientist at the Los Alamos National Laboratory specializing in weapons physics, emergency response, and computational physics. <MKIM> “Climate impact of a regional nuclear weapons exchange:An improved assessment based on detailed source calculations”. 3/16/18. DOA: 7/13/19. <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017JD027331>)

\*BC = Black Carbon

The no-rubble simulation produces a significantly more intense fire, with more fire spread, and consequently a significantly stronger plume with larger amounts of BC reaching into the upper atmosphere than the simulation with rubble, illustrated in Figure 5. While the no-rubble simulation **represents the worst-case scenario** involving vigorous fire activity, **only a relatively small amount of carbon makes its way into the stratosphere** during the course of the simulation. But while small compared to the surface BC mass, stratospheric BC amounts from the current simulations are significantly higher than what would be expected from burning vegetation such as trees (Heilman et al., 2014), e.g., the higher energy density of the building fuels and the initial fluence from the weapon produce an intense response within HIGRAD with initial updrafts of order 100 m/s in the lower troposphere. Or, in comparison to a mass fire, wildfires will burn only a small amount of fuel in the corresponding time period (roughly 10 minutes) that a nuclear weapon fluence can effectively ignite a large area of fuel producing an impressive atmospheric response. Figure 6 shows vertical profiles of BC multiplied by 100 (number of cities involved in the exchange) from the two simulations. The total amount of BC produced is in line with previous estimates (about 3.69 Tg from no-rubble simulation); however, the majority of BC resides **below the stratosphere** (3.46 Tg below 12 km) and can be **readily impacted by scavenging from precipitation** either via pyro-cumulonimbus produced by the fire itself (not modeled) or other synoptic weather systems. While the impact on climate of these more realistic profiles will be explored in the next section, it should be mentioned that **these estimates are** still **at the high end**, considering the inherent simplifications in the combustion model that lead to **overestimating BC production**. 3.3 Climate Results Long-term climatic effects critically depend on the initial injection height of the soot, with larger quantities reaching the upper troposphere/lower stratosphere inducing a greater cooling impact because of longer residence times (Robock et al., 2007a). Absorption of solar radiation by the BC aerosol and its subsequent radiative cooling tends to heat the surrounding air, driving an initial upward diffusion of the soot plumes, an effect that depends on the initial aerosol concentrations. **Mixing and sedimentation** tend to **reduce this process**, and low altitude emissions are also significantly impacted by precipitation if aging of the BC aerosol occurs on sufficiently rapid timescales. But once at stratospheric altitudes, aerosol dilution via coagulation is hindered by low particulate concentrations (e.g., Robock et al., 2007a) and lofting to much higher altitudes is inhibited by gravitational settling in the low-density air (Stenke et al., 2013), resulting in more stable BC concentrations over long times. Of the initial BC mass released in the atmosphere, most of which is emitted below 9 km, **70% rains out within the first month** and 78%, or about 2.9 Tg, is removed within the first two months (Figure 7, solid line), with the remainder (about 0.8 Tg, dashed line) being transported above about 12 km (200 hPa) within the first week. This outcome differs from the findings of, e.g., Stenke et al. (2013, their high BC-load cases) and Mills et al. (2014), who found that most of the BC mass (between 60 and 70%) is lifted in the stratosphere within the first couple of weeks. This can also be seen in Figure 8 (red lines) and in Figure 9, which include results from our calculation with the initial BC distribution from Mills et al. (2014). In that case, only 30% of the initial BC mass rains out in the troposphere during the first two weeks after the exchange, with the remainder rising to the stratosphere. In the study of Mills et al. (2008) this percentage is somewhat smaller, about 20%, and smaller still in the experiments of Robock et al. (2007a) in which the soot is initially emitted in the upper troposphere or higher. In Figure 7, the e-folding timescale for the removal of tropospheric soot, here interpreted as the time required for an initial drop of a factor e, is about one week. This result compares favorably with the “LT” experiment of Robock et al. (2007a), considering 5 Tg of BC released in the lower troposphere, in which 50% of the aerosols are removed within two weeks. By contrast, the initial e-folding timescale for the removal of stratospheric soot in Figure 8 is about 4.2 years (blue solid line), compared to about 8.4 years for the calculation using Mills et al. (2014) initial BC emission (red solid line). The removal timescale from our forced ensemble simulations is close to those obtained by Mills et al. (2008) in their 1 Tg experiment, by Robock et al. (2007a) in their experiment “UT 1 Tg”, and © 2018 American Geophysical Union. All rights reserved. by Stenke et al. (2013) in their experiment “Exp1”, in all of which 1 Tg of