# 2nr

## Warming

#### Microplastics have hurt survival, reproduction, and consumption processes of diatoms, inhibiting survival and photosynthesis – that’s Septania

#### Warming increases diatom growth which is k2 bioD—

#### [1] UV sensitivity – diatoms become less sensitive to UV, stopping degradation and inreasing photosynthesis

#### [2] Photosynthesis –strengthens photosynthesis absorption

#### [3] Carbon fixation –increase production of membranes, molecular repair, and activity

#### [4] acidity – it combats UV degradation

#### That’s Li et al

#### That’s key to survival–

#### [1] BioD – diatoms are the basis of oceans and food chains – causes oceanic ecosystemic collapse. That causes extinction – every species is interconnected to our resources – collapse causes global nuclear resource wars, which outweighs on timeframe and probability – resource wars have historically occurred, like Germany or French and Russian Wars – if resource wars true our ev o/w. That’s FDI

#### [2] Oxygen – half of all oxygen is produced by diatoms – that’s key to human survival – independent internal link that was dropped

#### That’s Roach

#### o/w on TF - It’s a tail-end scenario in the far future.

Kerr et al. 19---Dr. Amber Kerr, Energy and Resources PhD at the University of California-Berkeley, known agroecologist, former coordinator of the USDA California Climate Hub. Dr. Daniel Swain, Climate Science PhD at UCLA, climate scientist, a research fellow at the National Center for Atmospheric Research. Dr. Andrew King, Earth Sciences PhD, Climate Extremes Research Fellow at the University of Melbourne. Dr. Peter Kalmus, Physics PhD at the University of Colombia, climate scientist at NASA’s Jet Propulsion Lab. Professor Richard Betts, Chair in Climate Impacts at the University of Exeter, a lead author on the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) in Working Group 1. Dr. William Huiskamp, Paleoclimatology PhD at the Climate Change Research Center, climate scientist at the Potsdam Institute for Climate Impact Research. [Claim that human civilization could end in 30 years is speculative, not supported with evidence, 6-4-2019, https://climatefeedback.org/evaluation/iflscience-story-on-speculative-report-provides-little-scientific-context-james-felton/]

Scientists who reviewed IFLScience’s story found that it failed to provide sufficient context for this report—differentiating, for example, between speculative claims and descriptions of peer-reviewed research. In particular, the story’s headline (“New Report Warns ‘High Likelihood Of Human Civilization Coming To An End’ Within 30 Years”) misrepresents the report as a likely projection rather than an exploration of an intrinsically unlikely worst case scenario.

See all the scientists’ annotations in context.

REVIEWERS’ OVERALL FEEDBACK

These comments are the overall assessment of scientists on the article, they are substantiated by their knowledge in the field and by the content of the analysis in the annotations on the article.

Amber Kerr, Researcher, Agricultural Sustainability Institute, University of California, Davis:

The content of the IFLScience article is mostly an accurate representation of the contents of the Breakthrough report, but the article tends to gloss over important caveats and probabilities that are given in the report. The least accurate part of the IFLScience article is the headline, which is an outright misrepresentation of the report. The article title states that there is, overall, a “high probability” of human civilization coming to an end in 30 years. This is extremely misleading. What the Breakthrough report actually says is that, in the most unlikely, “long-tail” biophysical scenario where climate feedbacks are much more severe than we expect, THEN there is a high likelihood of human civilization coming to an end. But the report authors explicitly state that this “high-end scenario” is beyond their capacity to model or to quantitatively estimate.

Daniel Swain, Researcher, UCLA, and Research Fellow, National Center for Atmospheric Research:

The article uncritically reproduces claims from a recent report released by an Australian thinktank regarding the purported “end of human civilization” due to climate change over the next 30 years. While there is plenty of scientific evidence that climate change will pose increasingly existential threats to the most vulnerable individuals in society and to key global ecosystems, even these dire outcomes aren’t equivalent to the “annihilation of intelligent life,” as is claimed in the report.

Andrew King, Research fellow, University of Melbourne:

The report this article is based on describes a scenario which is unlikely, but several aspects of what is included in the report are likely to worsen in coming decades, such as the occurrence of deadly heatwaves. The conclusion of a high likelihood that human civilisation will end is false, although there is a great deal of evidence that there will be many damaging consequences to continued global warming over the coming decades.

Peter Kalmus, Data Scientist, Jet Propulsion Laboratory:

I don’t think it’s so easy to discount the essential warning of this report. However, it would have been stronger if the authors were more careful not to mention the unsupported concept of near-term human extinction, and the unsupported probabilistic claim that there is a “high likelihood” of their 2050 scenario which includes the collapse of civilization. I do not understand why non-scientist writers (neither report author is a scientist) feel a need to exaggerate sound scientific findings, when those findings are already quite alarming enough. I feel that humanity should undertake urgent climate action just as the report authors do, but I feel that misrepresenting the science is unhelpful and unnecessary.

Richard Betts, Professor, Met Office Hadley Centre & University of Exeter:

This is a classic case of a media article over-stating the conclusions and significance of a non-peer reviewed report that itself had already overstated (and indeed misrepresented) peer-reviewed science---some of which was already somewhat controversial. It appears that there was not a thorough independent check of the credibility of the message.

Notes:

[1] See the rating guidelines used for article evaluations.

[2] Each evaluation is independent. Scientists’ comments are all published at the same time.

ANNOTATIONS

The statements quoted below are from the article; comments are from the reviewers (and are lightly edited for clarity).

New Report Warns “High Likelihood Of Human Civilization Coming To An End” Within 30 Years

Richard Betts, Professor, Met Office Hadley Centre & University of Exeter:

The headline overstates the conclusions of the report (which is already overdoing things). The reports says it presents a scenario, and under that scenario and all the assumptions within it, the report claims that there is a “high likelihood of human civilization coming to and end”---but even then, the report itself does not give the end of civilisation within 30 years. The process supposedly leading ultimately to collapse begins around 2050 but takes a long time to take effect. Also the processes themselves are not well-grounded in science, as they over-interpret published work.

# 1nc

## 1

#### Interpretation: outer space consists of regions outside the atmospheres of celestial bodies

Tanabe 19 [(Rosie, updater and writer at NWE) “Outer space,” New World Encyclopedia, 1/8/2019] JL

Outer space (often called space) consists of the relatively empty regions of the universe outside the [atmospheres](https://www.newworldencyclopedia.org/entry/Atmosphere) of celestial bodies. *Outer* space is used to distinguish it from airspace and terrestrial locations. There is no clear boundary between [Earth's atmosphere](https://www.newworldencyclopedia.org/entry/Earth%27s_atmosphere) and space, as the [density](https://www.newworldencyclopedia.org/entry/Density) of the atmosphere gradually decreases as the altitude increases.

#### The moon has an atmosphere—

Siegal 21[(Ethan, a Ph.D. astrophysicist and author of "Starts with a Bang!" He is a science communicator, who professes physics and astronomy at various colleges. He has won numerous awards for science writing since 2008 for his blog, including the award for best science blog by the Institute of Physics.) “The “airless” Moon really does have an atmosphere, after all,” Big Think, November 17, 2021. <https://bigthink.com/starts-with-a-bang/airless-moon-atmosphere/>] RR

And yet, the Moon actually does have an atmosphere: one that’s measurable and detectable. In addition, it has something even better than an atmosphere: an atmospheric “tail” made of sodium atoms. Here’s the fascinating science behind our lunar companion’s tenuous, but nonnegligible, atmosphere, which we mustn’t ignore any longer.

#### Violation: Lunar Heritage Sites are located on the moon, not in outer space.

Nasa 13 [(Nasa, The National Aeronautics and Space Administration is America’s civil space program and the global leader in space exploration. The agency has a diverse workforce of just under 18,000 civil servants, and works with many more U.S. contractors, academia, and international and commercial partners to explore, discover, and expand knowledge for the benefit of humanity. With an annual budget of $23.2 billion in Fiscal Year 2021, which is less than 0.5% of the overall U.S. federal budget, NASA supports more than 312,000 jobs across the United States, generating more than $64.3 billion in total economic output (Fiscal Year 2019).) “Lunar Heritage Sites,” NASA, 12/13/13. <https://moon.nasa.gov/resources/53/lunar-heritage-sites/>] RR

**Chart, diagram

Description automatically generated**

This graphic highlights locations on the moon NASA considers "lunar heritage sites" and the path NASA's Gravity Recovery and Interior Laboratory spacecraft will take on their final flight.

Navigators on the GRAIL team have designed an end of mission plan that rules out the extremely remote possibility of either of the two GRAIL spacecraft impacting near any of these historic locations. The Apollo 11, 12, 14, 16 and 17 landing sites are indicated with green circles. The Surveyor sites are indicated with yellow squares. The Soviet Union's Luna and Lunakhod landing sites are indicated with red diamonds and red triangles, respectively.

The ground tracks for the Ebb and Flow spacecraft during their final half-orbits are shown in blue and red.

#### Standards:

#### Limits – their interpretation means that they allow for the elimination of private appropriation on earth, asteroids, galaxies, comets, mars etc. This explodes neg prep burdens since outer space activity is so vague – no generics exist to answer both the earth and the moon aff, so affs would just win with a tiny impact every round

#### Ground – allowing debates about celestial bodies denies the neg links to core generics like space democracy bad, space colonization good, the moon pic, the property rights NC, etc. – that kills clash by forcing negatives to the fringes of argumentation that disagree with everything and kills fairness by giving the aff a major prep advantage since they only need to frontline the few negative arguments that link to their aff.

#### Drop the debater – dropping the argument doesn’t rectify abuse since winning T proves why we don’t have the burden of rejoinder against their aff.

#### Use competing interps – reasonability invites arbitrary judge intervention since there’s no consensus as to what’s reasonable.

