

Ams Ocean Studies Answer Key Edition 9

General Circulation Models (GCMs) are rapidly assuming widespread use as powerful tools for predicting global events on time scales of months to decades, such as the onset of EL Nino, monsoons, soil moisture saturation indices, global warming estimates, and even snowfall predictions. While GCMs have been praised for helping to foretell the current El Nino and its impact on droughts in Indonesia, its full power is only now being recognized by international scientists and governments who seek to link GCMs to help them estimate fish harvests, risk of floods, landslides, and even forest fires. Scientists in oceanography, hydrology, meteorology, and climatology and civil, ocean, and geological engineers perceive a need for a reference on GCM design. In this compilation of information by an internationally recognized group of experts, Professor Randall brings together the knowledge base of the forerunners in theoretical and applied frontiers of GCM development. General Circulation Model Development focuses on the past, present, and future design of numerical methods for general circulation modeling, as well as the physical parameterizations required for their proper implementation. Additional chapters on climate simulation and other applications provide illustrative examples of state-of-the-art GCM design. Key

Features * Foreword by Norman Phillips * Authoritative overviews of current issues and ideas on global circulation modeling by leading experts *

Retrospective and forward-looking chapters by Akio Arakawa of UCLA *

Historical perspectives on the early years of general circulation modeling *

Indispensable reference for researchers and graduate students

An African folktale tells how the sun and water once lived on earth as friends, but because the sun failed to build his house large enough, he and his wife, the moon, were driven into the sky when the water came to visit them.

The principal goals of the study were to articulate the scientific rationale and objectives of the field and then to take a long-term strategic view of U.S. nuclear science in the global context for setting future directions for the field. Nuclear Physics: Exploring the Heart of Matter provides a long-term assessment of an outlook for nuclear physics. The first phase of the report articulates the scientific rationale and objectives of the field, while the second phase provides a global context for the field and its long-term priorities and proposes a framework for progress through 2020 and beyond. In the second phase of the study, also developing a framework for progress through 2020 and beyond, the committee carefully considered the balance between universities and government facilities in terms of research and workforce development and the role of international

collaborations in leveraging future investments. Nuclear physics today is a diverse field, encompassing research that spans dimensions from a tiny fraction of the volume of the individual particles (neutrons and protons) in the atomic nucleus to the enormous scales of astrophysical objects in the cosmos. Nuclear Physics: Exploring the Heart of Matter explains the research objectives, which include the desire not only to better understand the nature of matter interacting at the nuclear level, but also to describe the state of the universe that existed at the big bang. This report explains how the universe can now be studied in the most advanced colliding-beam accelerators, where strong forces are the dominant interactions, as well as the nature of neutrinos.

"This book by Lisa Tauxe and others is a marvelous tool for education and research in Paleomagnetism. Many students in the U.S. and around the world will welcome this publication, which was previously only available via the Internet. Professor Tauxe has performed a service for teaching and research that is utterly unique."—Neil D. Opdyke, University of Florida

During geologic spans of time, Earth's shifting tectonic plates, atmosphere, freezing water, thawing ice, flowing rivers, and evolving life have shaped Earth's surface features. The resulting hills, mountains, valleys, and plains shelter ecosystems that interact with all life and provide a record of Earth surface

processes that extend back through Earth's history. Despite rapidly growing scientific knowledge of Earth surface interactions, and the increasing availability of new monitoring technologies, there is still little understanding of how these processes generate and degrade landscapes. *Landscapes on the Edge* identifies nine grand challenges in this emerging field of study and proposes four high-priority research initiatives. The book poses questions about how our planet's past can tell us about its future, how landscapes record climate and tectonics, and how Earth surface science can contribute to developing a sustainable living surface for future generations.

