

Appendix: Weather Control

Weather control is a fascinating and worrying potential technology. If used in with intentionally nefarious intent, its effects could be catastrophic. It is not exactly climate change in the sense that we define it here, but it brings many of the problems of climate change, with the prospect of these problems arising at the time and place of an adversary's choosing.

Naturally occurring terrestrial and space weather events constitute only one set of challenges to national security. The concept of weaponizing the natural environment is nothing new. Congressional testimony dating back to the early 1950s recommends approval of research and development funding for weather modification experimentation. This in response to concerns Russia was beating us in learning how to control the weather and the potential threat that posed to the United States.¹⁸⁴ The United States has already demonstrated the potential to modify the weather in support of combat operations through its efforts in Vietnam. United States cloudseeding techniques used aircraft to disperse lead iodide into the atmosphere above portions of Southeast Asia to create a super-saturated environment during the Vietnamese monsoon season. The increased precipitation produced significant degradation of Vietnamese logistic capabilities as vehicles, carts, and men remained bogged down on certain roadways and paths soaked by nearly continuous rainfall.¹⁸⁵

Much like the United States, potential rivals already pos-

184. "Prohibiting Hostile Use of Environmental Modification Techniques," in *Multinational Corporations and United States Foreign Policy: Hearings Before the Subcommittee on Multinational Corporations of the Committee on Foreign Relations*, vol. 3, parts 15-17: 36-37. U.S. Senate Committee on Foreign Relations, Subcommittee on Multinational Corporations: 94th Cong., 2nd sess. 1976.

185. "Weather Modification." *U.S. Senate Subcommittee on Oceans and International Environment of the Committee on Foreign Relations*, 93rd Cong., 2nd sess., March 20, 1974:88-93. <https://www.vietnam.ttu.edu/star/images/239/2390601002C.pdf>.

sess the capability to artificially manufacture effects that manipulate the terrestrial and space weather environment. An example is the superheating of the ionosphere through directed-energy generation. This capability has the potential to disrupt communications, limit capabilities of missile defense or other monitoring radars, and contaminate the ionosphere to such a degree as to prevent use of U.S. space or missile defense systems. Normally these ionospheric scintillation experiments, like those performed at the High Frequency Active Auroral Research Program (HAARP) in Alaska, are benign in nature and used for purely scientific research purposes. However, the U.S. Air Force, U.S. Navy, and the Defense Advanced Research Projects Agency (DARPA) originally developed, designed and operated HAARP as a joint project to perform experiments that manipulate and potentially control the ionosphere to enhance Department of Defense (DoD) command, control and communications capabilities. Experiments ranged from extremely low-frequency waves for submarine communications to over-the-horizon-radar enhancement and even super scintillation events to disrupt or disable space assets in low Earth orbit. The HAARP program transferred to the University of Alaska for educational research after the DoD successfully accomplished their original experimental goals and determined to cut costs by terminating the experiments and HAARP facility.¹⁸⁶

However, the United States is not the sole possessor of a HAARP-like capability. Partner nations, such as Japan and Norway, operate their own antenna farms, as do Russia and China.¹⁸⁷ The use of ionospheric sounders operated by the Air Force make it possible to monitor

186. National Research Council. *Opportunities for High-Power, High-Frequency Transmitters to Advance Ionospheric/Thermospheric Research: Report of a Workshop*. Washington, DC: The National Academies Press. 2014: 1,3.

187. National Research Council, 18-19.

when manipulations of the ionosphere occur, so it would be difficult to heat the ionosphere without anyone's knowledge. However, the current distribution of these ionospheric sounders leaves large gaps in coverage exposing them to possible exploitation by an adversary.

Still another artificially induced weather effect manifests through the use of a nuclear detonation to induce an artificial radiation belt. The consequences of such an event would produce significant and far-reaching impacts to U.S. national security. First, the electromagnetic pulse generated during the initial explosion mimics the disastrous costs produced by a Coronal Mass Ejection (CME) induced geomagnetic storm. The United States would witness widespread power grid outages, loss of communication and navigation capabilities, plus long-term modification to the space environment. Damage to space assets in various satellite orbits would vary depending on detonation altitude and a loss of asset capability expected. These concerns do not spring from speculation. On July 9, 1962, the United States exploded the STARFISH PRIME nuclear device in the low Earth orbit at around 400 kilometers. Only 24 satellites were in orbit during the time of this test and subsequent tests that followed, but eight satellites suffered immediate damage during the tests while still others demonstrated shortened life spans from the artificially induced radiation belts. This nuclear testing also impacted communications and changed the space operating environment for decades to follow.¹⁸⁸