## Case

### Warming

#### Warming doesn’t rise to extinction – new studies.

Nordhaus 20 Ted Nordhaus, an American author, environmental policy expert, and the director of research at The Breakthrough Institute, citing new climate change forecasts. [Ignore the Fake Climate Debate, 1-23-2020, https://www.wsj.com/articles/ignore-the-fake-climate-debate-11579795816]//BPS

Beyond the headlines and social media, where Greta Thunberg, Donald Trump and the online armies of climate “alarmists” and “deniers” do battle, there is a real climate debate bubbling along in scientific journals, conferences and, occasionally, even in the halls of Congress. It gets a lot less attention than the boisterous and fake debate that dominates our public discourse, but it is much more relevant to how the world might actually address the problem. In the real climate debate, no one denies the relationship between human emissions of greenhouse gases and a warming climate. Instead, the disagreement comes down to different views of climate risk in the face of multiple, cascading uncertainties. On one side of the debate are optimists, who believe that, with improving technology and greater affluence, our societies will prove quite adaptable to a changing climate. On the other side are pessimists, who are more concerned about the risks associated with rapid, large-scale and poorly understood transformations of the climate system. But most pessimists do not believe that runaway climate change or a hothouse earth are plausible scenarios, much less that human extinction is imminent. And most optimists recognize a need for policies to address climate change, even if they don’t support the radical measures that Ms. Thunberg and others have demanded. In the fake climate debate, both sides agree that economic growth and reduced emissions vary inversely; it’s a zero-sum game. In the real debate, the relationship is much more complicated. Long-term economic growth is associated with both rising per capita energy consumption and slower population growth. For this reason, as the world continues to get richer, higher per capita energy consumption is likely to be offset by a lower population. A richer world will also likely be more technologically advanced, which means that energy consumption should be less carbon-intensive than it would be in a poorer, less technologically advanced future. In fact, a number of the high-emissions scenarios produced by the United Nations Intergovernmental Panel on Climate Change involve futures in which the world is relatively poor and populous and less technologically advanced. Affluent, developed societies are also much better equipped to respond to climate extremes and natural disasters. That’s why natural disasters kill and displace many more people in poor societies than in rich ones. It’s not just seawalls and flood channels that make us resilient; it’s air conditioning and refrigeration, modern transportation and communications networks, early warning systems, first responders and public health bureaucracies. New research published in the journal Global Environmental Change finds that global economic growth over the last decade has reduced climate mortality by a factor of five, with the greatest benefits documented in the poorest nations. In low-lying Bangladesh, 300,000 people died in Cyclone Bhola in 1970, when 80% of the population lived in extreme poverty. In 2019, with less than 20% of the population living in extreme poverty, Cyclone Fani killed just five people. “Poor nations are most vulnerable to a changing climate. The fastest way to reduce that vulnerability is through economic development.” So while it is true that poor nations are most vulnerable to a changing climate, it is also true that the fastest way to reduce that vulnerability is through economic development, which requires infrastructure and industrialization. Those activities, in turn, require cement, steel, process heat and chemical inputs, all of which are impossible to produce today without fossil fuels. For this and other reasons, the world is unlikely to cut emissions fast enough to stabilize global temperatures at less than 2 degrees above pre-industrial levels, the long-standing international target, much less 1.5 degrees, as many activists now demand. But recent forecasts also suggest that many of the worst-case climate scenarios produced in the last decade, which assumed unbounded economic growth and fossil-fuel development, are also very unlikely. There is still substantial uncertainty about how sensitive global temperatures will be to higher emissions over the long-term. But the best estimates now suggest that the world is on track for 3 degrees of warming by the end of this century, not 4 or 5 degrees as was once feared. That is due in part to slower economic growth in the wake of the global financial crisis, but also to decades of technology policy and energy-modernization efforts. “We have better and cleaner technologies available today because policy-makers in the U.S. and elsewhere set out to develop those technologies.” The energy intensity of the global economy continues to fall. Lower-carbon natural gas has displaced coal as the primary source of new fossil energy. The falling cost of wind and solar energy has begun to have an effect on the growth of fossil fuels. Even nuclear energy has made a modest comeback in Asia.

#### Climate change is key to food security, solve water scarcity, economic growth, and increased trade

Lamar Smith 17, B.A. in American Studies from Yale University, J.D. from Southern Methodist University, a business and financial writer for the CSM, “Don’t Believe the Hysteria Over Carbon Dioxide”, https://www.dailysignal.com/2017/07/24/dont-believe-hysteria-carbon-dioxide/

The benefits of a changing climate are often ignored and under-researched. Our climate is too complex and the consequences of misguided policies too harsh to discount the positive effects of carbon enrichment. A higher concentration of carbon dioxide in our atmosphere would aid photosynthesis, which in turn contributes to increased plant growth. This correlates to a greater volume of food production and better quality food. Studies indicate that crops would utilize water more efficiently, requiring less water. And colder areas along the farm belt will experience longer growing seasons. While crops typically suffer from high heat and lack of rainfall, carbon enrichment helps produce more resilient food crops, such as maize, soybeans, wheat, and rice. In fact, atmospheric carbon dioxide is so important for plant health that greenhouses often use a carbon dioxide generator to increase production. Besides food production, another benefit of increased carbon dioxide in the atmosphere is the lush vegetation that results. The world’s vegetated areas are becoming 25-50 percent greener, according to satellite images. Seventy percent of this greening is due to a rise in atmospheric carbon dioxide. Greater vegetation assists in controlling water runoff, provides more habitats for many animal species, and even aids in climate stabilization, as more vegetation absorbs more carbon dioxide. When plant diversity increases, these vegetated areas can better eliminate carbon from the atmosphere. Also, as the Earth warms, we are seeing beneficial changes to the earth’s geography. For instance, Arctic sea ice is decreasing. This development will create new commercial shipping lanes that provide faster, more convenient, and less costly routes between ports in Asia, Europe, and eastern North America. This will increase international trade and strengthen the world economy. Fossil fuels have helped raise the standard of living for billions of people. Furthermore, research has shown that regions that have enjoyed a major reduction in poverty achieved these gains by expanding the use of fossil fuels for energy sources. For nations to progress, they need access to affordable energy. Fossil fuels provide the energy necessary to develop affordable food, safe drinking water, and reliable housing for those who have never had it before. Studies indicate that in the U.S. alone, the natural gas industry is responsible for millions of jobs and has increased the wealth of Americans by an average of $1,337. Economic growth as well as greater food production and increased vegetation are just some of the benefits that can result from our changing climate.

#### Warming solves Greenland’s economy and rare earth mineral shortages

McGinnis 12 (Paul E. McGinnis is a contributing writer to EcoWatch. He has interviewed a stellar array of change makers including Sylvia Earle, Dean Kamen, Ray Kurzweil, Fabien Cousteau and Josh Fox. Paul is also a New York based real estate broker, and green building and renovation consultant. He is a member of the U.S. Green Building Council, the Northeast Sustainable Energy Association, and the New York State Association of Realtors. McGinnis, P. E. “Greenland’s Ice Melt Ignites Race for Rare Earth Metals,” 11/12/2012, http://ecowatch.com/2012/11/12/greenlands-rare-earth-metals//ghs-kw)

Greenland’s vast, pristine, virtually-untouched terrain is becoming a hotbed for resource extraction. The Arctic is melting at an unprecedented rate, making Greenland’s natural resources, including high demand commodities such as oil, gas, gold, iron, copper and rare earth metals, more accessible. Insatiable international oil, gas and mining conglomerates are now aggressively vying to control access to the riches glaciers once denied. “This is not just a region of ice and polar bears,” Prime Minister of Greenland, Kuupik Kleist, told Reuters in the capital Nuuk, formerly known by its Danish name Godthab. “Developing countries are interested in a more political role in opening up of the Arctic. Greenland could serve as a stepping stone.” Greenland has less than 60,000 people living in an 836,109 square mile area. Comparatively, Greenland is almost a quarter the size of the continental U.S. Until recently, the country was regarded by strategists as barren wasteland with little political or economic import. But now this once overlooked arctic island is being targeted by government and politically connected entities, anxious to extract what lies beneath the glacier ice sheet. The powerful and deep-pocketed interests include China, the U.S., Russia and the European Union. Many in Greenland are excited about the attention the remote island nation is attracting and are happy to have world powers courting Greenland looking to strike it rich. Greenlanders are hoping they too will get rich along with the foreign investors. Henrik Stendal, head of the geology department at Greenland’s Bureau of Minerals and Petroleum, a Dane who has worked in Greenland since 1970, told the U.K. Guardian in July: “We have shown that we have huge potential—it has been an eye-opener for the mining industry. The EU has shown a lot of interest and that’s been very good—we believe this could be very valuable for Greenland. There could be benefits for everyone—at present most of our income is from fishing and a little bit of tourism, so the government really wants another income.” In addition to oil and gas, and perhaps even more attractive to industry, are rare earth metals that lie beneath the ground in Greenland that are essential components in new technologies, including computer hard drives, cell phones and flat screen devices. The world is consuming these rare earth metals at a voracious rate. For instance, in the first weekend of sales, the 4G iPad mini sold four million units. Our appetite for these devices and the rare metals required seems unending. Rare earth metals are also essential elements to military guidance systems and other defense related technology. Most of the rare earth metals are currently sourced in China. Now, the world’s nations are considering Greenland’s resources not just from an economic point of view, but, perhaps more importantly, a strategic perspective. There is a national security imperative when looking at availability of these resources and who controls them. The New York Times reported in September: “Western nations have been particularly anxious about Chinese overtures to this poor and sparsely populated island, a self-governing state within the Kingdom of Denmark, because the retreat of its ice cap has unveiled coveted mineral deposits, including rare earth metals that are crucial for new technologies like cellphones and military guidance systems. A European Union vice president, Antonio Tajani, rushed here to Greenland’s capital in June, offering hundreds of millions in development aid in exchange for guarantees that Greenland would not give China exclusive access to its rare earth metals, calling his trip ‘raw mineral diplomacy.'” “In the past 18 months, Secretary of State Hillary Rodham Clinton and President Lee Myung-bak of South Korea have made debut visits here, and Greenland’s prime minister, Kuupik Kleist, was welcomed by President José Manuel Barroso of the European Commission in Brussels.”

