

Environmental consequences of nuclear war

Owen B. Toon, Alan Robock, and Richard P. Turco

A regional war involving 100 Hiroshima-sized weapons would pose a worldwide threat due to ozone destruction and climate change. A superpower confrontation with a few thousand weapons would be catastrophic.

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More than 25 years ago, three independent research groups made valuable contributions to elaborating the consequences of nuclear warfare.¹ Paul Crutzen and John Birks proposed that massive fires and smoke emissions in the lower atmosphere after a global nuclear exchange would create severe short-term environmental aftereffects. Extending their work, two of us (Toon and Turco) and colleagues discovered “nuclear winter,” which posited that worldwide climatic cooling from stratospheric smoke would cause agricultural collapse that threatened the majority of the human population with starvation. Vladimir Aleksandrov and Georgiy Stenchikov conducted the first general circulation model simulations in the USSR. Subsequent investigations in the mid- and late 1980s by the US National Academy of Sciences² and the International Council of Scientific Unions^{3,4} supported those initial studies and shed further light on the phenomena involved. In that same period, Presidents Ronald Reagan and Mikhail Gorbachev recognized the potential environmental damage attending the use of nuclear weapons and devised treaties to reduce the numbers from their peak in 1986—a decline that continues today. When the cold war ended in 1992, the likelihood of a superpower nuclear conflict greatly decreased. Significant arsenals remain, however, and proliferation has led to several new nuclear states. Recent work by our colleagues and us^{5,6} shows that even small arsenals threaten people far removed from the sites of conflict because of environmental changes triggered by smoke from firestorms. Meanwhile, modern climate models confirm that the 1980s predictions of nuclear winter effects were, if anything, underestimates.⁷

The Strategic Offensive Reductions Treaty (SORT) of 2002 calls for the US and Russia each to limit their operationally deployed warheads to 1700–2200 by December 2012. The treaty has many unusual features: warheads, rather than delivery systems, are limited; verification measures are not specified; permanent arsenal reductions are not required; warheads need not be destroyed; either side may quickly withdraw; and the treaty expires on the same day that the arsenal limits are to be reached. Nevertheless, should the limits envisioned in SORT be achieved and the excess warheads destroyed, only about 6% of the 70 000 warheads existing in 1986 would remain. Given such a large reduction, one might assume a concomitant large reduction in the num-

ber of potential fatalities from a nuclear war and in the likelihood of environmental consequences that threaten the bulk of humanity. Unfortunately, that assumption is incorrect. Indeed, we estimate that the direct effects of using the 2012 arsenals would lead to hundreds of millions of fatalities. The indirect effects would likely eliminate the majority of the human population.

Casualty and soot numbers

Any of several targeting strategies might be employed in a nuclear conflict. For example, in a “rational” war, a few weapons are deployed against symbolically important targets. Conversely, a “counterforce” war entails a massive attack against key military, economic, and political targets. We consider a “countervalue” strategy in which urban areas are targeted, mainly to destroy economic and social infrastructure and the ability to fight and recover from a conflict. In any case, when the conflict involves a large number of weapons, the distinction between countervalue and counterforce strategies diminishes because military, economic, and political targets are usually in urban areas.

Box 1 on page 38 describes how we estimate casualties (fatalities plus injuries) and soot (elemental carbon) emissions; figure 1 shows results. The figure gives predicted casualties and soot injected into the upper atmosphere from an attack on several possible target countries by a regional power using 50 weapons of 15-kiloton yield, for a total yield of 0.75 megaton. The figure also provides estimates of the casualties and soot injections from a war based on envisioned SORT arsenals. In the SORT conflict, we assume that Russia targets 1000 weapons on the US and 200 warheads each on France, Germany, India, Japan, Pakistan, and the UK. We assume the US targets 1100 weapons each on China and Russia. We do not consider the 1000 weapons held in the UK, China, France, Israel, India, Pakistan, and possibly North Korea. (Box 2 on page 40 provides information on the world’s nuclear arsenals.) The war scenarios considered in the figure bracket a wide spectrum of possible attacks, but not the extremes for either the least or greatest damage that might occur.