A similar detonation in today's congested space environment promises significantly worse outcomes. According to the Union of Concerned Scientists website, the space environment hosts over 1,738 known satellites as of August, 2017. No country has more to lose than the United States if a space-based nuclear detonation occurred. Leading all nations at 803 satellites, the United States has over 476 commercial, 150 governmental (with an additional 159 military), and 18 civil satellites

on orbit at various altitudes above the Earth.¹⁸⁹ While other nations would feel the effects of such an event, they are less likely to feel the level of national security implications when compared to the United States. Concerns over North Korean intentions during recent tests of their growing nuclear capability raise this to a very real threat. There is evidence that North Korea reached back to the early experiments of the United States and the Soviet Union during the late 50s and early 60s to gain insights on their own nuclear program. An atmospheric or space-based test of a North Korean nuclear weapon, designed to demonstrate national power or will on the international stage, would generate substantial disadvantages to U.S. national security as losses of space capability occur across a wide range of possible platforms.¹⁹⁰

Numerous additional examples exist that demonstrate the ability to manipulate the natural environment as an instrument of national power. Commonly referred to as Geoengineering, it is defined by the Intergovernmental Panel on Climate Change as "a broad set of methods and technologies that aim to deliberately alter the climate system to alleviate impacts of climate change."¹⁹¹ However, many of the geoengineering experiments currently underway to combat climate change possess the dual-use potential for weaponization of the natural environment. A report on Chinese efforts in the arena of solar geoengineering call for a variety of terrestrial or space-based options to combat CO₂ concentrations. The various methods discussed could change the physical, chemical or biological characteristics of the Earth's climate system. While some of these options

188. Conrad, Edward E. et al. "Collateral Damage to Satellites from an EMP Attack." *Defense Threat Reduction Agency*. 2010: 11-15. <https://apps.dtic.mil/dtic/tr/fulltext/u2/a531197.pdf>.

189. "UCS Satellite Database." *Union of Concerned Scientists*. 2017. <http://www.ucsusa.org/nuclear-weapons/space-weapons/satellite-database>.

190. Sanger, David E. and William J. Broad. "Prospect of Atmospheric Nuclear Test by North Korea Raises Specter of Danger." *The New York Times*. 2017. <https://www.nytimes.com/2017/09/22/world/asia/north-korea-atmospheric-nuclear-test-risks.html>.

191. "Climate Change 2014 Synthesis Report: Summary for Policy Makers." *Intergovernmental Panel on Climate Change*. 2014:89. https://www.ipcc.ch/site/assets/uploads/2018/02/AR5_SYR_FI-NAL_SPM.pdf.

may reduce greenhouse gas concentrations, they may also potentially create negative effects to an environment where one did not exist previously.¹⁹²

A report examining the United States' history in geoengineering reveals very similar possibilities. A National Center for Atmospheric Research, and Environmental Studies Program explored U.S. weather modification exertions back to 1947 and found a reactionary, checked past. In developing science and technology options, along with the accompanying legislation, weather modification ran the gamut of beneficial and detrimental outcomes across society. The study recommends any plans using geoengineering in climate change mitigation would benefit from a guiding framework of rules and regulations. It further endorses the establishment of a centralizing U.S. federal weather modification governing body to provide proper stewardship of the environment during any experimental development or actual implementation.¹⁹³ Anything less could lead to a broad range of potential environmental, technical, political, and ethical issues.

These very concerns culminated in the United Nations General Assembly holding the Convention on the Prohibition of Military or any Hostile Use of Environmental Modification Techniques (ENMOD) of 1976. The ENMOD Convention was the tool used to capture the spirit of international disarmament law explicitly envisioned to keep the manipulation of the environment out of the armed conflict arsenal. An additional protocol added a further ban on the use of methods and means of warfare that purposefully and excessively damage the environment. The overall language bans the hostile use of the natural environment to wage war and went into force as of October, 1978. The United States, along with 77 other nations, have ratified the treaty and agreed to live by its restrictions.¹⁹⁴ A decision to weaponize weather in the future would carry with it an almost certain international condemnation for any nation willing to undertake the effort. If someone could prove who did it

192. Cao, Long, Chao-Chao Gao and Li-Yun Zhao. "Geo-engineering: Basic Science and Ongoing Research Efforts in China." *Advances in Climate Change Research*, vol 6: 188-196. 2015. <https://www.sciencedirect.com/science/article/pii/S1674927815000829>.

193. Hauser, Rachel. "Using Twentieth-Century U.S. Weather Modification Policy to Gain Insight into Global Climate Remediation Governance Issues." *Weather, Climate and Society*, vol. 5: 180-191. 2013. <https://journals.ametsoc.org/doi/pdf/10.1175/WCAS-D-11-00011.1>.

194. "1976 Convention on the Prohibition of Military or any Hostile Use of Environmental Modification Techniques." *International Committee of the Red Cross, Advisory Service on International Humanitarian Law*. 2003. <https://www.icrc.org/en/document/1976-convention-prohibition-military-or-any-hostile-use-environmental-modification>.