It all began with Markus Jochum approaching one of us (HvS) – “when you guys are doing interviews with senior scientists from oceanography and related sciences, why are you not doing Walter Munk?” Indeed, why not? Walter Munk, an icon in oceanography, had just given a wonderful talk in a symposium in honor of his 90th birthday, sweeping a grand circle from his earliest work with Chip Cox on airborne measurements of ocean surface roughness to the latest satellite data – not simply a review, but the struggle of an active scientist opening up new perspectives – as inspiring and stimulating as when one of us (KH) first met him at the Ocean Waves Conference in Easton in 1961 (Fig. I. 1). Walter immediately agreed to share with us his recollections on the nearly seventy years of his path-

breaking contributions in a sheer amazing range of topics, from ocean waves, internal waves, ocean currents, tides, tsunamis, sea level, microseisms and the rotation of the earth to ocean acoustic tomography. With “you guys” Markus was referring to HvS and the various partners HvS had 1 invited to join him in conducting a series of interviews of retired colleagues.

Presents the core mathematics, statistics, and programming skills needed for modern climate science courses, with online teaching materials.

This book is a mini-course for researchers in the atmospheric and oceanic sciences.

"We assume readers will already know the basics of programming... in some other language." - Back cover.

The signals are everywhere that our planet is experiencing significant climate change. It is clear that we need to reduce the emissions of carbon dioxide and other greenhouse gases from our atmosphere if we want to avoid greatly increased risk of damage from climate change. Aggressively pursuing a program of emissions abatement or mitigation will show results over a timescale of many decades. How do we actively remove carbon dioxide from the atmosphere to make a bigger difference more quickly? As one of a two-book report, this volume of Climate Intervention discusses CDR, the carbon dioxide removal of greenhouse gas emissions from the atmosphere and sequestration of it in perpetuity. Climate Intervention: Carbon Dioxide Removal and Reliable Sequestration introduces possible CDR approaches and then discusses them in depth. Land

management practices, such as low-till agriculture, reforestation and afforestation, ocean iron fertilization, and land-and-ocean-based accelerated weathering, could amplify the rates of processes that are already occurring as part of the natural carbon cycle. Other CDR approaches, such as bioenergy with carbon capture and sequestration, direct air capture and sequestration, and traditional carbon capture and sequestration, seek to capture CO₂ from the atmosphere and dispose of it by pumping it underground at high pressure. This book looks at the pros and cons of these options and estimates possible rates of removal and total amounts that might be removed via these methods. With whatever portfolio of technologies the transition is achieved, eliminating the carbon dioxide emissions from the global energy and transportation systems will pose an enormous technical, economic, and social challenge that will likely take decades of concerted effort to achieve. *Climate Intervention: Carbon Dioxide Removal and Reliable Sequestration* will help to better understand the potential cost and performance of CDR strategies to inform debate and decision making as we work to stabilize and reduce atmospheric concentrations of carbon dioxide.

"The American Meteorological Society Education Program"--T.p. verso.

This book describes the development of ocean sciences over the past 50 years, highlighting the contributions of the National Science Foundation (NSF) to the field's progress. Many of the individuals who participated in the exciting discoveries in biological oceanography, chemical oceanography, physical oceanography, and marine

geology and geophysics describe in the book how the discoveries were made possible by combinations of insightful individuals, new technology, and in some cases, serendipity. In addition to describing the advance of ocean science, the book examines the institutional structures and technology that made the advances possible and presents visions of the field's future. This book is the first-ever documentation of the history of NSF's Division of Ocean Sciences, how the structure of the division evolved to its present form, and the individuals who have been responsible for ocean sciences at NSF as "rotators" and career staff over the past 50 years.

Ocean Mixing: Drivers, Mechanisms and Impacts presents a broad panorama of one of the most rapidly-developing areas of marine science. It highlights the state-of-the-art concerning knowledge of the causes of ocean mixing, and a perspective on the implications for ocean circulation, climate, biogeochemistry and the marine ecosystem. This edited volume places a particular emphasis on elucidating the key future questions relating to ocean mixing, and emerging ideas and activities to address them, including innovative technology developments and advances in methodology. Ocean Mixing is a key reference for those entering the field, and for those seeking a comprehensive overview of how the key current issues are being addressed and what the priorities for future research are. Each chapter is written by established leaders in ocean mixing research; the volume is thus suitable for those seeking specific detailed information on sub-topics, as well as those seeking a broad synopsis of current understanding. It

provides useful ammunition for those pursuing funding for specific future research campaigns, by being an authoritative source concerning key scientific goals in the short, medium and long term. Additionally, the chapters contain bespoke and informative graphics that can be used in teaching and science communication to convey the complex concepts and phenomena in easily accessible ways.