#### Conflict over resources in the arctic goes nuclear

Cohen 10 Ariel [Senior Research Fellow for Russian and Eurasian Studies and International Energy Policy, The Kathryn and Shelby Cullom Davis Institute for International Studies] “From Russian Competition to Natural Resources Access: Recasting U.S. Arctic Policy” The Heritage Foundation 6/15/10 <http://www.heritage.org/research/reports/2010/06/from-russian-competition-to-natural-resources-access-recasting-us-arctic-policy>

To advance its position, Russia has undertaken a three-year mission to map the Arctic.[26] The Kremlin is also moving rapidly to establish a comprehensive sea, ground, and air presence. Under Putin, Russia focused on the Arctic as a major natural resources base. The Russian national leadership insists that the state, not the private sector, must take the lead in developing the vast region. The Kremlin published its Arctic doctrine in March 2009.[27] The main goal is to transform the Arctic into Russia’s strategic resource base and make Russia a leading Arctic power by 2020. Russian Militarization of the Arctic.The military is an important dimension of Moscow’s Arctic push. The policy calls for creating “general purpose military formations drawn from the Armed Forces of the Russian Federation” as well as “other troops and military formations [most importantly, border units] in the Arctic zone of the Russian Federation, capable of ensuring security under various military and political circumstances.”[28] These formations will be drawn from the armed forces and from the “power ministries” (e.g., the Federal Security Service, Border Guard Service, and Internal Ministry). Above all, the policy calls for a coast guard to patrol Russia’s Arctic waters and estuaries.Russia views the High North as a major staging area for a potential nuclear confrontationwith the United States and has steadily expanded its military presence in the Arctic since 2007. This has included resuming air patrols over the Arctic, including strategic bomber flights.[29] During 2007 alone, Russian bombers penetrated Alaska’s 12-mile air defense zone 18 times.[30] The Russian Navy is expanding its presence in the Arctic for the first time since the end of the Cold War, increasing the operational radius of the Northern Fleet’s submarines.Russia is also reorienting its military strategyto meet threats to the country’s interests in the Arctic, particularly with regard to its continental shelf.[31] Russia is also modernizing its Northern Fleet. During 2008 and 2009, Russian icebreakers regularly patrolled in the Arctic. Russia has the world’s largest polar-capable icebreaker flotilla, with 24 icebreakers. Seven are nuclear, including the 50 Years of Victory, the largest icebreaker in the world.[32] Russia plans to build new nuclear-powered icebreakers starting in 2015.[33] Moscow clearly views a strong icebreaker fleet as a key to the region’s economic development. Russia ’s Commercial Presence. Russia’s energy rush to the Arctic continues apace. On May 12, 2009, President Dmitry Medvedev approved Russia’s security strategy.[34] This document views Russia’s natural resources in the Arctic as a base for both economic development and geopolitical influence. Paragraph 11 identifies potential battlegrounds where conflicts over energy may occur: “The attention of international politics in the long-term will be concentrated on controlling the sources of energy resources in the Middle East, on the shelf of the Barents Sea and other parts of the Arctic, in the Caspian Basin and in Central Asia.” The document seriously considers the use of military force to resolve competition for energy near Russia’s borders or those of its allies: “In case of a competitive struggle for resources it is not impossible to discount that it might be resolved by a decision to use military might.The existing balance of forces on the borders of the Russian Federation and its allies can be changed.”[35] In August 2008, Medvedev signed a law that allows “the government to allocate strategic oil and gas deposits on the continental shelf without auctions.” The law restricts participation to companies with five years’ experience in a region’s continental shelf and in which the government controls at least a 50 percent stake. This effectively allows only state-controlled Gazprom and Rosneft to participate.[36] However, when the global financial crisis ensued, Russia backtracked and began to seek foreign investors for Arctic gas development.

#### Not existential AND their models fail.

Piper 19---Kelsey Piper, citing John Halstead climate change mitigation researcher at the Founders Pledge. [Is climate change an "existential threat" — or just a catastrophic one? 6-28-2019, https://www.vox.com/future-perfect/2019/6/13/18660548/climate-change-human-civilization-existential-risk]

I also talked to some researchers who study existential risks, like John Halstead, who studies climate change mitigation at the philanthropic advising group Founders Pledge, and who has a detailed online analysis of all the (strikingly few) climate change papers that address existential risk (his analysis has not been peer-reviewed yet).

Halstead looks into the models of potential temperature increases that Breakthrough’s report highlights. The models show a surprisingly large chance of extreme degrees of warming. Halstead points out that in many papers, this is the result of the simplistic form of statistical modeling used. Other papers have made a convincing case that this form of statistical modeling is an irresponsible way to reason about climate change, and that the dire projections rest on a statistical method that is widely understood to be a bad approach for that question.

Further, “the carbon effects don’t seem to pose an existential risk,” he told me. “People use 10 degrees as an illustrative example” — of a nightmare scenario where climate change goes much, much worse than expected in every respect — “and looking at it, even 10 degrees would not really cause the collapse of industrial civilization,” though the effects would still be pretty horrifying. (On the question of whether an increase of 10 degrees would be survivable, there is much debate.)

Does it matter if climate change is an existential risk or just a really bad one?

That last distinction Halstead draws — of climate change as being awful but not quite an existential threat — is a controversial one.

That’s where a difference in worldviews looms large: Existential risk researchers are extremely concerned with the difference between the annihilation of humanity and mass casualties that humanity can survive. To everyone else, those two outcomes seem pretty similar.

To academics in philosophy and public policy who study the future of humankind, an existential risk is a very specific thing: a disaster that destroys all future human potential and ensures that no generations of humans will ever leave Earth and explore our universe. The death of 7 billion people is, of course, an unimaginable tragedy. But researchers who study existential risks argue that the annihilation of humanity is actually much, much worse than that. Not only do we lose existing people, but we lose all the people who could otherwise have had the chance to exist.

In this worldview, 7 billion humans dying is not just seven times as bad as 1 billion humans dying — it’s much worse. This style of thinking seems plausible enough when you think about past tragedies; the Black Death, which killed at least a tenth of all humans alive at the time, was not one-tenth as bad as a hypothetical plague that wiped us all out.

Most people don’t think about existential risks much. Many analyses of climate change — including the report Vice based its article on — treat the deaths of a billion people and the extinction of humanity as pretty similar outcomes, interchangeably using descriptions of catastrophes that would kill hundreds of millions and catastrophes that’d kill us all. And the existential risk conversation can come across as tone-deaf and off-puttingly academic, as if it’s no big deal if merely hundreds of millions of people will die due to climate change.

Obviously, and this needs to be stressed, climate change is a big deal either way. But there are differences between catastrophe and extinction. If the models tell us that all humans are going to die, then extreme solutions — which might save us, or might have unprecedented, catastrophic negative consequences — might be worth trying. Think of plans to release aerosols into the atmosphere to reflect sunlight and cool the planet back down in the manner that volcanic explosions do. It’d be an enormous endeavor with significant potential downsides (we don’t even yet know all the risks it might pose), but if the alternative is extinction then those risks would be worth taking.

But if the models tell us that climate change is devastating but survivable, as most models show, then those last-ditch solutions should perhaps stay in the toolkit for now.

Then there’s the morale argument. Defenders of overstating the risks of climate change point out that, well, understating them isn’t working. The IPCC may have chosen to maintain optimism about containing warming to 2 degrees Celsius in the hopes that it’d spur people to action, but if so, it hasn’t really worked. Maybe alarmism will achieve what optimism couldn’t.

That’s how Spratt sees it. “Alarmism?” he said to me. “Should we be alarmed about where we’re going? Of course we should be.”

Swedish teenager Greta Thunberg has taken an arguably alarmist bent in her advocacy for climate solutions in the EU, saying, “Our house is on fire. I don’t want your hope. ... I want you to panic.” She’s gotten strong reactions from politicians, suggesting that at least sometimes a relentless focus on the severity of the emergency can get results.

So where does this all leave us? It’s worthwhile to look into the worst-case scenarios, and even to highlight and emphasize them. But it’s important to accurately represent current climate consensus along the way. It’s hard to see how we solve a problem we have widespread misapprehensions about in either direction, and when a warning is overstated or inaccurate, it may sow more confusion than inspiration.

Climate change won’t kill us all. That matters. Yet it’s one of the biggest challenges ahead of us, and the results of our failure to act will be devastating. That message — the most accurate message we’ve got — will have to stand on its own.

#### Diatom population is decreasing from microplastics – kills diatoms, harms reproduction, and harms photosynthesis

ISTU SEPTANIA 20 [Writer @Earth.Org, Earth.Org - Past | Present | Future. “Saving the Ocean’s Invisible Forests,” February 17, 2020. https://earth.org/phytoplankton-saving-the-oceans-invisible-forests/.]

Such processes are made possible by microscopic single-celled aquatic creatures called phytoplankton. These tiny organisms, dubbed the ‘ocean’s invisible forests’, generate about half of the atmosphere’s oxygen and sequester as much carbon dioxide per year as all land plants. Similar to land plants, phytoplankton soak up sunlight and capture carbon dioxide for photosynthesis, producing oxygen. Just as trees store carbon in their trunks, leaves, stems and roots, phytoplankton store carbon in their bodies. When they die and sink to the seafloor, the trapped carbon in their bodies also sinks deep into the ocean’s waters. You might also like: Microplastics Found in Antarctic Ice for First Time Phytoplankton are at the base of the marine food web, meaning that they provide marine creatures- from the tiny animal-like zooplankton to whales- with food. When phytoplankton and zooplankton are eaten by other larger sea creatures, the carbon in their bodies is transferred to these animals. This carbon will then settle into marine sediments on the ocean floor in fecal pellets and animal carcasses. The process of carbon removal from the atmosphere and its absorption into seafloor sediments is called the biological pump. Through this process, the ocean regulates the Earth’s climate. However, the plastic waste crisis will have a detrimental impact on the climate. Every year, 8 million tons of plastic enter the world’s oceans, which are categorised into micro- and nanoplastics. Scientists continue to examine the effects of plastic debris on the biological pump process. Further, about four-fifths of all trash in the ocean comes from land-based activity, like poor waste management, litter and construction. A recent study published in the journal, Marine Pollution Bulletin found that plastic pollution in the ocean may negatively affect the ocean’s role in removing atmospheric carbon dioxide, which will eventually disturb the global carbon cycle. Microplastics in the ocean can negatively impact the growth of phytoplankton. Moreover, the abundance of microplastics– like those of the plastic garbage patches comprising thousands of tons of floating microplastics– forms a layer on the surface of the ocean, affecting light transmission and disturbing the efficiency of phytoplankton photosynthesis. Marine microplastics also affect the development and reproduction of phytoplankton and thus interfere with the process of oceanic carbon storage.

