

The Frosty Diplomacy of Nuclear Winter.

Scientific Predictions and Their Role in Global Affairs

An InsSciDE Case Study

Simone Turchetti

Centre for the History of Science, Technology and Medicine (CHSTM)
University of Manchester, United Kingdom

The formulation and reception of nuclear winter is paradigmatic of how scientific predictions can work as stimuli for science diplomacy activities and, in turn, inflate or deflate these forecasts' public resonance. Elaborated in the early 1980s, this theory predicted that the environmental consequences of a future nuclear conflict would have been catastrophic, rendering the whole earth uninhabitable and possibly leading to the extinction of humankind. This essay focuses on how the theory took center stage in competing science diplomacy exercises that, on the one hand, encouraged the sponsorship of new research in light of its policy implications for ridding the world of nuclear weapons and, on the other hand, actively sought to remove it because of the negative light it cast on organizations involved in nuclear deterrence.



Keywords:

Cold War, nuclear winter, scientific predictions, NATO, Paul Crutzen, Carl Sagan, public diplomacy, environmental diplomacy



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The Frosty Diplomacy of Nuclear Winter:

Scientific Predictions and Their Role in Global Affairs

How do competing diplomacy ambitions inform the promotion and demotion of international collaborative research leading to scientific predictions? The term “science diplomacy” is often used to underline how governmental and inter-governmental departments promote collaborative scientific initiatives and, in turn, seek to use this collaboration to strengthen relations between the countries involved. But promoting science across borders is hardly ever an innocent and transparent exercise aiming to reward studies with merit. It often aims instead to propel themes that align with (at times hidden) diplomacy objectives. In turn, it may lead to competing sponsorship efforts.

This is especially true in the domain of scientific predictions, namely research-based assessments that define future forecasts, especially at a global level, and inform policy provisions. Forecasts can actually be very divisive according to their policy implications, thus sparking competing efforts to sponsor or deflate novel research.

This case study exemplifies the analysis by looking at one specific scientific prediction, nuclear winter, that became popular within the global scientific community during the 1980s, with tensions between superpowers mounting in what we know as one of the most significant Cold War crises. The nuclear winter hypothesis predicted that a conflict with thermonuclear weapons secured no victory, as the whole earth would plunge into darkness due to the environmental impacts of a nuclear exchange. Nuclear winter was thought capable of rendering the whole planet uninhabitable for the foreseeable future. Even world areas like Australia, not directly targeted with nuclear weapons, would be affected, as fallout would spread globally.

The prediction of nuclear winter soon polarized scientists, political leaders and diplomats across the world along two fronts. Individuals and organizations concerned with blocking the proliferation of nuclear weapons immediately endorsed research on nuclear winter as part of their further campaign. Government and defense organizations directly involved in the exercise of nuclear deterrence sought instead either to stifle the further funding of nuclear winter research, or to fund competing studies proving the scientific prediction wrong.

This essay reconstructs the history of these competing efforts to promote and demote nuclear winter research, particularly in the recognition of the multiple legacies of nuclear winter’s “frosty” diplomacy. Today nuclear winter is a notion virtually absent from the landscape of the scientific debate, although it routinely re-surfaces in connection with renewed tensions between nuclear powers such as India and Pakistan (Witze, 2020). Yet the study of catastrophic environmental changes is

still a critical item in the global affairs agenda, given the ongoing research on global warming, which has in common with nuclear winter the bleak forecast of irreversible environmental change. Climate crisis is similarly entwined with global affairs with scientific, diplomatic and political communities often divided on what research should be sponsored. Hence, we may be able to understand a great deal more about divergent climate agendas through the lens of the nuclear winter case.