- Presents a coherent overview of the state-of-the-art research concerning ocean mixing
- Provides an in-depth discussion of how ocean mixing impacts all scales of the planetary system
- Includes elucidation of the grand challenges in ocean mixing, and how they might be addressed

The accuracy of chemical oceanographic measurements depends on calibration against reference materials to ensure comparability over time and among laboratories. Several key parameters lack reference materials for measurements in seawater, particles in the water column, and sediments. Without reference materials it is difficult to produce the reliable data sets or long-term baseline studies that are essential to verify global change and oceanic stability. Chemical Reference Materials : Setting the Standards for Ocean Science identifies the most urgently required chemical reference materials based on key themes for oceanographic research and provides suggestions as to how they can be developed within realistic cost constraints. Chemical analyses of seawater are uniquely difficult given the poorly known speciation and the low concentration of many of the analytes of interest. Analyses of suspended and

sedimentary marine particulate materials present their own distinct challenges, primarily due to potential interference by predominant mineral phases of different types. Of all the analytical methods applied to marine waters and particles, at present only a small fraction can be systematically evaluated via comparison to reference materials that represent the appropriate natural concentrations and matrices. Specifically, the committee was charged with the following tasks: - compile from available sources a list of important oceanographic research questions that may benefit from chemical reference standards; - create a comprehensive list of reference materials currently available for oceanographic studies; - identify and prioritize the reference materials needed to study the identified research questions; - determine for each priority analyte whether reference materials and/or analytic methods should be standardized; and - identify the most appropriate approaches for the development and future production of reference materials for ocean sciences.

America has one of the most varied and dynamic weather systems in the world. Every year, the Gulf Coast is battered by hurricanes, the Great Plains are ravaged by tornados, the Midwest is pummeled by blizzards, and the temperature in the Southwest reaches a sweltering 120 degrees. Extreme weather can be a matter of life and death, but even when it is pleasant—72 degrees and sunny—weather is still central to the lives of all Americans. Indeed, it's hard to imagine a topic of greater collective interest. Whether we want to know if we should close the storm shutters or just carry an

umbrella to work, we turn to forecasts. But few of us really understand the science behind them. All that changes with *The AMS Weather Book*. The most comprehensive and up-to-date guide to our weather and our atmosphere, it is the ultimate resource for anyone who wants to understand how hurricanes form, why tornados twirl, or even why the sky is cerulean blue. Written by esteemed science journalist and former USA Today weather editor Jack Williams, *The AMS Weather Book* covers everything from daily weather patterns to air pollution and global warming and explores the stories of people coping with severe weather and those who devote their lives to understanding the atmosphere, oceans, and climate. Words alone, of course, are not adequate to explain many meteorological concepts, so *The AMS Weather Book* is filled with engaging full-color graphics that explain such concepts as why winds blow in a particular direction, how Doppler weather radar works, what happens inside hurricanes, how clouds create wind and snow, and what's really affecting the earth's climate. For Weather Channel junkies, amateur meteorologists, and storm chasers alike, *The AMS Weather Book* is an invaluable tool for anyone who wants to better understand how weather works and how it affects our lives.

Ten years from now, what do you want or expect your students to remember from your course? We realized that in ten years what matters will be how students approach a problem using the tools they carry with them—common sense and common knowledge—not the particular mathematics we chose for the curriculum. Using our text,

students work regularly with real data in moderately complex everyday contexts, using mathematics as a tool and common sense as a guide. The focus is on problems suggested by the news of the day and topics that matter to students, like inflation, credit card debt, and loans. We use search engines, calculators, and spreadsheet programs as tools to reduce drudgery, explore patterns, and get information. Technology is an integral part of today's world—this text helps students use it thoughtfully and wisely. This second edition contains revised chapters and additional sections, updated examples and exercises, and complete rewrites of critical material based on feedback from students and teachers who have used this text. Our focus remains the same: to help students to think carefully—and critically—about numerical information in everyday contexts.