#### TURN: Increased CO2 and ocean temperatures increase diatom growth and make diatoms resistant to UV radiation

Li et al. 12 [Y. Li—State Key Laboratory of Marine Environmental Science, Xiamen University, Xiamen, 361005, China]. “Ocean Acidification Mediates Photosynthetic Response to UV Radiation and Temperature Increase in the Diatom &lt;I&gt;Phaeodactylum Tricornutum&lt;/I&gt;” Biogeosciences 9, no. 10 (October 12, 2012): 3931–42. https://doi.org/10.5194/bg-9-3931-2012. ~Anop

Global climate change brings about a combination of several factors that act together in such a way that they modify the dynamics of the ocean systems and hence, of the communities living there. In our study, we addressed the combined effects of three variables associated to climate change – ocean acidification (as addressed by a rise in CO2 and H+ concentrations), UV and temperature – on the cosmopolitan diatom Phaeodactylum tricornutum. Overall, we determined that the “greenhouse” treatment resulted in a generally better photosynthetic performance of this species and less sensitivity to UV. In the present study we used the same strain of P. tricornutum as in previous studies carried out by Wu et al. (2010). Increased growth rate and unaffected cellular chl a content under the elevated CO2 level were consistent between the present and those previous reports. Under the PAR alone treatment and increased temperature (Fig. 2b), the cells showed lower effective photosynthetic quantum yield under the elevated CO2 levels, which also agrees with the previous findings by Wu et al. (2010), with HC-grown cells having higher inhibition of electron transport rate. However, when shifted to the lowest (15 ◦C) or highest (25 ◦C) temperature levels, this trend disappeared (Fig. 2a and c). However, Wu et al. (2010) reported that the NPQ for the HC-grown cells was lower than the LC ones when the cells grown at PAR intensities of 120 µmol m−2 s −1 were exposed to an actinic light of 840 µmol m−2 s −1 within a time frame < 5 min. In this work, HC-grown cells showed higher NPQ than the LC-grown ones, with exposures of about 300 µmol m−2 s −1 (PAR) for over 50 min and performing the determinations with the actinic light of 300 µmol m−2 s −1 . The exposure time span might have accounted for part of this discrepancy in NPQ between this work and the previous study (Wu et al., 2010). In addition, since carbon concentration mechanisms (CCMs) of this diatom become down-regulated under elevated CO2 (Burkhardt et al., 2001; Wu et al., 2010; Hopkinson et al., 2011), and levels of light can modulate the efficiency of CCMs (Bartual and Galvez, 2003; Raven, 2011; Reinfelder, 2011), the cells grown at 70 (present work) and 120 µmol m−2 s −1 (Wu et al., 2010) levels would have different levels of CCM operation efficiency or different levels of energetics; so that may be why the discrepancy might have occurred. In addition, NPQ under solar radiation (long exposures of about 12 h) was remarkably stimulated under elevated CO2 levels of 1000 µatm (Gao et al., 2012). When exposed to UV, the HC-grown cells had a better photochemical performance (i.e., smaller decrease of 8PS II) than those grown in LC conditions, with the ratio of 8PS II in HC- to that in the LC-grown cells > 1 (Fig. 2), indicating that UV and high CO2 synergistically raised the yield. When the UV-induced inhibition of photosynthetic carbon fixation was examined (Fig. 7), obviously, the high CO2 level acted to reduce the UV-B-induced inhibition of photosynthesis, though the absolute photosynthetic carbon fixation rates were higher under the PAR-alone treatments compared to those with UV (Fig. 6). It has been previously found that effects of climate change variables (temperature and UV) were different according to the photosynthetic targets examined (Helbling et al., 2011), which could explain at least part of the differences observed between LC and HC preacclimated cells. Moreover, Wu et al. (2010) found for P. tricornutum that respiration was enhanced in the HC-grown cells and that its carbon concentration mechanisms (CCMs) were down-regulated. Photorespiration was also higher in the HC-grown cells of this species (Gao et al., 2012). On the other hand, high contribution of net CO2 uptake (about two-thirds) to total inorganic carbon acquisition was reported in P. tricornutum (Burkhardt et al., 2001; Hopkinson et al., 2011). Together with the down-regulation of CCM (meaning a lowered active uptake of inorganic carbon), enhancement of mitochondrial- and photo-respiration could have led to decreased photosynthetic carbon fixation due to the additional carbon losses. The stimulated quantum yield in the HC-grown cells appeared to be attributed to the extra carbon loss, i.e., extra electron drainage due to enhanced photorespiration, which provided a protective role. The UV-induced inhibition of the effective photochemical quantum yield was inversely correlated with temperature. The ratios of repair to damage (r/k) decreased with increasing NPQ (Fig. 4). Similarly, in the diatoms Thalassiosira pseudonana and Coscinodiscus radiates, when repair and photoinactivation are balanced, NPQ induction is small. NPQ induction increased under treatment conditions where photoinactivation exceeded repair (Wu et al., 2012). At the low temperature, the LC-grown cells showed higher UV-induced inhibition of photochemical efficiency (Fig. 1), and the recovery was slower (Fig. 5) compared with the HCgrown ones. The “greenhouse” treatment resulted in a significant (P < 0.05) decrease of UV-induced inhibition from 50–60 % to 27–36 %, of which UV-B accounted for about 8 % and 14 %, respectively. This trend appears to be similar to the changes observed in photosynthetic carbon fixation, as increase in its rates with increasing temperature was higher in the HC- than in the LC-grown cells (Fig. 6a, c and e), reflecting a synergistic effect of pCO2 rise and warming. This might be associated with enhanced activity of cellular enzymes and membrane fluidity, as they are temperature-dependent (Allakhverdiev et al., 2008), and accelerated molecular repair rates that usually increase with temperature within a species’ thermal window (Conkling and Drake, 1984; Gao et al., 2008). In the presence of UV-B, NPQ in the LC-grown cells was lower than HC-grown ones, especially under the lower temperature treatment (Fig. 4b). Down-regulation of CCM might have aided to enhance NPQ in the HC-grown cells due to the saved energy demand for CO2 active uptake, which could lead to an additional light stress (Gao et al., 2012). Activity and gene expression of Rubisco in the diatom Thalassiossira weissflogii increased with increased temperature, and this might have partially counteracted the UV-induced inhibition of photosynthetic carbon fixation (Helbling et al., 2011). On the other hand, high levels of UV can lead to degradation of periplasmic carbonic anhydrase (CAe) (Wu and Gao, 2009), as well as Rubisco and D1 protein (Bischof et al., 2002; Bouchard et al., 2005), and increased temperature could have stimulated the repair of the damaged molecules. The beneficial effects of increased temperature on photosynthesis under UV stress have been previously documented (Sobrino and Neale, 2007; Gao et al., 2008; Halac et al., 2010; Helbling et al., 2011), showing lower UV-induced inhibition or damages at higher temperatures. Differential sensitivities to UV have been reported in marine picoplankters when grown under elevated CO2 concentrations, with Nannochloropsis gaditana having lower sensitivity while Nannochloris atomus showed neutral response (Sobrino et al., 2005). For the diatom Thalassiosira pseudonana, when grown at elevated CO2 concentration, it became more sensitive to UV (Sobrino et al., 2008). In the present study, when the photosynthetic carbon fixation and 8PS II were compared, the UV-induced inhibition was lower on the former than on the latter, and higher CO2 weakened this inhibition. Regardless of the pre-acclimation CO2 levels, less inhibition caused by UV on carbon fixation might be due to stimulation of the activity of CAe (Wu and Gao, 2009), which catalyzes the inter-conversion of bicarbonate and CO2, therefore stimulating the uptake of CO2 during the exposures. Additionally, the increase of r/k with temperature was higher in the HC- than in the LC-grown cells, which reflects enhanced repair in these cells, as UV-induced molecular damage was independent of temperature (Ishigaki et al., 1999). In terms of ecological implications, future “greenhouse” ocean with decreased thickness of the upper mixing layer (enhanced stratification) may expose phytoplankton cells to higher exposures of solar UV as well as PAR. For diatoms like P. tricornutum, increased CO2 and seawater acidity might counteract somehow the harm caused by UV-B. Since UV-A results in negative effects on phytoplankton carbon fixation under high solar radiation but positive ones under reduced levels of solar radiation, playing a double-edged effect on phytoplankton (Gao et al., 2007b), its stimulating effects would be enlarged under ocean acidification conditions (Chen and Gao, 2011). Thus, the net effects of UV, temperature and CO2 will largely depend on the levels of solar radiation to which the phytoplankton cells are exposed. Consequently, mixing rates or mixing depth will explicitly affect the combined effects of the above climate change variables, as mixing exposes cells to fluctuating irradiances which can affect the balance between photodamage and repair of PS II. Increased NPQ, as found in this study, closely related to the decreases (UV-related) of the ratio between repair and damage rate (r/k) of PS II in P. tricornutum. The increased seawater acidity must have stimulated photoprotective processes, thus, leading to higher NPQ, which was especially pronounced in the presence of UV-B (Fig. 4). Increasing temperature, in some cold or temperate waters, may help the species like P. tricornutum to counteract negative effects of UVR or ocean acidification-induced harm. On the other hand, variable responses to combined effects of climate change variables are expected in view of their diversities in physiological pathways and ecological niches.

#### Diatoms are crucial to oxygen production and are at the base of the ocean ecosystem

Roach 04, John [John Roach is a Seattle-based journalist. He has contributed to National Geographic News since 1998 and spent the past five years covering technology, science, and the environment in blogs, news stories, and features for NBC News Digital. He formerly was on the staff of the Environmental News Network.]“Source of Half Earth’s Oxygen Gets Little Credit.” National Geographic News, June 7, 2004. https://www.nationalgeographic.com/news/2004/6/source-of-half-earth-s-oxygen-gets-little-credit/.~Anop

FISH, WHALES, DOLPHINS, crabs, seabirds, and just about everything else that makes a living in or off of the oceans owe their existence to phytoplankton, one-celled plants that live at the ocean surface. Phytoplankton are at the base of what scientists refer to as oceanic biological productivity, the ability of a water body to support life such as plants, fish, and wildlife. "A measure of productivity is the net amount of carbon dioxide taken up by phytoplankton," said Jorge Sarmiento, a professor of atmospheric and ocean sciences at Princeton University in New Jersey. The one-celled plants use energy from the sun to convert carbon dioxide and nutrients into complex organic compounds, which form new plant material. This process, known as photosynthesis, is how phytoplankton grow. Herbivorous marine creatures eat the phytoplankton. Carnivores, in turn, eat the herbivores, and so on up the food chain to the top predators like killer whales and sharks. But how does the ocean supply the nutrients that phytoplankton need to survive and to support everything else that makes a living in or off the ocean? Details surrounding that answer are precisely what Sarmiento hopes to learn. Robert Frouin, a research meteorologist with the Scripps Institution of Oceanography in La Jolla, California, said understanding the process by which phytoplankton obtains ocean nutrients is important to understanding the link between the ocean and global climate. "Marine biogeochemical processes both respond to and influence climate," Frouin said. "A change in phytoplankton abundance and species may result from changes in the physical processes controlling the supply of nutrients and sunlight availability." Oxygen Supply Phytoplankton need two things for photosynthesis and thus their survival: energy from the sun and nutrients from the water. Phytoplankton absorb both across their cell walls. In the process of photosynthesis, phytoplankton release oxygen into the water. Half of the world's oxygen is produced via phytoplankton photosynthesis. The other half is produced via photosynthesis on land by trees, shrubs, grasses, and other plants. As green plants die and fall to the ground or sink to the ocean floor, a small fraction of their organic carbon is buried. It remains there for millions of years after taking the form of substances like oil, coal, and shale. "The oxygen released to the atmosphere when this buried carbon was photosynthesized hundreds of millions of years ago is why we have so much oxygen in the atmosphere today," Sarmiento said. Today phytoplankton and terrestrial green plants maintain a steady balance in the amount of the Earth's atmospheric oxygen, which comprises about 20 percent of the mix of gasses, according to Frouin. A mature forest, for example, takes in carbon dioxide from the atmosphere during photosynthesis and converts it to oxygen to support new growth. But that same forest gives off comparable levels of carbon dioxide when old trees die. "On average, then, this mature forest has no net flux of carbon dioxide or oxygen to or from the atmosphere, unless we cut it all down for logging," Sarmiento said. "The ocean works the same way. Most of the photosynthesis is counterbalanced by an equal and opposite amount of respiration." Carbon Sink The forests and oceans are not taking in more carbon dioxide or letting off more oxygen. But human activities such as burning oil and coal to drive our cars and heat our homes are increasing the amount of carbon dioxide released into the atmosphere. Most of the world's scientists agree that these increasing concentrations of carbon dioxide in the atmosphere are causing the Earth to warm. Many researchers believe that this phenomenon could lead to potentially catastrophic consequences. Some researchers argue that enriching the oceans with iron would stimulate phytoplankton growth, which in turn would capture excess carbon from the Earth's atmosphere. But many ocean and atmospheric scientists debate whether this would indeed provide a quick fix to the problem of global warming. Research by Frouin and his Scripps Institution of Oceanography colleague Sam Iacobellis suggests an increase in phytoplankton may actually cause the Earth to grow warmer, due to increased solar absorption. "Our simulations show that by increasing the phytoplankton abundance in the upper oceanic layer, sea surface temperature is increased, as well as air temperature," Frouin said. As Sarmiento notes, phytoplankton obtains most of its carbon dioxide from the oceans, not the atmosphere. "Pretty much all of the carbon dioxide taken up by phytoplankton comes from deep down in the ocean, just like nutrients, where bacteria and other organisms have produced it by respiring the organic matter that sank from the surface," Sarmiento said.