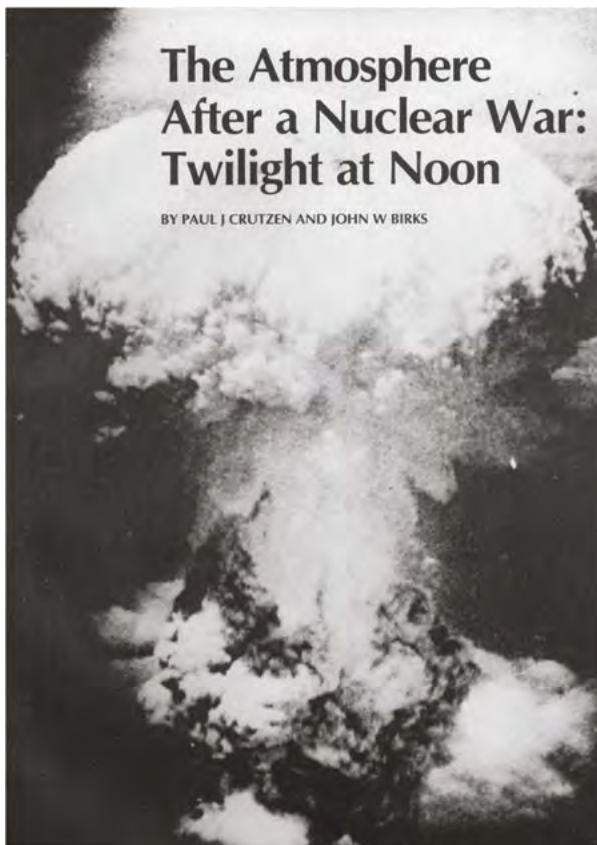
What follows thus examines the positioning of scientists and decision-makers, also as hybrid scientific-diplomatic figures acting as brokers in the promotion and demotion of nuclear winter studies. It first outlines how the concept emerged and divided scientists, diplomats and the wider public. It then explores how competing views lent support to alternative funding strategies. It finally concludes that science diplomacy might fruitfully be considered as a practice that hardly ever supports the promotion of scientific research at large, but rather one that informs the *selection* of scientific themes, topics and forecasts that align to specific diplomatic agendas. Such consideration would bring out, too, the pivotal role played in this practice by knowledge-brokers blurring the boundaries between scientific and diplomatic tasks.

Predicting a nuclear winter

By 1980, a number of new international collaborative projects either focused, or indirectly referred to, the environmental and climatic effects of nuclear explosions, especially given the circumstances of the Cold War and the renewed tensions between blocs. The hawkish stances of the UK Prime Minister Margaret Thatcher and the US President Ronald Reagan fueled the growth of nuclear arsenals to an unprecedented number of warheads. In this new landscape, climate and environmental experts began to consider what environmental effects a nuclear exchange could produce.

Extending his atmospheric studies of the 1970s, the Dutch chemist Paul Crutzen (later Nobel laureate, and originator of the Anthropocene concept) started to research what kind of emissions a nuclear war was likely to release. With his British colleague John Birks, he eventually showed that wildfires generated by nuclear explosions could produce what they called a photochemical smog engulfing the whole earth in darkness. In particular, the releasing of enormous quantities of dust could obscure sunlight, and generate what they termed as a twilight effect (Crutzen and Birks, 1982).

Crutzen and Birks's modeling caused some interest, but not as much as that resulting from the collaboration between US cosmologists James B. Pollack and Owen Toon, who had previously looked into climate-changing catastrophes in both Venus and Mars with the astronomer Carl Sagan and the atmospheric scientists Richard P. Turco and Thomas P. Ackerman. Their scientific article (later dubbed as TTAPS from the authors' surnames), highlighted that the nuclear twilight that Crutzen and Birks had described could irreversibly change the earth's climate (Turco et al., 1983).