As figure 1 shows, a war between India and Pakistan in which each uses weapons with 0.75-Mt total yield could lead to about 44 million casualties and produce about 6.6 trillion

Environmental Consequences Of Nuclear War Ecological And Agricultural Effects

Jurgen Brauer



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Environmental Consequences of Nuclear War, 1986 Environmental Consequences of Nuclear War, 1989

Environmental Consequences of Nuclear War Mark A. Harwell, 1985 The Use of Nuclear Weapons and the Protection of the Environment during International Armed Conflict Erik V Koppe, 2008-04-25 In 1996 the International Court of Justice delivered an Advisory Opinion on the legality of the use of nuclear weapons in which the Court stated that while the existing international law relating to the protection and safeguarding of the environment does not specifically prohibit the use of nuclear weapons it indicates important environmental factors that are properly to be taken into account in the context of the implementation of the principles and rules of the law applicable in armed conflict The present work analyses this conclusion focusing on the question whether or not the use of nuclear weapons during international armed conflict would violate existing norms of public international law relating to the protection and safeguarding of the environment Although the use of weaponry during armed conflict is usually related to the protection of individuals the rapidly emerging appreciation of and the worldwide realization of the intrinsic value of the natural environment as an indispensable asset for the continuation of life including human life on this planet both for present and future generations warrants a thorough and extensive examination of the question of the illegality of the employment of nuclear weapons from the point of view of international environmental protection law The book consists of two parts Part I discusses the historical development and the effects of nuclear weapons Part II discusses the protection of the environment during international armed conflict under *ius in bello* *ius ad bellum* and *ius pacis* Only then is it possible to assess the legality of the use of nuclear weapons under this particular set of rules **Nuclear Winter and Its Implications** United States. Congress. Senate. Committee on Armed Services, 1986

Environmental Consequences of Nuclear War (Envwar) 2 Vols. V. 1 Physical and Atmospheric Effects, V. 2 Ecological and Agricultural Effects International Council of Scientific Unions. Scientific Committee on Problems of the Environment, 1985

Cultural Norms, War and the Environment Arthur H. Westing, 1988 The present volume is an outgrowth of a select symposium convened by the Stockholm International Peace Research Institute SIPRI in co operation with the United Nations Environment Programme UNEP in Stockholm 15 18 March 1987 **Nuclear Weapons and Scientific Responsibility** C.G. Weeramantry, 2021-10-11 Several years ago when this work first appeared it had become apparent that scientists who play such a key role in the nuclear enterprise needed to be alerted to the many questions of conscience and legality that were inextricably interlinked with their work These questions lay at the heart of the nuclear weapons problem for whatever the political and military leaders might ordain the manufacture of such weapons was a plain impossibility without the active assistance of the scientific profession Yet no substantive work on this topic had until then been attempted Such a work appeared at that time to be an urgent and important need If the problem was then acute and serious it is even more so now The power of nuclear science has grown and with it has grown the power of the individual scientist to initiate new