This introductory oceanography text is intended to teach students the tremendous influence oceans have on our lives. They are encouraged to look at oceanography as a cohesive and united discipline rather than a collection of subjects gathered under a marine umbrella. This first edition teaches students about the historical, geological, physical, chemical and biological characteristics of the ocean environment using remarkable images and photos. The authors have incorporated essays written by several scientists discussing topics in their fields of specialization. And in order to understand the constant barrage of information concerning our planet and marine issues, the authors believe students must have a basic command of the language of

marine science in addition to understanding processes and principles. By the end of this course, the authors want students to be prepared for future environmental discussions and the ability to make decisions as informed global citizens.

The ocean is an integral component of the Earth's climate system. It covers about 70% of the Earth's surface and acts as its primary reservoir of heat and carbon, absorbing over 90% of the surplus heat and about 30% of the carbon dioxide associated with human activities, and receiving close to 100% of fresh water lost from land ice. With the accumulation of greenhouse gases in the atmosphere, notably carbon dioxide from fossil fuel combustion, the Earth's climate is now changing more rapidly than at any time since the advent of human societies. Society will increasingly face complex decisions about how to mitigate the adverse impacts of climate change such as droughts, sea-level rise, ocean acidification, species loss, changes to growing seasons, and stronger and possibly more frequent storms. Observations play a foundational role in documenting the state and variability of components of the climate system and facilitating climate prediction and scenario development. Regular and consistent collection of ocean observations over decades to centuries would monitor the Earth's main reservoirs of heat, carbon dioxide, and water and provides a critical record of long-term change and variability over multiple time scales. Sustained high-quality observations are also needed to test and improve climate models, which provide insights into the future climate system. Sustaining Ocean Observations to Understand

Future Changes in Earth's Climate considers processes for identifying priority ocean observations that will improve understanding of the Earth's climate processes, and the challenges associated with sustaining these observations over long timeframes. As climate change has pushed climate patterns outside of historic norms, the need for detailed projections is growing across all sectors, including agriculture, insurance, and emergency preparedness planning. A National Strategy for Advancing Climate Modeling emphasizes the needs for climate models to evolve substantially in order to deliver climate projections at the scale and level of detail desired by decision makers, this report finds. Despite much recent progress in developing reliable climate models, there are still efficiencies to be gained across the large and diverse U.S. climate modeling community. Evolving to a more unified climate modeling enterprise-in particular by developing a common software infrastructure shared by all climate researchers and holding an annual climate modeling forum-could help speed progress. Throughout this report, several recommendations and guidelines are outlined to accelerate progress in climate modeling. The U.S. supports several climate models, each conceptually similar but with components assembled with slightly different software and data output standards. If all U.S. climate models employed a single software system, it could simplify testing and migration to new computing hardware, and allow scientists to compare and interchange climate model components, such as land surface or ocean models. A National Strategy for Advancing Climate Modeling

recommends an annual U.S. climate modeling forum be held to help bring the nation's diverse modeling communities together with the users of climate data. This would provide climate model data users with an opportunity to learn more about the strengths and limitations of models and provide input to modelers on their needs and provide a venue for discussions of priorities for the national modeling enterprise, and bring disparate climate science communities together to design common modeling experiments. In addition, A National Strategy for Advancing Climate Modeling explains that U.S. climate modelers will need to address an expanding breadth of scientific problems while striving to make predictions and projections more accurate. Progress toward this goal can be made through a combination of increasing model resolution, advances in observations, improved model physics, and more complete representations of the Earth system. To address the computing needs of the climate modeling community, the report suggests a two-pronged approach that involves the continued use and upgrading of existing climate-dedicated computing resources at modeling centers, together with research on how to effectively exploit the more complex computer hardware systems expected over the next 10 to 20 years.