Cover page of Crutzen and Birks publication of January 1982 in *Ambio*. Source: Uploaded by author John W. Birks to ResearchGate.
www.researchgate.net/publication/236687098_The_Atmosphere_After_a_Nuclear_War_Twilight_at_Noon

Stakes:

Nuclear winter freezing future global perspectives

First presented to the US National Academy of Sciences (NAS) in June 1982, the Turco et al. study "Nuclear winter: Global consequences of multiple nuclear explosions" showed how dust produced in a nuclear exchange would not only reduce sunlight but also cause long-term effects on the atmosphere and the biosphere. A darkened atmosphere would at first produce critical changes in seasonal weather patterns and then make it difficult, if not impossible, to successfully carry on agricultural activities. The reduced sunlight would also affect climate, making seasons increasingly colder, possibly setting off an Ice Age. These authors thus considered a lasting nuclear winter as a far more plausible future scenario than that of a nuclear twilight.

In any case both the Crutzen and Birks and TTAPS studies predicted that a nuclear war would be catastrophic, possibly rendering the earth uninhabitable. This indirect inference that nuclear deterrence may expose humankind to the risk of extinction inevitably moved the focus of the debate from the scientific to the diplomatic and political tables.

Nuclear winter in the diplomacy and public arenas

Nuclear winter soon became a hotly disputed topic in the framework of the heightened tensions of the early 1980s. Crutzen's scientific findings lent further support to those who viewed recent decisions taken by world leaders as favoring the proliferation of more advanced nuclear missile systems. The findings also heightened the anxieties of nuclear protesters, thereby fueling the peace movements sweeping across Europe and climaxing in one of the largest demonstrations in German history in Bonn's Hofgarten on 23 October 1983. One week later, from 31 October 1983, a two-day conference took place at the Sheraton Hotel in Washington DC, which attracted 500 scientists, activists and journalists. The so-called Halloween conference marked the moment when the notion of nuclear winter moved towards the center of world affairs, re-affirming the catastrophic impacts of a nuclear exchange and, in so doing, lending support to those activists protesting against nuclear weapons.

In December 1983, Sagan went on to capitalize on these catastrophic projections in the context of a forum organized at the US Senate. He also wrote for the non-governmental US Council on Foreign Relations' magazine *Foreign Affairs*, pushing the scientific debate on nuclear winter into a space traditionally occupied by diplomats and international relations experts.

Sagan cautiously argued that “subthreshold” strikes would not necessarily produce a global catastrophe. But could a nuclear conflict be limited to a subthreshold exchange?

The new findings stimulated especially the US government and its defense advisers, but also – at this specific juncture – the North-Atlantic Treaty Organization (NATO), the defense alliance of Western Europe. In particular, the conclusions separately reached by Sagan and Crutzen called directly into question the alliance’s strategic posture: following the 1979 Dual Track decision, the allies had deliberated the deployment of the US missiles Gryphon, Pershing II and Cruise to counter the Soviet build-up of modernized SS-18 and SS-20 missiles. These intermediate range missiles increasing tensions between Cold War blocs had been deployed in West Germany, Italy and the UK, while Belgium and the Netherlands continued to debate the new nuclear option in what historians referred to as the Euromissiles crisis.

Sagan’s widely publicized nuclear winter also connected to bleak cinematic portrayals of nuclear war. On 20 November 1983, the ABC broadcast *The Day After*, which put on screen how an American family living in the Midwest was exterminated in a nuclear attack. A televised ABC debate followed the film and gave an opportunity to Sagan to publicize his findings further and discuss his predictions with former US Defense Secretary Robert McNamara, the US Secretary of State George Shultz, and his predecessor, Henry Kissinger. The following year, the BBC film *Threads* more vividly depicted the consequences of a NATO nuclear strike including nuclear winter.