#### Preserving biodiversity is key to survival

Paul Warner, American University, Dept of International Politics and Foreign Policy, August, Politics and Life Sciences, 94, p 177

Massive extinction of species is dangerous, then, because one cannot predict which species are expendable to the system as a whole. As Philip Hoose remarks, "Plants and animals cannot tell us what they mean to each other." One can never be sure which species holds up fundamental biological relationships in the planetary ecosystem. And, because removing species is an irreversible act, it may be too late to save the system after the extinction of key plants or animals. According to the U.S. National Research Council, "The ramifications of an ecological change of this magnitude [vast extinction of species] are so far reaching that no one on earth will escape them." Trifling with the "lives" of species is like playing Russian roulette, with our collective future as the stakes.

#### No resource wars impact---data proves

Agha Bayramov 18, PhD candidate and lecturer at the department of International Relations and International Organization of the University of Groningen, “Review: Dubious nexus between natural resources and conflict.” Journal of Eurasian Studies 9(1): 72-81.

The arguments of scarcity adherents have been challenged by a number of scholars in terms of qualitative and quantitative findings. According to Stern (2016) the assumptions underpinning the scarcity notion are illogical due to the exaggeration of threats arising from oil ownership from misperceptions of market information. Furthermore, Koubi et al. (2013) explain that despite their strong empirical explanations, scarcity scholars have weak quantitative research results ones that fail to prove the link between resource scarcity and intrastate or interstate conflict. The reason for this is that some large-N findings contradict early results, which illustrate that the scarcity-conflict nexus is more complicated than scarcity scholars would have us believe. Dinar (2011), meanwhile, argues that natural resource scarcity may in fact be an important force for cooperation between states. However, scholars of natural resource scarcity have hitherto ignored the ways in which scarcity can spur cooperation (Deudney, 1999).

Considering these findings, three conclusions can be drawn from this section. First, scarcity is a complex term and it should not be equated with only natural resources. As it is explained by Kester (2016) some countries may suffer from scarcity of technical, knowledge and human capacity rather than natural resources. In light of this, without a proper capacity it is also possible to have scarcity within abundancy of resources. While supporting the scarcity argument, Andrews-Speed (2015) offer an alternative explanation that natural resources are not physically scarce but there are indeed economic, political, environmental and equity barriers that can lead to a scarcity of natural resources. Due to the strong rule of law, decent neighbourly relations and existence of strong norms for compromise and of multilateral institutions, the North Atlantic countries are highly unlikely to utilize force against or declare war to each other. However, these dimensions and buffers are currently lacking in the Middle East, Africa and Asia. As such, the U.S and Europe should work closely with these regions to prevent any resource disputes erupting (Andrews-Speed 15). Similarly, Gleditsch (1998) explains that some highly developed countries have population density, clean water, and land degradation problems but they still do not suffer from environmental violence. Thus the main issue might be that poor economic development, rather than environmental scarcity, leads to conflict. Kester (2016) names this situation as “second-order-scarcity” which refers to a lack of technology, economic capacity, and knowledge to stop resource scarcity. In this regard, it may be scarcity, itself, rather than natural resources that leads to conflict.

Second, conflict can be defined differently based on different dimensions. However, the common consensus is that conflict consists of multiple dimensions (political, economic, environmental, historical, cultural, and geographical etc.) rather than single factor. In this regard, scarcity of natural resources is not strong enough, by itself, to induce either interstate or intrastate conflict. It needs in fact to interact with other variables. Finally, related to the previous reasons, scarcity of natural resources might be a contributing or marginal reason for rather than the root cause of a given conflict. In other words, it needs to interact with non-resource factors in order to cause violence.

political tensions between the two nations (Wolf, 1998).

### Neutrinos

AT: Wellerstein – 1) it’s about a test that happened in the past that didn’t cause their impact 2) also says that it’s basically sci-fi 3) doesn’t say “extinction” – just says catastrophic those aren’t the same

#### Prolif deters and is key to cooperation with adversaries

Koch Foundation 17 (Charles Koch foundation, December 4, 2017, an American conservative and libertarian public policy think tank based in Chicago.) https://bigthink.com/charles-koch-foundation/a-safer-world-is-one-where-americas-enemies-hold-onto-their-nuclear-weapons

The United States tries hard to keep nuclear weapons away from countries it considers foes. Given how close the world came to nuclear armageddon during the Cold War, and recent threats from so-called “rogue states" like North Korea, it may seem like an essential goal. But America's strategy for thwarting nuclear proliferation may be reaching a point where the costs outweigh the benefits.

The first nuclear bomb was exploded the same year as the invention of the microwave. Nuclear technology is no longer new, and therefore more difficult to keep from spreading. (Imagine trying to keep microwave technology under wraps all these years.) Developing a nuclear bomb from scratch, however, is much more costly than reverse engineering a microwave.

But snuffing out a country's nuclear capabilities is perhaps even more costly. It requires [destroying]~~crippling~~ a country's economy so its government can't invest in nuclear research (of course, its innocent citizens bear the brunt of that burden). It requires destroying factories and laboratories with aggressive bombing or cyber-sabotage campaigns. And it can even require kidnapping or killing scientists and engineers who conduct nuclear research.

Iran, for example, is seeking nuclear technology while coldly aware of the United States' military superiority. Likewise, the rest of the world is aware of America's massive nuclear arsenal—and of the fact that it's capable of annihilating any country on Earth at a moment's notice

This kind of behavior toward other countries, needless to say, won't engender kindness and cooperation. North Korea knows that developing a small nuclear arsenal has made the U.S. much more hesitant to invade its borders. It's a lesson Pyongyang learned recently from countries without nuclear weapons—Iraq, Libya, Syria—that were subsequently invaded by the U.S. So it makes perfect sense that America's enemies would be scrambling to develop nuclear weapons—not so they can fire them, but so they can also enjoy the benefits of deterrence.

So the question becomes: How often is the U.S. willing to wage preventive wars, and with how many countries does it really want this kind of relationship?

#### No impact to prolif

--aggression is rare, only in states with severe territorial threats

--most likely is expansion of existing disputes, but that has modest empirical effect

--accidents are disproven by seven decades of previous proliferation

--examples of accidents are all correlated with compellance, not prolif

--terrorism hasn’t happened, despite predictions

--no state would share weapons with non-state actors given obvious attribution

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Subsequent research has detailed the conditions under which new nuclear powers adopt these courses of action. Bell (2016) has argued that only those **few** new nuclear states who face **severe territorial threats**, such as Pakistan, opt for **aggress**ion, using their nuclear weapons as shields to deter nuclear and extensive conventional retaliation. Similarly drawing on Pakistan’s increased conflict propensity following its nuclear acquisition, Kapur’s (2007) research suggests that it is the **rare** combination of revisionist ambitions and conventional inferiority that leads new nuclear powers to pursue aggressive military policies toward their rivals. Importantly, while they offer different explanations, the two **studies concur** that aggression is a **fairly unlikely** effect of nuclear acquisition.

Meanwhile, according to Bell (2016), new nuclear states undertake an expansion of their foreign policy interests if their territory is not threatened and their relative material power is rising. Historically, such **expansions** have been **more** common than **aggression**: upon acquiring nuclear weapons, the US, South Africa, Israel and the Soviet Union all initiated several militarised disputes targeting states with whom they had no previous conflict (Bell and Miller, 2015: online appendix). Despite the mostly **low intensity** of these disputes, such **expansive** conflict behaviour can hardly be considered stabilising. Overall, then, new nuclear states seem to have a **moderately** destabilising influence on world politics: they initiate new disputes and take greater risks. At the same time, however, acquiring nuclear weapons **rarely** facilitates **severe** aggression.

Reconsidering nuclear accidents and nuclear terrorism

The notion that the spread of nuclear weapons would someday lead to tragic nuclear **accidents** or even nuclear **terrorism** has long been among proliferation pessimists’ foremost concerns. However, as reliable datasets on all (attempted) nuclear terrorism plots and on nuclear safety incidents in all nuclear states and proliferators have proved elusive, **empirical** scholarship has **not kept pace** with **theoretical** work. Hence, research has been limited to deductive analyses, buttressed by empirical illustrations. Even so, the **more sophisticated** of those **studies** have called the **pessimists**’ claims into question.

For instance, Cohen (2016, pp. 432–434) revealed that the vast majority of the gravest nuclear accidents that Sagan (1993, p. 9) points to as support for his logic occurred during global crises in 19**62** or 19**73**, when leaders sought to leverage their nuclear arsenals for **coercive bargaining**. It was, in other words, **not** organisational pathologies that raised the specter of accidental nuclear war, as Sagan holds, but rather the deliberate attempts at nuclear compellence. These accidents, then, represent the actual ‘effects’ of nuclear compellence: while the compellent threats did not affect the trajectory of either crises (Sechser and Fuhrmann, 2017, pp. 207, 220–224), they led to precarious nuclear safety incidents.