This volume reflects the current state of scientific knowledge about natural climate variability on decade-to-century time scales. It covers a wide range of relevant subjects, including the characteristics of the atmosphere and ocean environments as well as the methods used to describe and analyze them, such as proxy data and numerical

models. They clearly demonstrate the range, persistence, and magnitude of climate variability as represented by many different indicators. Not only do natural climate variations have important socioeconomic effects, but they must be better understood before possible anthropogenic effects (from greenhouse gas emissions, for instance) can be evaluated. A topical essay introduces each of the disciplines represented, providing the nonscientist with a perspective on the field and linking the papers to the larger issues in climate research. In its conclusions section, the book evaluates progress in the different areas and makes recommendations for the direction and conduct of future climate research. This book, while consisting of technical papers, is also accessible to the interested layperson.

We live on a dynamic Earth shaped by both natural processes and the impacts of humans on their environment. It is in our collective interest to observe and understand our planet, and to predict future behavior to the extent possible, in order to effectively manage resources, successfully respond to threats from natural and human-induced environmental change, and capitalize on the opportunities " social, economic, security, and more " that such knowledge can bring. By continuously monitoring and exploring Earth, developing a deep understanding of its evolving behavior, and characterizing the processes that shape and reshape the environment in which we live, we not only advance knowledge and basic discovery about our planet, but we further develop the foundation upon which benefits to society are built. Thriving on Our

Changing Planet presents prioritized science, applications, and observations, along with related strategic and programmatic guidance, to support the U.S. civil space Earth observation program over the coming decade.

The growing problem of changing environmental conditions caused by climate destabilization is well recognized as one of the defining issues of our time. The root problem is greenhouse gas emissions, and the fundamental solution is curbing those emissions. Climate geoengineering has often been considered to be a "last-ditch" response to climate change, to be used only if climate change damage should produce extreme hardship. Although the likelihood of eventually needing to resort to these efforts grows with every year of inaction on emissions control, there is a lack of information on these ways of potentially intervening in the climate system. As one of a two-book report, this volume of Climate Intervention discusses albedo modification - changing the fraction of incoming solar radiation that reaches the surface. This approach would deliberately modify the energy budget of Earth to produce a cooling designed to compensate for some of the effects of warming associated with greenhouse gas increases. The prospect of large-scale albedo modification raises political and governance issues at national and global levels, as well as ethical concerns. Climate Intervention: Reflecting Sunlight to Cool Earth discusses some of the social, political, and legal issues surrounding these proposed techniques. It is far easier to modify Earth's albedo than to determine whether it should be done or what the

consequences might be of such an action. One serious concern is that such an action could be unilaterally undertaken by a small nation or smaller entity for its own benefit without international sanction and regardless of international consequences.

Transparency in discussing this subject is critical. In the spirit of that transparency, *Climate Intervention: Reflecting Sunlight to Cool Earth* was based on peer-reviewed literature and the judgments of the authoring committee; no new research was done as part of this study and all data and information used are from entirely open sources. By helping to bring light to this topic area, this book will help leaders to be far more knowledgeable about the consequences of albedo modification approaches before they face a decision whether or not to use them.

Climate Change: Evidence and Causes is a jointly produced publication of The US National Academy of Sciences and The Royal Society. Written by a UK-US team of leading climate scientists and reviewed by climate scientists and others, the publication is intended as a brief, readable reference document for decision makers, policy makers, educators, and other individuals seeking authoritative information on the some of the questions that continue to be asked. *Climate Change* makes clear what is well-established and where understanding is still developing. It echoes and builds upon the long history of climate-related work from both national academies, as well as on the newest climate-change assessment from the United Nations' Intergovernmental Panel on Climate Change. It touches on current areas of active debate and ongoing research, such as the link between ocean heat content and the rate of warming.

Foreword. A transformed scientific method. Earth and environment. Health and wellbeing. Scientific infrastructure. Scholarly communication.