Protagonists: Knowledge-brokers pulling the strings of frosty diplomacy

The astronomer Carl Sagan eagerly embraced a new role as nuclear non-proliferation advocate, hence facilitating the transition of nuclear winter from the research laboratory to the corridors of power in Washington DC. By contrast, the physicist Robert Chabbal secretly sabotaged Paul Crutzen’s plans to bring nuclear winter research into the NATO science program due to concern about how it would impact on the alliance’s role in nuclear deterrence. His colleagues Antonino Zichichi and Edward Teller happily voiced their doubts about nuclear winter while being fully aware of how the resonance of these opinions would inform, as it did, the diplomatic arena. In particular, their brokerage lent further support to DoD and NATO views about the need to give furtherance to nuclear deterrence plans.



Cover image, *Science Digest* March 1985 issue. Source: Hearst Publications; www.slide-share.net/Revkin/hard-facts-about-nuclear-winter-1985

Promoting and demoting nuclear winter research

Because of its diplomatic and public resonance, the study of nuclear winter took centre stage in various international collaborative sponsorship efforts whose ambitions, to this day, continue to be far from clear.

First and foremost, NATO desisted from commenting on nuclear winter until 1986 to avoid giving resonance to a concept that undermined its strategic posture. But behind closed doors, the alliance’s science program (at the time one of the most prominent science diplomacy initiatives across Western Europe; Turchetti, 2018) was re-shaped to stall research subjects that might further display how catastrophic a NATO nuclear attack could be.

In particular, the French physicist Robert Chabbal, then NATO Assistant Secretary General for Scientific Affairs, agreed to delay several projects that could propel public condemnation of the alliance, including those on nuclear winter. Importantly, Crutzen had been invited to present plans for a workshop, and his proposal for a NATO Advance Study initiative on the global atmospheric transport of dust and soot (including a discussion of nuclear winter) was initially earmarked for funding, even if

with a depleted budget (half of what Crutzen had requested). In 1983, however, the NATO Science Committee that Chabbal chaired agreed to postpone several times the completion of studies on "abrupt" climate change, of which nuclear winter was an obvious case. Finally, in this year when nuclear winter became salient to protesters, the topic vanished from the list of NATO workshops to be supported.

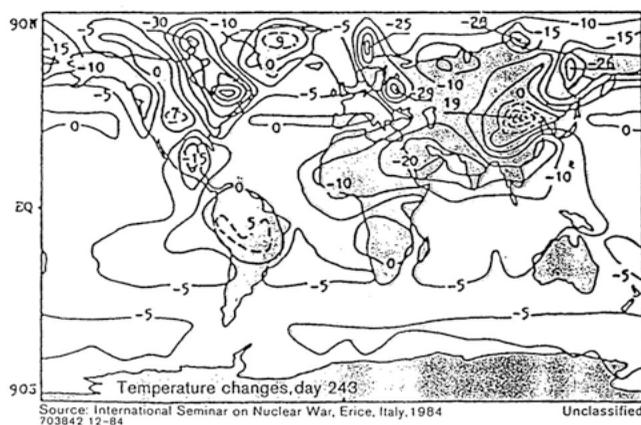
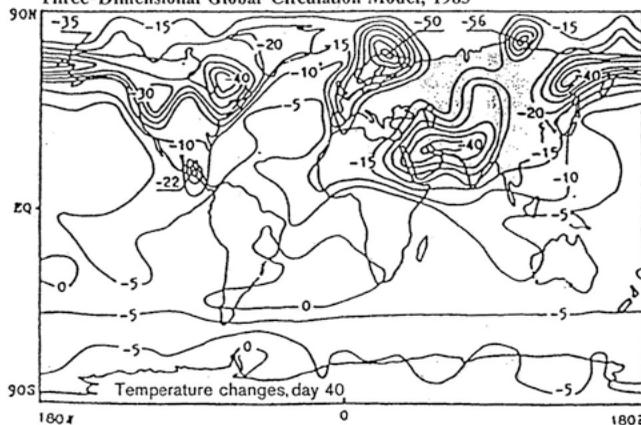
Meanwhile, another group of scientists with ties to the alliance criticized the TTAPS forecast, thus taking to Western Europe a debate already raging in the US and within NATO. The Italian nuclear physicist Antonino Zichichi, who by then had featured in several NATO-sponsored activities, now launched an initiative aiming to remove the catastrophic prediction of nuclear winter from the scientific arena. Previously, Zichichi had launched in 1980 an "International Seminar on Nuclear War" at the Science Culture center in Erice (Sicily). While NATO kept quiet publicly about nuclear winter and stalled funding its research, Zichichi's ongoing seminar became a competing authoritative voice against the TTAPS projections. It also offered a stage to speakers, like the US nuclear physicist Edward Teller, who defended NATO's posture and attacked pessimistic views on the environmental consequences of nuclear war. Teller, the controversial father of the H-Bomb and Ronald Reagan's outspoken science adviser, attended the Erice seminar every year, presenting a strong stance in favor of increasing the US defense budget and developing new defense systems to face the Soviet threat.