Other critics have rightly pointed out that, **seven decades** **in**to the nuclear age, the fact – however fortunate it is – that the world has **still no**t experienced a catastrophic fatal nuclear accident should **give proliferation pessimists pause** (Sechser, 2013, pp. 184–186). Obviously, the **bounded rationality** of such organisations alone does **not** make tragic nuclear accidents **nearly as likely** as the pessimists contend. Their fear, hence, seems to be **overstated**.

The **same** must probably be said about nuclear **terror**ism. Determinate predictions that a terrorist attack involving nuclear weapons was bound to occur **soon** (Allison, 2004, p. 15; Graham, 2008, p. VI) have **come and gone** without **anything** happening. Sceptical experts have argued that this outcome is **not surprising** at all, given the **formidable practical obstacles** such a terrorist scheme would encounter (Levi, 2009). Moreover, to the extent that fissile materials from nuclear weapons can now be **traced** back to specific state arsenals, the idea that a nuclear power could **willingly share** its arsenal with terrorists and hope to remain anonymous has been **challenged** as **lacking plausibility** (Lieber and Press, 2013).

#### Their evidence is biased punditry---the empirical record disproves escalation

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Both the classic proliferation optimism-pessimism debate and the recent empirical scholarship have studied the spread of nuclear weapons largely through a systemic lens: they have focused on how further nuclear proliferation affects international stability. For the **world as a whole**, as we have seen, the effects of **prolif**eration must be described as **(only) moderately** destabilising.

Crucially, however, these moderate overall effects are distributed unequally across states in the international system. As Kroenig’s work (2009, 2010, 2014b) stresses, states that are capable of projecting conventional military power over long distances are most affected by the consequences of further proliferation, regardless of whether their rivals or allies build the bombs. If rivals get nuclear weapons, then such power-projecting states lose their ability to coerce and invade these rivals. If junior allies acquire an arsenal, power-projecting states lose sway over the ally’s policies because they can no longer manipulate its military dependence. In contrast, states with little or no power-projection capability are affected by proliferation only if it occurs in their own region, but have little to lose from proliferation in other parts of the world because they did not have the capability to intervene in far-away countries in the first place and do not extend security guarantees to nations in other regions.

Given these differential effects, it is no surprise that regional military powers like France, West Germany and China have often refused to sacrifice economic benefits to prevent proliferation (Kroenig, 2014b; Müller, 1990), whereas nonproliferation has been at the forefront of US grand strategy throughout the nuclear age (Gavin, 2015). Equipped with the strongest conventional forces and the ambition to make its influence felt in every corner of the globe, the US has had the most to lose from the spread of nuclear arsenals: rivals with nuclear weapons might be better able to resist pressure from Washington, bolster other US adversaries or engage in aggression against the US or its allies and partners, while nuclear-armed allies may act more independently of, or even thwart, American interests (Bell, 2016).

Facing such daunting scenarios, the US has consistently opposed proliferation by foes and friends alike. To prevent others from building nuclear weapons, Washington has wielded all tools of US statecraft, ranging from security guarantees (Gavin, 2015), vigorous bilateral diplomacy (Schneider, 2016; Miller, 2014a) and mandatory US sanctions (Miller, 2014b) to collective technology denial (Burr, 2014) and even sustained collusion with its chief adversary, the Soviet Union (Coe and Vaynman, 2015). Remarkably, when these preventive efforts failed, the US more than once cut secret deals committing the new nuclear power to forgo nuclear testing so as to avoid, at least, triggering further proliferation (Miller and Rabinowitz, 2015).

Today, virtually every policymaker, official and **pundit** in the US intuitively opposes the spread of nuclear weapons as extremely dangerous, no matter where it occurs (Carus, 2016; Gavin, 2012b). The same can be said about many officials and experts from states that are US allies or close partners (Gibbons, 2015; Schwartz, 2014). Yet as we have seen, such **alarmist appraisals** are **not borne out** by the **empirical record** about how nuclear weapons have influenced international stability, but appear to be a **consequence** of the **differential effects** of proliferation. Thus, these **excessively concerned** voices do **not** abstract themselves from the **specific policy interests** of their states (Betts, 2001, pp. 64–65): They see an international order underwritten by US military primacy and American political leadership as preferable to any alternative.

Every official who shares that outlook must view proliferation as a major threat because it sharply limits Washington’s global influence and undermines the US-led international security order. Scholars, however, should be transparent about the fact that this appraisal is **coloured by specific policy preferences**. In contrast, an **equidistant** assessment of the available scholarship on nuclear proliferation can only conclude that, for the world as a whole, the spread of nuclear weapons appears to be destabilising, but **only moderately so**.

#### Reducing nuclear proliferation causes a de-facto shift to CBWs

Particularly true of stronger NPT norms

Narang 16 (Neil Narang, Assistant Professor in the Department of Political Science at the University of California, Santa Barbara, Senior Advisor in the Office of the Secretary of Defense for Policy on a Council on Foreign Relations International Affairs Fellowship, 4/6/2016 “All Together Now? Questioning WMDs as a Useful Analytical Unit for Understanding Chemical and Biological Weapons Proliferation,” The Nonproliferation Review. Volume 22. Issue 3-4. pp. 457-468. Taylor and Francis.)

The first inference that one may be tempted to draw from past findings is that a policy focused on achieving reductions in the global nuclear stockpile could cause a rise in chemical and biological weapons proliferation as more states view them as a “poor man's atomic bomb.” As noted above, our findings suggested that states appear to seek chemical and biological weapons for many of the same reasons as they pursue nuclear weapons. Furthermore, our findings also indicate that states that do not possess nuclear weapons appear to be systematically more likely to pursue chemical and biological weapons than states that do possess them. When combined, it may seem reasonable to suppose that, conditional on some level of demand for one of these types of weapons, reductions in the global supply of nuclear weapons could cause some states to pursue chemical and biological weapons as “imperfect substitutes” for the deterrence and compellence benefits of nuclear weapons.

A second inference that one may be tempted to draw is that a strengthened NPT may increase the risk of chemical and biological weapons proliferation. Understood in the terms of our study, policies and institutions designed to monitor and sanction the unilateral pursuit or dissemination of nuclear weapons material and technical expertise—like the NPT or the Nuclear Suppliers Group—might be understood as supply constraints that effectively increase the transaction costs of nuclear weapons acquisition. Furthermore, previous research has shown that the supply of sensitive nuclear assistance and civilian nuclear assistance are both positively associated with the risk of nuclear weapons pursuit and acquisition across states and over time.17

When combined, it may seem reasonable to suppose that, given some demand for a “weapon of mass destruction,” chemical and biological weapons could seem like relatively cheaper pursuits under a more robust global nuclear nonproliferation regime that further regulates the supply of nuclear weapons.

A third inference that one may be tempted to draw is that reductions in the global supply of nuclear weapons and a strengthening of the nuclear nonproliferation regime could increase the risk of chemical and biological weapons pursuit by terrorist groups. If one is willing to assume terrorist groups aim to influence governments by threatening to impose costs in order to achieve concessions— whether this be through strategies like coercion, provocation, spoiling, or outbidding—then it may seem reasonable to suppose that limiting the availability of nuclear weapons might shift the demand to other coercive instruments such as chemical and biological weapons.18

#### That causes extinction

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In the decades to come, **advanced bioweapons could threaten human existence**. **Although the probability of human extinction from bioweapons may be low**, **the** **expected value** **of** **reducing the risk** **could still be large**, **since such risks jeopardize the existence of all future generations**. We provide an overview of biotechnological extinction risk, make some rough initial estimates for how severe the risks might be, and compare the cost-effectiveness of reducing these extinction-level risks with existing biosecurity work. We find that reducing human extinction risk can be more cost-effective than reducing smaller-scale risks, even when using conservative estimates. This suggests that the risks are not low enough to ignore and that more ought to be done to prevent the worst-case scenarios. How worthwhile is it spending resources to study and mitigate the chance of human extinction from biological risks? The risks of such a catastrophe are presumably low, so a skeptic might argue that addressing such risks would be a waste of scarce resources. In this article, we investigate this position using a cost-effectiveness approach and ultimately conclude that the expected value of reducing these risks is large, especially since such risks jeopardize the existence of all future human lives. Historically, **disease events** **have been responsible for the greatest death tolls on humanity**. **The 1918 flu was responsible for more than 50 million deaths,1 while smallpox killed perhaps 10 times that many in the 20th century alone**.2 **The Black Death was responsible for killing over 25% of the European population**,3 **while other pandemics**, such as the plague of Justinian, **are thought to have killed 25 million in the 6th century**—constituting over 10% of the world's population at the time.4 It is an open question whether a future pandemic could result in outright human extinction or the irreversible collapse of civilization. **A** **skeptic** **would have many good reasons to think that existential risk from disease is unlikely**. **Such a disease would need to spread worldwide to remote populations**, **overcome rare genetic resistances**, **and evade detection, cures, and countermeasures**. Even evolution itself may work in humanity's favor: **Virulence and transmission is often a trade-off**, and so evolutionary pressures could push against maximally lethal wild-type pathogens.5,6 **While these arguments point to a** very **small risk** of human extinction, **they do not rule the possibility out entirely**. Although rare, **there are recorded instances of species going** extinct due to disease—primarily in amphibians, but also in 1 mammalian species of rat on Christmas Island.7,8 There are also historical examples of large human populations being almost entirely wiped out by disease, **especially when multiple diseases were simultaneously introduced into a population without immunity**. **The most striking examples of total population collapse include native American tribes exposed to European diseases,** such as the Massachusett (86% loss of population), Quiripi-Unquachog (95% loss of population), and the Western Abenaki (which suffered a staggering 98% loss of population).9 **In the modern context**, **no single disease currently exists that combines the worst-case levels of transmissibility, lethality, resistance to countermeasures, and global reach**. But many diseases are proof of principle that each worst-case attribute can be realized independently. For example, some diseases exhibit nearly a 100% case fatality ratio in the absence of treatment, such as rabies or septicemic plague. Other diseases have a track record of spreading to virtually every human community worldwide, such as the 1918 flu,10 and seroprevalence studies indicate that other pathogens, such as chickenpox and HSV-1, can successfully reach over 95% of a population.11,12 Under optimal virulence theory, natural evolution would be an unlikely source for pathogens with the highest possible levels of transmissibility, virulence, and global reach. **But advances in biotechnology** **might allow the creation of diseases that combine such traits**. Recent **controversy has already emerged** **over a number of scientific experiments that resulted in viruses with enhanced transmissibility, lethality, and/or the ability to overcome therapeutics**.13-17 **Other experiments demonstrated that mousepox could be modified to have a 100% case fatality rate and render a vaccine ineffective**.18 In addition to transmissibility and lethality, **studies have shown that other disease traits**, such as incubation time, environmental survival, and available vectors, **could be modified as well**.19-21 Although these experiments had scientific merit and were not conducted with malicious intent, their implications are still worrying. This is especially true given that there is also a long historical track record of state-run bioweapon research applying cutting-edge science and technology to design agents not previously seen in nature. The Soviet bioweapons program developed agents with traits such as enhanced virulence, resistance to therapies, greater environmental resilience, increased difficulty to diagnose or treat, and which caused unexpected disease presentations and outcomes.22 **Delivery capabilities** **have** also **been subject to the cutting edge of technical development**, **with Canadian, US, and UK bioweapon efforts playing a critical role in developing the discipline of aerobiology**.23,24 **While there is no evidence of** state-run bioweapons **programs directly attempting to** develop or **deploy bioweapons** that would pose an existential risk, **the logic of deterrence and mutually assured destruction could** **create such incentives** **in more unstable political environments** **or following a breakdown of the Biological Weapons Convention**.25 **The possibility of a war between great powers could also increase the pressure to use such weapons**—during the World Wars, bioweapons were used across multiple continents, with Germany targeting animals in WWI,26 and Japan using plague to cause an epidemic in China during WWII.27