Climate change is occurring, is caused largely by human activities, and poses significant risks for--and in many cases is already affecting--a broad range of human and natural systems. The compelling case for these conclusions is provided in *Advancing the Science of Climate Change*, part of a congressionally requested suite of studies known as *America's Climate Choices*. While noting that there is always more to learn and that the scientific process is never closed, the book shows that hypotheses about climate change are supported by multiple lines of evidence and have stood firm in the face of serious debate and careful evaluation of alternative explanations. As decision makers respond to these risks, the nation's scientific enterprise can contribute through research that improves understanding of the causes and consequences of climate change and also is useful to decision makers at the local, regional, national, and international levels. The book identifies decisions being made in 12 sectors, ranging from agriculture to transportation, to identify decisions being made in response to climate change. *Advancing the Science of Climate Change* calls for a single federal entity or program to coordinate a national, multidisciplinary research effort aimed at improving both understanding and responses to climate change. Seven cross-cutting research themes are identified to support this scientific enterprise. In addition, leaders of federal climate research should redouble efforts to deploy a comprehensive climate observing system, improve climate models and other analytical tools, invest in human capital, and improve linkages between research and decisions by forming partnerships with action-oriented programs.

The United States has jurisdiction over 3.4 million square miles of ocean in its exclusive

economic zone, a size exceeding the combined land area of the 50 states. This expansive marine area represents a prime national domain for activities such as maritime transportation, national security, energy and mineral extraction, fisheries and aquaculture, and tourism and recreation. However, it also carries with it the threat of damaging and outbreaks of waterborne pathogens. The 2010 Gulf of Mexico Deepwater Horizon oil spill and the 2011 Japanese earthquake and tsunami are vivid reminders that ocean activities and processes have direct human implications both nationally and worldwide, understanding of the ocean system is still incomplete, and ocean research infrastructure is needed to support both fundamental research and societal priorities. Given current struggles to maintain, operate, and upgrade major infrastructure elements while maintaining a robust research portfolio, a strategic plan is needed for future investments to ensure that new facilities provide the greatest value, least redundancy, and highest efficiency in terms of operation and flexibility to incorporate new technological advances. Critical Infrastructure for Ocean Research and Societal Needs in 2030 identifies major research questions anticipated to be at the forefront of ocean science in 2030 based on national and international assessments, input from the worldwide scientific community, and ongoing research planning activities. This report defines categories of infrastructure that should be included in planning for the nation's ocean research infrastructure of 2030 and that will be required to answer the major research questions of the future. Critical Infrastructure for Ocean Research and Societal Needs in 2030 provides advice on the criteria and processes that could be used to set priorities for the development of new ocean infrastructure or replacement of existing facilities. In addition, this report recommends ways in which the federal agencies can maximize the value of investments in ocean infrastructure.

As the Gulf of Mexico recovers from the Deepwater Horizon oil spill, natural resource managers face the challenge of understanding the impacts of the spill and setting priorities for restoration work. The full value of losses resulting from the spill cannot be captured, however, without consideration of changes in ecosystem services--the benefits delivered to society through natural processes. An Ecosystem Services Approach to Assessing the Impacts of the Deepwater Horizon Oil Spill in the Gulf of Mexico discusses the benefits and challenges associated with using an ecosystem services approach to damage assessment, describing potential impacts of response technologies, exploring the role of resilience, and offering suggestions for areas of future research. This report illustrates how this approach might be applied to coastal wetlands, fisheries, marine mammals, and the deep sea -- each of which provide key ecosystem services in the Gulf -- and identifies substantial differences among these case studies. The report also discusses the suite of technologies used in the spill response, including burning, skimming, and chemical dispersants, and their possible long-term impacts on ecosystem services.

Fundamentals of radiation for atmospheric applications -- Solar radiation at the top of the atmosphere -- Absorption and scattering of solar radiation in the atmosphere -- Thermal infrared radiation transfer in the atmosphere -- Light scattering by atmospheric particulates -- Principles of radiative transfer in planetary atmospheres -- Application of radiative transfer principles to remote sensing -- Radiation and climate.