soot was emitted in the atmosphere in the aftermath of the exchange. Notably, the e-folding timescale for the decline of the BC mass in Figure 8 (blue solid line) is also close to the value of about 4 years quoted by Pausata et al. (2016) for their long-term “intermediate” scenario. In that scenario, which is also based on 5 Tg of soot initially distributed as in Mills et al. (2014), the factor-of2 shorter residence time of the aerosols is caused by particle growth via coagulation of BC with organic carbon. Figure 9 shows the BC mass-mixing ratio, horizontally averaged over the globe, as a function of atmospheric pressure (height) and time. The BC distributions used in our simulations imply that the upward transport of particles is substantially less efficient compared to the case in which 5 Tg of BC is directly injected into the upper troposphere. The semiannual cycle of lofting and sinking of the aerosols is associated with atmospheric heating and cooling during the solstice in each hemisphere (Robock et al., 2007a). During the first year, the oscillation amplitude in our forced ensemble simulations is particularly large during the summer solstice, compared to that during the winter solstice (see bottom panel of Figure 9), because of the higher soot concentrations in the Northern Hemisphere, as can be seen in Figure 11 (see also left panel of Figure 12). Comparing the top and bottom panels of Figure 9, the BC reaches the highest altitudes during the first year in both cases, but the concentrations at 0.1 hPa in the top panel can be 200 times as large. Qualitatively, the difference can be understood in terms of the air temperature increase caused by BC radiation emission, which is several tens of kelvin degrees in the simulations of Robock et al. (2007a, see their Figure 4), Mills et al. (2008, see their Figure 5), Stenke et al. (2013, see high-load cases in their Figure 4), Mills et al. (2014, see their Figure 7), and Pausata et al. (2016, see one-day emission cases in their Figure 1), due to high BC concentrations, but it amounts to only about 10 K in our forced ensemble simulations, as illustrated in Figure 10. Results similar to those presented in Figure 10 were obtained from the experiment “Exp1” performed by Stenke et al. (2013, see their Figure 4). **In that scenario as well, somewhat less that 1 Tg of BC remained in the atmosphere after the initial rainout**. As mentioned before, the BC aerosol that remains in the atmosphere, lifted to stratospheric heights by the rising soot plumes, undergoes sedimentation over a timescale of several years (Figures 8 and 9). This mass represents the effective amount of BC that can force climatic changes over multi-year timescales. In the forced ensemble simulations, it is about 0.8 Tg after the initial rainout, whereas it is about 3.4 Tg in the simulation with an initial soot distribution as in Mills et al. (2014). Our more realistic source simulation involves the worstcase assumption of no-rubble (along with other assumptions) and hence serves as an upper bound for the impact on climate. As mentioned above and further discussed below, our scenario induces perturbations on the climate system similar to those found in previous studies in which the climatic response was driven by roughly 1 Tg of soot rising to stratospheric heights following the exchange. Figure 11 illustrates the vertically integrated mass-mixing ratio of BC over the globe, at various times after the exchange for the simulation using the initial BC distribution of Mills et al. (2014, upper panels) and as an average from the forced ensemble members (lower panels). All simulations predict enhanced concentrations at high latitudes during the first year after the exchange. In the cases shown in the top panels, however, these high concentrations persist for several years (see also Figure 1 of Mills et al., 2014), whereas the forced ensemble simulations indicate that the BC concentration starts to decline after the first year. In fact, in the simulation represented in the top panels, mass-mixing ratios larger than about 1 kg of BC © 2018 American Geophysical Union. All rights reserved. per Tg of air persist for well over 10 years after the exchange, whereas they only last for 3 years in our forced simulations (compare top and middle panels of Figure 9). After the first year, values drop below 3 kg BC/Tg air, whereas it takes about 8 years to reach these values in the simulation in the top panels (see also Robock et al., 2007a). Over crop-producing, midlatitude regions in the Northern Hemisphere, the BC loading is reduced from more than 0.8 kg BC/Tg air in the simulation in the top panels to 0.2-0.4 kg BC/Tg air in our forced simulations (see middle and right panels). The more rapid clearing of the atmosphere in the forced ensemble is also signaled by the soot optical depth in the visible radiation spectrum, which drops below values of 0.03 toward the second half of the first year at mid latitudes in the Northern Hemisphere, and everywhere on the globe after about 2.5 years (without never attaining this value in the Southern Hemisphere). In contrast, the soot optical depth in the calculation shown in the top panels of Figure 11 becomes smaller than 0.03 everywhere only after about 10 years. The two cases show a similar tendency, in that the BC optical depth is typically lower between latitudes 30º S-30º N than it