The 1984 Erice seminar in particular was entirely devoted to nuclear winter. It mainly featured scientists who had reservations about the TTAPS predictions, and Zichichi declared in the opening statement that there were serious doubts about the reliability of the data that Sagan and his colleagues had used. Teller aptly summarized the invitees' general skepticism and dismissed the notion that nuclear winter would have the predicted apocalyptic effects. His colleagues at the Lawrence Livermore National Laboratory rejected the projections on how fires would alter the atmosphere, also claiming that the troposphere would be affected only marginally. One scientist openly attacked Crutzen, claiming his estimates to be wrong. Crutzen, who was amongst the speakers, but whose article did not feature in the proceedings, replied on the spot. Teller ignored Crutzen and wrapped up the general criticism on nuclear winter with rhetorical aplomb:

Highly speculative theories of worldwide destruction [...] used as a call for a particular kind of political action serve neither the good reputation of science nor dispassionate political thought (Teller in Newman and Stipcich, 1992, p. 325)

Of course one might assume that the demotion of nuclear winter at Erice was exclusively a matter of scientific debate. Yet some of the more mysterious developments associated with the proceedings would actually demonstrate the opposite. The only workshop participant who confirmed the TTAPS conclusions was the Soviet physicist Vladimir V. Aleksandrov on the basis of his computerized models showing global changes in surface air temperatures. But in March 1985, he mysteriously disappeared in Madrid, and the mystery heightened diplomatic tensions between blocs since accusations were made about Soviet and US intelligence being involved in the disappearance. To this day the fate of the Soviet scientist is shrouded in mystery, and so is the knowledge of whether Aleksandrov had put together computer models accurate enough to prove the nuclear winter prediction correct. In any case, the Soviet scientists invited to the 1985 Erice seminar canceled their participation.

Figure 6
Soviet Nuclear Winter Research:
Three-Dimensional Global-Circulation Model, 1983



Source: International Seminar on Nuclear War, Erice, Italy, 1984
703842 12-84 Unclassified

Aleksandrov's depictions of predicted global temperature changes as presented to the Erice Seminar, 1984. Source: Director of Central Intelligence, 1984.

From diplomacy to conspiracy (and back to diplomacy)

The science diplomacy decisions about sponsorship taken at NATO and in Erice influenced the wider world affairs community. In particular, both the removal of nuclear winter from NATO's program and the conclusions reached by those who convened at Erice (eventually collated in the conference *Proceedings*; see Newman and Stipcich, 1992) facilitated the work of those who wished to consider nuclear winter as Soviet propaganda of limited scientific merit. In turn, these positions helped to elaborate policy measures aligned to this understanding.

This was first the case in the US, where the Department of Defense (DoD) was coming under increasing pressure to review and report on the environmental impacts of nuclear exchange. Unsurprisingly, the Secretary of Defense Caspar Weinberger now drew on the Erice proceedings in the writing of the report 'The Potential Effects of Nuclear War on the Climate'. He concluded that the scientific uncertainties on the phenomenon justified the current DoD security policy. A more extensive review was published in March 1986 and recalled the yet-to-be published presentations on the effects of fire and smoke delivered by Teller's colleagues at Erice.