This edition of Importing Into the United States contains material pursuant to the Trade Act of 2002 and the Customs Modernization Act, commonly referred to as the Mod Act. Importing Into the United States provides wide-ranging information about the importing process and import

requirements. We have made every effort to include essential requirements, but it is not possible for a book this size to cover all import laws and regulations. Also, this publication does not supersede or modify any provision of those laws and regulations. Legislative and administrative changes are always under consideration and can occur at any time. Quota limitations on commodities are also subject to change. Therefore, reliance solely on the information in this book may not meet the "reasonable care" standard required of importers. It has, improbably, been called uncommonly lucid, even riveting by The New York Times, and it was a finalist for the 2004 National Book Awards nonfiction honor. It is a literally chilling read, especially in its minute-by-minute description of the events of the morning of 9/11 inside the Twin Towers. It is The 9/11 Commission Report, which was, before its publication, perhaps one of the most anticipated government reports of all time, and has been since an unlikely bestseller. The official statement by the National Commission on Terrorist Attacks Upon the United States-which was instituted in late 2002 and chaired by former New Jersey Governor Thomas Kean-it details what went wrong on that day (such as intelligence failures), what went right (the heroic response of emergency services and self-organizing civilians), and how to avert similar future attacks. Highlighting evidence from the day, from airport surveillance footage of the terrorists to phone calls from the doomed flights, and offering details that have otherwise gone unheard, this is an astonishing firsthand document of contemporary history. While controversial in parts-it has been criticized for failing to include testimony from key individuals, and it completely omits any mention of the mysterious collapse of WTC 7-it is nevertheless an essential record of one of the most transformational events of modern times. During recent years, large-scale investigations into global climate change and other highly

visible issues have taken the lion's share of declining research funds. At the same time, funding for basic research in such core disciplines as physical oceanography, biological oceanography, chemical oceanography, and marine geology has dwindled. Global Ocean Science examines how the largest U.S. ocean research programs, such as the Ocean Drilling Program (ODP) and the Joint Global Ocean Flux Study (JGOFS), have significantly contributed to our understanding of the oceans. The book examines the impact of these programs on research, education, and collegiality within this diverse scientific community and offers recommendations to help ensure a vital future for ocean science, including: Specific results of the programs such as data collected, conceptual breakthroughs, information published, demonstrable use of program products, incorporation of new knowledge into education, and contribution to policymaking and decisionmaking by federal agencies. Mechanisms for efficiently identifying knowledge gaps and research questions, strategic planning of research programs, managing competitive proposals, securing needed resources, and more. This practical book will be welcomed by ocean investigators, users of oceanographic research findings, policymakers, administrators, educators, and students.

Now a National Bestseller! Climate change is real but it's not the end of the world. It is not even our most serious environmental problem. Michael Shellenberger has been fighting for a greener planet for decades. He helped save the world's last unprotected redwoods. He co-created the predecessor to today's Green New Deal. And he led a successful effort by climate scientists and activists to keep nuclear plants operating, preventing a spike of emissions. But in 2019, as some claimed "billions of people are going to die," contributing to rising anxiety, including among adolescents, Shellenberger decided that, as a lifelong environmental activist,

leading energy expert, and father of a teenage daughter, he needed to speak out to separate science from fiction. Despite decades of news media attention, many remain ignorant of basic facts. Carbon emissions peaked and have been declining in most developed nations for over a decade. Deaths from extreme weather, even in poor nations, declined 80 percent over the last four decades. And the risk of Earth warming to very high temperatures is increasingly unlikely thanks to slowing population growth and abundant natural gas. Curiously, the people who are the most alarmist about the problems also tend to oppose the obvious solutions. What's really behind the rise of apocalyptic environmentalism? There are powerful financial interests. There are desires for status and power. But most of all there is a desire among supposedly secular people for transcendence. This spiritual impulse can be natural and healthy. But in preaching fear without love, and guilt without redemption, the new religion is failing to satisfy our deepest psychological and existential needs.

A conversational introduction to combinatorics for upper undergraduates, emphasizing problem solving and active student participation.

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