is at other latitudes. This behavior is associated to the persistence of stratospheric soot toward high-latitudes and the Arctic/Antarctic regions, as illustrated by the zonally-averaged, column-integrated mass-mixing ratio of the BC in Figure 12 for both the forced ensemble simulations (left panel) and the simulation with an initial 5 Tg BC emission in the upper troposphere (right panel). The spread in the globally averaged (near) surface temperature of the atmosphere, from the control (left panel) and forced (right panel) ensembles, is displayed in Figure 13. For each month, the plots show the largest variations (i.e., maximum and minimum values), within each ensemble of values obtained for that month, relative to the mean value of that month. The plot also shows yearly-averaged data (thinner lines). The spread is comparable in the control and forced ensembles, with average values calculated over the 33-years run length of 0.4-0.5 K. This spread is also similar to the internal variability of the globally averaged surface temperature quoted for the NCAR Large Ensemble Community Project (Kay et al., 2015). These results imply that surface air temperature differences, between forced and control simulations, which lie within the spread may not be distinguished from effects due to internal variability of the two simulation ensembles. Figure 14 shows the difference in the globally averaged surface temperature of the atmosphere (top panel), net solar radiation flux at surface (middle panel), and precipitation rate (bottom panel), computed as the (forced minus control) difference in ensemble mean values. The sum of standard deviations from each ensemble is shaded. Differences are qualitatively significant over the first few years, when the anomalies lie near or outside the total standard deviation. Inside the shaded region, differences may not be distinguished from those arising from the internal variability of one or both ensembles. The surface solar flux (middle panel) is the quantity that appears most affected by the BC emission, with qualitatively significant differences persisting for about 5 years. The precipitation rate (bottom panel) is instead affected only at the very beginning of the simulations. The red lines in all panels show the results from the simulation applying the initial BC distribution of Mills et al. (2014), where the period of significant impact is much longer owing to the higher altitude of the initial soot distribution that results in longer residence times of the BC aerosol in the atmosphere. When yearly averages of the same quantities are performed over the IndiaPakistan region, the differences in ensemble mean values lie within the total standard deviations of the two ensembles. The results in Figure 14 can also be compared to the outcomes of other previous studies. In their experiment “UT 1 Tg”, Robock et al. (2007a) found that, when only 1 Tg of soot © 2018 American Geophysical Union. All rights reserved. remains in the atmosphere after the initial rainout, temperature and precipitation anomalies are about 20% of those obtained from their standard 5 Tg BC emission case. Therefore, the largest differences they observed, during the first few years after the exchange, were about - 0.3 K and -0.06 mm/day, respectively, comparable to the anomalies in the top and bottom panels of Figure 14. Their standard 5 Tg emission case resulted in a solar radiation flux anomaly at surface of -12 W/m2 after the second year (see their Figure 3), between 5 and 6 time as large as the corresponding anomalies from our ensembles shown in the middle panel. In their experiment “Exp1”, Stenke et al. (2013) reported global mean surface temperature anomalies not exceeding about 0.3 K in magnitude and precipitation anomalies hovering around -0.07 mm/day during the first few years, again consistent with the results of Figure 14. In a recent study, Pausata et al. (2016) considered the effects of an admixture of BC and organic carbon aerosols, both of which would be emitted in the atmosphere in the aftermath of a nuclear exchange. In particular, they concentrated on the effects of coagulation of these aerosol species and examined their climatic impacts. The initial BC distribution was as in Mills et al. (2014), although the soot burden was released in the atmosphere over time periods of various lengths. Most relevant to our and other previous work are their one-day emission scenarios. They found that, during the first year, the largest values of the atmospheric surface temperature anomalies ranged between about -0.5 and -1.3 K, those of the sea surface temperature anomalies ranged between -0.2 and -0.55 K, and those of the precipitation anomalies varied between -0.15 and -0.2 mm/day. All these ranges are compatible with our results shown in Figure 14 as red lines and with those of Mills et al. (2014, see their Figures 3 and 6). As already mentioned in Section 2.3, the net solar flux anomalies at surface are also consistent. This overall agreement suggests that the **inclusion of organic carbon aerosols, and** ensuing **coagulation** with BC, **should not dramatically alter the climatic effects** resulting from our forced ensemble simulations. Moreover, aerosol growth would likely **shorten the residence time of the BC particulate in the atmosphere** (Pausata et al., 2016), possibly **reducing the duration of these effects.**