The DoD could also make effective use of the findings of RAND Sovietologist Leon Gouré who had interviewed Aleksandrov in Erice and filed two reports on nuclear winter. The reports aimed to demonstrate that the nuclear winter prediction was a Soviet conspiracy based on flawed computer models. Drawing on Gouré's interviews, the DoD report now contended that nuclear winter studies had limitations and exaggerated scenarios for propaganda purposes. It also reiterated the effectiveness of current security provisions and, importantly, underscored the utility of the Strategic Defense Initiative (SDI, or Star Wars) as a solution to the nuclear winter scenario. Star Wars famously was a scheme for a space shield enabling the destruction of nuclear missiles on their path to targets. It never really proved more than a science fictional strategic option, and yet Weinberger asserted in the second DoD report that it could be considered an effective way to address the catastrophic environmental effects of a nuclear exchange. Sagan was unsurprisingly angered by the DoD use of nuclear winter to promote Star Wars (US General Accounting Office, 1986).

Now the same scientific conclusions and policy propositions unveiled in the Pentagon reports traveled to NATO and informed the formulation of an official stance on nuclear winter in Western Europe. In particular, the US political scientist Robert E Osgood (Johns Hopkins University) and the German

diplomat Henning Wegener (NATO Assistant Secretary General for Political Affairs) prepared a NATO report on nuclear deterrence acknowledging the gravity of nuclear winter but recalling that increased defense systems (e.g. Star Wars) would reduce the risk of escalation. On 14 April 1986, even the NATO Secretary General, the Briton Lord Carrington (Peter Alexander Rupert Carrington), felt inclined to mention nuclear winter, stating, however, that doom-and-gloom projections by concerned scientists like Sagan and anti-nuclear campaigners marching on European capitals were clearly mistaken.

By the end of the 1980s competing positions on scientific conclusions and security policy solidified, while nuclear winter came to occupy a less relevant space in public debates and diplomatic exchanges. Over the following decades, it vanished from the center of the political debate not because its scientific content was deeply flawed, as those attending the Erice conference had claimed, but rather because of its diminishing relevance. For instance, the rapprochement between Ronald Reagan and Mikhail Gorbachev which had started already in 1985 led two years later to the first treaty instructing the removal of intermediate-range nuclear forces (INF), including the Euromissiles, thus ridding the world of the pressing nuclear escalation menace. Yet some of those who had originally authored the TTAPS paper, such as Richard Turco, Alan Robock and Owen Toon, have continued to research nuclear winter and even found that a local nuclear conflict today could have catastrophic global impacts precisely because of its climatic effects (Krajick, 2020).

But with nuclear winter no longer a problematic item in NATO's research agenda, the alliance could increasingly invest in both "abrupt" and gradual climate change studies that the Science Committee representatives had previously forestalled for clearly diplomatic reasons. Many previously un-fundable researchers, including Crutzen, could now receive sponsorship and take part in NATO-endorsed conference proceedings.



Source: iStock/nouskrabs

Conclusions: The mobilization of science for diplomatic agendas

This essay suggests that our understanding of science diplomacy can be deepened by focusing on the role of scientific predictions in world affairs. Similarly to scientific imaginaries (see the InsSciDE case study by Robinson), predictions cast a vision of our future that binds decision-making in the present. Because of this binding, predictions become key features in the arena of world affairs and they have been so especially during the 20th century (and beyond), all the more so as the number and significance of transnational organizations in the geopolitical landscape has grown considerably.

In facing old and new predictions about worldwide catastrophes, whether due to nuclear winter or global warming, there is a tendency to connect science to diplomacy and policy in a linear fashion by assuming that once these predictions gain attention or even consensus in the worldwide scientific community, their study will receive further support. In turn, the results of international collaborative scientific efforts will be ready for use in world affairs to address global problems.