developments The changes in the world order that have occurred in the intervening years enable individual scientists to hold themselves out as available for employment Those who seek their expertise may include not only governments but other entities as well The power of global destruction that these scientists command renders it imperative that they be alerted on a continuing basis to the problems of conscience that arise Hence the need for a re issue of this work for which there had been many requests from concerned scientists professional groups socially concerned organisations and also from lawyers The book is re issued in its original form but updated by the inclusion of more recent work as contained in extracts from three judicial opinions upon the matter Bulletin of the Atomic Scientists ,1987-10 *The State of the Environment* Essam El-Hinnawi,Manzur H. Hashmi,2015-12-04 The State of the Environment is the annual report of the United Nations that contains the current state of the environment and the biosphere as well as certain important environmental issues The monograph also discusses social and economic issues and their implication to the environment The book covers environmental concerns air and atmospheric issues such as indoor air pollution changes in atmospheric ozone and the effects of carbon dioxide and other trace gases in the atmosphere issues related to land and water such as land and soil loss water quality and food production and power related issues such as energy production and consumption nuclear power and energy conservation Also included are other issues such as chemical wastes and other harmful substances diseases such as malaria and cancer and the effects of population on the environment The text is recommended for environmentalists and scientists who would like to know more about the issues related to the environment War and Public Health Barry S. Levy,Victor W. Sidel,1997 This is the first full description of the public health consequences of war and of what health professionals can do to minimize these consequences and to help prevent war itself The book covers the impact of war on public health human rights and the environment the effects of specific weapons systems during war and the preparation for war the effects of war and military activities on women children refugees and other populations the public health impacts of specific wars and the role of health professionals and organizations during war and in preventing war The book is well illustrated with numerous figures and photographs and is extensively referenced **Arms Control and the Environment** Lakshman Guruswamy,Suzette Grillot,2021-10-01 Arms and the Environment is the first book to systematically address the conceptual gap between international arms control norms and informed awareness of environmental perils It presents searching analyses and solutions from active professionals in a variety of related fields including international peacekeeping and defense procurement as well as representatives of concerned non governmental organizations and distinguished academics in the natural sciences law and political science Published under the Transnational Publishers imprint **War and Nature** Jurgen Brauer,2009-10-15 The inherent dangers of war zones constrain even the most ardent researchers with the consequence that little has been known for certain about the effects of war on stable environments War and Nature sifts through the available data from past wars to evaluate the actual impact that combat has on natural surroundings Examining

conflicts of various kinds the long war in tropical Vietnam the relatively brief and highly technical wars in the Persian Gulf and various civil wars in Africa and South Central Asia fought with small arms Brauer asks whether differences in technology location and duration are critical in causing environmental and humanitarian harm A number of unexpected conclusions are drawn from this data including practical agendas for collecting scientific evidence in future wars and suggestions about what the world's environmental and conservation organizations can do One thing War and Nature does is to show us how globalization can be a force harnessed for good ends

The Illusion of Progress Alexander Gillespie, 2014-10-14 Is sustainable development a charade sold to an increasingly misled public This book presents a wide ranging penetrating critique of sustainability and what it actually means The author argues that despite the rhetoric of socially and environmentally sustainable development and the ever increasing number of legislative environmental policies the real issues such as consumption population growth and equity are either sidestepped or manipulated in international policy and law Analyzing the main areas of concern economic growth market structure trade aid debt security and sovereignty he shows that the entire development structure and the underpinnings of the debate are leading down quite a different path to that intended by sustainability

Global Catastrophic Risks Nick Bostrom, Milan M. Cirkovic, 2011-09-29 A Global Catastrophic Risk is one that has the potential to inflict serious damage to human well being on a global scale This book focuses on such risks arising from natural catastrophes Earth based or beyond nuclear war terrorism biological weapons totalitarianism advanced nanotechnology artificial intelligence and social collapse

Global Ecology Sven Erik Jørgensen, 2010-04-16 Global Ecology focuses on the perception of the biosphere or the ecosphere as a unified cooperative system with numerous synergistic effects which describe the distinctive properties of this sphere This book is subdivided into five parts dealing with diverse aspects in global ecology The first part of the book provides comprehensive description of the biosphere including its unique characteristics and evolution This part also describes various spheres in the biosphere such as the hydrosphere noosphere and pedosphere as well as their composition The next part focuses on the global cycles including calcium carbon iron microbial nitrogen oxygen phosphorus sulfur and water cycles In addition global balances and flows are explained Presented in the third part are the results of the global cycles and flows as well as the patterns of the climatic factors and marine currents There is also a part discussing the climate interactions climatic changes and its effect on the living organisms The book concludes by covering the application of stoichiometry in the biosphere and in ecosystems The book offers a comprehensive view of global ecology and ecological stoichiometry which will aid in the processes of global ecology Provides an overview of the theory and application of global ecology International focus and range of ecosystems makes Global Ecology an indispensable resource to scientists Based on the bestselling Encyclopedia of Ecology Full color figures and tables support the text and aid in understanding