#### Terror doesn’t cause it.

Walt 16 Stephen M. Walt, international relations professor at Harvard University. [My Top 5 Foreign-Policy Unicorns — and Why I Want to Kill Them, 9-8-2016, https://foreignpolicy.com/2016/09/08/my-top-5-foreign-policy-unicorns-and-why-i-want-to-kill-them/]//BPS

3. The terrorist mastermind. A close cousin to the nuclear rogue is the terrorist mastermind, busily concocting elaborate and highly destructive plots to bring the world to its knees. People like Osama bin Laden and Islamic State leader Abu Bakr al-Baghdadi have made extravagant and dire threats, but the good news is that they’ve never come close to toppling a foreign government, winning millions of followers, or threatening our way of life. I don’t deny that some terrorist groups have devised and executed successful assaults — of which the 9/11 attacks were by far the most damaging — but a word like “mastermind” conjures up images of Dr. Evil-style villains who will inevitably outwit our feeble efforts to stop them and unleash fearsome destruction on an innocent world. In fact, as John Mueller and others keep reminding us, the vast majority of contemporary terrorists are incompetent misfits, and even the very best of them fall well short of evil genius. They can and do stage small-scale attacks that cause modest amounts of harm, but they have repeatedly shown themselves to be incapable of orchestrating complicated operations that could actually bring a stable country to its knees. There have been serious terrorist attacks in Boston; London; Paris; Brussels; Orlando, Florida; and several other places in recent years, for example — yet in each case, these societies proved resilient, and they are thriving again today. Or just look at New York City, which suffered the worst single attack ever and has since fully recovered. Terrorism is a problem, the lives lost to it are an unfortunate tragedy, and those who employ it are dangerous criminals. A few terrorists are moderately clever; most are not. None rises to the level of a “mastermind,” and none poses an existential threat. Reporters, pundits, and speechwriters should drop this term from their lexicon, because this particular animal doesn’t exist. Fortunately.

#### Even if there’s no rainout, no famine – plenty of foods can survive the conditions

Bendix 20 (Aria Bendix is a Senior Reporter at Insider, covering urban and environmental science, A full-scale nuclear winter would trigger a global famine. A disaster expert put together a doomsday diet to save humanity, Jan 10, 2020, BuisnessInsider, <https://www.businessinsider.com/how-to-survive-after-nuclear-war-what-to-eat-2020-1>, 3/24/20)//ww BJ

Even if a nuclear winter destroyed trillions of trees, mushrooms could feed on that dead matter, creating a regenerative food source that could potentially feed everyone on the planet for about three years, according to Denkenberger's estimates. Since mushrooms don't rely on photosynthesis, they can survive without much light. The same goes for seaweed. "Seaweed is a really good food source in a scenario like this because it can tolerate a low light levels," Denkenberger said. "It's also very fast-growing. In a nuclear winter, the land will cool down faster than the oceans, so the oceans will remain a little bit warmer. Seaweed can handle relatively low temperatures." To feed everyone on the planet, Denkenberger estimates that the world would need around 1.6 billion tons of dry food per year. Humans could potentially grow that amount of seaweed, he said, in three to six months. But in order consume the proper nutrients to ward off disease, humans can't rely on a single food source (or two). So Denkenberger put together a chart of what a typical 2,100-calorie diet might look like in a post-doomsday scenario. nuclear winter diet David Denkenberger and Joshua M. Pearce The diet involves a mixture of meat, eggs, sugar, and mushrooms. It also includes dandelions and tea made from tree needles, which contain Vitamin C. Naturally growing bacteria would serve as a source of Vitamin E, which is important for brain function. Denkenberger said he plans to study other natural food sources that could grow near the equator, where there would still be some sunlight post-disaster (though the temperature would be low). "One of the things I've learned by moving to Alaska is that, even in areas where the summers are so cool that trees cannot grow, you can actually grow potatoes," he said. Leaves also contain stringy fiber (cellulose) that could be converted into sugar, Denkenberger added. That process is already happening at biofuel plants, which convert cellulose into sugar to make ethanol.