But the case discussed herein shows that there is no linearity in the relationship between patronage of international collaborative research, the exercise of expertise on world affairs, and global decision-making. What this case shows instead is that some officials within national and transnational organizations routinely *mobilize* scientific evidence that aligns to their own worldviews and political ambitions in order to strengthen their diplomacy agenda. In turn, sponsorship offers an opportunity to align scientific predictions to diplomatic goals.

Those at NATO, for instance, sought to shape the scientific debate on nuclear winter through promoting studies that diverted attention to other scientific topics. Removing the prospect of a global catastrophe aimed to reduce the criticism towards the alliance's strategic posture, and thus used the science NATO promoted as a vehicle for public diplomacy too. This essay has displayed the *two-pronged* diplomacy approach that demoted nuclear winter. On the one hand, NATO officials avoided commenting on the controversial scenarios while offering support to competing research that dampened the environmental consequences of nuclear war. On the other, the Erice seminar cast doubts on the predicted environmental consequences of nuclear war.

In this case, furthermore, key policy decisions followed this skewed endorsement of diplomatically viable research. The official endorsement of Erice's conclusions by the DoD, as well as the displaying of the SDI as a persuasive security solution to the nuclear winter scenario, was a decisive factor

in persuading NATO officials to offer a commentary on nuclear winter in the NATO report on nuclear deterrence (and in Lord Carrington's 1986 speech) while, at the same time, removing nuclear winter from the set of studies sponsored by the alliance.



A Titan II intercontinental ballistic missile. Source: US DOD.

In revising a simplistically linear understanding of what connects, via the practice of science diplomacy, scientific patronage and expertise in global affairs, it is equally important that we consider the key role that knowledge-brokers play (Raj, 2009) in shaping science-diplomacy-policy iterations. These are hybrid figures often crossing the boundaries between science and diplomacy practices through activities set to align sponsorship and diplomacy objectives and, in turn, give greater resonance to or deflate scientific forecasts.

The history of nuclear winter has thus opened an important window to better view determinants and processes that science diplomacy operations materialize. In particular, it allows light to be shed on some of its key actors as hybrid figures putting to profit their scientific knowledge in the diplomacy realm by selecting research that aligns to diplomatic imperatives and, in turn, justifies and supports policy objectives. Understanding their influence opens a door to better understanding how past and present science predictions have shaped and will shape world affairs.

Study Questions

- What other scientific predictions you can think of have previously or currently gained significance in world affairs? How have they shaped diplomacy and policy initiatives?
- In particular, how does the prediction of irreversible changes to be derived from 1.5 degrees of global warming shape current science diplomacy initiatives and global policy responses?
- Given how knowledge-brokers play a role in connecting science/diplomacy/policy realms, should their role be weakened or strengthened?
- Does nuclear winter belong to the past or is it still "haunting" us?

Endnote

- A fuller version of this InsSciDE work has been published as a peer-reviewed journal article. See Turchetti S (2021) Trading Global Catastrophes: NATO's Science Diplomacy and Nuclear Winter. *Journal of Contemporary History* 56(3):543-562. doi.org/10.1177/0022009421993915

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Simone Turchetti

Simone Turchetti is a senior lecturer at the Centre for the History of Science, Technology and Medicine (University of Manchester), focusing on the international dimensions of scientific research, including science policy and diplomacy. He is also the president of the IUPHST Historical Commission on Science, Technology and Diplomacy (STAND) and the secretary of the European Society for the History of Science.



Selected Publications

(2022) Nuclear winter should chill every leader to the bone. In: *Special report: Nuclear weapons*. 360info. 360info.org/nuclear-winter-should-chill-every-leader-to-the-bone/

(2018) *Greening the alliance: The diplomacy of NATO's science and environmental initiatives*. University of Chicago Press, Chicago