#### BSL lab accidents make airborne TB and H5N1 mutations inevitable – those cause extinction – prefer studies

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Incidents causing potential exposures to pathogens occur frequently in the high security laboratories often known by their acronyms, BSL3 (Biosafety Level 3) and BSL4. Lab incidents that lead to undetected or unreported laboratory-acquired infections can lead to the release of a disease into the community outside the lab; lab workers with such infections will leave work carrying the pathogen with them. If the agent involved were a potential pandemic pathogen, such a community release could lead to a worldwide pandemic with many fatalities. Of greatest concern is a release of a lab-created, mammalian-airborne-transmissible, highly pathogenic avian influenza virus, such as the airborne-transmissible H5N1 viruses created in the laboratories of Ron Fouchier in the Netherlands and Yoshihiro Kawaoka In Madison Wisconsin. Such releases are fairly likely over time, as there are at least 14 labs (mostly in Asia) now carrying out this research. Whatever release probability the world is gambling with, it is clearly far too high a risk to human lives. Mammal-transmissible bird flu research poses a real danger of a worldwide pandemic that **could kill human beings on a vast scale. Human error is the main cause** of potential exposures of lab workers to pathogens. Statistical data from two sources show that human error was the cause of, according to my research, 67 percent and 79.3 percent of incidents leading to potential exposures in BSL3 labs. These percentages come from analysis of years of incident data from the Federal Select Agent Program (FSAP) and from the National Institutes of Health (NIH). (Details may be found in the Supplementary Material document.) Understanding human error is important to calculating the probability that a pathogen will be released from a lab into the surrounding community, the first step in calculating the likelihood of a pandemic. A key observation is that human error in the lab is **mostly independent of pathogen type and biosafety level**. Analyzing the likelihood of release from laboratories researching less virulent or transmissible pathogens therefore can serve as a reasonable surrogate for how potential pandemic pathogens are handled. (We are forced to deal with surrogate data because, thank goodness, there are little data on the release of potentially pandemic agents.) Put another way, surrogate data allows us to determine with confidence the probability of release of a potentially pandemic pathogen into the community. In a 2015 publication, Fouchier describes the careful design of his BSL3+ laboratory in Rotterdam and its standard operating procedures, which he contends should increase biosafety and reduce human error. Most of Fouchier’s discussion, however, addresses mechanical systems in the laboratory. But the **high percentage of human error reported** here calls into **question claims that state-of-the-art design** of BSL3, BSL3+ (augmented BSL3), and BSL4 labs **will prevent** the release of **dangerous pathogens.** How much lab-worker training might reduce human error and undetected or unreported laboratory acquired infections remains an open question. Given the many ways by which human error can occur**, it is doubtful** that Fouchier’s **human-error-prevention measures can eliminate release** of airborne-transmissible avian flu into the community through undetected or unreported lab infections. Human-error incident data. In its 2016 study for the NIH, “Risk and Benefit Analysis of Gain of Function Research,” Gryphon Scientific looked to the transportation, chemical, and nuclear sectors to define types of human error and their probabilities. As Gryphon summarized in its findings, the three types of human error are **skill-based** (errors involving motor skills involving little thought), **rule-based** (errors in following instructions or set procedures accidentally or purposely), and **knowledge-based** (errors stemming from a lack of knowledge or a wrong judgment call based on lack of experience). Gryphon claimed that “no comprehensive Human Reliability Analysis (HRA) study has yet been completed for a biological laboratory… . This lack of data required finding suitable proxies for accidents in other fields.” But mandatory incident reporting to FSAP and NIH actually does provide sufficient data to quantify human error in BSL3 biocontainment labs. Federal Select Agent Program incident data. FSAP incident data were collected from summary reports to Congress for the years 2009 through 2015. Three of the seven FSAP incident categories involve skill-based errors: 1) **needle sticks** and other through the skin exposures from sharp objects, 2) **dropped containers** or spills/splashes of liquids containing pathogens, and 3) bites or scratches from infected **animals**. Some skill errors, such as spills and needle sticks could be reduced with simple fixes (see below). The rule-based and knowledge-based incident categories are: 4) **pathogens manipulated outside of a biosafety cabinet** or other equipment designed to protect exposures to infectious aerosols; 5) potential exposures resulting from **non-adherence to safety** procedures or deviations from lab standard operating procedures, and 6) failure or **problem with personal protective equipment**–**a mix of skill, rule, or knowledge-based errors.** The seventh category is mechanical or equipment failure, or **defective labware**. Another category not mentioned in the FSAP reports is failure to properly inactivate pathogens before transferring them to a lower biosafety level lab for further research. During the 2009-2015 time period, FSAP received a total of 749 incident reports from select-agent research facilities. Conservatively, 594 or **79.3 percent** of those incidents involve **human error**. (Details may be found in the Supplementary Material.) National Institutes of Health incident data. Incident reports to the NIH Office of Science Policy cover the period from 2004 through 2017 and BSL3 and BSL4 facilities. They were obtained through a Freedom of Information Act request. There were no reported incidents from BSL4 facilities. Reporting to NIH is required only for incidents involving pathogens that contain recombinant DNA. While it is highly likely there have been incidents in BSL4 facilities, they may not have involved pathogens with recombinant DNA and so would not show up in the reports to NIH. The 128 incident reports provide extremely detailed descriptions. The reports are often several-dozen pages long so almost no questions remain about details. Of the 128 incidents, 86 or 67.2 percent were due to human error. This percentage is in the same ballpark as the FSAP reports. Some human errors are “one-off,” meaning they happened once and likely won’t happen again. **One-off errors are difficult to anticipate**, so it is **unlikely that one can** devise meaningful changes in standard operating procedures to **prevent them**. Here is one example of a one-off error, slightly modified from an incident report: A researcher was exchanging two plastic 24-well plates in the tabletop Sorvall centrifuge. While closing the lid, it was caught on a centrifuge wrench which was accidentally placed into the path of the lid. The wrench jumped and knocked one of the removed 24-well plates onto the counter. The plate landed at approximately a 45-degree angle and lost approximately half its contents to the bench top. For some errors, there are procedural changes that should reduce their frequency. For instance, needle sticks can occur from syringes with sharp metal needles when being used to transfer liquids from one small container to another. For injecting animals, sharp metal needles are needed; but for liquid transfers, blunt-plastic needles would suffice. Also, dropping items could sometimes be prevented using lab carts to transport items from place to place, rather than carrying them by hand. Here are three comments from the aforementioned Fouchier publication. “Only authorized and experienced personnel that have received extensive training can access the facility.” “All personnel have been instructed and trained how to act in case of incidents.” “For animal handling, personnel always work in pairs to reduce the chance of human error.” The first two bullets speak to standard training of lab workers who work with particularly dangerous pathogens. It is **unclear whether** the diligent **training of lab workers** he outlines **would** substantially **reduce human error**: The entities reporting incidents to NIH mention similar diligent training; nonetheless, undetected or unreported laboratory acquired infections occur with high frequency in these laboratories. Furthermore, it is unclear whether other laboratories creating and researching airborne-transmissible diseases are so carefully designed and diligent in their training. The two-person rule for animal handling is a good idea that is not typically mentioned in the detailed NIH incident reports. Animal bites and needle punctures brought about by unruly lab animals are not uncommon. Release from high biocontainment through incomplete inactivation. Beyond the aforementioned undetected or unreported laboratory-acquired infections lies **another route by which pathogens can be released** from high biosecure level labs—**incomplete inactivation.** Inactivation is designed to destroy the pathogenicity of an infectious agent, while retaining its other characteristics for research in which live pathogens are not needed. Since there are reliable inactivation procedures, **failure to inactivate is a human error.** Pathogens are inactivated for research that can be performed in lower BSL2 biocontainment, where it is much easier to carry out. Research in BSL3 and BSL4 laboratories is difficult, both because of restricted movement in the personal protective equipment that must be worn and because of restrictions in operating procedures that aim to minimize potential exposure to pathogens. While incomplete inactivation does not usually directly cause a release into the community, researchers in BSL2 labs are at a much higher risk of infection, and their street clothes, hair, and skin can become contaminated. But incomplete inactivation is a route to potential release into the community. The FSAP does not routinely collect data on incomplete inactivation, and it seems no one else does either. Thus, enough data to calculate probabilities for this type of incident are not available. But the Government Accountability Office (GAO) has weighed in on the issue. The GAO reports anecdotal evidence and some numbers on incomplete inactivation to support the contention that it is a serious issue. The office has identified 11 incidents, in addition to 10 incidents already identified by the FSAP. Notably, two of the incidents involved Ebola and Marburg viruses, which because of a lack of countermeasures (vaccines and antivirals) are researched at BSL4 facilities. Among other things, the GAO report called attention to a well-publicized incident in which a Defense Department laboratory “**inadvertently sent live Bacillus anthracis**, the bacterium that **causes anthrax, to almost 200 laboratories** worldwide over the course of 12 years. The laboratory believed that the samples had been inactivated.” The report describes yet another **well-publicized incident in China** in which “two researchers conducting virus research were exposed to severe acute respiratory syndrome (**SARS**) coronavirus samples that were incompletely inactivated. The researchers subsequently transmitted SARS to others, leading to several infections and one death in 2004.” The GAO identified three recent releases of Ebola and Marburg viruses from BSL4 to lower containment labs due to incomplete inactivation. A fourth release in 2014 from the **CDC labs occurred** when “Scientists inadvertently switched samples designated for live **Ebola** virus studies with samples intended for studies with **inactivated material**. As a result, the samples with viable Ebola virus, instead of the samples with inactivated Ebola virus, were transferred out of a BSL-4 laboratory to a laboratory with a lower safety level for additional analysis. While no one contracted Ebola virus in this instance, the **consequences could have been dire** for the personnel involved as there are currently no approved treatments or vaccines for this virus.” The CDC has issued a report on this mixup, and the steps they have taken to avoid this particular error in the future. All these incidents confirm the role of incomplete inactivation that would lead to an increased likelihood of release into the community from a BSL2 lab. These are **all human errors**, some involving BSL4 pathogens. Along with the observation that other human errors are the cause of more than two-thirds of potential exposures in BSL3 labs, i**t is clear that state-of-the-art laboratory design will not prevent release** into the community. The probability of release into the community. In an analysis circulated at the 2017 meeting for the Biological Weapons Convention, a conservative estimate shows that the probability is about 20 percent for a release of a mammalian-airborne-transmissible, highly pathogenic avian influenza virus into the community from at least one of 10 labs over a **10-year** period of **developing and researching** this type of pathogen. This percentage was calculated from FSAP data for the years 2004 through 2010. Analysis of the FOIA NIH data gives a **much higher release probability**—**that is, a factor five to 10 times higher**, based on a smaller number of incident reports. While there is no obvious reason in the NIH data that would explain this high probability, exposures and latent (not-active) infections with M. tuberculosis was indicated in four incident reports. M. tuberculosis is not a select agent so incidents involving it would not necessarily be reported to the FSAP. Tuberculosis is highly contagious by the airborne route, so it might be easier to acquire a TB infection in the lab. Unfortunately, airborne TB infections might be a harbinger of what could occur in research on airborne-transmissible flu. Facility-reported descriptions of the 11 relevant incidents are provided in the Supplementary Material (Appendix 2). Lab-acquired infections are often discovered some time after the incident occurred. Only for three were the causes confirmed to be human error. For the other eight, neither the infected lab workers nor facility officials knew how the infection occurred. While it is likely that human error was involved in many of these eight infections, their causes will never be known. Likelihood that mammalian-airborne-transmissible, **highly pathogenic avian influenza** release **could cause a deadly pandemic.** The avian flu virus H5N1 **kills 60 percent of people** who become infected from direct contact with infected birds. The mammalian-airborne-transmissible, highly pathogenic avian influenza created in the Fouchier and Kawaoka labs should be able to **infect humans through the air**, and the **viruses could be deadly**. A release into the community of such a pathogen could seed a pandemic with a probability of perhaps 15 percent. This estimate is from an average of two very different approaches. One approach involves purely mathematical branching theory, where Harvard researcher Marc Lipsitch and coworkers provide a graph in which, conservatively, the probability that a pandemic is seeded from a single release is **about 20 percent**. In the second approach, where infection progress through the community from person to person is simulated, Bruno Kessler Foundation researcher Stefano Merler and coworkers found that there is a probability from five percent to **15 percent** that a single release could seed a pandemic. How deadly and how transmissible such viruses are in humans is not known. Dealing realistically with human errors in lab research. Human error will continue to play a major role in laboratory incidents, and undetected or unreported laboratory acquired infections and incomplete inactivation incidents will continue to occur. **No matter how well facilities are designed** to prevent release into communities, **human error will dodge design.** For an already identified 14 labs creating or researching mammalian-airborne-transmissible, highly pathogenic avian influenza, the potential 16 percent probability of a laboratory release into the community over five years of research (a result found in a study now being prepared for publication) is already uncomfortably high. **NIH incident reports indicate possibly much higher probabilities** of a such a release–thus, a greater likelihood of a pandemic. This does not take into the account a release from **incomplete inactivation.** Combining release probability with the not insignificant probability that an airborne-transmissible influenza virus could seed a pandemic, **we have an alarming situation.** Those who support mammalian-airborne-transmissible, highly pathogenic avian influenza experiments either believe the probability of community release is infinitesimal or the benefits in preventing a pandemic are great enough to justify the risk. For this research, it would take extraordinary benefits and significant risk reduction via extraordinary biosafety measures to correct such a massive overbalance of highly uncertain benefits to too-likely risks. Whatever probability number we are gambling with, **it is clearly far too high a risk to human lives.** There are experimental approaches that do not involve live mammalian-airborne-transmissible, highly pathogenic avian influenza which identify mutations involved in mammalian airborne transmission. These “safer experimental approaches are both more scientifically informative and more straightforward to translate into improved public health…” Asian bird flu virus research to develop live strains transmissible via aerosols among mammals (and perhaps some other potentially pandemic disease research as well), should for the present be restricted to special BSL4 laboratories or augmented BSL3 facilities where lab workers are not allowed to leave the facility until it is certain that they have not become infected.