The Earth, Humanity and God Colin A. Russell, 2019-10-16 Originally published in 1994 The Earth Humanity and God discusses the relationship between science and religion The book

discusses the condition of the earth as it was at the time of publication and the future prospects of the planet arguing that neither the conventional mechanistic view nor New Age philosophy helps alone in evaluating our relationship with the Earth. The book examines methods of combatting the threats to the Earth exploring both a scientific and non scientific stance investigating the uncontrolled expansion of technology as well as empirical pre scientific mysticism. The book also explores the resurgence in ancient ideas of Mother Earth as a dangerous piece of romantic irrationality and suggests that these views pose a danger to religious scientific examinations. The book suggests instead a hard headed attempt to relate Biblical and scientific data and that this in turn can yield a valuable new understanding of the problems facing the world. *Volcanic Hazards and Disasters in Human Antiquity* Floyd W. McCoy, Grant Heiken, 2000-01-01 *Hiroshima and Nagasaki* Frank Barnaby, Douglas Holdstock, 2014-03-05 Fifty three years ago the first nuclear bombs were dropped on Hiroshima and Nagasaki. They killed some 250 000 people. A distinguished group of contributors examine the background and effects of the bombing and look at the lessons for a world which harbours 45 000 nuclear warheads. **Greenhouse: Planning for Climate Change** G.I. Pearman, 1988-01-01 It is important for the reader to understand clearly the objectives of these papers. They are not an attempt to provide accurate predictions of what is going to happen in Australia over the next few decades. Rather they represent sensitivity studies designed to illustrate to what extent we as a nation are dependent on the climate and likely to be affected by climatic change and attempts to develop the techniques for such sensitivity analyses. For this the climate scenario reproduced in the Appendix to this volume was a key

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Table of Contents Environmental Consequences Of Nuclear War Ecological And Agricultural Effects

1. Understanding the eBook Environmental Consequences Of Nuclear War Ecological And Agricultural Effects
 - The Rise of Digital Reading Environmental Consequences Of Nuclear War Ecological And Agricultural Effects
 - Advantages of eBooks Over Traditional Books
2. Identifying Environmental Consequences Of Nuclear War Ecological And Agricultural Effects
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Environmental Consequences Of Nuclear War Ecological And Agricultural Effects
 - User-Friendly Interface
4. Exploring eBook Recommendations from Environmental Consequences Of Nuclear War Ecological And Agricultural Effects
 - Personalized Recommendations
 - Environmental Consequences Of Nuclear War Ecological And Agricultural Effects User Reviews and Ratings
 - Environmental Consequences Of Nuclear War Ecological And Agricultural Effects and Bestseller Lists
5. Accessing Environmental Consequences Of Nuclear War Ecological And Agricultural Effects Free and Paid eBooks
 - Environmental Consequences Of Nuclear War Ecological And Agricultural Effects Public Domain eBooks

- Environmental Consequences Of Nuclear War Ecological And Agricultural Effects eBook Subscription Services
- Environmental Consequences Of Nuclear War Ecological And Agricultural Effects Budget-Friendly Options
- 6. Navigating Environmental Consequences Of Nuclear War Ecological And Agricultural Effects eBook Formats
 - ePub, PDF, MOBI, and More
 - Environmental Consequences Of Nuclear War Ecological And Agricultural Effects Compatibility with Devices
 - Environmental Consequences Of Nuclear War Ecological And Agricultural Effects Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Environmental Consequences Of Nuclear War Ecological And Agricultural Effects
 - Highlighting and Note-Taking Environmental Consequences Of Nuclear War Ecological And Agricultural Effects
 - Interactive Elements Environmental Consequences Of Nuclear War Ecological And Agricultural Effects
- 8. Staying Engaged with Environmental Consequences Of Nuclear War Ecological And Agricultural Effects
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Environmental Consequences Of Nuclear War Ecological And Agricultural Effects
- 9. Balancing eBooks and Physical Books Environmental Consequences Of Nuclear War Ecological And Agricultural Effects
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Environmental Consequences Of Nuclear War Ecological And Agricultural Effects
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Environmental Consequences Of Nuclear War Ecological And Agricultural Effects
 - Setting Reading Goals Environmental Consequences Of Nuclear War Ecological And Agricultural Effects
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Environmental Consequences Of Nuclear War Ecological And Agricultural Effects
 - Fact-Checking eBook Content of Environmental Consequences Of Nuclear War Ecological And Agricultural Effects

- Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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