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

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\*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.**

#### 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.

#### Nuclear weapons bring peace, empirics

Michael Shellenberger, 08-06-2018, "Who Are We To Deny Weak Nations The Nuclear Weapons They Need For Self-Defense?," Forbes, https://www.forbes.com/sites/michaelshellenberger/2018/08/06/who-are-we-to-deny-weak-nations-the-nuclear-weapons-they-need-for-self-defense/#7ce9e38d522f

No nation with a nuclear weapon has ever been invaded by another nation. The number of deaths in battle worldwide has declined 95 percent in the 70 years since the invention and spread of nuclear weapons; The number of Indian and Pakistani civilian and security forces’ deaths in two disputed territories declined 90 percent after Pakistan’s first nuclear weapons test in 1998. In 1981, the late political scientist Kenneth Waltz published an essay titled, “The Spread of Nuclear Weapons: More May Be Better.” In it he argued that nuclear weapons are revolutionary in allowing weaker nations to protect themselves from more powerful ones. International relations is “a realm of anarchy as opposed to hierarchy… of self-help… you’re on your own,” Waltz explained. How do nuclear weapons work? Not “through the ability to defend but through the ability to punish...The message of a deterrent strategy is this,” explained Waltz. “‘Although we are defenceless, if you attack we will punish you to an extent that more than cancels your gains.’” Does anybody believe France should give up its nuclear weapons? Certainly not the French. After President Barack Obama in 2009 called for eliminating nuclear weapons, not a single other nuclear nation endorsed the idea. All of this raises the question: if nuclear weapons protect weak nations from foreign invasion, why shouldn’t North Korea and Iran get them? Why Nuclear Weapons Make Us Peaceful On January 29, 2002, President George W. Bush denounced Iraq, Iran, and North Korea as an “axis of evil.” North Korea was “arming with missiles,” he said. Iran “aggressively pursues these weapons” and the “Iraqi regime has plotted to develop...nuclear weapons for over a decade.” One year later, the U.S. invaded and occupied Iraq. The ensuing conflict resulted in the deaths of over 450,000 people — about four times as many as were killed at Hiroshima — and a five-fold increase in terrorist killings in the Middle East and Africa. It all came at a cost of $2.4 trillion dollars. Now, 16 years later, U.S. officials insist that North Korea and Iran need not fear a U.S. invasion. But why would any nation — particularly North Korea and Iran — believe them? Not only did the U.S. overthrow Iraqi leader Saddam Hussein after he gave up his nuclear weapons program, it also helped overthrow Libyan President Muammar Gaddafi in 2011 after he too had given up the pursuit of a nuclear weapon. North Korean President Kim Jong-un may, quite understandably, see his own life at stake: Hussein was hanged and Gaddafi was tortured and killed. Both hawks and doves say North Korea and Iran must not be allowed to have a weapon because both regimes are brutal, but nuclear weapons make nations more peaceful over time. There were three full-scale wars before India and Pakistan acquired the bomb and only far more limited conflicts since. And China became dramatically less bellicose after acquiring the bomb. Why? “History shows that when countries acquire the bomb, they feel increasingly vulnerable,” notes Waltz, “and become acutely aware that their nuclear weapons make them a potential target in the eyes of major powers. This awareness discourages nuclear states from bold and aggressive action.” Is it really so difficult to imagine that a nuclear-armed North Korea and Iran might follow the same path toward moderation as China, India, and Pakistan? Nuclear weapons are revolutionary in that they require the ruling class to have skin in the game. When facing off against nuclear-armed nations, elites can no longer sacrifice the poor and weak in their own country without risking their lives. Had Iraq in 2002 been in possession of a nuclear weapon, the U.S. would never have invaded. As such, we should be glad that North Korea acquired the bomb since it guarantees the U.S. will never invade.

#### Nuclear deterrence is effective

Serena Carassale, 01-26-2019, "Has nuclear deterrence changed after the end of Cold War? (part 2)," Serena Carassale is the former vice president at the Venice Diplomatic Society and studied philosophy, international studies and economics at the University of Venice. https://www.venicediplomaticsociety.com/blog/has-nuclear-deterrence-changed-after-the-end-of-cold-war-part-2

Therefore, starting from the assumption of a loss of rationality, how can deterrence be still a valid strategy in the Second Nuclear Age? The answer lays in the shifting from capability to credibility, as stressed by Lowther: in order to allow nuclear powers to effectively respond to irrational actors with a strategy of deterrence, it is necessary for the latter to believe that traditional rational actors will also be willing to employ nuclear weapons as well.

On the contrary, in the intra-states relationships, no much difference can be appreciated since the Cold War and both the traditional Super Powers keep pursuing a highly costly policy of expenditures for nuclear weapons: China, differently, does not employ a similar capital, enabling the Country to simply keep a minimal level of deterrence, strategy which many lobbies are actually working to obtain in the US as well. What remains as common in the First and the Second World Nuclear Areas is that the US and Russia both base their strategic nuclear weapons on the other and consequently their expenditures and investments in such area - to make a realistic prevision - are not going to be reduced in recent times.

Concerning the role of nuclear deterrence in non-nuclear attacks, that is usually applicable to those countries not being part of the traditional circle of nuclear powers, thus representing a change since the Cold War. Those countries have mostly violated the Non-Proliferation Treaty, but never faced a direct military attack, as we have significant reason in believing that the root cause behind that lays in their nuclear capability: their nuclear deterrence strategy is therefore perfectly in function. North Korea, in contrast with Iraq, is the perfect evidence for the aforementioned. Differently from the latter, North Korea has a more bothersome and developed policy, for what concerns the proliferation of WMDs, but it might be that thanks to its very deterrence strategy the Country has never faced a NATO attack. The role of nuclear deterrence is although relevant even at a regional level when considering conventional attacks, as displayed in the case of the conflict between India and Pakistan: it is only for their nuclear arsenals that the two enemies, like the US and the Soviet Union before them, did not enter into a direct conflict.